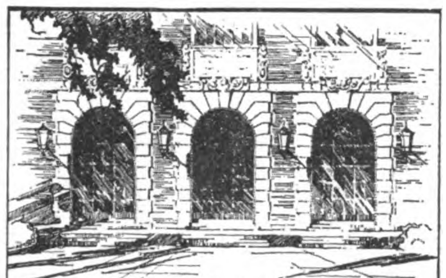

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Devoted to the interest of Blacksmiths, Wheelwrights and Wagon Builders

M. T. RICHARDSON CO., Publishers, Cooperstown, N. Y. 71-73 Murray St., New York

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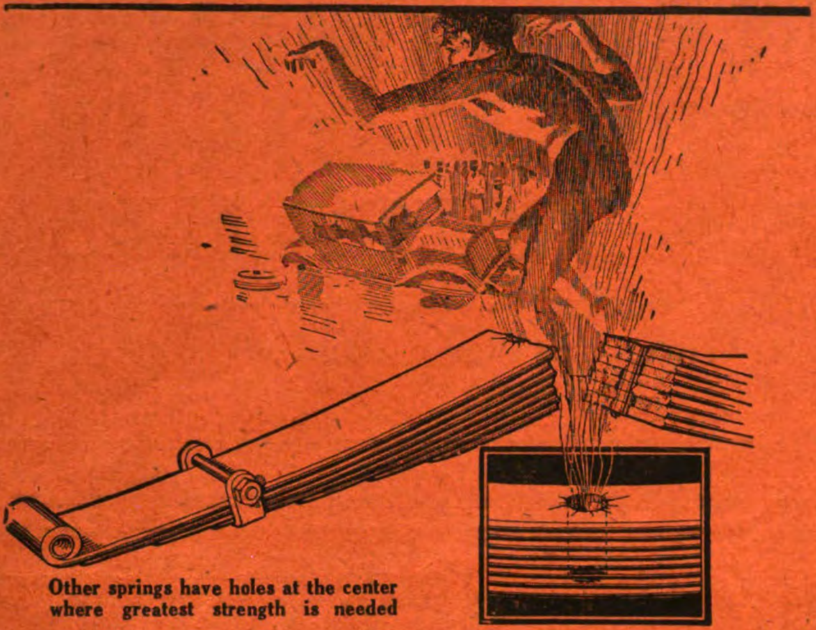

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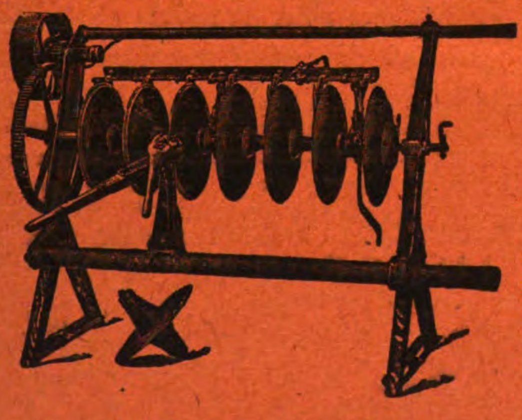

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Vol. LXXXV. No. 1 JANUARY, 1922 TERMS ONE DOLLAR A YEAR

Practical Horseshoeing

Further Information Relative to the Charlier Shoe and Tip

IT is undoubtedly wrong to cut into the horn until only a little protects the sensitive interior of the foot. "In this connection, it must not be forgotten that horn, even in thick layers, is a yielding substance (so that the untouched wall will gradually be affected by constantly maintained pressure), and that, though a considerable thickness of sound horn separates the shoe from the nearest vascular structure, evil results may follow, though tardily." But Charlier was not blind to this objection based on the deep grooving of the bearing surface of the horny wall. So Charlier advised that the bottom of the groove be not set deeper than the plane or level to which, by the usual methods, the sole would be pared.

"Unfortunately, with so shallow a groove, the frog no longer comes to the ground, because, on account of its want of cover, the shoe has to be very much thicker than the ordinary form. And this raising of the whole foot is ill-compensated by the increased thickness of the sole, especially when compared with modern shoeing, in which the sole is spared and therefore retains all its strength."

Depth of the Groove

The objection here raised to the direction of Charlier that the groove be not deepened beyond the usual paring of the sole centers on the idea that the shoe itself must then be made quite thick. Just how thick, though, will depend upon how much protection it is necessary to provide the sole. Under present-day methods, the sole is protected by widening, the band of iron in the shoe. This widening, effective on the inside edge, provides a kind of "cover." This cover is, however, not so necessary if the sole is sharply concaved. The objection, then, has only a reduced force in such cases—and perhaps it has little or none in the majority of cases where the sole is strongly arched.

On the other hand, in the cases where the sole has only a slight amount of arch and is consequently quite flat, the objection has greater force. For such cases, it is ordinarily necessary to protect the sole in some way. The present-day method is to have the band of iron project horizontally inward and thus provide a cover. This remedy can not be applied in the case of the Charlier shoe; so about the only thing to do to save the sole is to lift the foot farther from the ground. To do this, the metal is given a greater thickness. This is what is meant by the objection when it says that the shoe "has to be very much thicker than the ordinary form," "on account of the want of cover."

Thickness of the Iron

The reader will perhaps have no difficulty in seeing that this question of cover for the sole on the one hand and of thickening the iron on the other are opposed things. It is not permissible to go very far with the thickening of the iron as then the frog will be elevated too much and will in consequence be prevented from touching the ground even when the weight is applied.

There is, then, a limit beyond which, in a particular case, the iron must not be thickened. On the other hand, there is a limit beyond which the groove must not be deepened. What the farrier must decide is, (1) How deep can he cut? and (2) How thick can the iron be made? When he has the answer to these, he will be prepared to decide whether the sole will be sufficiently protected. If the answer is "Yes," then it is possible that he may have a case where the Charlier shoe is suitable. There are advantages to this shoe. The advantage that it yields to right and left is a particularly good one as it provides for the spread of the hoof, especially in the rear half.

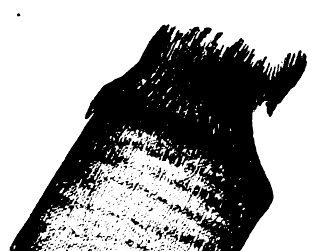
A caution may be set down here. The farrier might think it permissible to make the groove dip towards the rear and thus provide for sinking the shoe deeper at the heels. If this were permissible, it might provide perhaps for frog action. The difficulty about it is, however, that this may throw the weight wrong and in consequence put undesirable stress on certain tendons.

As to slipping—the Charlier shoe is an improvement upon the ordinary shoe without cogs, screws or roughened heels. But, apparently, it can not be roughened to any very considerable extent itself, so that we have here something of an objection.

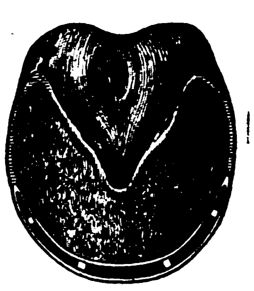
The Charlier Tip

Shoeing with half-shoes or tips is occasionally done with the view of meeting certain conditions. There is the ordinary tip which is essentially the front half of an ordinary shoe. The *Charlier Tip* consists of a thin front half which must not be broader than the wall onto which it is set. This tip may be fullered from end to end. There are 4 or 5 nail holes. Thus, there may be a hole at each end, with two others, one slightly to the right and the other slightly to the left of the very tip. The holes are set along the center line and are as far from one edge as from the other. Consequently, in order not to split the horny material, the holes are directed inwards in compensation. The outside edge may be sloped down and out.

The inner upper margin is rounded. As to the exact length of the half-shoe, "perhaps the best results are obtained when the ends



Hoof Prepared for Charlier Tip



Hoof shod with Charlier Tip

of the shoe do not extend further than the middle of the quarter; sometimes one branch extends to the heel, the other stopping short at the middle of the quarter (three-quarters tip)." The tip is to be partially sunk in a special groove cut by the special knife used to prepare the groove for the full Charlier shoe. "It is very important to obtain accurate fitting."

This Charlier tip is said to be very useful indeed when applied to upright, "blocky" feet having wired-in heels and atropied frogs. In such cases, "its use is often followed by remarkable improvement in a comparatively short time."

In making the groove, the horn is first rasped away and the special tool then applied.

Both the Charlier shoe and the Charlier tip, where applicable, tend to give the wall of the hoof a certain amount of opportunity for movement. The horny box is not kept so rigidly fixed that it can not give a little.

The flat shoe is approved by high authority as the most natural shoe. For a diseased foot, the bar shoe—that is, the shoe with a cross-bar at the rear—is often very advantageous. "It unites in itself all the good points of the ordinary shoe with few of its

Special Knife Used for Cutting Groove for Charlier Tips.

disadvantages. It arouses the normal movements of the foot when in abeyance, regulates them when disordered, and, if properly used, never injures but always improves the diseased or faulty hoof."

A horizontal bearing surface in the rear half of the shoe is considered of importance. Then, the weight should be distributed over the whole of the shoe in contact with the under surface of the wall. Also, the location of all nails in the forward half is thought to be important. Frog pressure can sometimes be provided for by the use of pads. If used at all, they may especially be employed where there are hard pavements.

The Transmission of Weight

Ordinarily, the full weight of the horse is borne by four feet when at rest, and by at least two when in motion. The front half of the horse is heavier, because of the neck and head, so that the fore feet support the heavier loads.

The investigator Pader is reported as having concluded that when at rest the center of transmission of weight is forward of the center of the sole—that is, about half-way between this center and the point of the frog. This is to be taken to mean in effect that the line of transmission of weight would come out at this midway point between frog tip and sole center. There is in fact no ground at this location to resist the weight. We incline then to the view that the weight comes down the leg to a point inside the foot and perhaps just over the said midway point, and that then it spreads to all points of the bearing surface of the hoof.

If Pader is correct in running the transmission line to a point midway between tip of frog and center of sole, then it would seem as if we would be entitled to call this midway point the "center of pressure" and to consider that the points of the shoe nearer to it are more subject to wear (other things being equal) and the points further away less subject to wear (other things being equal). But, of course, we must remember that the foot at rest is not necessarily in the position relative to weight transmission that it is when producing wear on the shoe. Wear is naturally produced just as the shoe strikes the ground and as it leaves the ground. It may be, but I do not claim to know, that the rest position is the average between the two.

However, Pader also concluded that the greater the inclination of the pastern, the further back the line of transmission of weight would fall. But to go on—Pader further concluded that, when the opposite limb is lifted and in consequence increased weight is thrown on the limb under observation, there is a bending of the fetlock and a shifting of the center of weight further back. Finally, he concluded that the center of weight never falls further forward than the tip of the frog nor further back than two-thirds of the length of the foot from the toe.

We must be cautious about giving our consent upon such points. Not all investigators are in agreement, and the question is rather a complicated one. And yet, it doubtless has its part, or should have its part, in decisions bearing on correct methods of shoeing.

By Way of Emphasis

We have now arrived at a point where it may be well to look back over what we have considered in the past and in doing so to emphasize a few points.

A steel or iron shoe is an unnatural thing. It holds the hoof in a vise-like grip and thus prevents certain activities. One of the things that are prevented is the wear and tear of the bearing edge of the hoof. The shoe prevents this wear and tear. Under natural conditions, the hoof would wear away. The new growth at the upper edge pushes the horny box down, just as the growth of the finger nail at the base pushes the nail forward. Since the metal shoe takes the wear and tear and the hoof edge is protected, it is necessary to pare away this edge from time to time.

Here is the farrier's opportunity to modify the action of the horse and to correct quite a number of things. For example, by examining the old shoe, the farrier may observe whether the wear of the metal occasioned by contact with the ground is even. Some parts of the shoe may show excessive wear. The paring of the bearing edge of the hoof may often be so managed as to correct this.

Providing for Excessive Wear

Sometimes, it will be well to provide more metal to take the excessive wear and thus prevent the shoe from letting the foot down too much at this point of wear More metal may be provided by widening the band of metal that makes up the shoe. The widening is done at the place where more metal is needed. Sometimes, it may seem well to reduce the amount of metal coming into contact with the ground. This might be because a certain location shows but little wear.

The general idea should be to provide a shoe that will wear evenly and so not change the way the horse's weight comes on the hoof. It is to be remembered that at any location the amount of metal touching the ground may be reduced simply by bevelling the edge somewhat. This may seem better, at times, than reducing the horizontal thickness of the metal in that part of the shoe.

Upon examining the horse's foot, the farrier may become convinced that the frog is not pressed up sufficiently when the animal is in action. He seeks to correct this, sometimes perhaps by reducing the height of the heels or heel calkins, sometimes perhaps by paring away more horn on the bearing edge at the heels.

Protecting the Sole

Sometimes, the sole may, upon examination, show that next the horny wall it is suffering from too much contact with the road. If the sole inside the line of contact with the horny wall is to be protected against this, it will at times suffice to broaden the strip of metal in the sole and thus have the inner edge of this strip to protect inwards and thus protect the sole against the ground.

The rounding of the under surface of the shoe at the toe is an important matter. This rounding at the extreme front may properly be provided whether the shoe lies perfectly flat on the ground or whether it is lifted at the heels by calkins. The rounding tends to prevent the shoe from cutting the neighboring foot.

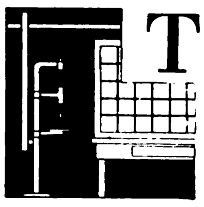
On top at the toe, the metal may be bent upward to form a clip. This should prevent the hoof from slipping forward on the metal surface of the shoe. It thus assists the nails. Besides, this metal turned-up toe takes the wear.

The farrier will do well to keep the *bar shoe in mind.* It is a good remedy for many things. It may be made by using a sufficiently long piece of iron. The heels are bent round so as to overlap. The overlap is welded, and the shoe then consists of a complete ring. The width and thickness of the bar part—that is, the part connecting the heels—may usually be made the same as other parts of the shoe. The frog surface is to be slightly concave. When a bar shoe is used, it is often possible to cut away for an inch, more or less, some of the horny edge. This may usually be done in such way that when the horse throws his weight on the foot, this part of the hoof feels little or no weight. This may be very desirable, sometimes, when the foot is diseased.

Small Florida Shops

How a Southern Smith Made Use of His Small Supply of Tools

By James F. Hobart.



THE BLACKSMITH who "kicks" of the meagre tool outfit in the shop where he may be working should see some of the so-called "shops" where repairs are made on some of the farms in Florida's remote districts. One shop has a section of railroad steel for an anvil

Another shop used a heavy casting which had once done duty as ballast in a Gulf vessel. Another shop had no vise save two pieces of heavy bar metal set upright in front of the bench. A bolt through a hole four inches from the top did the duty of a vise screw and the owner had fitted an ingenious housing over the bolt-end to prevent in from turning around when the "vise" was tightened with a wrench!

But with this smiple, home-made contraption, a native colored smith was doing some fine smith work and kept in order all the tools and vehicles used on the farm and citrus grove and even cared for an auto truck which hauled produce to a somewhat distant city!

Another shop had halfway decent tools, a vise and an old anvil, which still had its

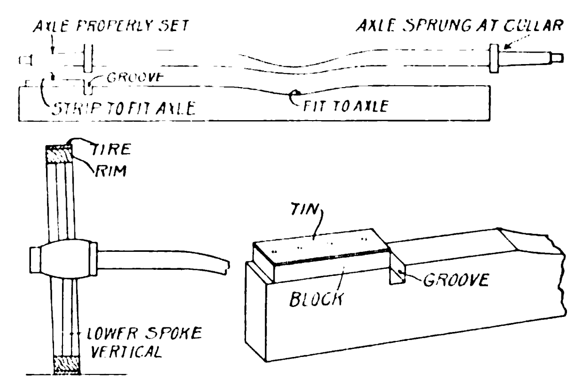


Fig. 1. Illustrating the Bent Axle and the way it was Straig..tened

shape but its corners had long since departed. I noticed the peculiar shape of the very slender "beak," and in reply to a query, the smith told how the horn of the anvil was broken squarely off when he acquired the tool in a junk-dealer's store during a long-ago visit to Jacksonville; how he had shipped the anvil home on the back of a mule and then used the tool for several years with the broken horn.

But one day, while another smith chanced to be visiting him, they got the anvil on the forge and heated the broken horn and forged it out into the slim beak which I had noticed. The smith told me it was an awful job to heat the anvil, took then nearly three hours and burned nearly all the charcoal they had. They forged an old wagon axle into a *porter-bar* which was driven tightly into the hole in bottom of the anvil and with this bar, they handled the anvil to and from the fire. The forging was done on the edge of the homemade forge, two hammers being used, one being "held-on" to act as an anvil, opposite to where the blows were struck with the other hammer.

It was a Sunday "evening" when I chanced upon this little smith shop. *Evening* in Florida means from 12 o'clock noon, until sunset; after which it is "night." They don't use the term "afternoon" in the land of sunshine—and sand-spurs! No native Floridian will touch hammer or forge on a Sunday, but he will talk about his work on that day, talk about it freely and with evident pleasure. A wagon with a "sprung" axle stood before the shed which sheltered the few smith tools and I asked the smith to tell me how he would set that axle with the few and slight tools to be seen around the forge?

"Golly, Boss" the man said:—"Cose I'll tell you how we'll fix that wagon wheel which

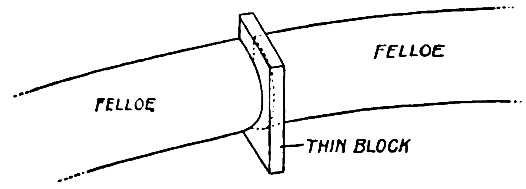


Fig. 2. Making a Felloe Longer

am pesterin' Mr. Hornsby so much he done brang it to us." And he did tell me, a quaint story it was, full of common sense and ingenuity, from which almost any smith may pick out some valuable points for his own work, even when he had the best of tools to do with. But the vernacular the story was told in! I never can reproduce it, so I will translate the story into the more plain English as follows, not only how he set the wagon axle and how he set the tire on its wheel but also how he made a tool wherewith some carpenters made about a thousand wooden framing pins.

How He Did It

"When I have to set an axle," said the smith, "First I take a look at the other end of the bent axle and determine if that end is in need of attention also. This point may (as shown by the sketch) the lower spokes of the wheel on the good end of the axle. If (as shown by the sketch,' the lower spokes are vertical, then that end of the axle may be all right and may be used to set the bent end from.

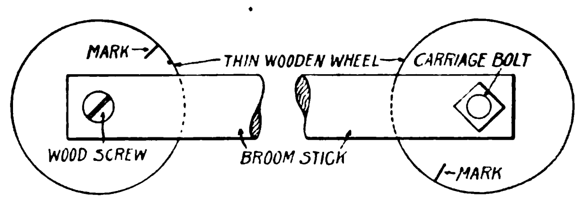


Fig. 3. A. Home Made Traversing Wheel

"Next, I look at both wheels and see if the dish is the same in each. The sketch shows that the upper portion of the wheel inclines to the left, the top of the tire and rim being well to the left while the lower spokes stand vertical. This is because the wheel is slightly saucer-shaped, and this is called the dish of the wheel. If one wheel be more dishing than the other, than allowance must be made when setting that end of the axle which goes into this most dishing wheel. The more the dish, the nearer straight will be the under side of the axle when it is properly set.

"One end of the axle having been found O. K, strip off the clasps and remove the axle from its bed-piece. Strip off everything, then fit the axle to a straightedge about four or five inches wide, by sawing a notch for the collar at the good axle and cutting off the straightedge where it touches the collar on the bent axle. Scoop out the edge of the straightedge until it fits closely to the *bottom* of the axle all the way from the middle to the collar on the good end of the axle.

"Do not cut much beyond the middle of the straightedge. Try it against the axle to see if the cutting out is enough. When right, reverse the straightedge and try it on the end of the axle which is bent, trying the axle against the side of the straightedge as before. If the straighedge end still fits to the axle close to the collar on the good end of the axle, then the axle is probably all right between the collars and the straightedge may be scooped out to fit along its whole length between the collars.

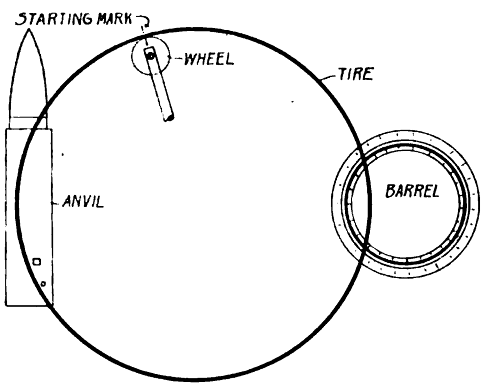


Fig. 4. How to use the Traversing Wheel

"If, upon trying the half cut straightedge against the axle it is found that there are other bends in the axle than beyond the collar, then use your judgment in scooping the remainder of the straightedge and later, bend the center of the axle to fit the completed straightedge. Usually, nothing will have to be done between the collars of the axle and the straightedge can be worked out along both ends to fit the good end of the axle.

Wagon smiths have a metal straightedge with adjustable arms which may be set out to bear against the axle in the middle of its length and just beyond the collar, also at the tip end of the axle close to the thread. If you can lay hands upon one of these axle gages, then use it by all means and lose no time in making up a wooden straightedge as above described.

"Having fitted the straightedge— to the *Bottom* of the axle, *never to the top*—plane out a strip of board to fit between the straightedge and the wheel bearing surface

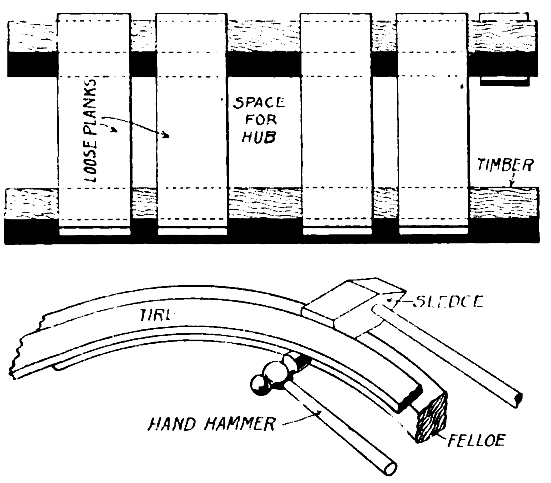


Fig. 5. Applying a Tire and Above, a Wheel Holding Frame

of the axle. This will be a slightly tapered piece when well fitted, it should be nailed to the edge of one straightedge and a strip of tin nailed over the edge of the strip as shown in the engraving. The strip of tin is to prevent burning the straightedge out of shape when it is applied to the hot axle. If very much bending is required to the axle between the collars, it may be necessary to protect other parts of the straightedge with strips of tin also.

"Having carefully fitted the straightedge, remove the collar from the bent end of the axle and heat end enough that it may be straightened by taking a pry between heavy timbers or by bending it with a jack screw or by blows from a wooden maul upon the end of the axle. Bend carefully, a little at a time until the straightened axle fits the straightedge. Usually the collar is shrunk on and may be driven off readily after it has been heated a bit while the axle is kept cold. Sometimes the collar may be shrunk back in place again by heating it red hot and driving it upon the cold axle.

Braze the Loose Collar

"But sometimes the collar will not stay tight after having been removed and replaced, in which case, the collar should be put carefully in place and brazed to the axle. Be very carefull that the axle is made straight sidewise, that neither end bends ahead or backwards in the least for if this matter be not carefully looked after, the front and rear wheels will not track—that is, follow one another exactly. Some axles are set to give the wheels a very little gather. This means that the wheels, instead of both pointing straight ahead in two parallel lines, are set to lines which converge at a considerable distance ahead of the vehicle.

Look to the "Gather"

"Gather causes the wheels to crowd against the collars on the axles instead of against the nuts so a wheel will not easily come off should a nut be lost. But be sparing about giving gather to the wheels as too much will surely cause the vehicle to run very hard. You can test the axle for gather by placing the straightedge on either side of the axle and measuring with inside calipers

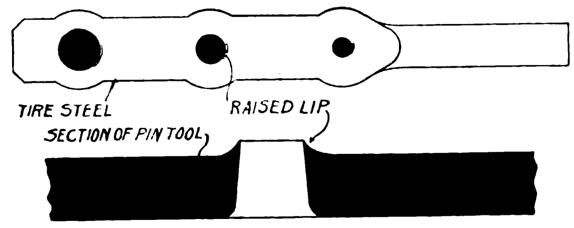


Fig. 6. Device for Making Round Pins

or with a bit of wood, the distance between each straightedge both at end of thread and close to the collar. In this manner you can determine if the axle has been bent to make the wheels gather. If so, make the straightened end like the other one, but beware of too much gather least the collars wear out and the horses work harder than necessary.

Removing a Tire

Strip the tire carefully, take out all the tire-bolts and work out any pins or nails which may fasten tire and rim together. Usually a loose tire will come off easily but if it be necessary to drive it off, do so by striking on the felloe with a rather heavy hammer and at the same time, holding a sledge against the tire—but not against the rim—opposite to where the blows are being struck as shown by one of the sketches.

Enlarging a Wheel-Rim

"If the tire be only a trifle too small, the rim of the wheel may be enlarged to fit the tire by inserting one or more thin flat pieces of hardwood as shown in the sketch, in which a flat square bit of wood is inserted and afterwards work off the projecting corners even with the felloes. Sometimes these pieces may be made of metal. If made of wood, select the hardest possible timber for in the pieces, side-grain is exposed to pressure and will not withstand as much as end-grain. Sometimes short bits of an old felloe are sawed off in a miter box and carefully slipped into place. The trouble with these pieces is to keep them fair with the wheel rim, whereas the square pieces may be slipped in any way, and then worked flush after the tire has been set.

In case the tire has broken, or is so loose that a piece must be cut out, first traverse the wheel and the tire to see how much tire material must be removed. The Blacksmith probably has a little steel traversing wheel but we can use the round bottom end from a tall round peach basket or may saw

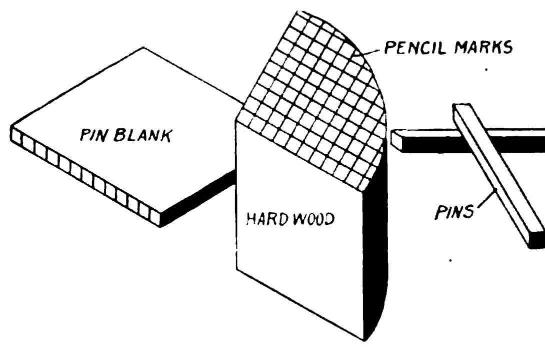


Fig. 7. How the Pins are Taken Out of the Stock

out a thin wooden disc 8 to 10 inches in diameter as shown in the sketch—one being shown in a broom-stick handle which has been split to receive the wooden wheel and fastened with a wood screw. The other wheel [only one is needed] is shown fastened to one side of a stick with a carriage bolt which is driven tightly into a hole in the stick and lies loosely in the wheel which is free to revolve very easily. Traversing can if necessary be done with the disc without any handle, just holding it in the hands and carefully rolling the wheel around the tire and wheel.

Measuring a Tire

"Place the tire nearly level upon blocking which does not project inside to interfere with the traversing wheel. The sketch shows the tire resting on edge of anvil and a barrel. Get inside the tire. Make a starting on the inside and another mark on traverse wheel as shown. Bring these starting marks together and slowly roll the traverse wheel around inside the tire, making another mark on the wheel when the starting mark on the tire is reached again. Place the wheel on a barrel or box and traverse the rim in the same manner from a starting mark thereon and marking the wheel when that mark is reached again.

"Don't get the two new marks on the wheel mixed up. Mark them carefully. Now, look over the wheel rim and see how many open spaces are between the felloes. If there are only two pieces in the rim, there will not be much opening but with short felloes, the openings may aggregate a half inch or more. Carefully deduct this "open distance" from the distance on traverse wheel which ends with last mark made fair with starting mark on wheel rim. With the "open distance" thus deducted, compare the new mark made there with the mark made when traversing inside of tire. If these marks come fair with each other, the tire is a bit too large and is same size as wheel in fact, but will be loose when set.

"Perhaps the marks show that an inch or more of tire must be cut out. It is well to cut the tire to exact net wheel size as indicated by the traverse wheel marks, then the weld will take up about half an inch but will be a bit thicker than the tire, which will be half an inch too short, thereby giving a chance to shrink it tightly around the rim. The weld, being a bit too thick, may be drawn down a little if it be found necessary to lengthen the tire a bit more. A very little experience will show how to allow for weld take-up and for just the right amount of tire shrinkage so as not to have the tire loose or to cripple the wheel-rim.

Heating a Tire

"Having welded the tire, place it level upon three or four bricks laid on the ground. Scatter shavings or straw around the tire

(Continued on page 13)

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Our Editor's Letter

AS OLD father Time passes along his keys to the unclothed cherub of the New Year we sit ourselves down and resolve to do and not to do certain things in 1922. As a matter of fact the New Year Resolutions habit is established as an American custom; from the time when we can first hold a pencil in our chubby fingers we are taught to put upon paper our ideals which we intend to strive for during the coming year.

Some prominent writer has asked what New Year resolutions are for if not to be broken and to date we have seen no answer. It must be that everyone, when they contracted the resolution habit, also contracted the habit of breaking their resolutions.

Take the vice of smoking, for instance, I'll venture to say that 99 out of every 100 smokers resolve to quit the evil weed at twelve o'clock on December 31st. But by the middle of January the various tobacco companies are preparing to pay an extra dividend, for by that time the smokers are making up for their lost enjoyment.

Like everything else that we do we are carrying this resolution thing too far. We are acting like a lot of children and are merely "showing off." If we simply were to formulate our resolutions in our own minds instead of sticking our chests out and informing the whole world, then the resolutions fad would die a sudden death.

In my early youth I looked upon New Year's day as the time when I had full license to boast to my parents how good I intended to be, without being held to my promises. I made resolutions because that seemed to be the thing to do and the more I made, the more virtuous I thought myself. Two full pages of closely written promises was a normal average and seemed to make a fairly good impression on my parents. I cannot recall that I had any serious intentions of keeping any of those resolutions, I doubt if I considered the matter in that light at all; making them was the only important step.

With the passing of time I realized that there was a certain glory in being able to say to one's friends that one had been able to keep certain resolutions for a length of time and with this realization I began to consider the first step as being of importance. And it was then that I formulated my resolutions with the idea of making them work for me, rather that toward my enslavement.

Perhaps no better example is to be had than my masterpiece in the way of resolutions. A certain neighbor of ours complained bitterly of the fact that the "gang" often raided her orchard. Being one of the suspected boys I fell in for my part of punishment. My dad had a method of direct questioning which usually led me to confess and so I frequently suffered, in season, for my pilferings.

And so it happened that my parents came to suggest that I resolve not to raid old Mrs. Gordon's orchard during the coming year. Coming, as it did, in the nature of a threat I thought it wise to comply and drew up a formal resolution not to steal any of Mrs. Gordon's apples during the following season.

My parents talked the matter over and decided, for me, that this particular resolution was one which was to be observed to a nicety. Should I break it the wrath of ages would burst upon my head and I realized that they really meant business.

Along about the latter part of June I was called to the mat of justice by my parent whose main argument was a seasoned razor strop. His charge was that someone had raided Mrs. Gordon's orchard and liberally partaken of many ripe and juicy cherries.

"Father," said I with tears in my voice, "my resolution is unbroken." By mien was so convincing that he believed me and I escaped punishment. Literally I did not lie to him, though I had eaten my share of the cherries.

In another few weeks I was confronted with the fact that all Mrs Gordon's peaches had mysteriously vanished during an evening when I had been visiting a friend in the neighborhood. Between the two of us we again convinced my stern parent that my New Year's resolution was still unbroken.

When, still later, Mrs. Gordon surprised a number of boys in her pear trees and managed to snatch my hat from one of the youngsters, circumstantial evidence was too strongly against me and my defence was broken down by my dad and the strop. I was forced to confess all and though my father saw the argument, he would not admit my innocence of guilt. It is true that I had promised not to steal Mrs. Gordon's apples and that nothing was said or inferred concerning cherries, peaches or pears, but it availed me nothing.

My dad carefully pointed out to me that he wasn't punishing me for breaking my resolution, for I didn't break it, but he was punishing me merely on general principles because he thought I needed it.

I tell this story because I feel that it fully illustrates the point which I want to make; Our New Year's resolutions are either made to be broken or are so made that they can be evaded but kept. The fellow who swears off smoking is no hero if he has never smoked before in his life. The fellow who vows not to burglarize the U. S. Treasury at Washington isn't saying much and the bachelor who resolves not to beat his wife isn't making much of a sacrifice.

So let's start a new style in resolutions this year; let's resolve to *Do* things instead of vowing not to do them: Instead of resolving that we *won't* swear, or steal, or lie, or kick the dog out of the easy chair, let's resolve that we *will* be pleasant to our neighbors, that we will try to give everyone a square deal and that we *will* fight fair, if we must fight at all.

But before we make those resolutions let's be mighty careful that we don't make a great number which we cannot keep or don't intend to keep. It is better to make only one and keep it than to make a dozen and break them all before the clock strikes 12 again.

And above all, after we've made those resolutions, foolish or otherwise, let's keep them to ourselves, for then, if we break them no one can laugh at us. As the Chinaman would say, "He who laughs with his mouth shut can smile the longest."

Our Railroads

TALK with any well read man of to-day about the high cost of living and our economic future and sooner or later he will bring up the fact that there is something wrong with the railroads. And there are many men who blame all our present day evils upon the railroads just as they did upon the war and upon the weather.

But whether or not the railroads are blamable for all our troubles is a question. Surely they are at fault in many ways and until they realize this, they cannot prosper. It is argued that the reason why tariffs are high is because the volume of business is comparatively small. The business man claims that he cannot afford to ship goods because tariffs are too high. The whole is a vicious circle which can be cut only by the railroads.

In the beginning of things, before our railroads spread their network over the country, transportation was by means of horses, for the motor truck was yet to come. At first the railroads, in an endeavor to obtain the business, put the tariff rates low enough so that the farmer could afford to ship his goods to outside markets. At first the roads lost money, but as the volume increased they began to show profits and they could afford to make reductions in rates. This resulted in more business and every one was happy.

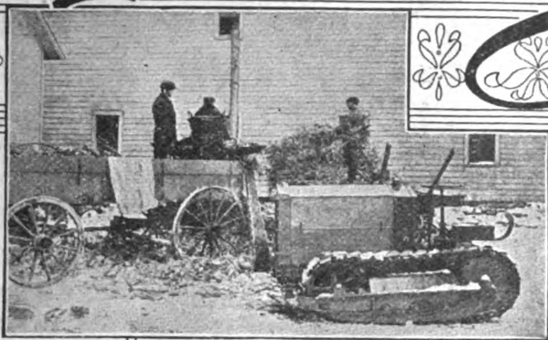
There came a time when the railroads began to adopt an independent attitude toward the public. Careless of goods intrusted to them, tardy in making adjustments on losses and entirely independent as to making deliveries were factors which prejudiced the people against them. Then came the motor truck, at the critical time, and made inroads upon the railroad business.

The motor truck is a dependable unit for transporting goods. True, one cannot be so sure of collecting damages from the truck company, but one can afford a few losses if the aggregate of deliveries is satisfactory. The farmer, for instance, can afford to have a dozen eggs to a case broken if he can be sure that the case will reach its destination. In the case of the railroads he cannot even be sure that the whole case of eggs will be delivered for several months. And by that time the eggs are better than his chance for obtaining damages from the railroads.

The cost of shipping by truck is greater than by freight in most cases but the truck transportation companies are anxious to serve the public, they study the public's needs and, as a general rule, are careful in handling the goods. They have come to realize that promptness in delivery of a product in good condition is worth far more to the shipper than the payment of a claim for a loss.

Just as the motor bus has put the electric car transportation companies out of business, so will the motor truck wreck the railroads, unless the latter change from the "public be dammed" policy to one of "the public be served."

Tractor Repair Department



F.M.

Fitting Factory Tractor Bearings

They Require Considerable Attention Before They Are Put in Place

BY DAVID BAXTER

THEORETICALLY the new factory bearings for tractor connecting-rods fit accurately. That is they are supposed to be ready to put in place without any filing, fitting or otherwise adjusting. But in practice the blacksmith will find that they usually require considerable attention if they are to give the best service.

Each individual bearing is accurately and correctly machined at the factory so that it is an exact duplicate of the others and no doubt would fit a new tractor, but after the tractor has been used a season or two the shape and size of the different parts are naturally altered more or less, according to the treatment accorded the tractor in use. If it has been handled carelessly the parts will be worn or sprung more than if it were well taken care of. And of course there is some difference in the kind of tractor and the work it has been doing.

Fig. 1. Enlarging the Oil Grooves with a Special Chisel

However, let us take a specific example of fitting machined babbit bearings to tractor engines connecting rods and see just what was done to make them as wear-proof as possible. Then by studying the details the mechanic should be able to work out a system of fitting new bearings to other makes of tractors. He will find they are all enough alike to be practically the same as regards to the main adjustments.

The job illustrated and under discussion here consisted of the fitting of factory made bearings to the connecting rods of a Wallis tractor. The previous bearings were rendered useless through lack of oil.

The first step, of course, was to remove the crank case from the engine and place it upon a bench as shown in one of the pictures. This is easier in the long run and permits the smith to do better work.

Then the old babbits were removed from the connecting rods; bearings and caps. These were placed in a special container to be saved for junk. The piston and rings were all right so they were not removed from the connecting rods. Had this been done, however, the work of fitting the new bearings would no doubt have been simpler but the time required to remove and replace these castings is a doubtful saving in the long run.

After making sure the correct size bearings had been selected the first thing was to cut or rather to enlarge the oil grooves. They were supposedly of correct dimensions as they came from the factory but the mechanic deemed them too narrow to give the best service. One of the prime causes of burned or melted bearings is that the oil is not evenly or plentifully spread, due to the oil grooves being too small.

The enlarging of the these grooves was accomplished as indicated in Fig. 1. This also shows the extent and nature of the grooves. The new bearing was here fastened securely in the vice. The mechanic was very careful not to bend or otherwise damage the new metal. Then with light blows of a hammer upon the curved-point chisel, the grooves were widened and deepened, the edge of the chisel being ground to a round sharp nose in order to obtain a half-round perfectly smooth groove. Care was taken to make the bottom of the groove smooth and at the same time not to mar the surface of the metal outside of the groove. This was accomplished by the manner of holding the cutter and striking with the hammer. The knack is easily learned with a little practice. All of the bearings were grooved before taking up the other parts of the work.

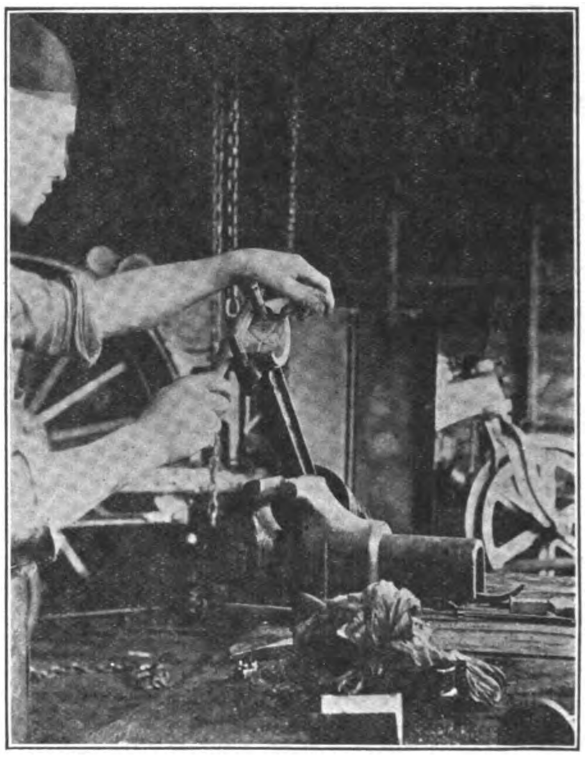


Fig. 2. Filing the Sides Flush with the Casting

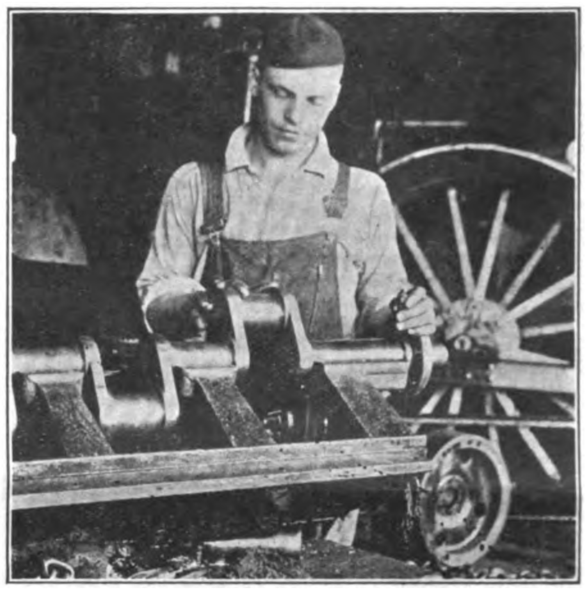


Fig. 3. Apply a Thin Coat of Prussian Blue to the Crank Pin

The next step, which is illustrated in Fig. 2, was to file the edges of the babbit metal flush with the sides of the connecting rod bearing. The rod was securely fastened in the vice as shown, and the dressing was done with the flat side of a fine grained file. In this the mechanic was careful to file all one way. That is, the file was not sawed back and forth; the strokes were all in a direction away from the man. Toward the finish this work was slow in order to be accurate and leave the bearing level endwise. A fine file left the edges square and the surface smooth, whereas a coarse file would leave the surface rough or round the corners off the bearing metal. It was essential to see that both edges were filed the same in order that the new bearing would fit exactly in the half of the connecting rod.

After this the connecting rod cap was fitted with a new bearing in much the same manner. This bearing was grooved and filed the same as the other half. Then all of the rest of the caps, as well, as the other connecting rods were fitted with new bearings in a manner practically identical with the first. Some required a little more or less filing. And in some it was necessary to dress the shoulders a trifle to make the bearings fit the rod casting; which was merely a matter of the condition of the part.

The next step was to fit each connecting rod to its crank shaft. The cranks and rods were numbered so there would be no mistake when assembling the engine. This was essential on account of a slight variation in the wear of the different cranks.

The work consisted, first, of painting the surface of the crank with a substance called Persian Blue, or Venetian Blue, which is obtainable in a handy tube. A quantity of the stuff was squeezed out of the tube and spread in a thin, even coat over the entire surface of the crank pin. This was conveniently accomplished with the fingers of one hand as is shown in Fig. 3. No part of the crank pin surface was exposed in the slightest degree when the coating was complete. The whole surface of the pin was covered with the Blue.

The whole weight of the piston and rod was permitted to rest squarely upon the crank pin. When certain this was the case, the mechanic worked the connecting rod slowly back and forth around the pin. This was repeated several times, at the same time pressing firmly down upon the crank pin with the metal of the new bearing. This brought the metal of the new bearing surface in direct contact with the Blue on the crank pin.

The idea was to locate any high spots in the new bearing; the blue marked the high spots and missed the low ones. In other words, the blue rubbed off the crank to the higher places on the new bearings, leaving the lower portions uncolored. Each and every connecting rod was in its turn treated to this marking process.

When satisfied that the blue had marked the bearing correctly, the next step was to scrape the inner side of it as indicated in Fig. 5. The scraper was held squarely across the bearing and the sharp edge of it used to cut or scrape away the spots marked by the blue of the crank pin. This scraping was a particular operation deftly attended. Where the blue was heavy the scraping was deeper. Where the blue showed but faintly, very little bearing metal was removed. Care was taken to prevent the scraper from slipping endwise to cut or mar the surface of the new bearing.

A handy scraper for this purpose is easily made by grinding the teeth from a half round file. The whole surface of the blade is ground as smooth as a knife blade. The edges are ground and polished sharp and true. The flat side is hollow-ground the full length of the file. If this tool is given a slightly lateral movement while in operation it will remove the surplus babbit easily and perfectly straight.

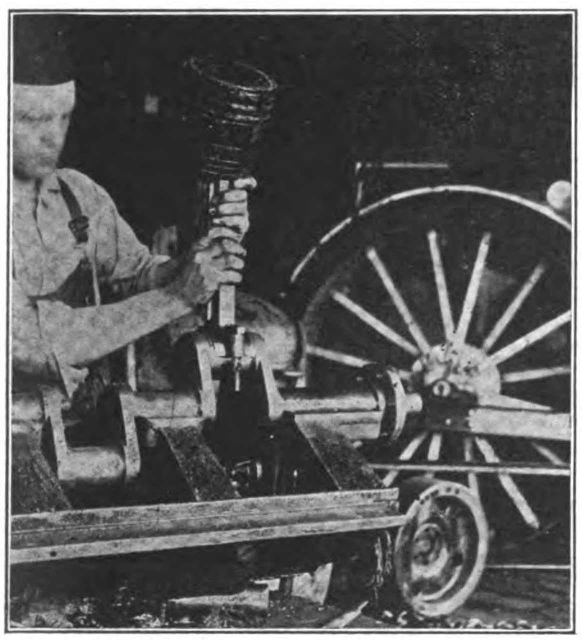


Fig. 4. Testing the New Bearing on the Blue-Coated Crank

After scraping the blue deposit from the surface the bearing was again fitted to the crank and worked back and forth. Once more the blue was transferred to the bearing but this time fewer high spots were exposed. These were removed with the scraper as before. Then the crank was freshly coated with blue again and the bearing tested. This process was repeated until the whole surface of the bearing coated with an evenly spread deposit of the blue. This was an indication that there were no longer any high spots in the new metal and that the bearing was ready for service.

The cap of each bearing was treated in the same manner as the connecting rod: the surface of the crank pin to which each cap belonged, was re-coated with the blue several times and worked back and forth to detect the high places in the surface of the cap bearings. Then these high spots were scraped level too.

Sometimes each cap bearing has to be tested quite a number of times and carefully scraped, very carefully watching the action of the scraping tool. As with the connecting rod bearing this work must be slowly and accurately done. Just enough bearing metal is scraped off each time to remove the blue. If too much is removed the mechanic will be forced to remove more from other portions next time, and as a result he may cut down the bearing too much. So he cannot be too cautious in the matter of fitting and scraping new bearings.

Now after all of the bearing surfaces had been tested and scraped in all of the connecting rods and their caps each pair was bolted together around its own crank pin to estimate the number of shims needed. These shims varied in thickness and were made of copper to conform to the shape of the casting. Some required a considerable number of shims; others required but few. They were for the double purpose of preventing the bearings from being too loose on the crank pin and to permit a re-adjustment to the running condition of the bearing.

A sufficient amount of shimming permits the bearing to be tightened from time to time as the engine runs. It also affords some play when the bearing is bolted too tightly.

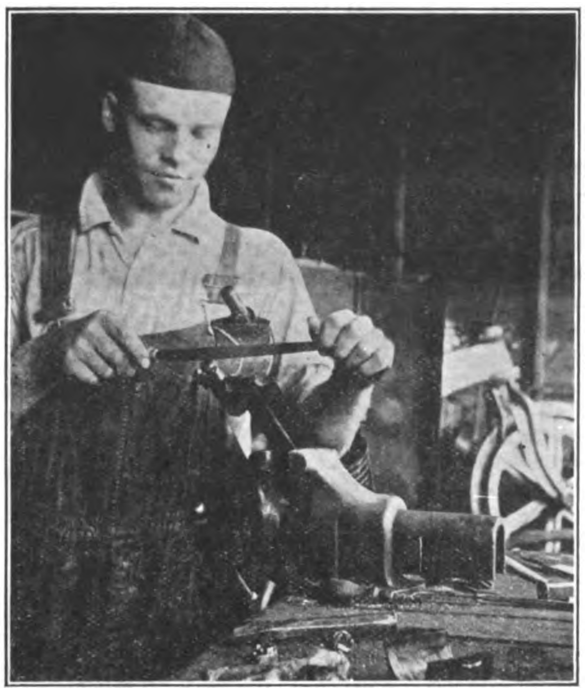


Fig. 5. Scraping off the Blue High Spots

In Fig. 6 the placing of the shims is indicated. In event the bearing is too tight they will mash together enough to allow the bearing to operate without running hot. They may be purchased from the tractor manufacturer or can be cut out of sheet copper by the mechanic who is renewing the bearings.

In this case when assembling the pistons, connecting rods, and crank case the mechanic was careful not to get the bearings so tight as to be rigid. Some little play was necessary to prevent friction from melting the babbit. But they were not allowed to remain loose enough to start knocking.

In this connection it should be plain that it is often necessary to file the ends of the bearings and the shoulders of the crank pins. Otherwise they will tend to bind and run hot. In this particular case enough room was left to permit a slight sidewise play of the connecting rod bearings.

Now when testing the surface of new bearings with Persian Blue the end fit was also noted and enough babbit filed off to permit the essential end movement.

And thus we see that the fitting of factory made bearings is often a matter requiring considerable care and some skill, although simple enough if the mechanic attends to all of the seemingly insignificant details.

The mechanic who puts in the machined bearings without first filing and testing them is storing up future trouble. He should not think that just because they are factory made they are bound to be a perfect fit.

Fig. 6. Placing the Copper Shims

A SUCCESSFUL business man is one who can attend all these get-together noonday luncheons without letting his work go to pot.—*Dallas News.*

NERVOUS PIANO SALESMAN (*formerly a department store clerk*) : Shall we send it for you?

—*Boston Transcript.*

WALLPAPER SALESMAN: Something quiet and soothing, I suppose?

CUSTOMER: No, something loud and irritating—its for the guest chamber.—*Life.*

"The only friend Withers has in the whole wide world is his dog."

"Yes, and it is beginning to tell on him."

"What, on Withers?"

"No, on his dog."—*Life.*

"Pa!"

"Well, my son?"

"What is the last word in hospitality?"

"It isn't a word, son. It's a hiccough."

—*Birmingham Age-Herald.*

"The evidence seems to show," said the detective, "that the thief wore rubbers and walked backward."

"Then we must look out for a man with receding gums," remarked the wag of the force.—*Boston Transcript.*

TEACHER: Johnny, your conduct is outrageous. I will have to consult your father.

JOHNNY: Better not, teacher—it will cost you two dollars. He's a doctor

—*Buffalo Express.*

The reason there are so few good husbands is that the test is so severe. A really good husband will register something which looks like genuine grief on learing that the household's favorite fern has died in spite of everything that could be done for it.

—*Kansas City Star.*

"Strange," murmured the magazine editor, "that this anecdote about Lincoln in his early days has never been in print before."

"It isn't strange at all," returned the contributor with some indignation. "I just thought it up last night."

—*American Legion Weekly.*

SMALL FLORIDA SHOPS

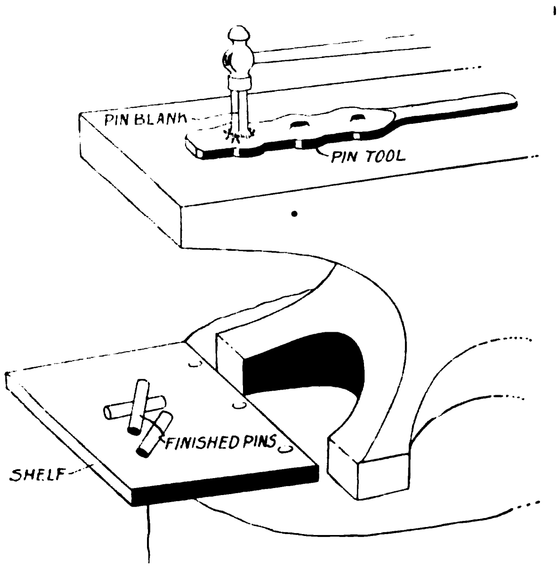
(*Continued from Page* 9)

for kindling, then place light sticks criss-cross around the tire and set the fuel on fire. Old barrel staves and hoops, cut about 12 inches long, make good fuel for tire heating. Thick heavy pieces should not be used for the time of heating a tire unless very heavy, should not be more than fifteen minutes. Fuel which will be consumed in about that time should be selected.

"The lucky smith has a large slab of stone, concrete or cast iron upon which to true up wheels after the tire has been put in place. The plank and timber—Truing Platform—will answer, but the wheel must be laid thereupon dished side down. Do not heat the tire too hot. A black heat, just before the steel begins to turn dull red is all that is necessary. Have two pairs of tongs ready. An assistant with one pair, grasps the tire opposite to you and you both hurry the rim to the wheel and drop it in position. If necessary, pry with the tongs and drive with hammers against inside of tire until it slips down over the tire. Have at hand, pails full of water and as soon as the tire slips on, put water on tire and rim to prevent burning the rim.

Truing the Rim

"Having checked the burning, and before the tire has cooled much, drive the felloes fair with the tire, with two hammers, one



How the Pin Block is Used

on either side as shown for driving off the tire, only a hammer may be used instead of the sledge. Rap all the felloes into place as quickly as possible, then finish cooling the tire and the wheel is finished save for putting in whatever tire bolts may be necessary. For final cooling of the tire, nothing is better than a hog trough filled with water and placed close at hand. Just as soon as the felloes have been trued with the rim, set the wheel on edge in the trough and roll the wheel around in the water. For quenching blazing wood when putting the hot tire in place, a garden watering pot with the rose spray removed, is just the thing. A stream of water from the pot spout may be quickly spread around the wheel, preventing the wood from burning. The entire operation of tire-setting must be carried out from start to finish as quickly as possible and with a stop until finished!

Tool for Making Wooden Pins

"Wooden pins, fit for heavy barn framing or for putting together a cart body are easily made in our Farm Workshop with homemade tools. Big framing pins an inch to an inch and a half in diameter and eight to twelve inches long may be made up by dozens or hundreds and little three-eighths by two-inch pins may be made in the same way when it is not possible to obtain dowel rod to be cut up into pins from three-foot lengths.

"To make the pin tool, a punch or "drift-pin" will be required. As shown by the sketch, this tool should be taper and several sizes of pin making tools may be made with the same tapered punch. For very small and extra large pin-tools, different sizes of punches should be made and used.

Details of Pin Making

"Almost any flat bit of iron or soft steel will serve as a pin-tool. The sketch shows one made from a bit of tire steel. Three sizes of holes have been punched with the drift pin as shown and a raised lip has been built up around each hole by punching from the bottom of the tool mostly.

"The sketch shows how the lip may be raised by driving the punch from below while the pin tool rests over a hole larger than the one being punched. The small holes were punched over the hardy hole of the anvil but when a tool for making large framing pins was being forged, the tool was placed over a short piece of two-inch steam pipe which in turn stood on the anvil. The lip was afterwards finished a bit with a file and being made a bit too small with the punch, was finished with a round file accurately to size.

Tool Ready for Use

"Finished as shown by the section sketch, the pin tool is ready for use. It will make pins if left on top without the raised lip but a smoother pin is made with less driving, when the lip is formed upon the tool. The stock should be split from blocks—never sawed to size. Mark off one end of a block with a pencil into squares of proper size as shown by sketch and split out the square blanks with a hand axe, driving the axe into the end marks with a beetle of a block of wood. Split the thin wide strips with the axe, into square strips as shown.

"To make the pins, place the pin tool over the anvil hardy hole for all sizes of pins which will pass through that hole. Place a blank on end fair above the lipped hole and drive the blank down through the hole with a hammer. The corners and sides will be peeled off by the lip tool and a pretty smooth pin will be dressed out. Stop hammering while the blank end is still at least a half inch above the pin tool, place another blank on top the first one and drive the first blank through with or through the second. So doing, prevents the tool lip from being struck by the hammer, the lightest blow from which will surely injure or ruin the delicate raised lips.

Drive the Blanks Straight

"Be very careful to keep the blank exactly vertical while driving it. If the blank be permitted to lean one way or another, it will come out either rough or crooked and but an apology for a pin. But when kept vertical, a good pin is usually secured. Do not drive with too heavy blows. Trying to drive the pin an inch or an inch and a half with each blow will probably force the blank sidewise more or less and possibly make the pin too small or possibly crooked. When extra smooth pins are desired, drive the blanks twice—First through a tool a bit larger, then drive again through an opening of the right size. Taking off less material at a time leaves a smoother pin and one more closely to required diameter"— "An' that's the way, Suh, we done make good with a few tools, the things which done pesters and gives us misery in our haid!"

GETTING RID OF THE RATTLE

By D. A. Hampson

THE LOOSENESS around spring and spring shackle bolts is responsible for much of the rattle on cars of a year or two's running. We can always get new spring bolts and new shackles and spring eye bushings, but up under the fender is a hole that, on most cars, require a shop session to put in shape. The shackle at the back end of the front spring straddles, at its upper end, the frame, and a bolt passes through the frame and the forging riveted to the frame at this point to give requisite width. This hole is not usually bushed and, being up where it is hard to get at the means of lubrication, the bolt generally is dry. This means that it wears the hole badly, aided by the pounding that the front wheels get and transmit.

When the car is put in the shop, it will save time to take off the front wheel—it is awkward enough at best to work in cramped quarters close to a muddy fender. Cars in the price class which do not have bushed holes will have 7/16 inch or 1/2 inch bolts. This means that a bushing should be at least 5/8 inch in diameter. If there is an electric drill in the garage, enlarge the worn hole to 5/8 inch, or over if within the capacity of the drill. Then make a steel bushing to fit and make it as tight as can be forced home; if it squeezes the hole too tight for the bolt, pass a reamer through. If there is no drill available, get a taper reamer and ream until the hole is round—then turn the bushing on the outside to fit. It should not cost over five dollars to thus fix any car and it is worth double that amount to be rid of that thump, thump, thump right in front of you all the time.

DRILLING is the most frequent operation in repair work, next to some strictly hand processes. Figs. 1 and 2 show a drilling idea of more than passing value.

It is a means of extending the reach of a drill press or, more frequently, a breast drill or portable drill. There are some hand breast drills on the market with the chuck and shank readily detachable and this unit

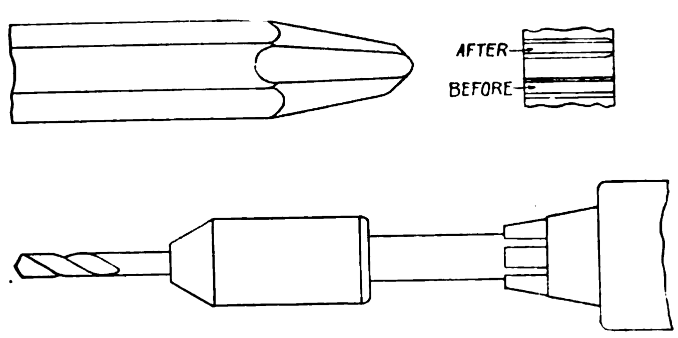


Fig. 1 at Top; 2 Below

may then be caught in the chuck of another drill as has been done in Fig. 2. When a hole has to be drilled far up between surrounding parts some form of extension, as this must be used. There is one maker who puts out a slim chuck, similar to that shown, with the shank an integral part of the chuck, the whole selling for about $3 and being intended for just such drilling jobs in restricted locations.

Get in the push and you won't need a pull.

A self-made man can beat an old rooster at crowing.

You have to watch your step to leave footprints in the sand of time.

The man who waits for outside forces to drag him up into a higher place will never get any higher than he is right now.

How much are your profits? If you don't know them you may be pretty certain that they are measurably less than they might be.

You are doing business in the most progressive country on the face of the earth. You can't lose—if you advertise what you have to sell

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ADVERTISEMENTS of SHOPS FOR SALE or TO RENT, SHOPS WANTED or SITUATIONS or HELP WANTED,

will be inserted under this head at 3 cents a word, including the address, for each insertion, payable in advance; but no advertisement will be accepted for less than 60 cents, however small.

Remittances may be made in postage stamps where the amount to be sent is less than $1.00. Address

M. T. RICHARDSON CO., Advertising Department,

71-73 Murray St., New York. Publishers of the Blacksmith and Wheelwright

For Sale

Blacksmith Shop and Garage. Two sets of tools complete.

One frame building in L. shape, 40 x 40 x 20. I will sell either for one-half cash or less if party agrees for same. Only one blacksmith in town. Work for two men all the year around. Address J. W. Kesler, Orrin, N. D.

FOR SALE, a first class Horseshoeing Shop, tools and stock, in town of 15000. Shop doing good business; work for two good men the year around. Reason for selling, poor health. If interested, address S. M. Atkins, 122 West Comstock Street, Owosso, Michigan.

Will sell Blacksmith's tools and wood working machinery. Will rent building. One room 18 x 60, one 14 x 60. W. Gordon, Canal Fulton, Ohio.

Smith's Steel Hardening Solution to harden Artesian and Oil well drills and other steel tools used in machine shops. Price $3.00. Address C. Smith. Lewisburg, Pa.

Wanted to Buy

Wanted to buy reasonable second hand pair of Barcus horse stocks. J. H. Snyder, Vandergrift, Pa.

Wanted

WANTED—to work in a Power Shop for general work with view of buying. Geo. Core, 313 . 22nd Street, Birmingham, Ala.

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A good business without capital, honorable, ue and straight; worthy of investigation. Turn over and under, inside out, up side down, a ean high class business I am giving up beuse of old age. Full instruction $1.00. George Velles Moseley, Newburgh, N. Y.

Patents

PATENTS FOR INVENTIONS.

H. W. T. JENNER, patent attorney and mechanical expert, 622 F Street, Washington, D. C. Established 1883. I make an examination and report if a patent can be had and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions. Trademarks registered.

For Blacksmiths

Toy's Modern Methods doing hard jobs easy will help every smith make more money. Will make a blacksmith of a good helper or handy man. Forging or solid welding, hardening and tempering to standard with colored tempering charts. All for one dollar. Samples free. W. M. Toy, Sidney, Ohio.

Valley City and Light Delivery Sleigh Bobs

The sleigh bobs which are manufactured by Sherwood Hall Co., Ltd., Grand Rapids, Michigan, are worthy of the careful attention by every blacksmith, for they represent another means of earning money in a comparatively easy way for him.

These may be obtained finished and painted, ready to set on a small grocery wagon body on or any other light delivery body, without shafts. They are also furnished in white, without any shoes or draw irons on them, also without shafts. Readers should write for full particulars in regard to this company's products which are very reasonable in price.

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CLASSIFIED BUYERS' GUIDE

BLACKSMITH AND WHEELWRIGHT

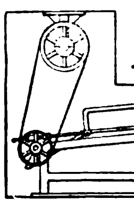
and TRACTOR REPAIR JOURNAL

Vol. LXXXV. No. 2 FEBRUARY, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

Read the Editorial Regarding This New Series of Articles

By J. F. Springer



A GOOD many workers in steel will perhaps be surprised to learn that ordinary steel is not the same everywhere. It can not be said of steel, as it can be said of a piece of absolutely pure iron, that every particle is the same as every other particle. In fact, any piece of ordinary steel in its natural state—that is, in the annealed condition—consists of two very different materials. The one is soft and ductile; the other is hard and brittle.

And the steel itself partakes of these diverse qualities; for steel may be made into wire by the wire drawing process, consequently, it is more or less ductile. But it is not as ductile as the soft and ductile material which is one of the two constituents of steel. The reason is doubtless because steel is made up, in part, of material that is brittle. In short, the steel is not as soft and ductile as one of its constituents but it is softer and more ductile than the other constituent. It is a kind of hybrid—just as a mule is a hybrid between a donkey and a horse or an apricot is a hybrid between a peach and a plum.

Ferrite

The soft and ductile material in steel is *iron*—pure iron. This iron is often called *ferrite*. The hard and brittle material is known as *cementite*. Usually these materials are more or less interleaved. That is, there will be a thin layer of cementite, and next a thin layer of ferrite, and then one of cementite again, and another of ferrite, and so on.

Now, if one wants to see and handle a piece of ferrite and a piece of cementite, he will need to do something different than attempting to split up a piece of ordinary annealed steel. The cementite and the ferrite are there; but they occur in layers of microscopic thinness. By means of a proper microscope the layers may be distinguished one from another.

Preparing Steel for Microscope

The bit of steel may need to be especially prepared so that the microscope may clearly show the edges of the alternating layers in a way such as to make them appear different to the eye. There are ways of doing this and the result is very striking. The edges appear as stripes, the one material dark and the other light.

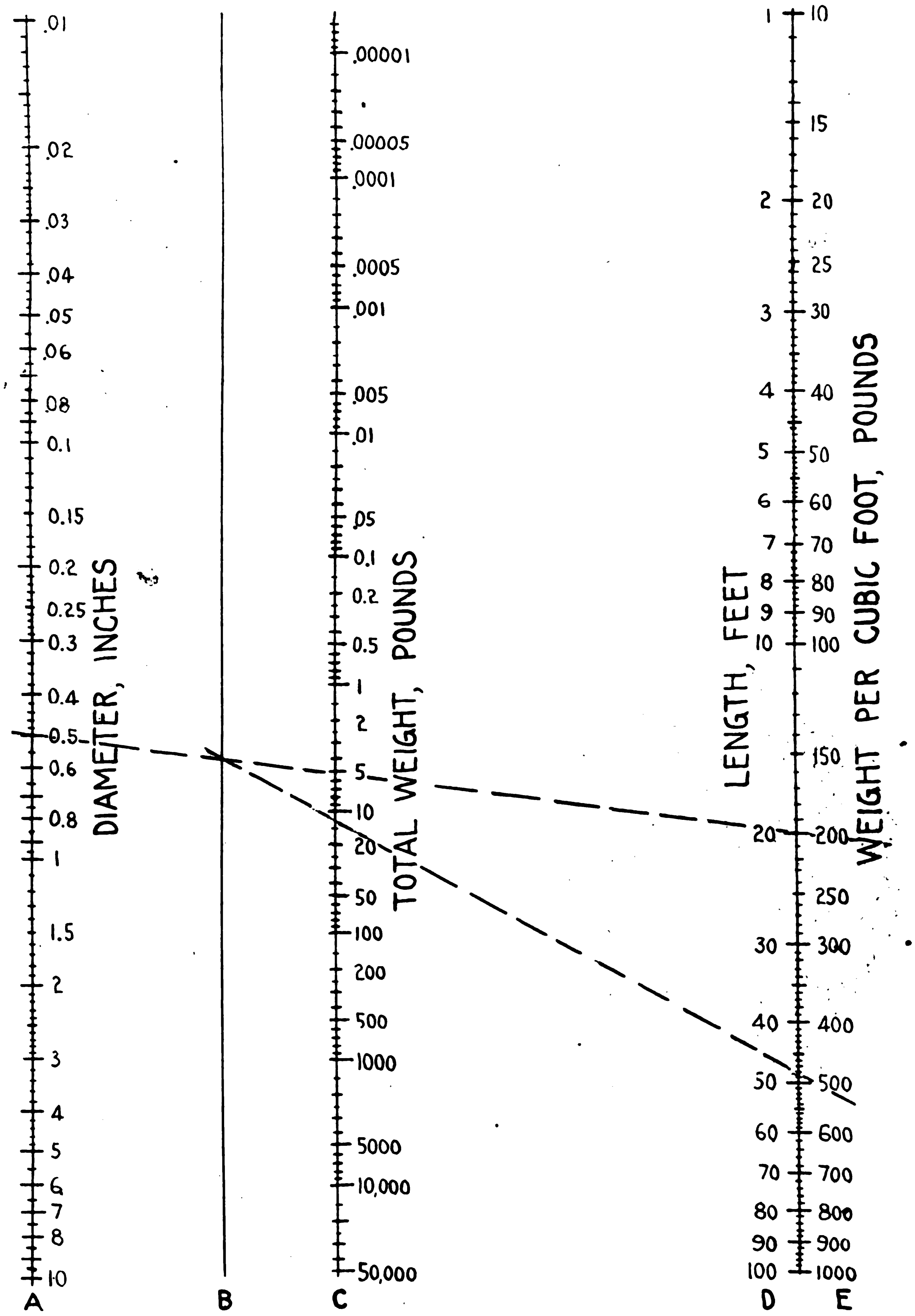
However, we may get at the matter in another way. Pure, electrolytic iron is nothing but ferrite; so that if one gets hold of a substantial piece, he has the opportunity not only to see but also to handle ferrite. Iron is one of the chemical elements, and consists of just one thing which the chemists are unable to decompose into other substances. Electrolytic iron, by the very nature of its mode of manufacture, may be made extraordinarily pure. Such iron is the same as the soft and ductile constituent of ordinary, annealed steel. A name for it is, as we have learned, ferrite.

In order to get a substantial bit of the other constituent—the one that is hard and brittle and has the name cementite—one has only to secure a chunk of the hardest white cast iron. This will probably not be pure cementite, but it will be near enough for us just now.

Now, we can set up the pure electrolytic iron at one place and "pure" white iron at another. Then we can fill in the interval, in imagination, with steels having varying proportions of the two constituents. Thus, we may begin with the ferrite and put next to it a steel containing only an extremely minute quantity of cementite. That is, this next-door neighbor to ferrite would be almost all ferrite and would contain only a very small proportion indeed of the other constituent.

Then, next to this, we could place a steel consisting almost entirely of ferrite, but containing just a minute trifle more cementite. And so on—we could arrange a series, each member containing a little more cementite than its preceding neighbor; and we may continue until at last we reach the piece of nothing-but-cementite at the end. We may, if we choose, view the entire series—pure electrolytic iron and "pure" white iron included—as a series of steels.

The pure iron would then be a steel containing 100 per cent ferrite and 0 per cent cementite; and the "pure" white iron would



be a steel containing 0 per cent ferrite and 100 per cent cementite.

I said we could arrange such a series, *in imagination*. It is not necessary to be so reserved as that. It is to be understood as probable that the whole series could be constructed—that is, that all the varieties could be actually made—and that one need only be particular to say that not all of the series are in actual industrial use to-day.

Now let us consider the matter of hardness. I shall exclude, just now, the hardness that may be produced by heating the steel to a proper temperature and then chilling it. Steels differ, even in their natural, annealed condition, in respect to their hardness. In fact, we may say that in general the more cementite a steel contains, the harder will it be. Ferrite is soft and cementite is hard. Naturally, then, the greater percentage of cementite should correspond with the greater degree of hardness. This is an important industrial fact.

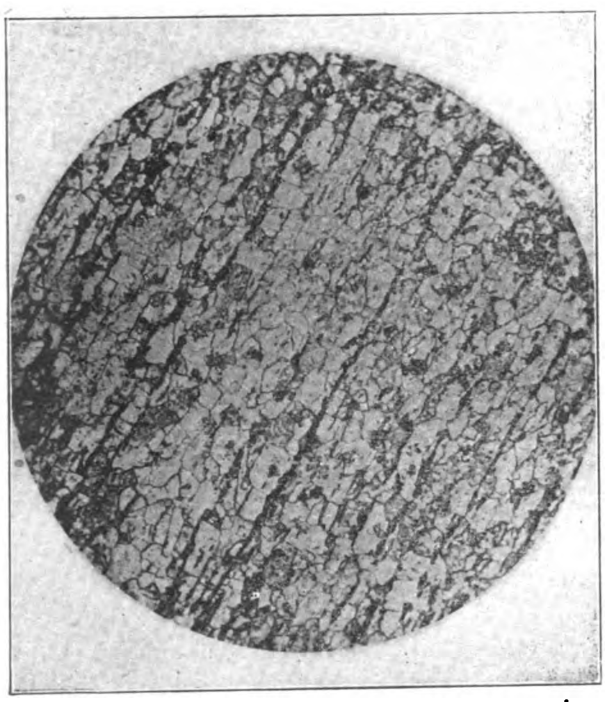
Increasing Hardness of Steel

It may, however, be stated more simply by saying that the hardness of steel increases with the carbon percentage. This amounts to the same thing, since cementite is composed of a definite proportion of carbon. So that the more cementite there is, the more carbon there is; and the more carbon, the more cementite. Either way, then: The percentage of cementite or of carbon in a steel is an index to the hardness.

In actual shop practice, however, the matter is somewhat confused by the fact that practically all commercial steels contains impurities, such as phosphorus, manganese, etc. Some of these impurities have their own special effects in respect to hardness. The thing to do, unless you have some special light on the subject, is to consider the rule as absolutely correct for all ordinary steels—say, steels containing less than 2 per cent of carbon—and to bear in mind that the impurities have a modifying influence.

I said that cementite contains carbon. This is true. In fact, all the carbon in steel is in the cementite. The other constituent is pure iron and so contains no carbon. New, cementite happens to be a chemical combination. Just a word on such combinations to make sure we all understand.

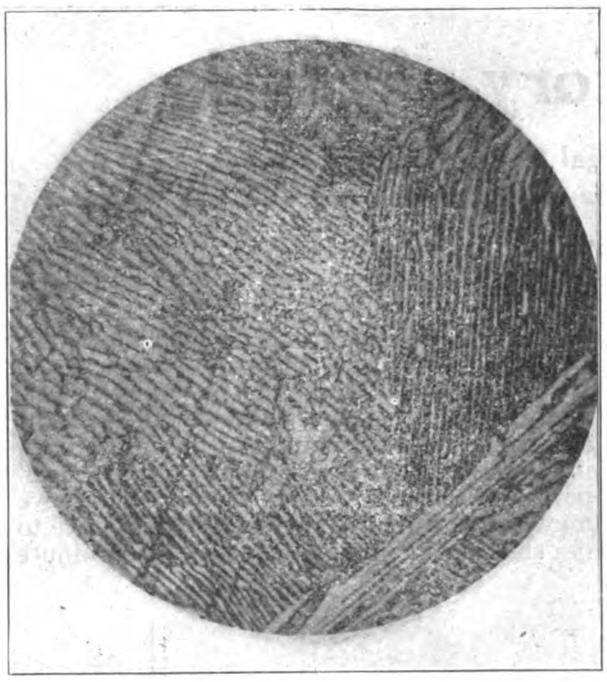
Water is a chemical combination, and consists of two gases, hydrogen and oxygen. And it doesn't resemble either one. There is in fact no trace of either gas to be detected by an examination of water, until we deal with the sample of water after the manner of a chemist.



Wrought Iron 100 diameters

Nitrate of silver, sometimes used as a caustic application to destroy warts, is a colorless crystalline substance. And yet, it consists, chemically, of the metal silver and the two gases nitrogen and oxygen. In a similar way, cementite consists of carbon and iron (or ferrite).

There will be no use, however, in getting a piece of white cast iron and trying to find either the carbon or the iron—unless we test the sample in the way chemists would proceed. You can't find any carbon (if the sample is really a pure cementite), no matter how strong your microscope nor how perserving you may be. Nevertheless, carbon is there and also iron.



1.50 per cent carbon 1500 diameters Normalized Steeel

Now it so happens that the various elements in compounds usually occur in very exact proportions. In the present case, the iron weighs just about 14 times as much as the carbon. That is, the carbon is 1/15 of the whole weight. Or, we may state the same thing thus: The carbon is 6 2/3 per cent of the whole weight of the cementite.

Here is an interesting and perhaps valuable thing even from a practical point of view. If we know the carbon percentage of a sample of steel, we can determine the percentage of cementite in that sample. For example, if we know that the sample is a 0.40 per cent carbon steel, then we have a starting point from which to get the cementite percentage.

In 100 pounds of this steel, there would be only 0.40 pound of carbon. But this carbon is 1/15 of the whole weight of the cementite; so that, to get that weight, all we have to do is multiply 0.40 pound by 15. We thus find that the 100 pounds of the steel contains 6 pounds of cementite. Or, we may simply multiply the carbon percentage (0.40) by 15 and get the cementite percentage—namely 6 per cent. We learn then that carbon steel containing 0.40 per cent of carbon contains 6 per cent of cementite.

The remainder of the steel is ferrite. In the present case, we learn that there is present 94 per cent of this pure iron. In 100 pounds of this steel are 94 pounds of ferrite and 6 pounds of cementite. Whatever hardness this steel has beyond the hardness of the simple iron is due to these 6 pounds of cementite, the hard and brittle constituent.

Studying the Pictures

The foregoing explanation will be of value in studying photographic views that disclose the stripes of ferrite and cementite. From the carbon percentage, we may readily calculate the cementite percentage. By subtracting from 1, that is from 100 per cent, we get the ferrite percentage. We may test our calculations by noting whether the two percentages—of ferrite and cementite—together make up 1 or else 100 per cent. By considering the photograph, we may be able to judge roughly the relative amounts of the totals of dark and light stripes and patches. These are not safe indexes, if used alone.

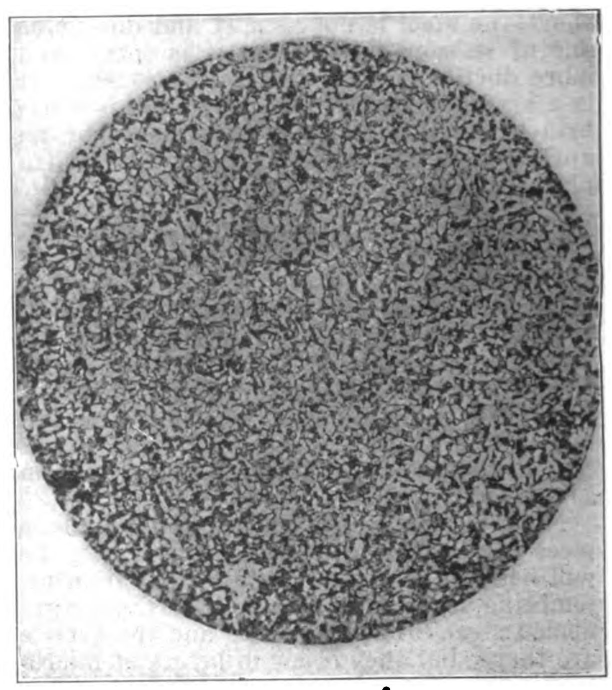
For example, we look at the photographic view and conclude that the cementite stripes and patches are one-half those of the ferrite, in so far as area is concerned, that is, the ferrite area is 2/3 and the cementite area 1/3 of the total area. These are areas, and not volumes, however. And it is volumes with which we need to be concerned. Accordingly, we take the square roots of 2 and 1 (or of 2/3 and 1/3) and cube them and then compare the results. Thus, the square roots of 2 and 1 are 1.414 and 1.000. The volumes then, are in the ratio 2.828:1.000. Or, we might have taken the cube of the square roots of 0.6666667 and 0.333333 and have obtained the same ratio. We have now learned that if the ferrite *appears* to be double the cementite, it really is more than double—almost three times as much, in fact (2.8 times, according to our results).

The foregoing depends upon the assumption that the ferrite and the cementite occur in similar shapes. This, doubtless, is not always true, even approximately. But, it is of more or less importance to see that we are dealing with *volumes* and not with areas, although the photograph shows only the latter. Taking the square root and cubing the result is, nevertheless, a step in the right direction.

A Further Explanation

There is another point. It is, as we have seen, possible to determine the weights of the cementite and the ferrite in a given sample if we know the carbon percentage and the weight of the sample. And we have just found a way to get a line on the relative volumes. We might check the latter against the former, if we knew something about the specific gravities of ferrite and cementite. Roughly, they are the same. So that, if we know relative volumes we may then assume that the relative weights are the same.

Or, and this will appeal to many, we may proceed thus. The carbon percentage enables us to calculate the ferrite and cementite



Steel, but worked 0.30 per cent carbon 100 diameters

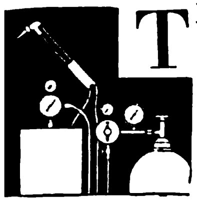
weight percentages. Then, since the specific gravities are roughly the same for the two constituents, the relative volumes will be the same as the relative weights. Let us have a numerical example and get this idea clear.

Suppose we have a photograph before us of a sample of carbon steel having a carbon content of .50 per cent. Multiplying this by 15, we get 7.5. This is the percentage of cementite. Subtracting from 100, we get 92.5 per cent for the ferrite. Now the ratio of 92.5 to 7.5 is 37 to 3. This means that the weights of the ferrite and cementite are as 37 to 3—or, about 12 to 1. That is, the ferrite weighs 12 times as much as the cementite. As the specific gravities of the two constituents are about the same, we get finally the fact that the volumes are roughly as 12 to 1.

But, in the photograph, we are looking at a section, which shows areas and not volumes. However, assuming that the shapes are similar, we can get the relative area by taking the cube roots and squaring them. That is, we take the cube roots of 12 and 1 and then square them. We thus get, first 2.3 and 1 for the cube roots, and 5.3 and 1 for the squares of the cube roots. *This means* *roughly, that the picture ought to show over five times as much ferrite as cementite.*

The foregoing is useful when we have a photograph of a section of steel whose carbon percentage is known, and do not have information as to whether the light patches correspond with ferrite or not. That is, we see light and dark patches and stripes, but are unable to tell the ferrite from the cementite. Under such conditions, we may frequently clear the matter up by calculating in the way explained what the relative areas ought to be. However, to bring out all the facts, the photograph should represent a very high magnification. Otherwise, the fine lines showing the interleaving of the ferrite and the cementite may not be visible.

If, however, the magnification is great enough to make everything 500 times larger than natural and 500 times broader than natural, we may be able to judge whether the view, is mostly white or mostly black. I have before me now a reproduction of a photomicrograph which is stated to be with a magnification of 500. There is a considerable island or peninsula and neighboring parts of similar islands or peninsulas. The steel is known to contain less than 0.90 per cent of carbon, but how much less is not stated in connection with the photograph. These islands or peninsulas are mixtures of white and black, and are in fact examples of the interleaving of ferrite and cementite. But this does not tell us whether white represents cementite or ferrite. Between the islands or peninsulas are broad white bands. The amount of white in these bands added to the white in the islands or peninsulas seems enough to give it the preponderance over the black. We may readily calculate that any steel having less than 0.90 per cent carbon should show in a microphotograph a proponderance of ferrite. Consequently we consider that the white represents ferrite.



THE next machine of importance in our Experimental Department is the No. 330 Variety Saw which is made by the J. A. Fay & Egan Company of Cincinnati, Ohio. This machine should be of interest to all of our readers who are called to do automobile truck or carriage body repair work.

We spoke in a previous article of the utility of such a machine in an automobile repair shop and we reiterate that such a machine can be utilized to pay just as big returns as any other machine in the repair shop. Every up-to-date repair man must realize that when he turns away automobile repair work of *any* sort he is taking a chance on losing a good customer. If he can keep all of the work in his own shop he can give greater satisfaction than if the customer must tie up his valuable machine in three or four different places.

The variety saw which we have should be amply large enough for any sort of automobile, truck or tractor wood work. In itself, the machine might be said to be a complete carpenter shop, and during the past six months of our ownership we have yet to find a wood-working job which could not be accomplished on it. New uses of the machine come up daily. Later in this article we will take up the various uses to which our variety saw has been put.

The Saw Table

The table to this machine measures 36x42 inches. Is well ribbed for strength and accurately milled to surface. The table is fitted with two grooves running parallel with the saw arbor, and into these grooves fit the guides for the mitre, cross cut fences. The table is mounted upon semi-circular milled rockers which slide into milled cheeks mounted on the table yoke.

These milled rockers allow the table to swing or angle up to 45 degrees, and the micrometer index on the side shows the exact angle at which the table inclined. On our machine we have found that the action of this angle arrangement is so smooth that it can almost be spun by the momentum of the hand wheel.

The table yoke is moved upward and downward by means of a second hand wheel working through a low pitch screw mounted on ball bearings. Our machine is fitted with ten-inch saws (crosscut and rip) and will cut up two inches in thickness. The regular equipment includes fourteen-inch saws, instead of the ten-inch. We mention this to show that the machine has a wide range, and with a three-horse power motor the machine should easily cut up at least four inches in thickness.

The saw arbor is mounted on the column which is a heavy one piece cord casting which also carries the table yoke. The saw arbor is mounted upon two babbitted bearings which are provided with large oil chambers. It is an easy matter to lubricate this machine when the table is tipped to about fifteen degrees, at that point both mandril bearings are accessible.

The saw end of the mandril carries two spacing collars in addition to the two collars ordinarily used. With these collars removed, a space of over three inches is had and this space may be utilized for mounting dado or gaining heads, of which we will speak later.

Location of Sliding Table

The other end of the saw arbor is provided with a fitting for holding a round shank auger or ordinary drill, and as will be noted in the illustration, a sliding table nineteen inches by ten inches is located beneath this boring device. A projecting casting mounted on the main column is designed to carry a square mortise chisel.

The device may be used of course either with the square hole cutting adjustment or simply for boring round holes for dowel pins. The movement of the table and the adjustment is such that it will cut a square hole in the stock three inches deep and as large as sixteen by eight inches in dimensions. The table has a vertical adjustment of eight inches and moves forward and back from the auger, a distance of five inches.

Capacity of Machine

Our machine is equipped to bore three-eighths and five-eighths inch square holes and round holes to practically any reasonable size. The pressure for boring both round and square holes obtained through a long, foot lever and only a minimum amount of effort is required for the work. The holes have square corners and are clean cut. An automatic stop arrangement is mounted upon the table so that they may be cut to any predetermined depth up to the limit of three inches.

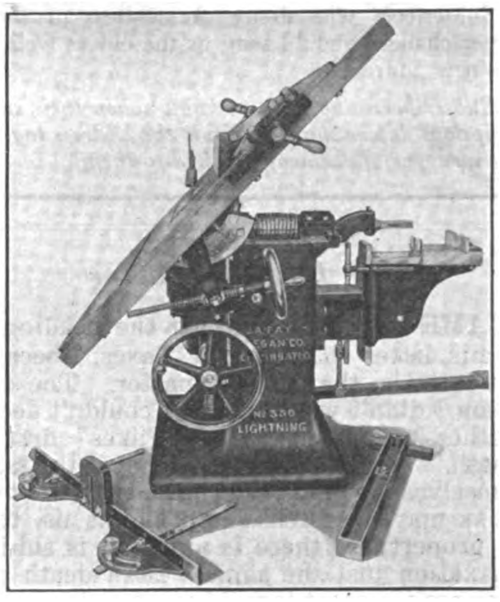
By moving the stock along, the machine may be used for slotting. The equipment furnished with the machine, in addition to the two saws, a cut off and a rip saw, consists of a bevel ripping fence which is adjusted to any angle from the perpendicular to about 45 degrees. Beyond this point the table may be tipped to bevel any angle between straight lines.

Fence Adjustment Bar

The plain ripping fence is faced off on each side and can be used either to the left or to the right of the saw. This fence is so arranged that it can be adjusted parallel with the cut. Both the adjustable bevel fence and the plain ripping fence slide along a milled bar at the front of the machine. This bar extends out to the right of the table so that fences can be set to the extreme edge of the table on either side. This fence bar is fitted with a graduated scale to sixteenths of an inch.

The two mitre fences are fitted with a yoke so that they may be used either singly or together. The fences are provided with an index plate and will swing to 45 degrees. The saw is entirely enclosed beneath the table with a sawdust basin which connects through a chute to a box or dust chute beneath the machine. Under ordinary conditions saw dust is not around the floor but is forced into the chute by the speed of the saw itself.

The whole machine is heavy enough to take in any work within the capacity of the saw. It is rigid and well designed. We have found that the machine has many uses other than those outlined above and have mentioned that it is a whole carpenter shop in itself. Practically any work done in the ordinary carpenter shop except scroll saw work can be accomplished on this machine.



Number 330 Lighting Variety Saw.

Various Possibilities

A wide wooden throat is provided on the top of the table. This throat may be removed very easily, leaving a space over three inches wide and the whole length of the dust chute. The two spacing collars may be taken from the saw arbor leaving a space about three and one-half inches in width. The retaining collar on the end of the saw arbor carries an expanding bushing which tends to center any fitting placed upon the arbor. This means that the arbor may be fitted with circular wooden wheels, which in turn may be covered with leather for buffing, with gritcloth for sanding, or with cloth discs for polishing work.

(Continued on page 11)

BLACKSMITH & WHEELWRIGHT AND TRACTOR REPAIR JOURNAL

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Our Editor's Letter

I CAME very near making the heading of this letter "Death and Taxes," because that is to be the subject matter. The only reason I didn't was because I couldn't decide whether to put the word "Taxes" first or "Death." Most of us realize that if the taxes themselves do not result in death, the tax blanks may. And if death claims us, then our property, if there is any left, is subject to taxation just the same. Both death and taxes are the most tangible facts which exist and this is why it is so difficult to decide which one to put first.

Doubtless the majority of our readers are subject to the income tax law; many as individuals, some as corporations or partnerships. And not every one understands, fully, the tax law. Since the matter of deductions and expenses is so important I feel that it would be of some help to the readers to consider, in this letter, a few of the outstanding facts.

There has been a change in the application of the law this year as compared with last. While there is a general exemption of $1000. for unmarried men and of $2000 for married men, there is an additional exemption of $400 for each dependent. If, for instance, you support a minor child, or aged parents, you may consider them as dependents, provided they have no independent income of their own.

If, however the child is not a minor, or if your aged parents have other income, or if someone else helps to support them, you should not report them as dependents.

Within reason, you are entitled to subtract from your income, the amount which you give to recognized charities and benevolent organizations. Thus you can subtract the amount which you donate to the Red Cross, the Church fund, or to an hospital.

If you are in a position to furnish reasonable proof, you can deduct the various war taxes which you paid last year. You paid a tax on candy, patent medicines, theatre tickets, railroad fares, and so on and there is no reason why you should pay again.

The things which I have so far mentioned are fairly well understood, perhaps, but the matter of taxation on real property, your house or your shop is not so clear.

Suppose you own a part of your own house or your shop and that you alone occupy or do business in these buildings. There is a mortgage on both places. You are allowed to subtract, from your income, the amount of money paid out for interest on the mortgages. But you cannot subtract the money paid on the principal. You are also entitled to subtract the tax which you paid to the city or county on this personal property.

If you own the house or shop and someone else occupies it, then you are entitled, not only to the above mentioned deductions but also to deductions for repairs. If the repairs are in the nature of additional investment, however, you cannot subtract them. Let me explain this.

Suppose the tenant asks you to repair the plumbing, a hole in the floor, or a broken window. The cost of such a repair is deductable. If, however, you build an addition to the house, put on a new roof, re-decorate a room or paint the building, then it is clear that this is something which adds to the value and hence it cannot be considered as an expense. This particular item should be considered very carefully because it is such an easy matter to make an error in filling in the return.

The matter of deduction for depreciation on buildings is one which you should take up with the local tax collector. The value of certain types of buildings drops faster than others, but you are entitled to a deduction for depreciation. The depreciation item and the cost for repairs and additions should be considered at the same time.

The income report should be carefully gone over as well. If you are married, and claim the $2000 deduction, you must report, in your return your wife's income. If you report a minor dependent, and that dependent earns a certain salary, this money should be reported as a part of your income. If you own real estate and there is an income from it, naturally this income must be reported.

Be very careful about reporting income from investments. Certain stocks and bonds are exempt from taxation and certain stocks have the taxes paid at the source, before you receive the dividends. The stock certificates or the bonds will show this.

After you have put all of these things down on paper and know exactly where you stand, take the matter up with the nearest revenue department and have them advise you in making out the return. Do not be afraid to ask for help for it may save you considerable money and none of us care to pay any more in taxes than is necessary.

A New Series of Articles

IN this issue we start a new series of articles relative to the construction and treatment of steel. The very nature of the work requires that it be somewhat technical but we are doing our best to make the subject matter so clear that everyone can understand it.

Many of the readers will wonder just why they need to know how steel is made inside in order to treat it properly. The average smith is content to know that if he heats steel to a red heat and plunges it in water, he will obtain a hard product. In this hit or miss fashion he makes tools and parts, sometimes the product gives satisfaction sometimes his customer raises a big "howl."

If the results are good, the smith explain matters by saying that the steel is good; i bad, he blames the metal. But in the major ity of cases he alone is to blame.

Your reputation depends entirely upo your work. Your customer does not care fo excuses, he wants results that satisfy. I you chance to displease him a few times h goes to another smith and you lose the cus tomer.

But steel is not a metal with fads and fan cies; it does not turn bad because it wants to it is not a friend or foe of Luck. It is merel a thing which follows natural laws and thos laws can be controlled by you.

Until you understand those laws and know what steel is, how it is made and similar "in side information" you are working in th dark. And this is the reason we have starte this series of articles. Read them carefully study the matter until you understand it an you will have no further worries abou "finiky" metal.

An Aged Worker

YOU wouldn't think by looking at us, tha we had been in this trade an extra lon time, but with this February issue we embar on our 43rd year of service. This is a rathe ripe old age for a magazine. Usually th magazines run along for a few years and the stray from the beaten path, but the Black smith and Wheelwright has stuck in the sam straight groove for nearly half a century.

'Tis said that progress demands a broaden ing of policy and that a single track purpos leads only toward failure. But such a state ment is not always true. Although we hav remained in this field for so many years, w are not in a narrow groove. We refuse t be bound by the traditions of the past if prog ress demands otherwise. Our faith is sti with the Blacksmith and it is our intention t remain with him as counsellor for many year to come.

And as we start our 43rd year of servic in the industry we want our readers to know that we are still looking toward their bes interests. We start our new year with th same creed as all others in the past, "To pub lish a magazine for the Blacksmith an worker in metals which will be a help, a par ner in the business. To put into that mag zine articles which will interest him. T advise him in his business to the end that l will prosper and remain a friend to man an beast."

The Cut-Out Fool

Dr. S. Harper Smith

Some chumps go whizzing along the stre
With noisy cut-outs snorting,
And running here and running there,
Like some mad bull cavorting.
It seems they cannot learn to know,
How sensible people feel,
That bigger the noise at the muffler,
The bigger the fool at the wheel.

Some people are fools for the want of se
And some for the want of money,
And some are prone to make fools of th
selves,
In their efforts to be funny.
But the worst of all is the fiend that hold
His cut-out with his heel,
For the bigger the noise at the muffler,
The bigger the fool at the wheel.

I can drive every day, in a quiet way,
Will never a sound to annoy;
I whistle a lay, as I hear people say
"His silence is golden; Oh joy!"
The cut-out man should get such a bump
That he would learn to feel
That the bigger the noise at the muffler,
The bigger the fool at the wheel.

OUR OWN REPAIR SHOP

(Continued from page 9)

The average repairman can easily make a set of cutter heads for this machine and use it for making ordinary ornamental molding or for jointing. Thus he can cut the boards or planks for a truck, plane them, sand them and make them up into the truck body with panels and ornamental molding without going out of his own shop for anything but rough material. With a slight amount of work the machine may be adapted to planing up to three inches in width on the table and as wide as twelve inches in width on the mortising and boring device.

Small Florida Shops

A Blacksmith Who Pulls Teeth as a Side Line

By James F. Hobart

THE writer has known of a barber who practiced tooth-pulling and a shoemaker in Massachusetts pulled teeth as well as drove pegs but a blacksmith-dentist is about the limit, especially when the man made and used his instruments for pulling his own teeth. Figure 1 shows a pair of pliers made by a smith and with which he pulled his own teeth and some from the jaws of his customers.

This smith lived several miles from town, operated a cross-roads shop and once, when a long grumbling tooth began to work overtime and the smith couldn't get hold of the offender with the horse-shoe pincers, he made the forceps shown by the engraving and yanked out the offending molar *pronto!*

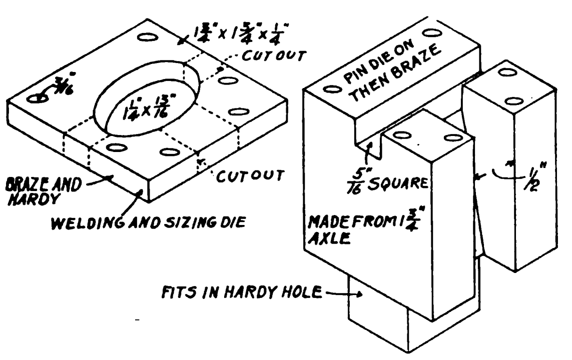
The forceps were made from a piece of three-quarter-inch octagon steel intended for cold chisels. A lot of care and a good bit of time were put into the forging. The steel was never heated to a bright red and not a blow was struck after the last sign of redness had vanished. The smith said that it made the steel brittle to hammer it when black cold and that it made it "rotten" to heat it to or above a low red.

The jaws were made about three-quarters of an inch long outside and five-eighths inside, the straight part of the jaws, between the bend and the rivet, being one-eighth inch thick. The tool was seven inches long and was not hardened, save the points of the jaws which were hardened and "drawn" to a dark straw color about an eighth of an inch back from the end.

Pulling His Tooth

First time the smith tried to use this instrument, he had a sad experience and hurt his jaw horribly. The ends of the pliers were ground down to a thickness of about one-thirty-second inch and when the smith tried to get hold of his aching molar, the steel pressed deep into the gum, deep enough to hurt badly but not deep enough to free the flesh from the tooth. Next the smith tried to lance around the tooth with the small blade of his pocket knife, but he only made himself bleed and cuss, without much effect upon the tooth.

Then he ground the ends of the pliers' jaws to a sharu edge and whetted them well

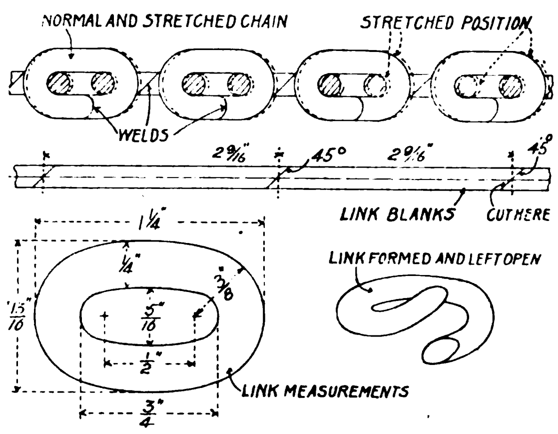


on an oil stone, placed the sharpened jaws over the aching tooth, took a long breath, shut his eyes and surged down with all his strength upon the handles of the plyers! It made him gasp and groan, but he hung on. The sharpened jaws went to the bone, cutting the flesh free from the tooth.

Then the smith clamped upon the handles of the plyers, surged, twisted and groaned until all at once, so he said, the top of his head seemed to break off and the tooth came out! That smith told me he never enjoyed anything in all his life as he did the pulling of the first tooth for a customer. Said he (the smith) got even for all the pain it cost him to get his own tooth out!

Chasing the Shop Loafers

In a little Pinellas County, Florida shop, located adjacent to a general store, the smith was greatly bothered by the daily aggregation of the village wiseacres who met at the store or in his shop to tell each other how



the affairs of the nation ought to be run. One man persisted in sitting right on a corner of the forge next to the anvil, where he was very much in the way, and there he spent hours to the discomfort and vexation of the smith.

This man never comes to the shop any more and the smith is glad, for the person never had any work done and was always in the way. A sixteen-inch square of boiler-plate which the smith kept on the corner of his forge, was the favorite seat of the loafer.

Finally the smith got a line on the time when this man daily appeared at the shop and half an hour before, he placed that bit of boiler-plate above the forge fire where it became black-hot and remained so until the man was seen coming toward the shop, when the smith deftly slipped the plate upon the corner of the forge and then watched Bill saunter in and settle accurately upon the hot plate.

In a very few seconds, there was a yell, a smell of burning cloth and flesh and Bill scattered for the door, stopping only for an instant to souse his burnt place in the slack tub as he went past that appliance. The rest of the loafer gang gave Bill a haw-haw and gathered about the anvil, sitting upon trestles, kegs and whatever of the smith's work they could roost upon.

The smith was "loaded" for this gentry also. He had broken an old stove door into small pieces and two of these he placed upon a piece of galvanized strap steel one-sixteenth inch thick and a little more than an inch wide. The smith obtained a lot of this material without charge from a hardware store. It is used for strapping together into bunches, sheets of galvanized steel. These strips are about 30 inches long and many uses can be found for them in a smith shop.

Upon one of these strips, about a foot long, the smith placed a couple of pieces of cast iron stove plate as shown in figure 2, then he placed the strip carefully in the forge fire and took a welding heat upon it, dipping it in sand a couple of times as the heating proceeded.

The smith watched the cast iron closely. It would melt before the steel, and just at the instant that the cast iron showed signs of beginning to "run," the smith slid the steel upon the anvil, grabbed up his heaviest sledge and struck the hot cast iron a mighty blow. The mushy, nearly melted cast iron, when struck by the sledge, flew in a thousand brilliant, burning sparks over the hands and clothing of the shop loafers who sprang up as the sparks hit them and at the second sledge blow they all ran out of the shop in a mad scramble. Ever since, they have been very wary and never congregated close enough to the anvil to be in the way of the smith.

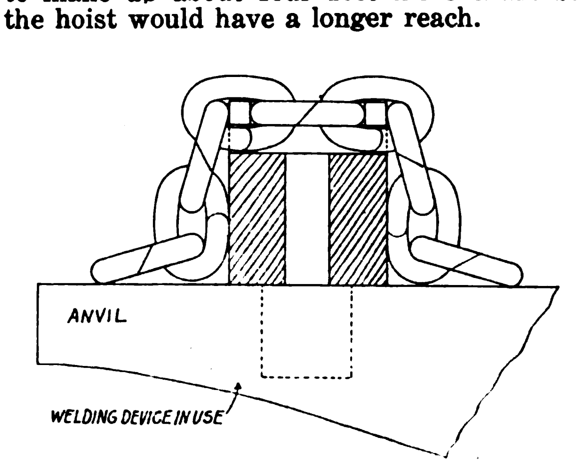
"Reckon it must have teched 'em up a bit," said the smith with a grin as he told the writer about it, " 'cause it sure burned four holes right through my new leather apron!"

Repairing a Hoist Chain

The writer chanced to be in a smith shop just as a chain was being repaired for a differential hoist. The smith was doing a good job, a neat one, and work which it may pay other smiths to "get next" to. The chain had been broken in three places, also it had been stretched in nearly every link as shown by the dotted lines in figure 3—where each of the little links of one-quarter inch steel are shown to have been slightly elongated.

A hoist chain of ths kind is made to fit over two shaves upon the same shaft, thus forming a "double block"; the chain links fitting into little pockets of which in the one-half-ton differential chain hoist, there will be found pockets for twelve or thirteen links on one of the sheaves, while the other sheave has one more or one less pocket so that one revolution of the sheave will hoist or lower the single lower sheave the length of one chain link.

The sheaves have pockets only for the flat links, those lying edgewise fitting into a groove. Thus each pocket really cares for two links of the chain. When too heavy a load is hoisted, the chain will be stretched as shown by the dotted lines and this stretch of each link, the smith was trying to correct as well as to mend the chain which had been broken into several pieces. He also desired to make up about four feet more chain so the hoist would have a longer reach.



The sketch shows that the links were welded on the side instead of end as is usual with hand-made chain. The original links were evidently put together in an electrical welding machine as the grip marks could be plainly seen on each link at the weld.

The Link Measurements

As shown by figure 4 the length of a link should be 1¼ inches, its width over all, 13/16 inch. The smith cut off steel for the new links on a small shear and made the cuts at 45 degrees as shown and welded the ends at that angle without upsetting. In figure 4, a dotted line is shown along the middle of the link. The smith calculated the length of blank according to the length of that dotted line and had no allowance to make for the "take-up" of the steel during the bending of the blanks into links.

The sketch shows that the radius of the dotted circle, or half circle, is ¼ inch and the distance between the centers is ½ inch, therefore the required length of link blank would be the circumference of a ½-inch circle, plus twice the ½-inch distance between centers. The circumference of a ½-inch circle is nearly 1.57-inch. Add twice the center distance, or 1. inch, makes the blanks 2.57, or very nearly 2 9/16 inches as shown by figure 5, and this sketch also shows the manner in which the links were cut off with the little shear and punch machine.

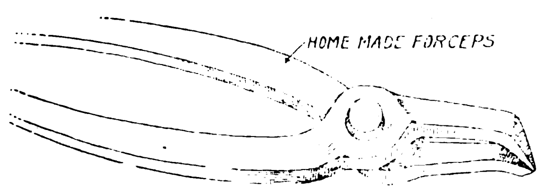
Forming the Links

The smith rigged up a hinged lever and three or four projecting pins around which the blanks were bent into shape by a single movement of the swinging lever. Then each link was off-set about a quarter of an inch as shown in figure 6, the steel being side-bent far enough to allow for the hooking together of the links.

The four feet of new chain was made in pieces of two feet each, then the two pieces joined together with another link and afterwards attached to the main chain in a similar manner, the several pieces of the chain were joined in like manner, then the chain was made endless by fastening the ends together with another link. Great care was taken to see that the chain was not twisted when the extreme ends were joined together.

Sizing the Links

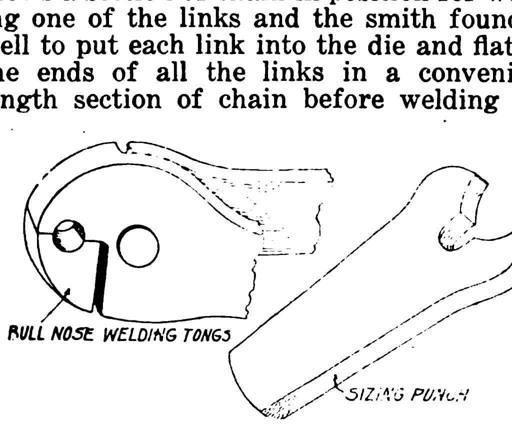
The smith made a sizing-tool in which the new links were put together to exact measurement, and also in which each old link was shortened until all its stretch had been re-



moved. The sizing-tool was made in two pieces as shown in figures 7 and 8. The welding and sizing die was made from a bit of tool steel, 1¾-inch square and a quarter-inch thick through which was drilled out and filed smooth, a hole the exact size of a finished link. The three sections indicated by the dotted lines were cut out after the die had been securely fastened to a hardy, made from a bit of 1¾-inch wagon-axle from the scrap-heap.

The bit of old axle was forged to fit in the hardy-hole, then cut off and squared up about four inches above the anvil-face. Two grooves were sawed and chiseled—or drilled—as shown by the sketch, then the sizing die was placed fair on top, fastened with stout 3/16 inch pins as shown, then brazed securely to the hardy. If there be an oxy-acetylene welding outfit at hand, then dispense with both dowels and brazing and weld the die and hardy solidly together.

Then cut away the die so the end-links can lie flat and cut away the half-inch section in front in order that the welding tongs may be applied to a link placed in the die. Figure 9 shows a section of chain in position for welding one of the links and the smith found it well to put each link into the die and flatten the ends of all the links in a convenient length section of chain before welding the

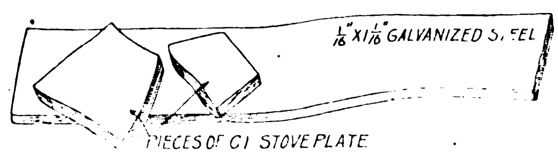


links which was then done, one after the other in the section.

Welding a Link

To weld a link, the smith took the usual heat, heating only one link at a time, then he slipped the link into the die as shown and grasped the heated ends of the link with a pair of heavy Bull-Nose Welding Tongs, the business end of which is shown by a sketch. The smith made these tongs and laid the jaws with bits of tool steel. In using them, he dipped the tongs into the slack tub after making each weld so the ends of the tongs could not soften.

One quick strong squeeze was given to a welding-hot link and the tongs-jaws fitting closely to the link, formed the weld instantly.



The die in which the link had been laid, forced the steel to keep its shape, and making a weld in any link was a matter of only about five seconds after the welding heat had been taken. The vertical slot in the welding and sizing die should be made wide enough—about a half inch—to admit the welding tongs easily.

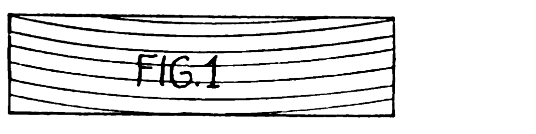
The stretched links were shortened quickly in the welding die. The smith made up a punch as shown in figure 10, which would fit snugly against the end of one of the links when the edgewise link was turned vertically upward and held there. A heat being taken upon a section of chain with stretched links, one link would be placed in the sizing-die, one end of the link projecting. The sizing punch would be placed against the protruding link-end and a tap or two of a hammer against the punch, quickly shortened the link so it would go into the die where it was flattened if necessary and otherwise brought to exact size and shape required to make the link fit well and run easily in the sheaves of the hoist.

The sizing punch was made of quarter-inch thick tool steel, a greater thickness being in the way. This tool was not hardened but was kept cool by occasional dipping into the slack tub. Later, the smith found that another punch was desirable, a punch which would just go between the edgewise links as a link lay in the welding die. In fact, this last punch was merely a flatter and it was used to make the link lie perfectly flat and straight for it was found that a twist in a link gave trouble when it passed over one of the sheaves.

Platform Gears

Method of Making Straight Timber Platform Gears

FOR general purposes the plainer the platform gear the more desirable it is both on account of cost and durability, also because of the ease by which it can be repaired. This is more especially the case where a platform is used with straight-silled bodies of the democrat type and where the upper platform is low. This type requires the use of low front wheels, but they are not intended to turn entirely under the body unless the body used has a cutunder instead of a straight sill. It is necessary, therefore, to study the conditions closely and to construct the under bed in a manner that will give the full height required, as there is a limit to the "open" that can be given to the elliptic springs. This makes the bed the most difficult part of the gear to make, and necessitates the use of the best of timber, otherwise it will be necessary to plate it heavily, and this is one of the things to avoid when making low-priced gears. The gear maker is often tempted to cut away from the upper as well as the lower side of the main bed to give it a light appearance, but by so doing weakens it very much. This may appear desirable while the gear is in the workshop, but when it is under the body, in the place where it is to be used, the heavy bed does not appear so objectionable to the eye, and all the labor spent in lightening it is lost, because of its location. In selecting timber for the bed get planks that have the grain running from



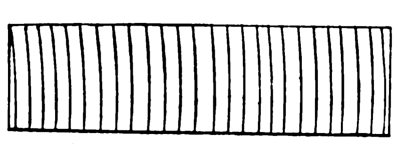


FIG.2

Fig. 1. Plank end showing the layers extending across the width
Fig. 2. Plank end showing the layers crossing the thickness

side to side of the plank, as shown by Fig. 1, not across, as shown by Fig. 2. By this means the timber when in the bed will be in a position where it will support the greatest strain. Fig. 3 shows the plank with a main bed marked upon it. If the grain crosses the plank, as in Fig. 2, the part at A will be very weak, as the layer will run across as shown by Fig. 3. If cut from a plank with the grain running as in Fig. 1 the bearing is more or less upon the edges of the layers, and the strength is greatly increased. This matter is often overlooked not only in regard to main beds but in many other timbers. A little study and care will quickly prove the advantage of placing timber in the position where it will give the greatest resistance or where its elasticity will not be impaired. It may be best in some cases to have the layers across the bar and in other cases to run in the reverse connection. There

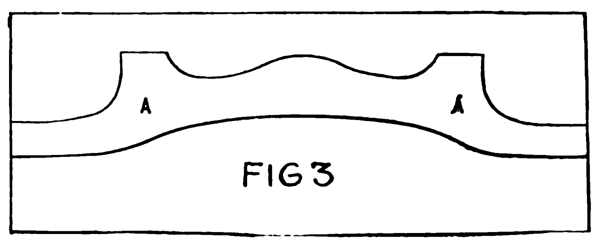


Fig. 3. Plank with main bed drawn thereon

are few timbers in a carriage part where the position of the grain is an important matter, but where there is but one, and that one that receives a large percentage of a load, it is good judgment to make that one as it should be, instead of trusting to chance, and the time to decide is when the plank is selected and the pattern placed upon it prior to its being cut.

The platform shown this month is intended for a light vehicle; that is, one that is intended to carry medium loads of freight, or for a carriage that will not provide seating room for more than four persons. Fig. 4 shows the ground plan of the lower platform. A, the main bed. This should be of two-inch white oak. The best quality is demanded, as all the strain falls upon this piece, and from necessity it is cut so that the full strength of the wood cannot be maintained. If it was entirely straight a depth of two and a half inches would be ample for a vehicle that was not intended to carry more than 1,400 pounds, but, being cut out to give the required raise to the bed, the lightest point between the bearings should not be less than three inches; if possible, without unduly enlarging other parts, it can be made three and a quarter inches deep, in which case no iron-work other than the kingbolt plate and the end plates will be required. In finishing slightly round the sides, but do not cut much away at the top and

bottom; all that is required is to relieve the bed from the appearance of flatness. The hound B should be of good white oak, one and three-quarter inches deep and one and a half inches wide at the bed, and tapered to one and a quarter inches square at the block D. The futchels C should be one and a half inches square at the draw-bar ends and one and a quarter inches square at the bar D, the taper in the depth to be from the lower side, leaving the top straight. In connecting the end at G cut the sides so that when the two pieces are joined the ends will

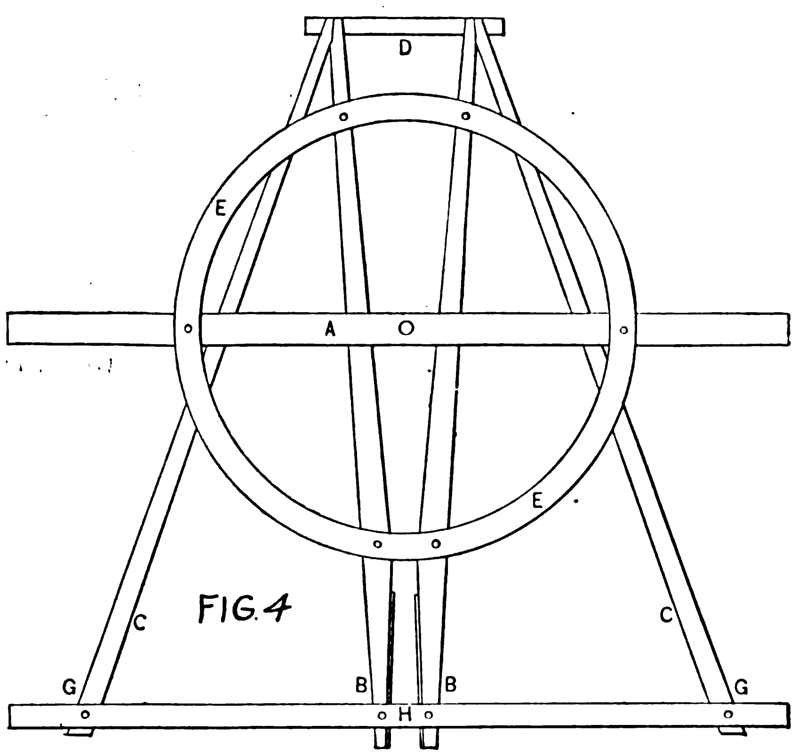


Fig. 4. Ground plan of platform.

be one and a quarter inches square. The lower fifth-wheel plate E should be one and an eighth by three-eighths inch thick and made perfectly true on the upper surface, so that the two plates will wear evenly throughout. This, of course, implies the same care with the upper plates and at the same time suggests the importance of having the wood bearing perfectly level, so that when the securing bolts are tightened they will not throw the plate out of a true line. The blacksmith who lacks facilities for truing plates should never attempt to make them, as they

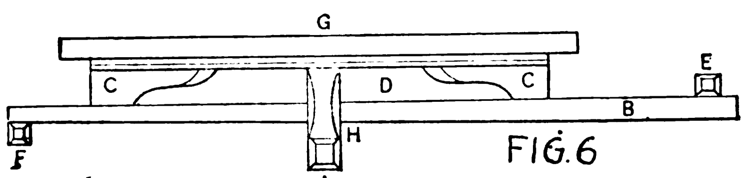


Fig. 6. Side elevation of platform.

can be purchased from carriage hardware dealers in all parts of the country. These plates are bent and trued by machinery, and the circle as well as the faces are far truer than any man can make them who has not the best of machinery, and even with that it will be found more economical to purchase standard sizes than it will be to make them in the smith shop.

The draw bar H need not be more than one and a half inches wide and two inches deep, as its principal use is to secure the forward ends of the various pieces of the frame. If fitted for shafts the jack plates will be sufficient to give the required strength. In gears where half springs are used the strain on the end of the futchel and draw bar is so great that the bar must be large and the connecting ironwork strong, but in this case the elliptic springs are entirely independent of every piece of the gear except the main bed. The pole jaws should have a bearing of 2 inches; this will be all that is required to support the pole. The opening at the outer ends between the plates should be 2¾ inches, at the rear 1½ inches, the jaw plates to be 12 inches long; some prefer 15 inches for the jaw plates, but this length is not necessary for a light gear.

The end view of the platform is shown by Fig. 5. In this is shown as the principal feature the face of the main bed A and the location of the mortises for the hounds and futchels, together with the fifth-wheel plates. It is well to give this illustration close inspection, as it shows clearly the weak spot, previously mentioned, in the bed, and it will serve to enforce the importance of making the bed strong enough to overcome all weakness occasioned by the cutting away of the bed between the bearings B B.

Fig. 6 shows the elevation plan. A, the main bed when set high, as is necessary in this case. B, the line of the hounds and

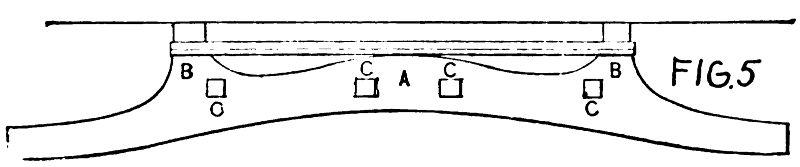


Fig. 5. Front end view of the main bed.

futchels, they being level on the top lines. The futchels C, Fig. 4, are a little larger at the draw bar than at the cross bar D, the hound B, Fig. 4, being a half inch deeper than the futchels at the jaw end. The location of the hounds and futchels are shown by C, Fig. 5, and the side position by H, Fig. 6. By comparing the illustrations the location and form will be readily understood. D shows the location of the fifth-wheel plates and C the segment blocks that are needed to support the plates. The front segment rests upon the hounds back of the jaw, the point where the hounds are the heaviest. The bolts that secure the lower fifth-wheel plate pass through the front segment, but to give it greater solidity the segment should be notched down about a quarter of an inch over the hound. The shoulders serve to prevent the segment twisting. These segments must be of hard, tough oak. The rear segment is long enough to rest upon the four bearings of the hounds and futchels. This is necessary, as the rear end of the futchels and hounds are lighter than the front. The hounds and futchels should be about a quarter of an inch deeper forward of the main bed than they are at the rear, and of uniform thickness at the rear of the face of the bed. This allows for a shoulder on each that should be boxed into the bed an eighth of an inch. E shows the end of the draw bar, F the end of the rear or tie bar, and G one of the cross bars to which the top fifth-wheel plate is bolted.

A New Yorker is a person so ignorant of gardening matters that when you speak of weeds he thinks you are referring to a make of skid chains.—*New York Globe.*

Joe Bell Says--

As junk, old tires don't bring much money these days. But converted to other uses, the material has considerable salvage value. One man last Winter cut up four old tubes into inch wide strips for use around his house as weather strips on windows and doors; when he got through, he had enough left to sell that brought him in the price of one new tube. (It took time to cut the strips neatly but it was time that most people would waste.)

This same man had never favored the canvas strip, or flap, and never put them in his shoes. He had saved them until he had a dozen. These he took to an upholsterer who paid him the full price for them as he would for regular material that he used for supporting chair and sofa seats—both parties were satisfied, one getting a return for surplus junk and the other getting better material for the same price.

And when the scrap markets of the world get back to normal, auto owners should remember that tubes are nearly pure rubber and command double the price of shoes. Also remember to remove valve stems from tubes before selling the latter. At war and pre-war prices, junk men bought tons of tubes at shoe prices and tons of brass at one of the prices for rubber. If in doubt, ask your machinist friend before selling.

There are people to whom the instinct of business is stronger than that of self preservation as I learned not long ago. We were working in the rain getting a car up the bank on that bad S turn out near Pine Bush. We had her almost out on the road again when our attention was attracted to a yellow closed car approaching at a rapid rate. It looked very much like the one belonging to Henchel, the real estate man. For some unknown reason they failed to slow up—striking the curve the car skidded and rolled over twice before our astonished eyes, the closed top completing the circle and the whole becoming a sort of hoop that rolled along the road!

"Come on Joe," shouted the boss, "We'll see how badly they are hurt" and we left the one job where it was and ran to the second wreck. Two men were crawling out of the yellow car as we reached it; neither paid any attention to us; we heard these words, "Hench, you want a thousand too much for that darn farm." Yes, Henchel had been driving a bargain with one of his prospects and both men had been so engrossed that they hadn't been upset by the mishap that might easily have resulted in their death.

The Cut-Out Fool

(Continued from page 10)

Throughout life's game, we find it the same,
That those who are raising a riot
Are not the ones who are earning the "bones,"
But those who work on the quiet.
Wherever we go we find it so,
It's a maxim as true as steel,
That the bigger the noise at the muffler,
The bigger the fool at the wheel.

SPEAKING FROM EXPERIENCE

"Pa!"

"Well, my son?"

"What is the last word in hospitality?"

"It isn't a word, son. It's a hiccough."

—*Birmingham Age-Herald.*

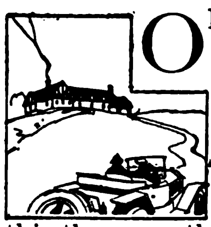
Tractor Repair Department

F.M.

Burning Out Carbon

The Simplest and Quickest Method of Removing Carbon

By David Baxter



OF all methods of removing the carbon deposits from automotive engines, that known as carbon burning is probably the simplest and quickest, and on account of this it is no doubt the best if properly executed. Despite this there are those, who, for various reasons do not want to recommend the process, and say carbon burning is injurious to the valves and pistons.

But if the mechanic attends to a few essential precautions and is careful what he is doing, there is no danger of setting the car on fire or warping the valves and pistons. The chief precautions are to see that the gasoline supply is cut off and that the valves are closed before igniting the carbon; also that the carburetor and oily parts of the engine are covered with asbestos paper. If the carbon deposit is heavy there is often quite a pyrotechnic display. But this is not necessarily dangerous even where the gasoline tank is located over the dash, provided the mechanic will isolate it properly; by placing a sheet or pad of asbestos paper between the tank and engine.

The only extra equipment required for carbon burning is a tank of oxygen, a regulator valve and a torch. As many garages nowadays have a welding plant in connection with their other repair departments the carbon burning outfit is really not an additional equipment; the welder already has everything but the carbon burning torch; most welders have that too. In fact, the gas welder is the logical one to do this class of work, due to his knowledge of the oxygen apparatus.

In any event it may be well to impress upon the mechanic, especially the beginner in the carbon burning art, that he is to use oxygen only. That is if he is employing the welding plant for the work. Otherwise he will presumably have nothing but the oxygen at hand and therefore will be in no danger of using the other welding element, acetylene.

Some welders even go to the extreme and use a regulation welding torch fitted with a special carbon burning tip. This is really hazardous as there is always danger of turning on the acetylene accidentally. To be safe this welder should take the acetylene hose entirely off the torch; then he will not accidentally turn on the acetylene pressure. Nor will he be tempted to use it to start the combustion.

Oxygen alone will not burn without it nothing will burn. Increasing the oxygen increases the combustion. That is what the carbon burning process is in reality; a high rate of combustion. The carbon deposit is the fuel and the oxygen maintains the combustion.

However, when removing the carbon from an automobile engine the oxygen should not be under high pressure; and it should be constant. For this reason a regulator or reducing valve should be interposed between the torch and the tank of oxygen. Then the pressure can be accurately gauged; a valve such as is used in welding is no doubt the best.

A Carbon—Burning Torch Has But One Hose

If the oxygen pressure is too low the carbon will not burn well since the supply is not sufficient to keep the combustion continuous, and if the pressure is too high it will blow the fire out or overheat the chamber.

In few words, the carbon process consists of dropping a lighted match into the spark plug hole, or a bit of burning waste will do, and bringing the jet of oxygen in contact with it. Then as fast as the carbon burns the oxygen is supplied. The carbon literally consumes itself. The tip of the oxygen jet follows the burning, usually in circles around the cylinder and piston's head.

To prevent the flying sparks from endangering the car, the operator should take the precautions suggested above. That is he should be careful of the gasoline supply and protect the greasy parts of the engine with sheets of asbestos paper as shown in the photographs accompanying this discussion.

Protect the Carburetor

The carburetor especially should be guarded. Also it is well to be careful where the carbon burning is done. It should not be executed in a crowded space or where trash, greasy waste or other combustibles are piled. Perhaps it is not necessary to warn against doing the carbon removing near oil, gasoline tanks or barrels. Some good chemical fire extinguishers are not out of place near where the carbon burning is done. Instances are recorded where the car was burned on account of carelessness and the absence of proper facilities.

Look Out for a Display of Fireworks; For at Times the Sparks Fly Fast

After these precautions are attended the engine is started, or permitted to run, until it stops of its own accord; first cutting off the gasoline supply at the tank. Being sure the engine consumes all of the gas in the carburetor and tank pipes. The vacuum feed is entirely drained, too. The engine is then ready for the burning process.

The spark plug is taken out of the first cylinder. If the carbon is dry and hard it is in an indication that the carbon in the chambers will not burn freely but should first be moistened with kerosene or alcohol. Only a very small quantity should be employed, however. Just a drop or two squirted on the walls of the chamber; sufficient to start the combustion.

Keep Oxygen Pressure Normal

It does no good to increase the oxygen pressure when the carbon is too dry to burn well. Nor is it a good idea to inject too much kerosene as this will tend to raise temperature on the combustion, which might warp the metal

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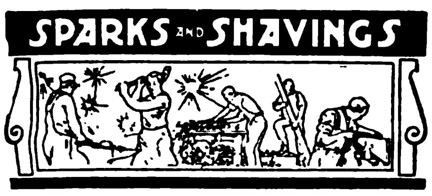

Titanic Springs

Many blacksmiths are finding it not only practical but profitable to sell automobile springs. Many are already selling Titanic Springs manufactured by the Tuthill Spring Co., 760 Polk St., Chicago, Ill. and it would pay those who are not already familiar with the Titanic line to investigate it.

These springs are constructed with a "Hump Center" which it is said is unbreakable and thereby avoids accidents. The manufacturers guarantee them forever against center breakage.

It will be to the advantage of smiths to write to their nearest distributor for full detailss.

Little Giant Punch and Shear

Few tools are more useful or pay for their cost more quickly than the Little Giant Punch and Shear which is manufactured by the Little Giant Punch & Shear Co., Box 56, Saparta, Ill.

When once a smith uses this machine, it is said, he can scarcely understand how he ever got along without it, using the old hand method. He is able to devote more time to other work which he has been compelled to delay before acquiring the Little Giant.

Blacksmiths owe it to themselves to write to this company and get full particulars.

Thomson's Speed Band Renewer

One big problem confronting drivers of Ford cars has always been to eminate "hattering" in Ford speed bands. As everyone familiar with Ford mechanism knows, the speed bands run in oil. After three to xe days of driving, with shifting speeds and applying the brake, the speed band gets a hard, glazed surface due to the heat of friction burning and crystallizing the oil on the bands. After that the brake grips just like steel on steel, causing "chattering" and shaking and when the foot-brake is applied hard, occupants of the car are thrown forward by the sudden stop as the brake seizes.

To overcome this "chattering," a new preparation, known as Thompson's Speed Band Renewer, has just been placed on the market. It is a liquid compound and is manufactured by the Thomson Auto Specialties Company, of Columbus, Ohio, who are well-known as makers of automobile oils and other preparations.

Thomson's Speed Band Renewer is easily applied. The maker recommends that the crank case be drained of oil before applying, but this is not absolutely necessary. The driver removes the transmission cover and lossens the speed bands. He then raises them off the top of the drum with a screw-driver and pours about one ounce of the Renewer on top of each band, so that it runs all around. The speed bands are then tightened and the gears and brakes should be worked hard. This "treat 'em rough" usage spreads the Renewer and soaks it into the hard glazed surface of the bands. The solution dissolves the crystallized oil and softens the band to its original pliability.

Thomson's Speed Band Renewer is sold in 10 oz. cans. Each can contains service station use, it is put up in gallon containers. It may be obtained from distributors everywhere and the Thomson Auto Specialties Company is appointing new representatives to facilitate the distribution of this new and highly successful preparation.

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in the castings; one of the acts of carelessness or ignorance hinted at in the beginning of this article.

If the carbon deposit on the spark plugs is moist the operator is practically assured of a continuous combustion so he should not inject additional oil through the plug hole. The condition of the plug is a good indicator of the interior.

After draining the engine, placing the spark plug guards and removing the first plug, the next step is to adjust the regulator value; first attaching the carbon torch hose to the regulator if this is not already in place.

The regulator thumb screw is turned to the right until the pressure gauge registers about ten to twelve pounds; not over fifteen pounds.

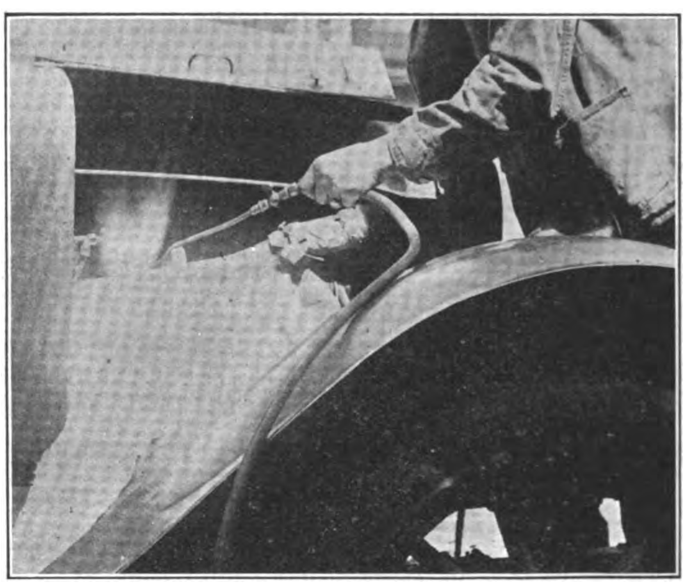
Then the engine is "turned over" until the first piston, the one under the open plug hole, comes up to the compression position. In other words crank the engine until the first cylinder to be operated upon is on compression; until the piston is at the top of the stroke and the valve is closed. It should be made certain that the valve is closed as it is only the open or partially open valve that may get damaged by the burning process. The carbon burning should not be started until the operator knows the valve is tightly seated.

Lighting the Oxygen

The long copper nozzle or tube of the carbon torch is then inserted in the spark plug hole. Then a lighted match or blazing particle of oiled waste is dropped into the spark plug hole and the oxygen is turned on.

As soon as the oxygen strikes the blazing match the sparks commence to fly, accompanied by a loud roaring noise. Sometimes a sheet of flame is blown out of the hole. The tip of the torch tube is briskly moved around in the chamber, following the course of the burning as much as possible.

Sometimes it is necessary to drop several lighters into the cavity during the burning



Note the Blaze Issuing From the Spark-Plug Hole; Also the Asbestos Paper To Protect the Oily Parts.

process in order to be sure all of the carbon is removed or to keep it burning. Usually, however, all of the deposit is removed in one stretch. When it will no longer ignite it is safe to assume that all of the deposit is burned and the piston top, chamber, and valve should be bright and clean.

The next thing is to use an air hose or hand bellows to blow out all grit or other substance that may be remaining after the carbon is burned. Road dust or silica is sometimes found in the cylinders; the oxygen process will have no effect on this or other non-combustible that may have been drawn into the cylinder. All such substances must be blown out after the burning is finished.

Then the valve, seat and piston top are swabbed with clean kerosene, and the spark plug is replaced to prevent the intrusion or more dirt when the next cylinder is treated. After this the engine is cranked in preparation for the next cylinder cleaning.

The second piston is moved upward to bring it on compression the same as the first one, after the second spark plug has been taken out. The burning process is repeated on this cylinder the same as on the first; without disturbing the asbestos paper protectors.

Then all of the other cylinders are treated practically the same as the first, one after another; the spark plug of one being replaced before attacking another.

The operator soon learns to tell when things are going right. He learns with practice to know when the pressure is too low or too high. If considerable flame issues with the sparks he will decrease the oxygen pressure.

A CLUE

"The evidence seems to show," said the detective, "that the thief wore rubbers and walked backwards."

"Then we must look out for a man with receding gums," remarked the wag of the force."—*Boston Transcript.*

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

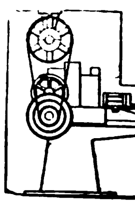
BLACKSMITH AND WHEELWRIGHT
and TRACTOR REPAIR JOURNAL

Vol. LXXXV. No. 4 APRIL, 1922 TERMS ONE DOLLAR A YEAR

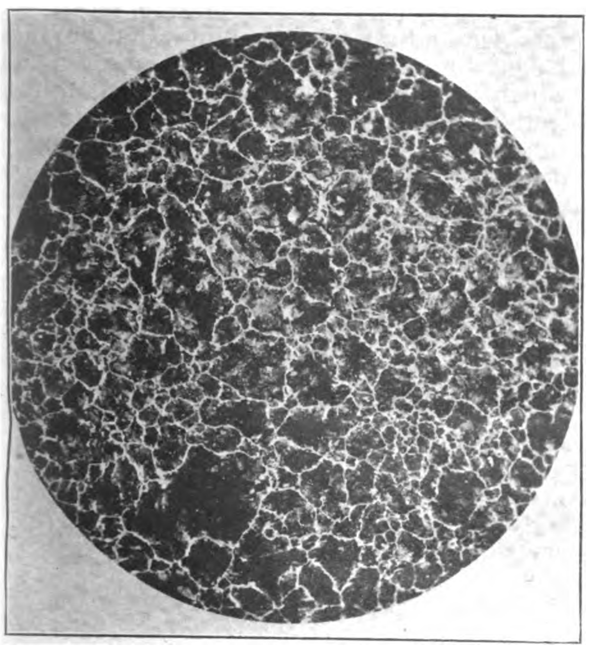
The Inside Story of Steel

Preparing Microscopic Sections; Observing Effects of Heat Treatment

By J. F. Springer



THERE is a simple experiment that may be tried, which will show the reader that the grain size does appear different even to the naked eye, or to the eye, assisted only with a hand magnifying glass. Take a short length of steel bar—say, a piece 12 or 18 inches long. Heat one end, with a fire that is not too rapid,



This is a tool steel that has been heated and slowly cooled. The grain sizes are to be assumed to be just the same as when the heat was hottest. (Magnified 100 diameters.)

until the bar is heated a *dull red* at some distance from the flame and a *white* at the flame. Then we have all the colors from below medium cherry red up to white. With a piece of chalk, mark the point at which the dullest red begins and the point judged to be a medium cherry red. The cooled bar may now be notched with a cold chisel at the two chalk marks and at intervals all along between the dull red and the end of the bar that was heated white.

Breaking up Bar

By cutting a notch all round at each point selected, short pieces of the bar may be broken off, one after the other, beginning at the end that was white. In fact, one may mark these pieces with numbers, prior to breaking them off. We will then be able to put the bar together again just about as it was before. By the foregoing method, one secures samples showing the structure of the steel as it existed at various temperatures from white down to dull red. The broken surfaces tell the tale.

We are now privileged to examine the structure either with the naked eye or with the eye assisted by a magnifying glass. Now, I am going to claim that these sections across the steel bar are going to disclose all that can be shown with a high-power microscope on carefully prepared sections. At the same time, the intelligent experimenter will doubtless be able to convince himself, without much trouble, that from the fracture at medium cherry red on to that at white, the structure gets coarser and coarser. Between dull red and medium cherry red, there should be no difference.

The recent scientific method would proceed by polishing or otherwise treating the surface from each section or a spot on that surface for the purpose of bringing out the structure. After getting ready a sample spot for each heat, the scientific experimenter would examine the spot with a high-power microscope. He may stop here, or he may go on to use the photographer's camera. That is, he may make views which can be handed around and can be comfortably studied.

The photographs may be called *microphotographs*. Such photographs are often reproduced in the form of a half-tone engraving by means of which periodicals may show in their columns views that are approximately what the expert investigator sees when he looks through the eye-piece of his microscope. Such photographs are shown in connection with these articles, the reproductions having been made by the half-tone process. Most of those shown are by courtesy of the Bausch & Lomb Optical Co., Rochester, N. Y.

Oversized Grains

The matter of the oversized grains is really very important. I have already illustrated this point by two examples. Let us consider another.

Suppose it is a question of a forging. Everybody who has done forging and some others know that the better the steel, the less difficult is the hammering when forging is being done. The more heat, the less muscle. It is not hard to see then that the man who does the forging will be inclined to want the steel heated up pretty hot.

Now, right here comes in the matter of the oversized grains. The hotter the steel, the bigger the grains. And, it would seem that we will have to consider that the bigger the grains, the weaker the steel will be when cold. So, then, the workman's idea of saving his muscle leads to damaged steel. This certainly is important. It was probably known long ago that there was such a thing as overheated steel—that one could heat steel to a point that resulted in damage to the quality. But probably no one knew in the old days that the damage started in at medium cherry red. This is what is now to be considered and acted upon.

It might be thought by some that if the grains grow bigger and bigger as the steel is heated up from medium cherry red to dazzling white, the reverse process would take place as the steel cools off. But, unfortunately, such is not the case. The biggest size reached is the one that remains when the steel is cold again. There is a way—really, there are two ways—of making big grains become smaller; but cooling off is not one of them. Cooling off, apparently does nothing at all to the grains.

Let me give a practical example or two illustrative of the advantage of observing close limits in the heat treatment of steel.

First, I call attention to a point or two having reference *to the casehardening* of soft steel. Soft steel is used for many parts where a hard surface is required. Casehardening supplies the hard surface. The reason that soft steel is used instead of one of the harder grades is doubtless the fact that it is much easier to cut soft steel on the lathe, planer, drill press, shaper, milling machine, etc., than it is to machine hard steel. This is a well-known fact and, if the reader does not know it, it is probably because he has not been right up against jobs that are carried out on soft steel and other jobs that are carried out on hard steel.

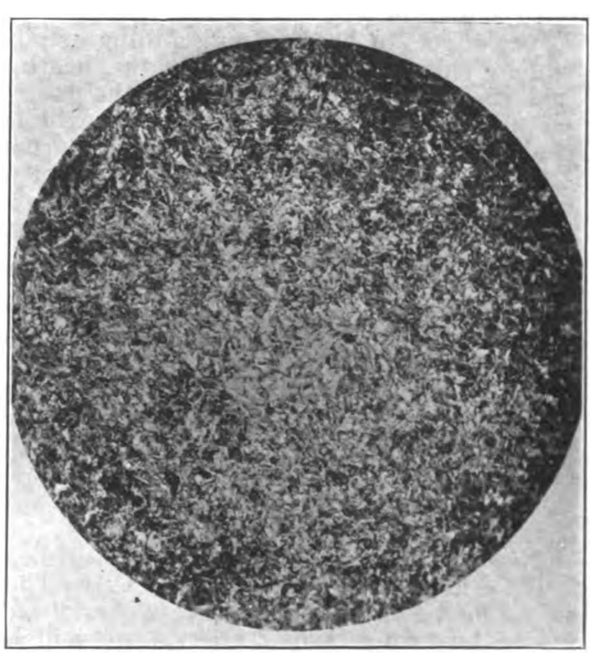
At any rate, the difference is very marked. Let me be sure that we understand each other as to hard and soft steels. By "hard" steel, I mean steel that is naturally hard when in the annealed state: I have no reference to steel made hard by heating and quenching The natural softness and hardness of steel turns on the percentage of carbon present.

Affect of High Carbon Percentage

As a general rule, the more carbon, the harder the annealed steel will be; and the less carbon, the softer the annealed steel will be. And the harder the annealed steel, the more difficult the machine operations are to be regarded. In short, then, in any manufacturing or general shop where steel parts are to be cut on the lathe or other machine tool, it will be advisable to use steel containing as small an amount of carbon as possible. I speak now merely of the ease of doing the work on the machines. This consideration that soft steels are easy to cut and hard steels hard to cut, has been undoubtedly a very strong influence in causing manufacturers and others to use soft steel wherever possible.

If the part required a hard surface so as to cause it to wear well, this surface could be supplied by the application of the case-hardening process. For example, the ball races in bicycles, motor cycles, etc., need to be hard on the surfaces where the balls run. So, a good many ball races, perhaps the great majority, intended for bicycles have been made of soft steel and afterwards case-hardened.

The making of the steel-parts was then a cheap process, and the case-hardening process is also a cheap one. The result was that it cost next to nothing to produce a pair of ball races for a bicycle if they were made as described, instead of being cut out of tool steel containing, say, 1.00 or 1.20 per cent of carbon. This steel is comparatively hard to cut, and this adds to the expense. Besides, tool steel costs more money than low carbon steel. Take another case. Suppose the article is a spindle, one or both ends of which operate in babbitt bearings. A soft steel spindle case-



This steel is also a tool steel but it has been hot worked and the grains made smaller. (Magnified 100 diameters.)

hardened at the bearing regions may often be used instead of a spindle made of hard tool-steel. And so on, with any number of things.

Sometimes, no doubt, the soft steel center with the hard surface produced by the case-hardening process would be a better article, so that the use of soft steel might become desirable for other reasons than economy in manufacture. In short, the case-hardening of soft steel is something that, for one reason or another, is often done.

Now in carrying out this process, the new knowledge brought into existence or to the point in recent years is a very great value indeed. Consider a moment. In a case-hardened article we have two very distinct steels. The central part is soft steel that has been heated and then chilled quickly. The surface skin consists of a high-carbon steel that has been heated and suddenly cooled. There is, no doubt, an intermediate or transition region where the steel grades to less and less carbon as one penetrates in towards the center. But this transition region is to be regarded as practically of small thickness.

Low-Carbon Steel

Let us disregard it for the moment and fix our attention on the central body where the steel contains no more carbon than it did originally. That is, it is still low-carbon steel. The effect of the heating and quick chilling is to make the steel harder and more brittle. It will also add to it strength for resisting a pull. However, the brittleness will often not be wanted, even if the strength against a pull (tensile strength) is somewhat increased. In short, it is desirable often to keep it as soft as possible.

It will be best, perhaps, to settle on a certain percentage of carbon for the original steel. Suppose we put it at 0.35 per cent. This is a fairly soft steel. When it is heated to a bright red and quickly chilled, it will undoubtedly be harder and more brittle than before. If the heating is carried higher, we are to expect an increase in both hardness and brittleness.

On the other hand, it will probably have a better grain size—that is, in effect, will be stronger against a pull. But increased hardness and increased strength against a pull may not be so much needed. As brittleness is to go along with them, there will be many cases where the manufacturer will probably want just as little brittleness as possible. He will want the old pliability that goes with softness.

In short, he will often want just as little of the effects of heating and chilling as possible. This means, then, that the heating and chilling should be done at the lowest possible temperature. This matter will be controlled by the outside skin of high-carbon steel. Whatever heat is used when about to harden will be more or less effective on the inside core. Consequently, we are to seek as low a temperature as possible for it.

In short, we are out to do the hardening with as little heat as possible. Now, the outside steel will be a *tool steel* and contain more than 0.90 per cent carbon. This is the thing to fix our attention upon. It would hardly be worth while to case-harden, if the outside skin were not made a tool steel.

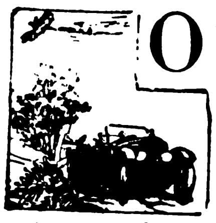
Rule for Tool Steels

Now the rule for all *tool steels* is to heat a little above 1274° F. (=690° C.). That is, we heat a little above *medium cherry red.* If we heat to a *bright* cherry, we will be about right—a trifle more, though, will not be amiss, as some time (and therefore heat) may be lost in getting the work into the quenching bath.

It is probably the general practice nearly everywhere to do the quenching when the work comes out of the furnace where it has been absorbing carbon from the bone dust in which it is packed in iron or steel cases. Now the temperature needed for heating the work for the business of absorbing carbon is a good deal higher than 1274° F. In fact, about the lowest advisable temperature for 0.35 per cent carbon steel is 1572° F. A good deal of case-hardening is done at 1800° F., or thereabouts. Naturally, the temperature will fall a few degrees from the moment the furnace door is opened until the boxes and their contents all go into the water or until the work is gotten out and dumped into the water. But there will hardly be a drop that will bring the temperature down to the neighborhood of 1274°.

In short, the heat developed in case-hardening is entirely too high to permit it being used in the hardening operation. A brittle effect is to be expected in the core of soft 0.35 per cent steel. The proper hardening temperature is as already said, to be regulated by the tool steel skin. This requires for hardening something better than medium cherry red—say, bright cherry red—and this temperature should not be exceeded except for some very good reasons.

Continued next Month



OF all the small tools in a shop, the vise is undoubtedly the most important. As a matter of fact it would be impossible to do repair work without such a tool. It is the first small tool that the repair man should contemplate and the more he can get in the way of such a tool, the better the investment.

We feel that our choice of the Stewart Handy Worker, made by the Chicago Flexible Shaft Co. of Chicago, Ill., is a wise one, for in this tool we have not only a strong, serviceable vise but an all around machine shop in itself.

As a vise, the Handy Worker is an excellent tool and is plenty heavy enough to carry ordinary repair jobs within reasonable limits. The tool has a weight of approximately 80 pounds and is made of fine grained cast iron.

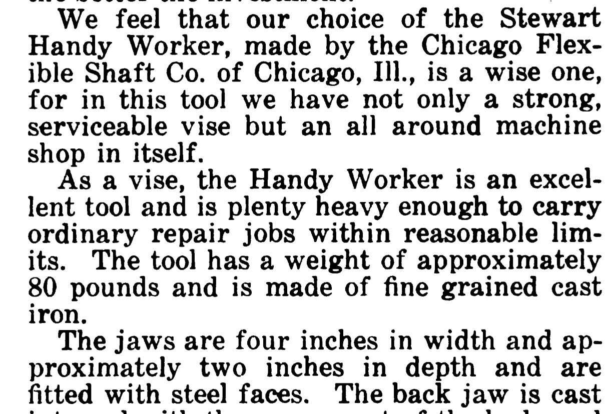
The jaws are four inches in width and approximately two inches in depth and are fitted with steel faces. The back jaw is cast integral with the upper part of the body and is unusually heavy for its size.

Location of Feed Screws

The feed screw is located at the back of the vice, instead of the front as in the conventional design and this screw is fitted with a 5½ inch handwheel, which operates upon a ⅞ inch feed screw of fairly low pitch.

The front jaw extends down almost to the bottom of the whole machine and is mounted upon two one-inch cold rolled steel rods. The latter slide into holes in the body and guide the jaw. It is easy to see that a fairly accurate adjustment may be obtained, since the fitting of the bars to the body is much easier than the fitting of a large sliding member would be.

The length of the feed screw and the bars permits an opening of 4¼ inches between



The Stewart Handy Worker

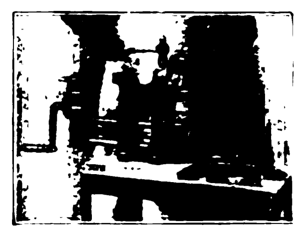
the jaws, though this is far from the limit of the machine as will be seen later.

The back jaw of the vise is prolonged to form a steel faced anvil with a saddle at the end and a square hardy hole. This jaw, together with the anvil is fitted with three square projections which fit into square holes in the main body of the tool.

By opening the vise slightly the back jaw and the upper part of the body can be slipped forward and removed, leaving a flat surface. Upon this flat surface fits an angle plate, which is held in place by three square projections. With the angle plate in place a wide range vise is formed, capable of taking 12 inches in width between the jaws. Thus the vise has a range of from zero to one foot in width.

With this sort of construction the smith may utilize the tool to grip practically any reasonable length for he can easily bend up an angle plate from flat iron. In our shop we have clamped together pieces aggregating nearly three feet in width, something which could be done only upon a tool with a removable back jaw.

Both the front jaw and the main body of the machine carry a pair of projections into which fit a set of steel pipe jaws. The opening between the jaws is such that they will grip 1½ inch pipe or its equivalent.



"Cutting Off" with the Handy Worker

The front jaw carries a rotating spindle which is fitted with a threaded end on the inside as well as a square hole. The threaded end of this spindle fits into an arbor which in turn carries a 4½ inch emery wheel.

Beneath the spindle, on the front of the jaw, are two sets of reduction gears, so arranged that a hand crank may be applied to either set or to the spindle itself.

By this means three sets of spindle speeds may be obtained, 14 to 1; 4 to 1; and a direct drive, these various speeds being used for driving the emery wheel or a square shanked drill which can be placed in the spindle.

The grinding wheel may be removed from the arbor and a polishing or buffing wheel put in its place; in fact the machine is really a small lathe in its way and the mechanic will soon find that it has hundreds of uses.

The maximum dimensions of the tool are 25 inches long from handwheel to front of jaw, 12 inches high and 7 inches wide. It is designed for fastening to the work bench with four bolts or lag screws. In our case we have mounted it upon a heavy oak block and so arranged the block that it may be swung around on a swivel.

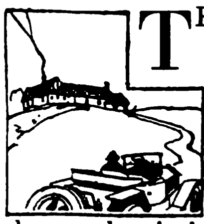
Not only is the Handy Worker a blacksmith or repair shop tool but it should be of interest to every car owner. The device has so many uses that it should form a part of the equipment of every man who "tinkers" about the house or shop.

The illustrations accompanying this article will serve to give the reader an idea as to the utility of this handy, unit machine shop.

Renewing Babbitt Bearings

Each Step Plainly Described and the Various Operations Illustrated

By Chas. H. Willey



THERE have been, from time to time, many articles written and published in various papers and magazines on the subject of the care of babbitt bearings, yet the writer has failed to note any that treated the subject in plain everyday mechanics' language, so my attempt here will be to cover the subject mostly by simple sketches and description of this task.

In writing on this subject it is necessary for the writer to assume that one who attempts to re-babbitt a worn-out bearing shall, of course, have at least some knowledge of mechanical work; so even though the article is written in as simple a way as possible, the smith must use his own judgment and discretion to a certain extent.

Dis-assembling the Bearing

The first task met with is that of dis-assembling the bearing. Each cotter pin, nut, and bolt, and the bearing liners or shims, should be put where they can be found; the old bearing babbitt metal must now be removed and if one has a gas torch it can be done as shown in Fig. 1.

The bearing parts are set on end in a pan and the flame of the torch directed on the babbitt, which will melt and run into the pan, thus saving it for recasting. The bearing shell will be heated dry by this method and a warm dry bearing shell is essential for good results in babbitting the bearing. When there is no torch available, a wood fire built around the bearing parts will do.

The next thing to do is to prepare the bearing for re-casting the new lining. There are many different types of bearings and to tell how to set each one up for pouring the bearing is impracticable, but the general class can be done as shown in Figs. 2, 3, 4, 5, 6. Special babbitting liners must be cut from cardboard to fit in close to the shaft in order to separate the two halves of the bearing. This liner must have a V-piece cut out of it at the center, as shown in Fig. 2. Additional liners may be put in to allow for the take-up of the new bearings when they wear.

The shaft must be centralized in the bearing shell and it may be done with a few wooden wedges and a scale, a rule, or a pair of inside calipers, as shown in Fig. 3, and after it is held in a central position by the wedges, a couple of V-block stands can be made to hold it permanently in that position while the bearing V is being cast, these stands and their uses are shown in Figs. 4, 5.

The wedges are then removed and cardboard washers cut to fit over the shafts and up against the bearing ends; then these are puttied over to dam up the ends of the bearing and hold the melted metal in. A dam is built of putty around the oil hole in the center of the top bearing for facilitating the pouring of the babbitt. There must be a vent hole left in one end to allow the escape of air and the filling up of the whole bearing with molten metal.

If there are two oil holes in the cap, one is used for a pouring gate and the other for a vent. When only one hole is available, a riser and vent hole must be arranged in the putty dam at one end of the bearing.

If only one half of the bearing, say the cap, is to be babbitted it can be done as shown in Fig. 6. A sheet tin or iron piece is bent to the shape and size of the shaft and width of the bearing shell, and this clamped on the bearing cap as indicated; then a putty or fire clay dam built around the bottom of it and the metal poured from the open end A.

For holding a shaft central in the lower half of a bearing a good kink is shown in Fig. 7, that of drilling and tapping in the shell holes for adjusting screws. These screws can afterwards be removed, or if of soft brass, they can be left in.

Fig. 8 shows how a pair of clamps can be made to go around a shaft to provide a mold for pouring a half bearing.

When one has several connecting rod crank bearings to babbitt it is worth while to make up the babbitting jig shown in Fig. 9. It consists of three pieces, of hardwood base B with a recess hole in the center to take the split round wood babbitting mandrel C, this mandrel to be the size of the crank pin. A slot in the center of the mandrel is made to receive the division plate D, which is of 1-16 sheet iron. The connecting rod is placed on it as shown in Fig. 10.

There are several kinks for preventing the babbitt from adhering to the shaft. These are shown: in Fig. 11, that of coating the section of the shaft with a thin smear of white lead; and Fig. 12, smoking the shaft with a tallow candle. The soot coating insulates the shaft and prevents it from chilling the hot babbitt that is poured on it. A strip of brown paper pasted around the shaft, Fig. 13, gives clearance where desired.

String-Winding for Oil Grooves

The winding of a piece of string around the shaft, as shown in Fig. 14, is a stunt often used to make a spiral oil groove. The babbitt is cast on the string and the string removed after the bearing is poured.

New bearing metal comes in bars and it should be cut into small pieces as shown in Fig. 15. This makes the melting of it easy. Sometimes if one has a hot fire and starts to melt a bar of babbitt without cutting it up, there is danger of burning some of the first-melted metal before the remainder of the bar is melted.

The proper way to test babbitt for melting to tell when it is at the heat for pouring is that shown in Fig. 16, the holding of a pine stick in the melting metal. The stick will char when the metal is at the correct heat.

A good ladle that will hold enough babbitt to pour the whole bearing at one time is desirable, for there should be no let-up in the pouring. Two separate pourings of babbitt seldom join well. A good ladle is shown in Fig. 17. It has a hook on the ladle body at E that can be used to lift the melting pot off the fire and carry it near the work. Another hook is secured to the handle at F which permits the use of a lifting triangle G. The end of the ladle handle is bent down at H which allows one to set the ladle down when it contains molten babbitt, and yet not tip over.

After the bearing has been cast, if it is one that has been cast rough size, that is, allowing plenty of babbitt to be bored out to fit the bearing journal, then it is a good plan to pein the babbitt into the shell as shown in Fig. 18. This is accomplished by means of many blows with a ball pen pein machinist's hand hammer. The peining closes the babbitt metal together, makes it denser and able to withstand hard usage, thus giving long life.

Anchoring the Babbitt

Right here the writer wishes to impress the workman that it is very important that all bearing shells must have some sort of anchor holes or dove tail

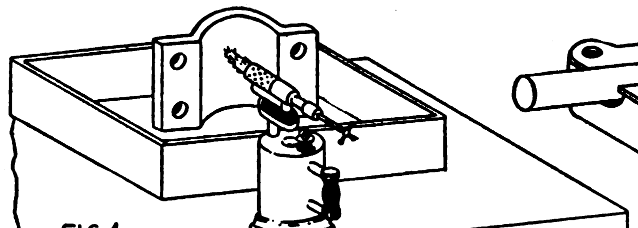


FIG.1

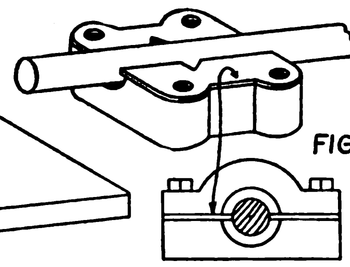


FIG.2

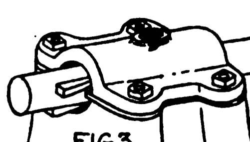


FIG.3

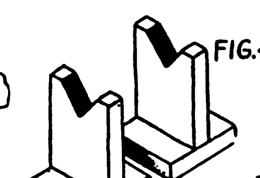


FIG.4

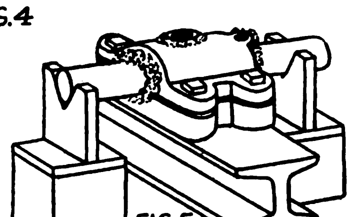


FIG.5

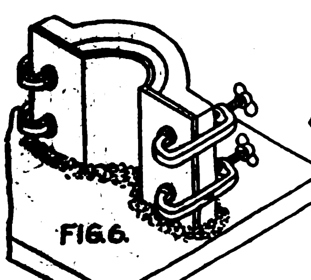


FIG.6.

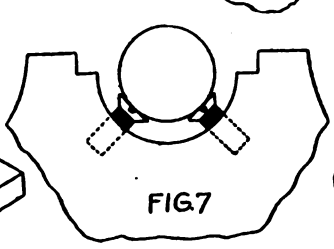


FIG.7

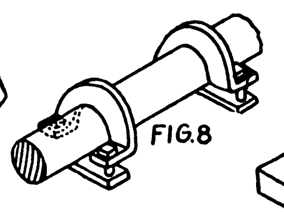


FIG.8

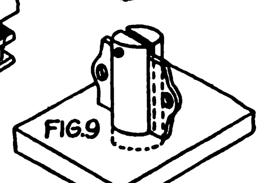


FIG.9

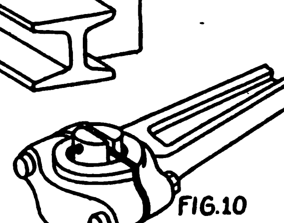


FIG.10

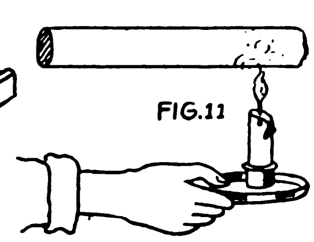


FIG.11

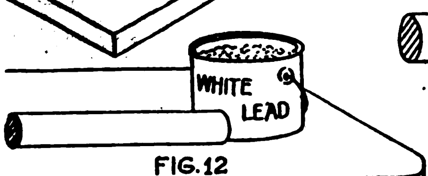


FIG.12


FIG.13

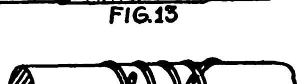


FIG.14

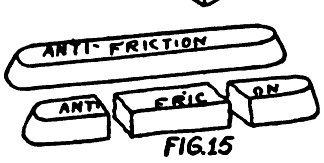


FIG.15

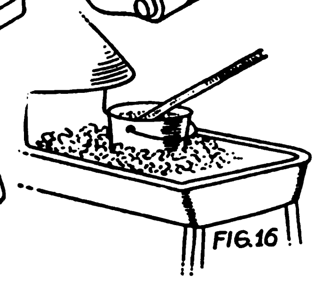


FIG.16

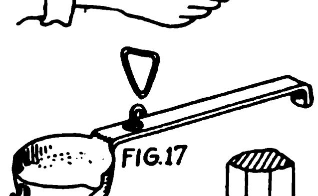


FIG.17

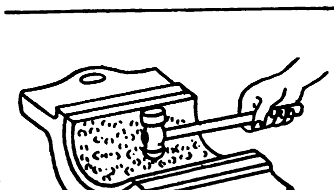


FIG.18

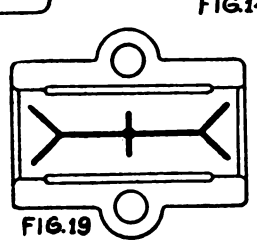


FIG.19

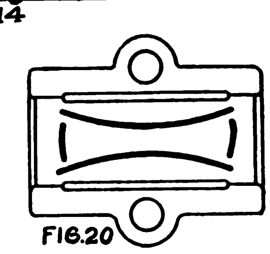


FIG.20

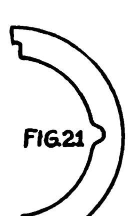


FIG.21

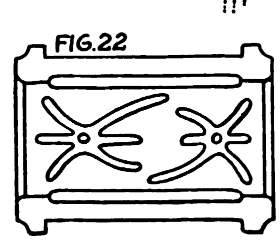


FIG.22

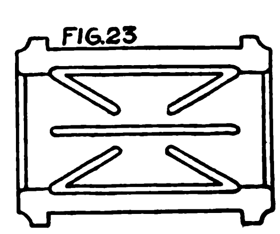


FIG.23

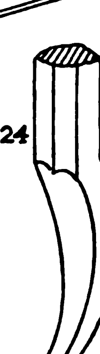


FIG.24

slots to make the bearing lining metal grip or anchor to it. When the bearing shell is too thin to permit such method of anchoring, then the inside of the bearing shell must be thoroughly cleaned and tinned with solder. This will form an excellent surface for the babbitt to adhere to.

Oil grooves must be cut to provide a reservoir and means of distributing the lubricant over the bearing surface. There are many different styles of oil groove layouts and a good deal depends on the service for which the bearing is called upon to render, and the size of the bearing.

A bearing that performs light duty and is of small size need not have elaborate design of oil grooves, a single groove leading from the oil hole across the bearing crown to near the edge being sufficient. No oil groove should ever be cut clear to the edge, for it would allow the oil to escape and be lost, resulting in a burned bearing.

Fig. 19 shows a very good way to cut the oil grooves in the top half of a crank pin bearing, and Fig. 20 the design of the lower half. All grooves should be deep enough to carry plenty of oil and have their edges rounded as shown in Fig. 21.

For large main bearings a good layout for the top half is that shown in Fig. 22 and the lower half in Fig. 23. This work can be done with a hand hammer and a curved round nose oil-groove chisel of the type shown in Fig. 24.

A good way to hold the bearing shell while cutting these grooves, is that of bolting the half bearing down on the bench, as shown in Fig. 25. This gives plenty of access to the bearing with no danger of it slipping or moving when the hammer blows are struck on the grooving chisel. The style of oil grooves in this sketch is of the simple layout for light service bearings.

Bearings of tractors are called upon to stand hard service and many of them are large bearings, especially the main shaft bearings; these bearings should have substantial oil grooves and be fitted by means of leads. This consists of placing on the circumference of the shaft three or four short lengths of soft lead wire. The pieces of wire are held on the shaft by placing a small bit of yellow soap on the ends and pressing it to the shaft as shown at A in the sketch, Fig. 26.

After the lead wires are in place the bearing cap is put on and the nuts set up tight on the liners. In tightening up the liners, it is necessary that it be done evenly; first take down all the slack by hand, next go over each nut lightly with a wrench; start, say on bolt No. 1; then go to bolt No. 2; then to No. 3; and then to No. 4, as shown in Fig. 26. Then repeat the routine until they are all up tight.

Use the same care in slacking off and removing the nuts, then lift the bearing caps and determine the bearing clearance and fit by sizing up the leads by the use of a wire gauge or a micrometer. The thickness of the lead is thus determined in thousandths of an inch.

Fig. 27 shows the clearance space of a bearing cap as determined by the measurement of the lead thickness. The writer has found it convenient to mark the position of the leads on the inside of the cap, together with their thickness, with a pencil; as shown in Fig. 27. These will then serve as a correct guide when scraping the bearing to get the correct fit.

Before attempting to refit a new set of bearings to any shaft or crank shaft it is a good plan to true up the shaft journals. If one has the machine shop equipment, the proper way to do it is that of turning the journals in the lathe. However, if one must get along without that important tool, then the bearing journals can be lapped in by use of the simple lapping tool shown in Fig. 28.

The Lapping Tool

This consists of two pieces of hardwood hinged together at one end and a hole the size of the shaft bored through it, then the hole is lined with emery cloth or it can be made large enough to take two old half bearings and these treated with lapping compound. The device is used on improvised centers as shown in Fig. 29. The centers are easily made by bending up pieces of iron at right angles and putting in pointed screws bent at right angles, as indicated in Fig. 30.

In fitting a crank shaft, much better work can be done if a special stand be used as shown in Fig. 31. The workman can get at the various journals with ease.

A good set of bearing scrapers can be made of old files bent at the forge and ground to shape on the grinding wheel. These are shown in Fig. 32.

To fit crank bearings by the spotting method, the crank pin is given a thin smear of lamp black and oil or a smear of Prussian blue, being very careful to spread it very thin and even. Then as shown in Fig. 33, set the connecting rod with its cap squarely down on the crank pin; and press down; give a forward and backward movement, then lift off and examine the bearing for high spots. The marking paint will indicate these.

The lower half of the bearing is tested the same way, then these high spots are scraped as shown in Fig. 34.

The process is repeated until a fairly even and correct bearing surface is obtained.

Testing

The bearing, after scraping, is assembled and put through the moving test shown in Figs. 35 and 36. The bearings should move easily, yet not have any play. Adjust the thickness of the liners till this is possible.

In fitting new bearings be sure that the bearing shell is seated hard in the cap and connecting rod, then as in Fig. 37, file the lips flush. A method of doing this is shown in Fig. 38; this is a flat hard wood board with a sheet of coarse emery cloth tacked on it. Old bearings that have worn down so that there are not any liners left may be made to give longer service by removal of the bearing cap and brass metal in this manner.

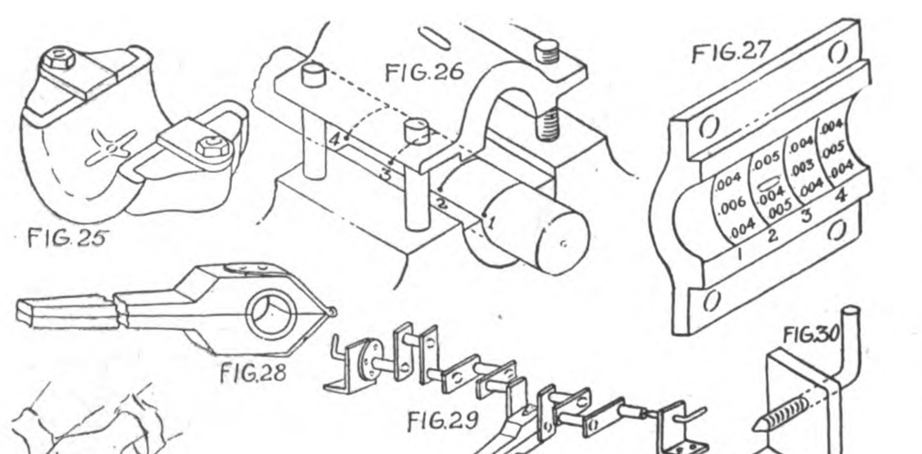
The biggest secret of installing bearings which will last, as contrasted with those which may burn out in the course of a few months, is in having the bearings rest upon the shims instead of binding upon the journals.

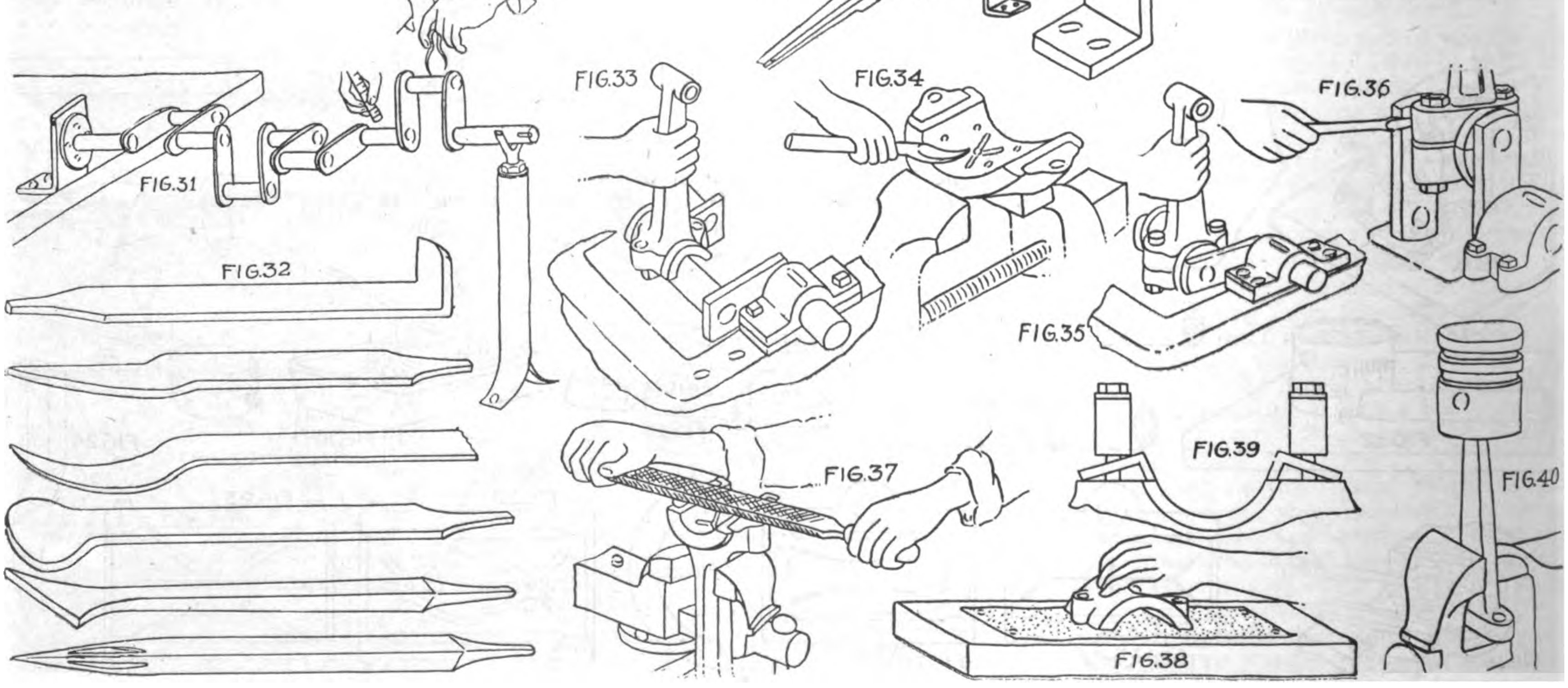
Naturally, a perfect fit is impossible there will be high spots which will tend to wear off and it is advisable to have a slight amount of friction to accomplish this purpose. However, in the main, the real pressure of the set screws holding the bearing caps should be carried by the shims.

After the shaft has been running for a short time it is well to examine the bearings and tighten them if necessary. It is more practicable to make several adjustments, spreading over a period of months than to set the bearing so tightly in the first place that it is destroyed in a few months.

IT DIDN'T HELP

Two farmers met on a country road, and pulled up their teams. "Si," said Josh. "I've got a mule with distemper. What did you give that one of yours when he had it?" "Turpentine. Giddap!" A week later they met again. "Say Si, I gave my mule turpentine, and it killed him." "Killed mine, too. Giddap."

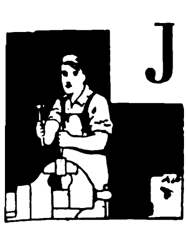




Digging Out Broken Set-Screws

When you are Having Difficulties The Use of the Methods Described will Help

By JAMES F. HOBART



JUST think of the "fun" you have had with set-screws once in a while! You know how a fellow feels "way down in his boots," when one of these pesky things is twisted off through a too-vigorous application of a wrench. But cheer up! Though the digging out of the broken set-screw calls for a little work and much patience, still it can be done—and without taking the car or engine to town.

Follow a Regular Plan

There is a regular procedure which should be followed with broken off set-screws. First,

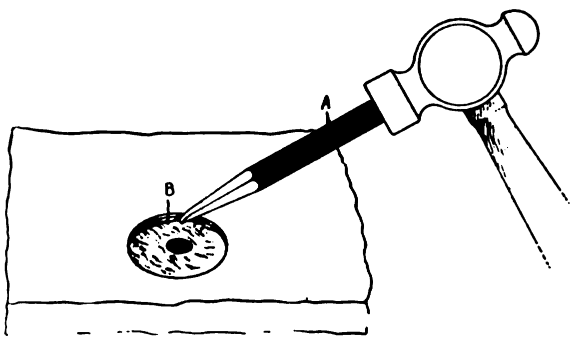


Fig. 1. It Will Come Out Easily This Way if Not Too Tight.

try to remove the root of the screw with a small cold chisel made up from a bit of old rat-tail file or something similar. Make it as shown at A in Fig. 1, slim and sharp; then apply it to the visible end of the screw as shown at B. Use a very light hammer, for heavy hammer blows do not seem to start the screw as well as light blows. The heavy ones drive the chisel into the set-screw instead of causing it to turn around.

This method, if rightly applied, will usually start four out of five screw stubs, and once started they may be easily and quickly backed out, to the delight of the worker. But make sure that the chisel is inclined in the right direction and is applied as closely as possible to the edge of the broken screw section. If the chisel, A, be inclined in the opposite direction or applied to the other side of the screw, the blows will tend to tighten the screw instead of remove it. Driving the chisel against the center of the screw will *not* start it.

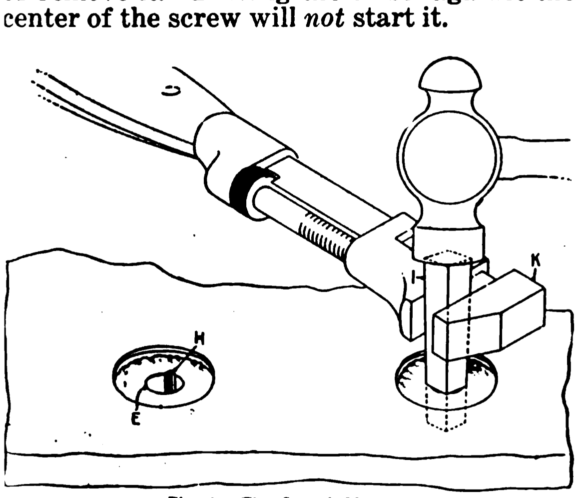


Fig. 2. The Second Method.

If the method described fails, then try drilling a hole in the stub with a left-hand drill bit. But first apply a flat punch to the center of the stub and hammer a bit so as to smooth down the broken fibres and allow of marking the exact center of the screw with a small center-punch, preparatory to drilling.

Drill a hole exactly in the middle of the screw, as shown at E in Fig. 2. Take particular pains to center the drill very accurately, for if this way fails the hole, exactly centered, will be required for a further treatment which never fails.

Hole E may be started with an ordinary drill, but it is well to start with the special drill-bit shown at F, Fig. 3. A drill of this kind may be easily forged from a piece of round tool steel, or even from a round file. It is known as a "flat" drill and its type was in universal use before the twist drills were known. But there is one thing different with tool F; it is made left handed. A look at the cutting edges, GG, will show that this drill must be turned left handed to make it cut. This is what is done in drilling hole E and in a majority of cases the broken set-screw comes right out under the unscrewing impulse of the drill.

Should the screw fail to start even after hole E has been drilled to the very bottom of the set-screw, then, with chisel A, cut four little channels around the hole, one of which is shown at H, in Fig. 2. Cut these grooves so that they will fit the corners of square plug I, when it is driven into the hole.

Another Way

Having cut the slots deep enough to hold plug I firmly when driven in, place wrench K in position and pull steadily upon it, at the same time tapping the plug with a hammer. Almost every set-screw stub which has resisted other attempts at removal will yield to this treatment. But a few may still refuse to come out, and must then be sent to the "Court of Last Appeal"; which is, to drill out the broken screw end to the very roots of the thread, and then chisel it from place. It is

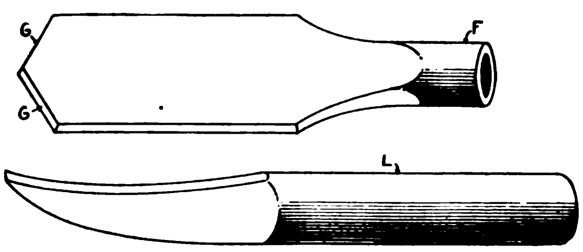


Fig. 3. The Tools Used.

for this reason that hole E should be accurately centered when made.

This last method should be worked out in the following way: Re-drill the hole E as large as possible, as shown at N in Fig. 4, clear to the very roots of the screw thread. Then cut channel O right down to the bottom of the threads around the set-screw. After thus drilling, cut the channel O to the bottom of the threads of both the screw and the metal into which it has been tapped. Use a very thin chisel, about as shown at L in Fig. 3. The cutting part is made very narrow, not more than 1-16 inch for small set-screws.

Cut right down through the threads of both the screw and hole as at O, until the shell has been completely severed. Then take tool A and try to bend inward a portion of the thin shell. A little patient work will usually loosen the threads from each other until the shell can be lifted out of the hole. Occasionally the hole in N may not be quite large enough and the shell refuse to double together so as to fall free of the threads.

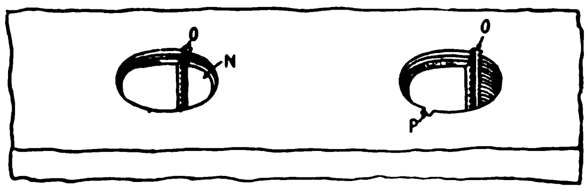


Fig. 4. The "Court of Last Appeal."

In this case cut another grove at P, opposite O, and the shell, thus cut into two parts may be more easily forced clear of the threads.

The grooves O and P do very little if any harm; being very narrow, they remove but little of the holding power of the thread. So just run a tap into the hole to smooth the threads roughened by cutting the grooves; fit in a new set-screw and the mechanism is as good as new.

CLEAR AS MUD!

A tourist reports seeing the following police regulations posted up in Ireland:

"Until further notice every vehicle must carry a light when darkness begins. Darkness begins when the lights are lit."

The Akron-Selle Co's Products

The Akron-Selle Co. of Akron, Ohio, are undoubtedly the largest manufacturers in the world of spring wagon gears and other wagon specialties. About 1000 styles of gears are turned out by this company in their immense plant at Akron and they have a record of 40 years' experience in the production of this line of material.

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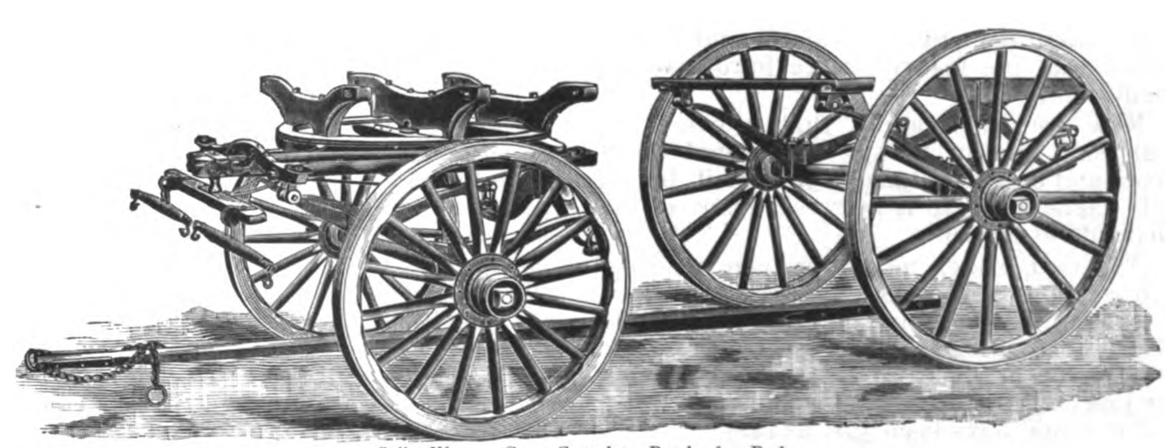

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Our Editor's Letter

IN this month's letter I'm not going to be especially serious; in fact my subject can be looked at from the extremely humorous viewpoint. When you come to think of it most anything is funny if you look at it from the right angle.

Take the case of the window cleaner, who according to the *New York Times* of this morning, fell from the fifth story of a building, landed on top of an automobile and bounced up and down a few times. When he finally came to rest he was hustled into a taxi by an officer and carried to the morgue. Naturally one might suppose that a fellow couldn't fall five stories and still be a fit subject for a hospital.

But at the morgue the window cleaner opened his eyes, glanced around and stated that he was entirely displeased at the neighborhood.

He was taken to the hospital and it was found that his injuries were hardly worth mentioning.

Now you must admit that a five story fall isn't exactly funny, one cannot do it often and expect to make a joke of it, but in this particular case it possesses many of the elements of humor.

And that brings us to our own little pet subject, that of moving day. We celebrated last month by moving our offices from 71 Murray to 16-22 Hudson street. From the standpoint of distance this wasn't such a big job, only a matter of a few hundred yards, but it would have been just as easy a matter to have moved to the other end of the city if packing and crating were to be considered.

For two weeks prior to the moving day I was in the plight of a hen who has just forgotten where she left her brood of chickens; or better, perhaps, more like the dog who is ready for a full meal and cannot seem to locate the ham bone he buried the day before.

About every five minutes I needed something which I had just packed at the very bottom of the biggest crate in the office. And then, when I had re-packed the box, nailed it up and piled a few other boxes and crates on it I would think of something else in it that I needed.

Everything I didn't need I stumbled over; everything I did need was at the bottom of a box. And when you come to move, brother reader, you mark my words, you will find that every box has just as many bottoms in it as there are things in it.

Make a wish that you need something and you can almost see a box begin to wiggle and groan, and whatever you wished for will crawl to the bottom. I know that this doesn't sound quite logical but it worked that way for me.

And after I had opened every box so many times that I had about decided to leave off the nails and use buttons instead, the moving men came.

Have you even seen a New York moving man at work? Well, they are trained to put a cubic foot of furniture into nine cubic inches! Take a good, experienced and careful moving man and he can move three legs of a chair without breaking a single one; in fact he seldon breaks the other leg, but usually keeps that one in the van until all the other furniture is up, then brings it along carefully done up in a blanket.

And they are clever! We had one desk which was only about two inches wider than the door into our new office. Do you think that they were crude enough to take a piece off of the desk? Of course not, they took a piece out of the door jamb and then hauled it through a window.

And when these husky men had finished with our office furniture and the furniture was as near finished as furniture can be and still remain furniture, they left us in a swirl of dust, old files and chairs without feet.

For the next week we unpacked and moved things around. The more we unpacked the more we had to move things around. But now, instead of finding what I wanted in the bottom of the box it simply wasn't in the box at all.

The week before we moved we spent in finding things we had packed but the week after we moved we spent in trying to find things which were unpacked. I hope that you understand what I mean.

But even the worst of things must end sometime and so finally we stopped mixing things up and began to put them in order. Instead of taking a file from one corner and carefully packng it beneath the files in the other corner, we began to put things where they belonged. And it didn't take long to set things right.

But after we had found everything we needed, packed away all we wanted to keep and taken account of the remains we were surprised at the amount of stuff which we could throw away.

Since that time the junk man has called upon us regularly; maybe he is making his fortune upon what we throw away, but at any rate I have discovered that the habit of saving unnecessary things is an evil one.

Moving day, or moving week wasn't quite so interesting and funny as it might have been but it did us a world of good. I'm not so sure that it is not a good idea to move once a year. I don't mean literally change offices, but have a sort of cleaning up week during which time everything is given a good cleaning and a careful "once over." If a thing has passed its usefulness, pass it along to the junk man.

Moving day has many advantages for it not only furnishes a good excuse to discard the useless things but it gives us a chance to know what we have.

How many of my readers know what they have in stock? Of course I know what you will say to this question, you will tell me that you know you have so much flat iron, so much square, round, so many shoes, calks and so on. But how about the rest of your stuff? How about that old harrow disc, the wagon axle, that half bushel of old wagon irons, those things which you have "salvaged" from time to time and are piled around in the four corners of your shop? I'll bet that you couldn't put your hands on them when you wanted them!

And so I'll turn serious long enough to tell what I learned from our moving week. I learned that I had lots of valuable records, data and so on hidden away beneath piles of old junk which could be thrown away.

And it is so with many of the shops in the country. A clean up week is a wonderful help, it takes time but it saves money. Bits of odds and ends can be put where they belong, and things can be put to one side ready for use when the time comes.

So, in your next slack time take a few hours to fix up the shop and enrich the junk man, you'll find as I did that it is really worth while.

Spring Business

IT IS with no intention of making a play upon words that we consider Spring Business as related to automobile springs. It is true that the Spring season tends toward broken springs and therefore the two are closely related.

But in all seriousness we feel that the smith who is neglecting this branch of his business is overlooking something. Talk with any automobile owner and he will tell you that he favors springs made by a smith to those which he can buy from a factory.

It is true that a good blacksmith can make a superior carriage or automobile spring, for, next to shoeing horses he is, or should be, an expert worker of metals. But it is also true that there are many manufacturers who put out springs of the best quality. We must admit this. But this does not discount the fact that the motorist looks to the smith for his automobile springs. The mere fact that the public thinks that the smith can make better springs than anyone else should be capitalized by the blacksmith.

Every blacksmith in the country should be equipped to take care of the Spring, spring business. It hardly pays, now-a-days to make up a whole new spring; new springs can be obtained at very low prices and if the smith is careful to buy only the best, then he can be sure of his reputation.

But the smith should also be able to make his own springs. Quite frequently he is called upon to replace a single leaf and he may not have a factory made one in stock. Or it is possible that the car is an old one and the spring is different from those being made today.

The blacksmith should make a practice of attending to any sort of metal repairs on the automobile, for the minute that he turns away business, he is discouraging the customer.

If the customer is thus turned away a few times he gets out of the habit of calling upon the smith and away goes the business.

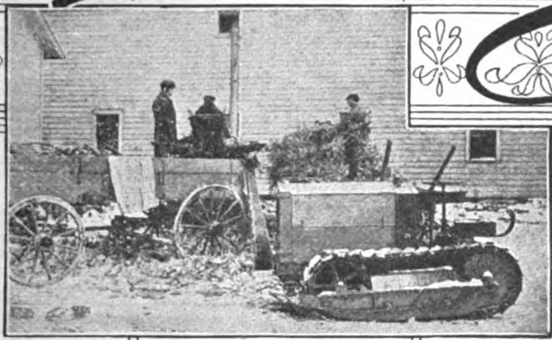
And it is for this reason that we take occasion to mention automobile springs. Once you can get the car owner into your shop and install a good spring you can obtain his confidence and he will naturally call upon you for future repairs.

Spare Time Fillers

If you have made money in any other line in addition to the regular one, won't you please pass your ideas along in order that your fellow craftsmen may profit by your example?

Remember that the fellow who helps his neighbor is the one who can always expect his neighbor to help him.

Tractor Repair Department



F.M.

Other Uses for Welding Torch

Why not Learn Other Uses to Which This Tool Can be Put

By David Baxter

THE blacksmith who has installed an oxy-acetylene welding plant will find that the torch has many uses besides the mere fusing together of broken machinery parts, not only in cases where the torch only can be ɪsed but in many instances where it can be ɜmployed more conveniently and is cheaper :o do the work of some other tool.

In other words the torch welder black-smith can do work with the oxy-acetylene welding torch which can be done in no other way; and he can do lots of work with this

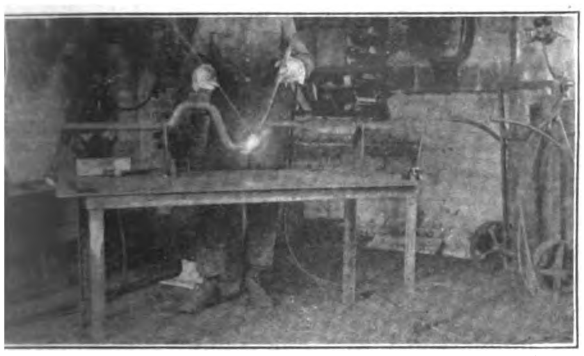


Fig. 1. Arrangement of crankshaft while building up worn cranks.

orch which can be done in other ways too. 'he welding together of broken castings is ɪerely one side of the torch operator's trade.

As an illustration of the versatility of the ɪodern combination tool, the gas welding orch, let us consider for example the job ɪown in the photographs, which accompany ɪis discussion. Here is a fair sample of ɪ unusual, although extremely simple usage r the fusion torch aside from the purpose r which the torch was first invented.

Another use for the torch is also indicated these pictures, and will be described in etail herein. In reality, therefore this will a two fold discussion, although the jobs be covered were taken in at one time.

In short, this article will be an exposition the methods employed in putting the torch use in two ways besides fusion welding in e strictest sense of the word.

The first and perhaps the commonest use r the welding flame, barring the fusing of rts together, is the putting on or building of worn or missing machinery parts. This ight, without much argumentive opposi-on, be called fusion welding, but in the rictest interpretation of the word is not. ecause, after the first layer of new metal is lded, the succeeding layers have no connec-on with the original fusion, save that they here to it thus.

Each succeeding application of new metal but a continuation of the first fusion. hen complete, the pile of new metal is, or ould be, one solid mass; although in descriptions of built up work it appears that the renewed part is deposited in distinct layers.

The blacksmith will find that his work is not substantial unless each deposit is thoroughly soaked into the lower or previous deposit, so to speak. It must be entirely fused with the metal below it to make one homogeneous pile of metal. Otherwise there will be unconnected, or at most, poorly connected places, which are liable to chip off at any time. Such work is adhesion and not fusion.

So the main rule for building up worn areas is that all additions of filler metal be thoroughly melted into the surface below. First it is necessary to melt the worn surface deep enough to form a solid anchor for the succeeding deposits. And here is where most failures originate! The smith does not melt deep enough before adding the filler metal. In combination with this fault he usually does not entirely melt the metal of the worn area. It might be said too, that both of these faults are due to one cause: the welder endeavors to bring the surface to a molten state too quickly. The result of this is a shallow, sluggish melting. Or, if a large welding flame is used, the melting is shallow and badly burned or oxodized, which is the same thing.

The remedy is to hold the flame back until the heat has had time to soak in. In other words, to apply it slowly and let the melting come on gradually.. It is probably best accomplished by keeping the welding flame in motion, swinging in arcs, or revolving in tiny circles over the melting spot. That is, watching the effects of the flame and moving it when there is danger of burning the metal. Or, to the more proficient blacksmith welder, it could be stated: move the flame in accordance with the melting condition of heated area.

Another "Must"

The next essential is to see that the new metal is added to the previous deposit and not merely piled on top of it. The molten filler is fed into the melted pool by direct contact; about like one would pour a slow stream of water into a pan to raise the surface of the water therein. However, the likeness ceases here, as the molten metal can not be allowed to drip into the bath. The passage of a drop of metal through the air chills and oxidizes it sufficiently to prevent complete mixing with the bath.

Nor is the building up of worn parts so particular as the usual welding job. First, because it usually occurs on jobs where it is not necessary to take care of expansion and contraction. In this event the casting need not be heated previous to applying the welding flame. The chief exception occurs where it is necessary to preheat to prevent a bulk of metal from drawing the heat of the welding flame away faster than it can be supplied; where the heat of the melting is conducted to cold parts of the job so rapidly that it is difficult to keep the bath fluid. However, cases do occur where it is absolutely necessary to pre heat to prevent contraction cracks, so the novice should not take it for granted that he does not need to preheat built up jobs. In such an event he may be governed by the rules of strict fusion welding in a like event.

Find the Happy Medium

At any rate he must learn not to overdo the matter. If he applies the flame too ardently and too slowly he is almost certain to oxidize the metal and thereby render it porous and brittle; perhaps make it too hard to machine. If he overheats in preheating, part of the life of the metal is destroyed. With practice, however, these things become almost instinctive.

Let us consider the job illustrated and see how the work of building up worn portions was achieved in each particular instance. The pin part of each crank was worn, as was each of the bearing parts at the ends of the crankshaft. Also, the whole crank shaft was out of line; but this formed another use for the welding torch, which we shall study later.

This crank shaft was part of a threshing separator, so the shaft had to run true for best results.

First the crank shaft was placed in a pair of V-stands, as indicated in the photos. Common V-blocks would serve the purpose just as well. They were for the purpose of permitting the shaft to be revolved as the worn portions were repaired, in order that the melting part be always upward in a horizontal position. A sloping or vertical surface permits the molten metal to flow or sag to one side, thus hindering a perfect mixture of the metals.

Fig. 2. Locating the bend with a surface gauge.

Next, the flame was adjusted to a strictly neutral condition, which was essential to minimize the danger of injuring the metal and at the same time to furnish sufficient heat. The torch, or flame, size was selected according to the manufacturers' instructions. The tipe of the white cone was brought close to one end of the worn crank; touching the metal but not close enough to be bent back. Here, it was swung back and forth, slowly across about an inch of the upper arc of the shaft, bringing this spot to a white melting condition. As this was being accomplished, the filler rod of quarter inch mild steel was caught up and brought close to the heated area so it would be heating in preparation to being introduced to the molten bath when that was ready.

When an area of about an inch across was fluidly melted to a depth of approximately a quarter of an inch, the red hot end of the filler rod was placed in contact with the bath. Then the flame was made to cross and re-cross the rod and molten bath, bringing both to the same stage of heat, and causing the melting filler to settle into the melted crank metal. A twisting movement of the filler rod assisted this action.

Keep Rod in Motion

In fact the rod was continuously in slight motion; more so as conditions warranted, to mix thoroughly the two metals and work the oxide or other dross to the surface where it could be blown aside by the force of the flame. The flame was made to work in conjunction with the filler rod and the melting condition of the two metals; striking the bath at first from one angle and then another. Perfect unison between the flame and rod is one of the greatest secrets of good welding.

When this first pool of filler was built up to the desired thickness, the flame and rod were gradually moved to another portion of the worn area, where the operation was repeated, the second pool being but a continuation of the first. Then another elongated pool, and yet others were added, until the entire length of the worn crank was covered.

Care Must be Taken

Then the shaft was revolved in the V-blocks to bring another worn portion upward. This was attacked and treated in much the same manner as the first strip. But this time the welder had to be careful to melt down the edge of the first deposit and thoroughly fuse the second application to it. That is, the edge of the first deposit had to be fused until it joined with the second as well as with the shaft metal.

The shaft was revolved with each additional strip, until the entire worn part was covered. In places a second layer had to be placed on top of the first. In this event it was essential to melt almost the full depth of the first layer before adding the second. No flux was used on any part of this job as none is needed in melting steel. Nor was any preheating employed because the shaft was light enough so that the welding flame kept it hot. Neither was there any danger of contraction cracks.

After the four cracks were built up, one at a time, the shaft was rearranged with the V-stands beneath two of them instead of at the ends as shown. Then the worn bearings were built up in the same manner: a strip at a time, alternately revolving the shaft.

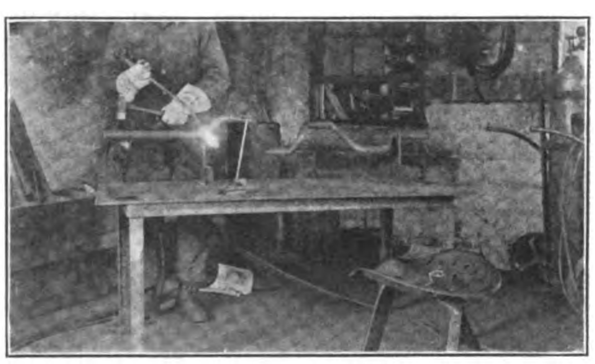


Fig. 3. Aligning a crooked crankshaft with the welding torch.

After this the entire job was allowed to cool until almost cold, for the purpose of permitting the contraction to set the crank shaft in normal line again.

Now here is another use for the welding torch, and one which will come in handy many times to the blacksmith who caters to general repair work: the straightening of crooked rods or other machinery parts. In the case illustrated: the aligning of the bent crank shaft.

First the bent shaft was placed in the V-stands as shown in Fig. 2. Then a machinist's common surface gauge was used to locate the bend. The pointer was set to touch the top of the shaft as indicated in this picture. The cranks were revolved and the pointer set until the end of the shaft was at its highest point. This showed that the bend was upward to the outer end.

Then the gauge was placed aside and the welding flame used to heat the shoulder as indicated in Fig. 3. The neutral flame was used on this job too, not because there was danger of injuring the metal but because a maximum heat was obtained for the flame size. A larger flame produces the desired effect, quicker.

The flame played back and forth and around over the bend in the shaft until an inch on each side of the shoulder turned red hot; a bright red, but not anywhere near a melting heat was thus attained. Then, while he held the flame upon the heated spot with one hand, the operator took up a hammer and struck a few light blows upon the high end of the shaft, driving it slightly downward.

The surface gauge was set up again to determine the amount of this straightening. The shaft was revolved and the pointer changed. The shoulder was again heated and hammered and the pointer employed to ascertain the result.

When at last the pointer touched the top of the shaft all of the way round as the crank was revolved, the crank shaft was straight enough for its purpose. Sometimes it was necessary to drive the shaft in another direction, due to the first blows being too heavy.

Thus we see the aligning of this job was very simple when compared with the old method of heating it in a forge fire; and not nearly the risk of ruining it through burning it like would have been the case in the old way.

The examples given here are two of the simplest uses for the welding torch outfit but they should prove its intrinsic value to any blacksmith or repairman. Of the many other uses for the wonderful little flame aside from its original purpose, perhaps, we can see more in future articles, such as melting babbitt, soldering, tinning, carbon burning, lead burning, and so forth.

TIRE CHAINS

THERE is no such thing as a non-skid tire! Neither is there such a thing as a non-skid device for the wheels of the automobile any more than there is a theft proof lock or a 100 per cent perfect measurement, or 100 per cent efficiency. Perfection in anything is unknown.

The matter of skidding is purely one of conditions. A non-skid tire may prevent skidding while the car is operated on a smooth, hard road, but drive into a moist snow-bank and the tire fills up until it is as smooth as a piece of ice. A sticky, clay soil too, will fill up the non-skid surfaces of a tire and the driver is helpless. Then tires cannot be depended upon to prevent skidding under all conditions.

Now although chains or similar devices *do* prevent skidding under normal conditions, even these cannot always be depended upon. If the whole road-bed slides, then the car goes with it and so when you drive either with non-skid tires or with chains, do not forget to be cautious.

Tire chains will, under most conditions, prevent skidding if they are correctly applied. The average driver is prone to apply chains incorrectly and if you will listen at a well traveled road on a "chainy" day you will hear this fact plainly. The rat-tat-tat of a loose or broken chain is very common as is also the buzz of a set of tight chains. A set of properly attached chains will give a metallic whirr.

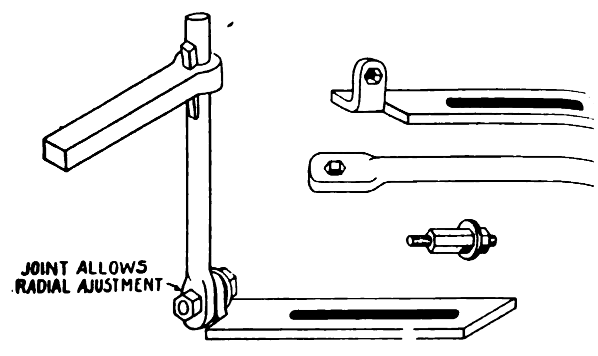
Chains should be attached to the tire loosely but not so much so that they will bang against the mud guards. If the chains fit the tire perfectly they will not always prevent skidding and they will wear the tire.

It is also necessary that the cross chains be all of the same length, so that if you make repairs to them, be sure to observe this fact.

IMPROVED DRILL POST

By Charles H. Willey

THE sketches show a type of drill post old "old man" that we made in the shop which enables us to use the ratchet drill



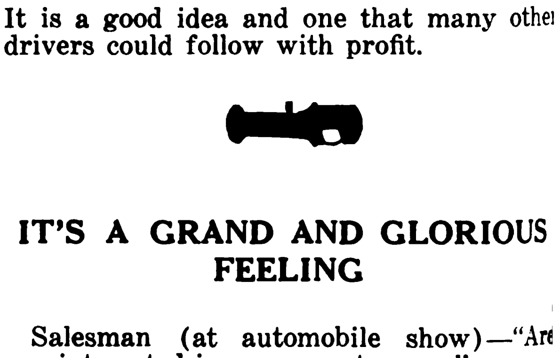
Construction of Drill Post.

in any position desired and permits rigging up for drilling in places that would be very unhandy with the old type of "old man."

The feature of this post is the joint at A which is given in detail at B, C, and the hexagon bodied bolt at D. This bolt is simply a piece of hexagon stock turned down and threaded at each end and then on one end a large washer is put on and the nut pinned to keep it from turning.

SOMETIMES there is felt the need for an alcohol torch. Without enumerating general cases, the mechanic does need such an outfit at times—and usually when one cannot be had. But it is possible to make a most acceptable substitute from a small oil can and some wick. Clean the can thoroughly, partially fill with alcohol, and put in the wick—Candle wick or lamp wick or even store cord cut to lengths. This makes a first-class torch which will give a clean flame, some light, and be safer than any other kind of similar equipment. BUT, bear in mind that this is not to be used around cars or car parts where there is the least danger of gasoline fumes.

IT'S HARD to teach an old dog new tricks so when Gus Pfaff, in middle life, found it necessary to use an auto truck in his business and drive it himself, he decided he wouldn't trust to fickle memory in shifting gears. To that end he glued a six-inch square of paper on the gasoline tank in front of him and laid out on it this diagram large enough and black enough to be seen at any time:



It is a good idea and one that many other drivers could follow with profit.

IT'S A GRAND AND GLORIOUS FEELING

Salesman (at automobile show)—"Are you interested in a new motor car."

Pedestrian Visitor—"Naw, I'm just seeing how it feels to dodge 'em without getting hit."

WANT ADVERTISEMENTS

ADVERTISEMENTS of SHOPS FOR SALE or TO RENT, SHOPS WANTED or SITUATIONS or HELP WANTED,

ill be inserted under this head at 3 cents a word, including the address, for each isertion, payable in advance; but no advertisement will be accepted for less ian 60 cents, however small.

Remittances may be made in postage stamps where the amount to be sent less than $1.00. Address

M. T. RICHARDSON CO., Advertising Department,

1-73 Murray St., New York. Publishers of the Blacksmith and Wheelwright

For Sale

Blacksmith and wagon shop 26 x 40 two story ment. The best equipped shop in this part of e country, the only gas welding plant in town. bargain. Store-room in rear 14 x 18. Doing a od business. Reason for selling I want to go a farm. Chas. H. Hesse, Cold Spring, Minn.

Blacksmith Shop and Garage. Two sets of ols complete.
One frame building in L. shape, 40 x 40 x 20. will sell either for one-half cash or less if party rees for same. Only one blacksmith in town. ork for two men all the year around. Address J. W. Kesler, Orrin, N. D.

Bargains in lathes—15 x 6 with gap; x 8; 18 x 6; 28 x 12; 26 x 14; 1¼ hand rew machine; Lincoln miller; 8 inch icker; new heavy punch and shear; new inch jointer with attachments; new litting shears and brake lining cutters. icknell Mfg. Co., Janesville, Wisconsin.

320 acres or less unimproved Wisconsin nd, 40 acres fine maple timber, clay loam il, on main road, Cheese factory on land, ljoins cleared farms, good location for acksmith shop or store. H. S. Bicknell vner, Janesville, Wisc.

For sale—Blacksmith shop, double house id one acre of land and all necessary ols, shop is 26 x 42 ft. with gasoline igine. Only shop in town, large territory. rite M. W. Olczyk, Box 2, Beaver, Wis.

FOR SALE—A two fire (driven by 18" ectric blower) blacksmith and horseshoe- g shop, including the real estate with ick building. This property is located in e heart of business district in city of teen thousand population in north east rkansas. This shop is the finest equipped, ost modern in the United States and as to date as money and human ingenuity n make it. Has eleven metal and wood- orking machines driven by two motors id two sets of lion shafts, full and com- ete stock of material. Reason for sell- g the owner wishes to retire. Address)pportunity", Care of the Blacksmith & heelwright, P. O. Box 654, City Hall ation, New York.

For Blacksmiths

Toy's Modern Methods doing hard jobs easy will help every smith make more money. Will make a blacksmith of a good helper or handy man. Forging or solid welding, hardening and tempering to standard with colored tempering charts. All for one dollar. Samples free. W. M. Toy, Sidney, Ohio.

Patents

PATENTS FOR INVENTIONS.

H. W. T. JENNER, patent attorney and mechanical expert, 622 F Street, Washington, D. C. Established 1883. I make an examination and report if a patent can be had and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions. Trademarks registered.

Wanted

WANTED—To buy rubber tiring machine, new or second handed. Todd Donigan Iron Co., Louisville, Ky.

Universal Hose Clamps

One reason for the popularity of the Universal Hose Clamp which is manufactured by the Universal Industrial Corporation, Hackensack, N. J., is the fact that this clamp will fit any hose from one inch to three inches and up to six feet in diameter.

The device comes in two sizes, the "Junior," one-quarter inch to one and one-half inches, and the "Senior" one inch to three inches. It consists of a band of tough, cold rolled ribbon steel, a bolt and nut. There are holes every five-eighths of an inch apart in the band with scores between them.

It is only necessary to clamp the band around the hose, insert the bolt in the nearest hole, tighten up on the nut and then break off the over-lap.

Buffalo Products

Very few concerns manufacture such a large line of products as does the Buffalo Forge Co. of Buffalo, N. Y. This line includes forges, electric blowers drills, floor and post type, shears for cutting angles, bars and sheets. The shears cover every size from the little bench type hand power shear to the heaviest power shear made. Blacksmiths who are anxious to get ahead are beginning to realize the necessity of using up-to-date tools and it would pay them to investigate these tools made by the Buffalo Forge Company.

At any rate it would be to their advantage to write to this company for the complete catalog.

Sparks

"Sparks" is the name of a little house magazine that is being published by the Bastian-Blessing Company, West Austin Ave., at La Salle St., Chicago, Ill. For those who are interested in the subject of better welding or cutting with the oxy-acetylene or oxy-hydrogen process, it should prove of great value, and we should advise them to write to this company for the latest issue of "Sparks."

SPARKS AND SHAVINGS

Laffitte Welding Plates

he Phillips-Laffitte Co., Philadelphia, manufacture the well known Laf- Welding Plates. These plates be- ie more popular every year and more ksmiths than ever are using them. y are great time and labor savers for that reason are well liked. he Phillips-Laffitte Co. will be glad end samples to blacksmiths who are rested.

Harvey Springs

arvey Boltless Automobile Springs h are manufactured by the Harvey ng and Forging Co., 1083 Seven- th St., Racine, Wisconsin, are prod- which should be investigated by y blacksmith. These springs which extremely well made are known to lurable and the manufacturers guar- e their easy riding qualities. ıll information may be obtained by ing to the makers.

Phoenix Horse Shoes

ost blacksmiths know that the enix Horse Shoe Company of Chica- Ill., is a large manufacturer, but not now that this concern is the largest ufacturer of horse and mule shoes ie world. Blacksmiths who use these s testify to their excellent qualities. Bull Dog Toe Calks are almost uni- ally used. will pay blacksmiths to write to the enix Horse Shoe Co. for data re- ling their products.

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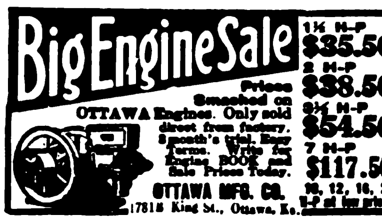
CLASSIFIED BUYERS' GUIDE



BLACKSMITH AND WHEELWRIGHT
and TRACTOR REPAIR JOURNAL

Vol. LXXXV. No. 5 MAY, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

How the Percentage of Carbon Effects the Strength

By J. F. Springer

THERE is another bad feature connected with hardening the exterior skin by using the heat developed in the process of absorbing carbon from the bone dust or other material. Such temperatures are high—runoff does not restore the steel to its normal grain size nor does it give back strength.

This is to be regarded as the verdict of the new information, obtained partly through the microscope. In fact, any heating of steel of 0.35 per cent carbon above 1400° F. (= 760° C.) is to be viewed as harmful. In short, then, heating the work in the packing cases results in damage, and this damage is not corrected by simple cooling.

The Remedy

What then may be done? The thing to do is to permit the work to cool to blackness (or lower) from the heat of the furnace where the packing cases and contents are heated. The work is then heated up to the proper point for *annealing* steel containing 0.35 per cent of carbon. This will be something over 1400° F. (= 760° C.). This is a *full cherry red*, but not a light red. This is higher than a little above 1274° F. (medium cherry red), which is enough for the handling by quenching but not high enough for the annealing. We select the heat just above full cherry red because it will be proper for the annealing and will also do for the hardening. "Annealing" is here used in the sense of restoring the grain size to the best degree possible.

If the reader will carefully study the foregoing account as to case-hardening, from start to finish, he may expect to get a good grasp on the advisability of doing two things:

(1) Giving the work a second heating.

(2) Stopping this heat at the lowest possible point.

Progress in the Study

These are important matters, and I think I may say that, in the days before the microscope began to aid us in our study of steel, it was not possible to follow any such procedure or know why it should be followed. Now it is possible to have this programme and also to know why it ought to be employed.

In fact, in very recent years, there has grown up an extensive art know as the *heat treatment of metals* which accomplishes wonders in the improvement of iron, steel and other metals. There has always been a certain amount of knowledge available on this subject. Men have for ages hardened steel tools, such as axes, swords, etc. Tempering has also been known for a long time.

But of late there have been so many and such important developments that heat treatment now includes a very wide range of operations. This may be understood better perhaps when I say that a recent book of nearly 500 good sized pages is occupied with nothing else than heat treatment of steel. It begins with the forging heat and goes on to all kinds of annealing, hardening, tempering, etc. It deals only with steels of various kinds, and does not cover copper, brass, etc. This book could not have been written in the days before the microscope began to add to our knowledge.

There are several different kinds of strength. Thus, a metal or other material may have *crushing strength*. Then there is an opposite kind of strength known as *tensile strength*. This is resistance to pulling.

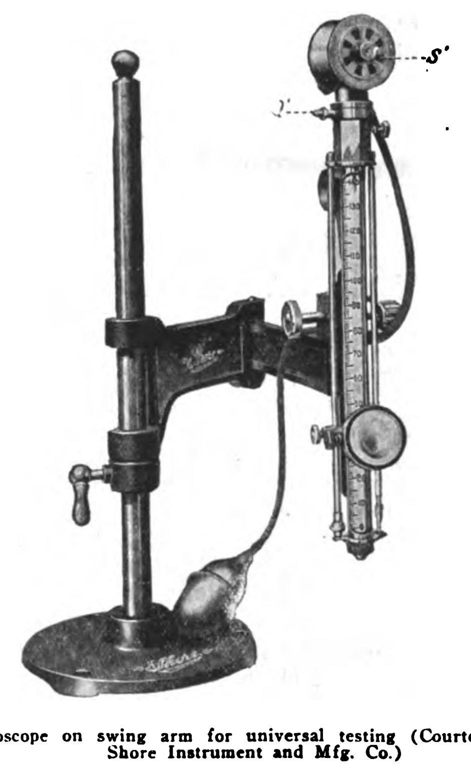
Concrete—that is, simple concrete containing no reinforcement—is a good example of a material having a fairly good crushing strength. It has accordingly a property very suitable to a building material. Block upon block of concrete may be piled up and the lower part of the wall will stand the weight. That is, the lower part resists very well the crushing effect of the weight above it.

Similarly, when the concrete is poured so as to make one high wall, as at the Gatun Locks of the Panama Canal. The lower part has sufficient crushing strength to sustain the great load above it. On the other hand, plain concrete is weak in resisting a pull. It has in fact but little tensile strength. If there had been no way to overcome this defect, concrete would today be very limited in its field of usefulness.

Strengthening the Concrete

Happily, however, it was found possible to imbed in the concrete bars of steel and thus give it the tensile strength needed. Really, steel is a wonderful material both in respect to crushing strength and in respect to tensile strength. The combination assists greatly in making it the most wonderful material in the world, so far as is known. There are many things that possess good crushing strength—such as granite, brick, etc. But in steel we have a material that adds a splendid tensile strength.

Tensile strength is really a very important quality. Our tendons which connect muscles with bones that are more or less distant illustrate this fact. Nearly all movements of parts of the body are accomplished by pulls. Few or none are brought about by pushes. Tensile strength is the principal thing depended on in such structures as the Brooklyn Bridge over the so-called East River at New York. The steel cables used on our passenger and freight elevators and in many other situations are examples of a wonderful and high degree of tensile strength.



Scleroscope on swing arm for universal testing (Courtesy of Shore Instrument and Mfg. Co.)

Steel is one of the most notable of all materials in this respect. Consequently, it is important to know something of what it is that gives it this kind of strength. In the first place, wrought iron—that is, pure iron with no carbon in it—is not particularly strong when it comes to resisting a pull. But, if carbon be added to the iron and a new material, steel, be made, an increase in tensile strength follows.

Carbon Increases Strength

In fact, each small addition of carbon results in a good substantial increase in the tensile strength.

For example, suppose we consider such steel as that made by the open hearth process. This steel gains steadily in tensile strength as the carbon increases. We may take for our starting point steel that contains no carbon at all. This is pure iron, say. If it be subjected to test in the usual way in a special testing machine, wrought iron would probably show a tensile strength of 40,000 pounds per square inch. That is, a square bar having a cross-section one inch on a side would have a cross-section of exactly one square inch. Such a bar should resist a pull of 40,000 pounds.

If the bar is smaller and its section measures only ½ inch on a side, then the cross-section will have an area of exactly ½x½ =¼ square inch. This bar would then resist a pull of 10,000 pounds.

The strength in both cases is precisely the same. So also if the square bar is heavier than a one-inch bar, it will withstand a pull of more than 40,000 pounds; but the resistance is always 40,000 pounds *per square inch*.

Well, then, this gives us an idea of wrought iron and its tensile strength. It is a good strong material. But read what happens when carbon is added. If the steel has been properly made by the acid open-hearth process, then every time we add 0.01 per cent to the carbon, we increase the tensile strength 1,000 pounds per square inch. Thus, by adding to wrought iron the small amount of 0.10 per cent of carbon, we get steel which will resist a pull of 50,000 pounds per square inch. A steel containing only 0.35 per cent of carbon will nevertheless have a tensile strength of 75,000 pounds per square inch.

Relatively Small Amount of Carbon

Reflect a moment as to this matter. The 0.01 per cent of carbon that has the effect of adding 1,000 pounds per square inch to the tensile strength is really a very small relative amount. If the steel bar or the steel cable weighed 100 pounds, then the 0.01 per cent means only a trifle of carbon—in fact, only 1/6 of an ounce. This means, in the case, say, of the steel cable, that every time 1/6 of an ounce of iron is replaced by 1/6 of an ounce of carbon, we add 1,000 pounds per square inch to the power to resist a pull.

A wrought iron cable with a section of one square inch will sustain a load of 40,000 pounds. If we now replace 1/6 of an ounce of the iron in every 100-pound length by 1/6 of an ounce of carbon, we will have a cable capable of sustaining 41,000 pounds.

Replace in this way until $\frac{35}{6}$ ounces of iron per 100-pound length have been replaced by $\frac{35}{6}$ ounces of carbon. The result is a cable capable of sustaining 75,000 pounds. And it has all been accomplished by replacing $\left(\frac{35}{6}\right) = 5.8$ ounces of iron by the same weight of carbon, per 100-pound length.

Carbon in Cementite

From what we have already learned, all this carbon has gone into cementite. The cementite is in pearlite, there forming the layers that alternate with layers of pure iron. That is, the steel consists of grains of pearlite imbedded in a honeycomb of pure iron (ferrite). The pearlite is made up of layers of cementite and ferrite, each alternating with the other. All the carbon is in this cementite.

So, then, we really have the rule: The more cementite the steel cable contains, the stronger it is. This is a wonderful fact. And the reader will perhaps think it is still more wonderful, when he learns that pure cementite is probably rather weak. It is understood that cementite alone has a tensile strength around 5,000 pounds per square inch. This is very much less than the tensile strength of ferrite alone—pure iron.

It has, as we have already assumed, a strength of 40,000 pounds per square inch. Yet, when the two are intermingled to form steel we get a strength greater than either one. And the more we increase the relative amount of the weaker of the two things (that is, of the cementite), the greater will be the strength of the steel. These facts are certainly wonderful.

A Surprising Result

I suppose we are to conclude that some great gain is brought about by the *way* the cementite and the ferrite co-operate. It is easy to understand how cementite adds to the hardness, because cementite itself is very hard. But in this case of tensile strength, we have the surprising result that the more we use of a weak article, the stronger the mixed material will be. Here is a case where a partnership produces an unexpected result.

Now, the steel assumed in the foregoing is that made by the acid open-hearth process. If the basic open-hearth process is used, the strength is still increased as the carbon is added, but the increase is at a slower rate. Instead of an addition to the tensile strength of 1,000 pounds per square inch, the increase is to be taken as 770 pounds. If the steel has been made by the Bessemer process, we are, according to Bradley Stoughton, rather to use an amount somewhat smaller yet. But, if the steel has been made by the crucible process, we are to add more than 1,000 pounds.

Other Factors Increase Strength

There are other things that add to the strength. Thus, phosphorus increases the strength. But, this is no great advantage in comparison to what takes effect with carbon. First, if the steel is to suffer vibrations and sudden shocks when in service, phosphorus is not a desirable ingredient. Second, when the phosphorus amounts to 0.12 per cent, any further increase brings about a weakening. That is, phosphorus adds strength up to 0.12 per cent and then reverses its beneficial action.

Manganese seems also to add to the strength but not in a way especially desirable. Therefore we come back to carbon. Here is a reliable friend. Carbon adds strength at a steady rate until we get to tool steels (from 0.90 per cent carbon on up). And it continues to add strength to the tool steels until the carbon amounts to, say 1.20 per cent, although the rate of the increase of strength is slower. After 1.20 per cent, the addition of carbon results in a steady decline in the tensile strength.

It may be gathered from the foregoing that carbon is the principal dependence in adding to the natural strength of pure iron. By means of carbon, we can get strength up into the region of very hard tool steels—in fact, up to a carbon content of 1.20 per cent.

Think of it for a minute. Simply by making 1/6 of an ounce carbon, 100 pounds of steel can be given a tensile strength 600 to 1100 or 1200 pounds per square inch greater. And this will continue steadily as we add carbon up to the point when we have added the 1/6 ounce 90 times. Even then the carbon amounts to less than a pound in the total of 100 pounds. We have gotten a strength wonderfully greater than that of pure iron. Even if we go on past the point where the carbon content is 0.90 per cent—that is, past the point where 15 ounces out of the hundred pounds is carbon—we add to the strength, although at a slower rate. All this is extraordinary—so much is done by so little.

Now we could find out all this perhaps without a microscope. Probably we would have found it out. The microscope, however, comes in, much in accordance with the following. After we get great strength by adding carbon, we can play hob with the steel simply by handling the forging, annealing, hardening, etc., in a wrong manner. The microscope informs us as to the structure and appearance of steel that has been properly heat treated. In fact, it enables us to get things to a point where we can tell just what we are doing.

Hardness Testing

Naturally, other devices have come into use in connection with the study of steel and of other metals. Thus, we have machines to test the crushing strength of steel and machines to test the tensile strength. Then, there are devices which seek to test the hardness. There is quite a variety, and probably no two exactly agree. This needs a word of explanation.

It would seem as if people could hardly agree on what is meant by hardness. We say that the diamond is hard. In fact, there is a scale of hardness to which the name of Moh is attached, which informs us that this material is harder than this and softer than that. Moh's scale depends, doubtless, on a kind of hardness that is tested by scratching. If a diamond scratches a piece of glass, then the diamond is rated as harder than the glass. If the glass, in turn, scratches aluminum, then glass is rated as harder than this metal. We get from these few experiments a scale of three substances, which may be arranged thus:

Diamond
Glass
Aluminum

If the harder material is understood as being higher in the scale, then these three are correctly arranged. But, this system would not answer the needs of today. It is often advisable, not to say necessary, to know various fine stages of a single material. The "scratch" idea does not seem to have been very successful, since the two principal methods now in use have nothing to do with scratching.

Two Systems

Brinell and Shore are the names of the two systems. By Brinell's method, a hard steel ball is pressed into the surface of the piece of steel whose hardness is to be determined. I am not going into all the minutiae. Suffice it to say that the further in a given size of ball is pressed by, say 3,000 kilograms of pressure, the softer the steel is to be rated. But if the dent in one piece of steel is twice as deep as in another, the latter is not counted as twice as hard. The rule does not run along quite that way.

However, it is true that the shallower the dent, the harder the steel is to be rated. Numbers are given to different degrees of hardness. This is, roughly, the Brinell method.

A HOME MADE REPAIR

My neighbor, Doctor Barnes, does not follow the crowd; he likes to be different. The celluloid "lights" in the rear of his car top had become scratched up and dim, as do all of their kind. It got so bad he couldn't see behind. He went to various top men and they all told him the same tale—it was a big job to put new lights in, he would have to leave the car and the top would have to be taken off entirely and, oh, it was a big job anyway you looked at it.

So Doc studied. Finally he and his good wife put in new glasses—and it looks like a $20 job, too. It cost sixty-four cents and a little of their time and they got five dollars worth of pleasure out of it. The window space in that Jack Rabbit top is 10 inches by 24 inches, divided into four sections by inch-wide vertical strips of mohair. After the old celluloid was torn out, Mrs. B. ripped the stitching in part and cut entirely across the center strip.

Two panes of first grade window glass 10 inches by twelve inches had been secured and had all the edges thoroughly rounded. Each was to fill two sections. They were slipped in at the center, one to the right and one to the left, between the two piles of the top material. Sewing up the severed middle strip was an easy task for friend wife who also made other deft passes with the needle to improve the job and the top generally.

These glasses are far superior to celluloid —clear to look through and superior in appearance—and after months of service they prove that they are well adapted to a mohair top. Car owners who have puzzled as to what was the best thing to do with that part of their tops might follow this example to their advantage.

THE BLACKSMITH FIXED IT

Everyone knows what a lathe chuck is and how useful they are on repair work—half of automobile repair work requires the use of a chuck. And they are rather expensive, costing from one dollar to two dollars per inch of diameter, so I was rather surprised to see a nice 12-inch chuck on the little foot power lathe in the garage of a friend whom I knew didn't have any too much money.

He anticipated my thought and explained that it had been sold to him for a dollar at a machine shop where some carelessness had actually cracked the chuck body in two, rendering it "beyond repair." But he had taken it to a blacksmith who shrunk an iron band around the outside making it as good as new and at a total cost of three dollars for a splendid big chuck.

This man had just finished turning off his brake drums, something that too few car owners know about. When brake lining gets worn down, the copper rivets touch the drum, scoring the latter in time in spite of the relative softness of copper. Then when new linings are put on they are quickly worn out by the ridges of the drum. If the drums are taken off, it is the work of but an hour a piece to machine the surfaces smooth which gives the linings a full bearing clear across.

WHEN ONE TON IS TWO TONS

Coal merchant (anxiously): "Hold on! That load hasn't been weighed. It looks to me a trifle large for a ton."

Driver: "T'ain't intended for a ton. It's two tons."

Coal Merchant: "All right. Go ahead."—*New Departure News.*

CRUEL

"I once knew a man that stayed home with his wife every night for thirty years."

"Ah! that was true love!"

"No, that was paralysis."—*New Departure News.*

A Modern Man in an Old Time Job

Since 1678 the Pratts have Run This Shop in Essex, Connecticut

(Reprinted by Courtesy of the American Magazine)

THE touring motorist, whirling through the quaint little Connecticut river town of Essex, would be unlikely to notice the small, one-story building which is the village blacksmith shop. But if his eye caught the inscription over he door, he would be more likely to linger han not. And lingering would be worth .is while. The inscription, cut deep in a olid block of stone, reads:

1678 Pratt's Village Smithy

Every horse owner in the county knows hat sign. Also, he knows that, even as in 678, the name of the smith is Pratt. Peraps not all of them know that for two hun.red and forty-three years there never has een a time when the name was not Pratt. 'or James L. Pratt, ninth of his line in merica, is the eighth Pratt to preside over he Essex smithy. He will continue to do so o the end of his years, whether the business rospers or not.

The Reason Why

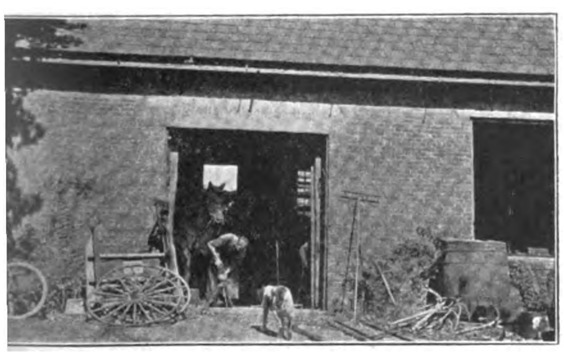
A good many people do not understand vhy Jim Pratt, wealthy, well educated, trav-led, stands by his forge day after day and ninisters to the needs of his neighbor's orses. But Jim Pratt knows. And some lay, if you should happen into his shop and atch a far-away look in those keen blue eyes, e may tell you about it.

Then you will learn that when he was a oung man blacksmithing was the one job e wanted to avoid. He couldn't quite undertand why his father stuck to the shop. So he nocked about the world for a few years, ried seafaring, engaged in various occupaions in the Middle West—then returned to ssex at the age of twenty-seven and apprenticed himself to his father to learn the blackmith trade, at one dollar and twenty-five ents a day.

The Call of the Trade

Jim Pratt had tried to avoid his heritage, nd failed. The silent call of his blacksmith ncestors was too urgent. Whenever he tried apply himself to anything else, there would se within him the thought of those six sleepg blacksmiths and the other one who was ollowing on in their footsteps—all Pratts. nd finally that insistent thought turned his ce toward Essex and the forge.

His apprenticeship meant more than learng the art of horse-shoeing. Because that only a part of the work done at the Pratt nithy. The course of instruction covered mmered strap hinges, locks, door pulls, ills, andirons, ship fittings, and wagon res; and the Elder Pratt was a stern masr. So today you can find Jim Pratt's handiork in most of the important Essex homes,



The outside of Jim Pratt's Shop

d on scores of the boats and launches that the lower waters of the Connecticut.

As the fledging blacksmith progressed, re grew up in his heart a love for his de, and as time went on the traditional pride in the output of the village smithy more and more took possession of the new incumbent, and he became a stickler for perfection. His reputation grew, until it was a common thing to hear the remark, "If Pratt made it, it's all right."

A Humorist

Besides being considered an excellent blacksmith, Pratt is regarded as a humorist. And he is. He always is keen for a verbal sparring match and the conversation heard in his little shop is lively and entertaining. At all times his opinions are worth attention. For instance, he has declared, "The only perfect thing I know of is a blacksmith's anvil. And the proof of its perfection lies in the fact that its form and construction have remained unchanged for centuries, and nobody has been able to improve it."

When not at his forge, Jim Pratt finds time for a variety of civic activities. He is a deputy sheriff of the county, town select-

At work at the forge

man, and serves on most public committees. He is a director of the Dauntless Shipyard and a member of the Council of the Dauntless Club, one of the best known sportmen's clubs on the Connecticut.

He is a crack shot and a keen fisherman. His knowledge of the haunts of ducks and reed birds, as well as the hiding places of shad and bluefish, is unexcelled. At the wheel of his yacht, the "Friday," he is as much at home as in his shop. He works hard and plays hard and, taking everything into account, there is no doubt that Jim Pratt is quite as happy as that other village blacksmith who toiled under the spreading chestnut tree.

GORDON STILES.

FROM A SAFE DISTANCE

If you don't think co-operation is necessary, watch what happens to a wagon when a wheel comes off.

"NAN"

A True Story of Memorial Day

F. A. Sovereign.

FROM the year 1862 until the close of the Civil War in 1865 Wilbur Haynes served his country as captain of a company of Ohio volunteers. His steed was a chestnut sorrel mare known by the name of "Nan." Captain Haynes took a great fancy to this young mare, and was just as particular in seeing that her groom obeyed to the letter in the caring for her as he did in seeing that his soldiers obeyed while on the field of action.

The two naturally became fast friends, and Captain Haynes often remarked that it would be a hard task to part from Nan at the close of the conflict, if they were both permitted to live through the war.

At last the conflict ended, and as he filed in line for his discharge he was given not only his honorable discharge, but also a letter from the War Department, advising him that Nan was now his property.

Of course Mr. Haynes was highly elated over having been given this beautiful mare, and with great pride he rode her back to his home, where she was turned out into the green pasture and placed on the pension list.

Nan was never worked and was ridden only on special occasions. On Decoration Day each year she headed the procession, mounted by Captain Haynes, followed by the fifes and drums and the boys in blue.

No one enjoyed this more than Nan. Year after year, on the thirtieth day of May, this procession was formed and led by Nan mounted by Captain Haynes. They marched from the City Hall to the cemetery, where the services were held.

One year, as they were forming the line at the City Hall for their annual march to the cemetery, in respect to their fallen comrades, Captain Haynes remarked that this time he would walk beside his comrades, as Nan was now too old to lead again the procession. This occasioned much gloom over the entire company, as they all had learned to love the beautiful mare, and they felt that without her the line was incomplete.

Nothing, however, could change the mind of Captain Haynes. He advised the boys that Nan was on a full pension and had served her time well, and never again would she be burdened by a saddle.

The line was formed, Captain Haynes leading on foot, followed by the fifes and drums.

Two blocks down the street Nan's home was passed. She was in the back lot, enjoying herself at the feed-rack. Suddenly she heard the fife and drum and pricked up her ears. As the parade marched by, she bowed her neck and proudly pranced around the lot. As the column marched down the street, getting farther and farther away from Nan, she could stand it no longer, but sprang with a bound over the fence and galloped down the road, until the head of the line was reached. Now, how proud she looked as she led the procession, keeping time as it seemed to the beating of the drums! She led the way without a rider until the cemetery gate was reached. Here she halted and waited patiently until the services were brought to a close. She then took her place in the line with the men, and at the command, "Forward, march," she headed the procession back to the town. When her own home was reached, she walked slowly to the gate, and with a knowing nicker, which Captain Haynes said was telling him that she was too tired to iump back over the fence, asked him to open the gate for her.

From this time on until her death from old age, Nan led the annual procession of the boys in blue.—*From Our Dumb Animals.*

HAD ONE AT HOME

Singleton—"They have machines now that can tell when a man is lying. Ever seen one?"

Wedmore—"Seen one? By gosh. I married one."—*Boston Transcript.*

BLACKSMITH & WHEELWRIGHT
AND TRACTOR REPAIR
JOURNAL

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Our Editor's Letter

Of course some of us like to take a bunch of figures and make them perform for us, and there are many bald-headed, high browed professors who can prove by figures that in ten million years from now this old earth will be chugging along with several of its cylinders missing and a temperature of some hundreds of degrees below the freezing point of water. And as these prof's carefully check up each other they wrinkle their brows in deep worry for they are as much concerned over the world ten million years hence as you might be if you knew that it was going to smash next week.

There are many kinds of figures, some of them are fancy, some of them are plain. The fancy figures don't interest us so much as the plain ones, for we are more concerned with the price of steak than with the possible fate of our earth several millions of years from now. Anyway, if the earth is to freeze to death one need not worry about prices then.

The National Automobile Chamber of Commerce, Inc., recently published a 96 page booklet of statistics and though we haven't as yet found time to look over all of the figures we have found a few which are mighty interesting because they explain the conditions in our industry and show us a way out of the tangle to business success.

Since the automobile came into general usage the horse drawn vehicle has gradually been pushed off the roads. The farmer can hardly spare time to make a trip to town behind a horse at ten miles an hour when he can hop into an automobile and speed over the distance in one third the time. Fifty miles a day is enough to get a groan of dispair out of the average horse, while that distance is nothing but a good starter for the average automobile. Is it not logical, then, that the farmer plans to keep an automobile for his about country work?

In the same way that the automobile has displaced the light horse, the motor truck has partially displaced the draught animal. A one ton load is aplenty for one horse, too much in fact if the roads are poor, but a mortor truck may be had to haul five or six tons, or even more. A horse drawing a load might average five miles an hour, but a five ton truck, fully loaded, can be driven over the same kinds of roads at from 15 to 20 miles an hour. Thus a farmer might load his truck, take the goods to market, unload and be back upon his farm ready to start the morning work whereas had he used a horse drawn wagon he would have consumed the entire day delivering the same amount of produce.

The light car, fitted with a trucking body can be used to take milk and garden stuff to the market so easily and rapidly that it hardly pays to freight or express it.

As if this were not enough to worry the poor old horse, along comes the gasoline tractor and plows up a field in the time that it would take for the average horse to do a furrow. And the tractor doesn't stop to nibble the grass or pull the leaves from the trees in the orchard.

The automobile, the truck or the tractor consume only when they work. If a farmer is snowed in and cannot do his work he need not worry about feeding working stock if he owns such machinery.

A horse feeds up on green grass, groans several times, lies down in the stall and dies, perhaps. Maybe his hide is worth several dollars, but generally he is literally a "dead" loss. The motor vehicle is not subject to colic, doesn't cast its shoes and though it may balk on occasions, it will yield to reason.

And now let us consider those figures which we mentioned in the first part of this letter. A survey made throughout the country by the National Automobile Chamber of Commerce shows that the average farmers (not gentlemen farmers, but those who make farming a business) have been able to increase their gross incomes 68% by the use of motor vehicles as against their former incomes before acquiring such machines. Practically two-thirds of all the motor vehicles owned in this country are utilized by farmers.

One more figure and we're through with statistics. Over one third of the automobiles in use are owned by people in towns of 1000 population or under and, needless to say most of our blacksmiths are located in such towns, for the small town is the best place for the average smith.

Now it must be plain to you, brother reader, that if the automobile and other motorized equipment keeps up its stride, your horse business will drop away. If you will change your work gradually, so that you, slowly but surely, get the automobile work, you will not be left in the rear.

The horse will never be extinct for his uses are many; as a matter of fact from my office window, in one of the busiest parts of the city, I can see a greater number of horses than trucks; however, in some parts of the country the horse is a curiosity.

If you find your business dropping off, work into the automobile, truck and tractor game, then your business will grow again.

Cleanliness and Business

We have before us a clipping from one of the small magazines devoted to business in general and we are keeping it because it tells a little story about cleanliness. There is a mighty fine lesson in the story so we are going to pass the substance, along; maybe it will set some of our readers to thinking.

The story is about a small garage and repair shop which was located in a fairly good neighborhood. The proprietor, who was also the only mechanic, was not only very careless about his personal appearance but his shop was dirty and everything seemed coated with grease. He was an excellent mechanic and, at first, had a fair amount of business.

But as time passed he grew more careless about things, the dirt and grease thickened and his better patrons did not care to go into his place of business. People with nice cars did not want the upholstery all greased up from his greasy overhalls. His business gradually dropped away until he had only work from people who were themselves careless; so careless that did not pay their bills, and so, finally he sold the shop.

The new proprietor shut the shop up for two weeks, for it took that time to clean things up. The new man used plenty of whitewash, put in a new concrete floor, electric lights and washed the windows. It was hard work at first, but the new man finally got the trade coming into his shop again. People with good clothes were no longer afraid of visiting him and the new man eventually worked up a fine business with people who were careful of their cars and had the money.

A clean shop is an orderly shop and an orderly shop is an efficient place. A clean shop radiates cheerfulness and honesty and customers are not afraid to visit it. A clean shop indicates an intelligent head and therefore reflects credit upon the man who runs it. Now there is such a thing as honest dirt—a piece of coal; a clay mold: the lead in a pencil; but there is as much difference between this kind of dirt and un-cleanliness as between sand and iron rust. You cannot expect to be a good blacksmith and still keep your hands lily white, but dirty hands are not unclean, it all depends upon the kind of dirt and the excuse for it, also the way you wear it.

And it is the same way with your shop; a pile of soft coal in the middle of the floor is dirt and will drive away your customers, in time, while that same coal, if kept in an orderly looking bin is in the nature of clean dirt.

If you want to keep good customers you must keep your shop looking as though it were a place of business, not a junk shop. If you must keep old iron and rubbish, keep it in bins or orderly piles and as much out of sight as possible.

And when you are called upon to repair a wagon or carriage, or perhaps an automobile, be very careful about getting grease and dirt upon the vehicle. So many mechanics are prone to crawl onto clean upholstery with dirty clothes and leave grease. When the owner gets into the seat he picks up the dirt and spoils his or her suit. The cost of the suit is often greater than the cost of the repair which the mechanic made and that owner seldom returns. Cover the seats with cloth before you sit in them and you will not lose your customer.

But above all, don't have a lot of dirty, greasy boxes standing around where your customers can get against them. Keep your shop clean!

A MERE DETAIL

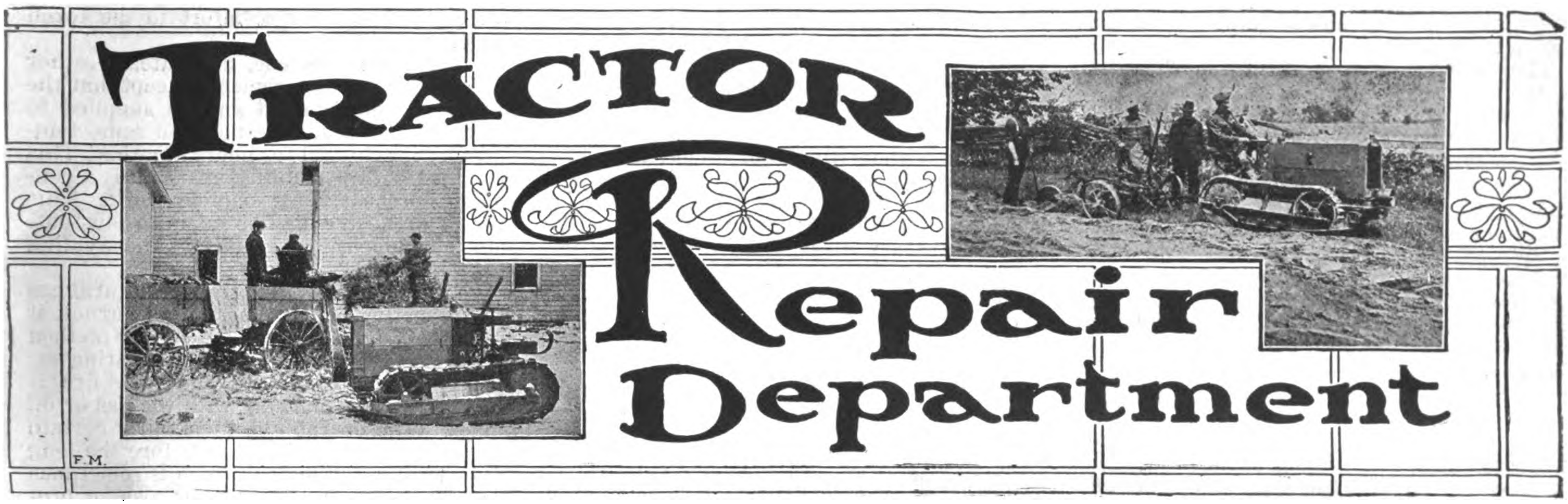
A tourist in Scotland, stopping at a cottage for a drink, observed the old inhabitant attempting to chop a large log of wood with an ancient-looking axe.

"That's an old axe you've got there, isn't it, dad?" he asked.

"Aye, it is," came the reply; "it's nigh on a hundred years old."

"Indeed," said the surprised tourist. "I shouldn't have thought it was so old as that."

"A'weel, mebee it's no' exactly that," answered the old man. "It's had two new heads and three new handles since then!"—*The Lightning Line.*



Preheaters

The Various Kinds of Preheaters and Method of Operation

By David Baxter

MOST of the failures in oxy-acetylene welding are no doubt due to the fact that the welder does not understand the heat reactions of the welded job, in other words the expansion and contraction, or else he is not equipped to take care of this very important fundamental of the welding process.

For the expert torch operator there is scarcely a job nowadays that cannot be welded if the facilities are at hand to execute the work and proper precautions are *taken*, but many simple welds are lost through a misunderstanding of the basic principles of heat reactions. The chief of these is the fact that metal expands upon being heated; it enlarges its dimensions and contracts or shrinks to very near its original size when it cools; the cold metal occupies a smaller space than it did when heated.

A Problem to be Solved

This, then, is the main problem for the blacksmith to solve when he enters the torch welding business: He must learn to control expansion and contraction. Or it might be said, he must learn to overcome these actions, or to make them act to serve the best ends of the welding process. For, while all metals expand and contract with the fluctuation of heat, some jobs do not need preheating.

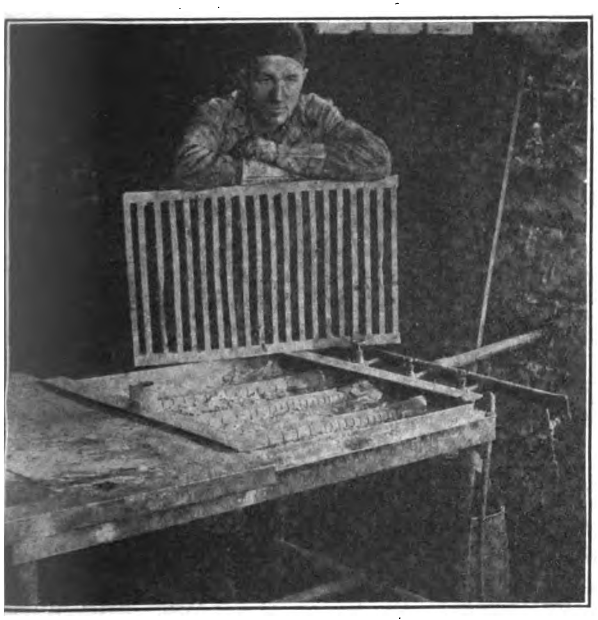


Fig. 1. A handy preheating table utilizing natural gas as the heating agency.

Probably the best and simplest way to control expansion and contraction is by heating the job previous to applying the weld heat. This is known in the welder's vernacular as preheating, or heating the job previous to welding it. By applying the heat in a certain way the welder can counteract or overcome the heat reactions in different jobs. That is, he can heat a job or part of a job by some separate agency before he applies the welding flame and thereby take advantage of the contraction in such a way as to prevent it from cracking the job.

Then there is another side to the preheating question, aside from the necessity of governing expansion. Some jobs need it for other reasons than to prevent cracking or warping in the welded job. Some jobs do not need preheating because the nature of the metal or the shape of the piece permits the normal action of the heating and cooling metal; the push and pull of the heat reacts without warping or cracking the object welded.

In the first instance heavy wrought iron and steel jobs do not need preheating on account of the expansion and contraction, because the nature of the metal permits the action to function within itself, so to speak; the metal itself absorbs the expansion and contraction.

In the second instance the casting or the part to be welded is of such shape that the push of expansion and pull of contraction are not retarded. Nothing prevents the expansion of the weld from pushing outward, and for the same reason the pull of contraction is not held back.

To illustrate the first instance, consider as examples such articles as crank or straight shafts, boiler flues, small steel castings and gears. In the second instance, such articles as stove legs, broken lugs or worn gear teeth in cast iron, or other articles made of aluminum or other metals where the part to be welded on is small and projects outward from the main body of the job. In such instances the part welded on, or perhaps both parts of the job, are free to move out and in with the heat reactions of the weld and therefore do not ordinarily need preheating to prevent distortion or cracking.

Preheating for Various Reasons

However, it must be said that some jobs which do not need preheating to prevent cracking must be preheated to prevent warping. In this class is found tanks, boiler or other sheet metal welding, as well as heavy shafting welds. Once the welder grasps the idea, he can soon learn to judge the necessary part of the preheating idea, or the omitting of it.

In the class that does not need preheating to prevent certain effects of heat reactions there is a class which should be heated for other reasons previous to applying the torch flame, and during the progress of the welding. This is the kind of job that is so heavy the heat of the torch flame is drawn away by conduction so rapidly that it is difficult to keep the weld fusing properly. Heavy jobs require a large, powerful flame in order that it may melt the weld properly and still furnish enough to replace the heat lost by conduction.

But this is a waste, both in time and in welding gas, since the welder can get the job hot by some cheaper agency and thereby cut the necessity for using a torch so large. He can thereby gain time, since it should be obvious that the weld will melt faster if it is red hot before the welding flame is applied than it will if it is welded without preheating.

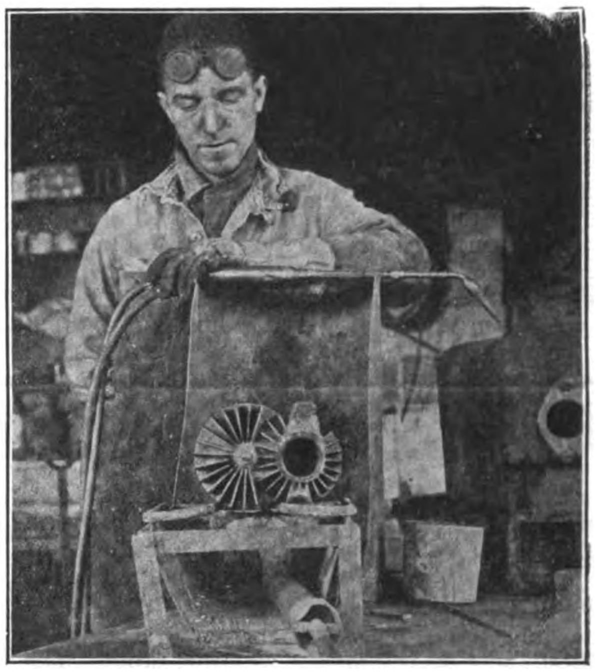


Fig. 2. A portable preheater utilizing gas for heating small jobs.

Therefore we see that the welding jobs are preheated to prevent distortion and cracking, to save time, and to cheapen the work. It might be added that in many cases a better weld is obtained if the job is carefully preheated before applying the torch flame. Most always it is a better weld if the preheat is maintained during the welding process.

Now, with thees ideas in view, a number of devices have been evolved, both for all-over preheating and for localizing or concentrating the heat. In the latter case it should be said that many jobs are welded easier by confining the heat to some specific spot or part of the casting.

By localizing the welder not only saves preheating fuel but he obtains better results in the finished job. If he is a thorough student of the art he will discover that he can make the preheating fire work to his advantage. He can often heat one part to take care of contraction in the other.

An examination of the preheaters that have been devised by some welders may prove helpful to other welders in working out their welding problems. The first thing, though, is to decide what preheater fuel is best adapted to local and shop conditions. That is, the kind of fuel which will be the most economical in the end. This factor frequently has the most influence in the choice of preheaters.

The fuel which may seem the cheapest in first cost may prove to be the most expensive taken altogether. What is handily appliable in one locality may be almost prohibitive in another.

Natural gass is no doubt the best all-around fuel used in preheating. It furnishes a hot, steady heat or a slow dull one, according to the will of the operator. In fact the natural gas flame is readily adjustable and may therefore be "set" at almost any desired degree of temperature. It is of great advantage to be able to control the preheater accurately.

There is no fuss or muss to clean up after the job is welded, nor is there any wasted time or fuel in cooling the job such as there is where coke or charcoal is utilized; the flame is cut off and the heat starts to fall almost immediately.

Advantage of Gas Preheater

Another advantage of the gas preheater is its wide range of adaptations. It may be arranged to heat one or several small jobs; or it may be arranged to heat a large job or any part or parts of a large job. This may be accomplished with a stationary preheater, or the welder may employ a small portable gas burner attached to a hose. Examples of both are shown in the illustrations accompanying this discussion.

In Fig. 1 is shown a simple but effective method of employing natural gas for preheating purposes. This is especially adapted to blacksmith shops or auto repair welding shops where it is possible to obtain natural or artificial fuel gas.

The preheater forms part of the welding table and is constructed by flattening several two-inch pipes and then sawing halfway through the curve on each side, at intervals of one to two inches along their length. The flattening is best accomplished by heating the pipes and hammering them with a sledge. The sawing is done after the pipes are flattened. This picture shows the sawed gas-outlets quite clearly.

Each Gas Burner Leads to Manifold

Each gas burner thus made leads to a manifold where it is opened or closed by an individual globe valve. One or more of these home-made burners may operate at one time.

The whole battery of burners occupies about half of the entire welding table. The other end is occupied by the thick cast iron leveling plate. A grating as shown in the picture is provided to cover the burner section.

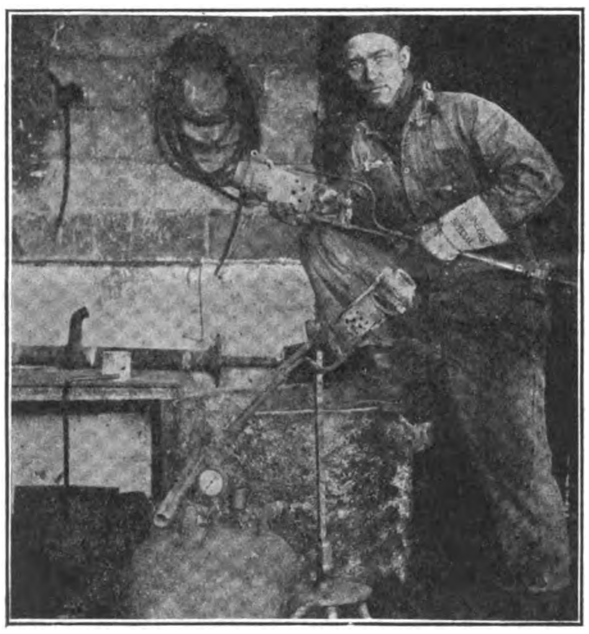


Fig. 3. An air pressure oil burner is a handy preheater for general purposes.

A table and gas-fired preheater like this one is readily made in any welding shop. It need not be patterned after the design shown in the cut but may be longer, or narrower, to suit the ideas of the individual torch operator. The legs are made of pieces of cast off wrought iron pipe. The top sections are of angle iron and flat iron bars welded together with the oxyacetylene flame.

Automobile and tractor jobs such as crank housings, cylinder blocks, cylinder heads, gears, brackets and traps, may be welded on this table without the troublesome arrangements usually required where coke or charcoal fires are employed. Where the job needs to be covered or banked for slow cooling, this feature is easily taken care of with asbestos paper by spreading it over the casting.

Preliminaries

Where the job requires to be aligned and spot welded, it is first leveled up on the plate and then moved over to the battery of gas burners to be preheated and welded. If it is essential to re-heat the job before the cooling process is started, it is only necessary to turn on more gas to increase the heat.

A preheater table like this does not demand this particular style of gas burner but may have incorporated a series of star or circular burners such as are used in gas stoves or ovens. The main idea is to arrange them so that a large or small amount of heat may be furnished as desired.

In Fig. 2 is shown the portable adaptation of the natural gas preheater. This consists of a common star burner attached to a hose and inserted beneath the grating of an oven-like device for preheating small articles like the air-cooled cylinder shown in the picture.

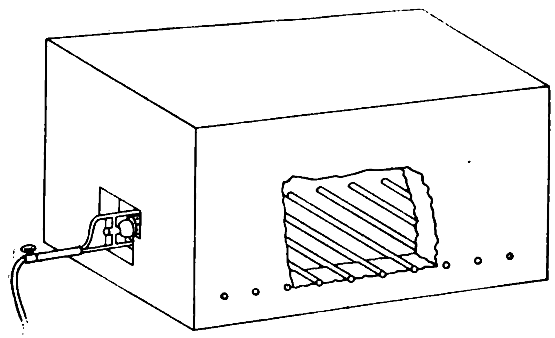


Fig. 4. Brick preheater oven.

The chief advantage of this apparatus lies in the fact that it may be employed with a minimum expense.

The job is placed on the grate; the gas is ignited; the oven placed over the casting, and the job permitted to heat to the required stage. The heat is all confined to the one job; none is wasted as is the case where a small casting is heated over a large burner. Of course it is obvious that no large tractor cylinder block or other castings of this nature can be preheated with so small an outfit, although any number of these single burners could be placed to heat a large job.

Another Type

Another form of preheater quite commonly used in many welding shops is illustrated in Fig. 3. This is one type of air-pressure kerosene burner, consisting of a heavy steel tank fitted with a pressure gauge and air pump, two lengths of hose and two generator burners. The whole of this completes an outfit with which the welder may heat a small job or a very large one just as easily.

One burner may be cut down to its lowest pressure for a small casting or both may be used full blast on a big job, or any of the graduations in between. The temperature may be graduated with a fair degree of accuracy in either case, which is a great saving in truly scientific welding.

This type of preheater is often used in heating large jobs where it is necessary to heat only a comparatively small section of the work, where it is essential to preheat to take care of expansion, or where it is better to heat to facilitate the melting. The flame of the generator-burner is directed against the spot where the heat is needed without waste or unneeded discomfort to the torch operator.

It will burn kerosene, distillate, or other fuel oils with no requirements except that the pressure be maintained and oil supplied to the tank. A steady heat of the same temperature is achieved for hours at a time. This combined with portability, makes this a convenient preheater for outside work. This kind of preheater may be taken to jobs outside the shop just as readily as the welding tanks and torch.

Where the welder has access to natural gas for preheating or possesses an oil burner, it is sometimes better to combine either method with coke fire or charcoal for preheating extremely heavy castings. The coke fire is kindled and kept burning with the gas or oil flames. The operator is then fairly certain that the fire will not die out before the long heavy weld is completed, which is sometimes the case when using charcoal or coke for preheating.

The blacksmith may get along fairly well by using his forge as a preheater in combination with charcoal but the results are not always so certain and he must be careful about burning part of the job before the other part is ready for welding. In any case he should have some sort of portable preheater for road work; something that will produce a steady heat of long duration in the event that he must do all of the work himself.

Nowdays many automobile and tractor jobs are heated and welded over an open fire such as the gas burners shown in Fig. 1, without any preparation for confining the heat, but the job must nearly always be covered up when cooling. When it is necessary to confine the heat the casting is covered with sheets of asbestos paper or sheet iron oven. Either of these may be employed when utilizing the oil burners.

A fire-brick oven may be built around the casting when the oil burners are utilized. The bricks are loosely laid without mortar and are used over again on any number of jobs.

In any event the welder must have some form of preheating system before he can succeed in a general welding repair business. He must remember that in its simplest form the theory of expansion and contraction is about as follows: The weld metal when deposited is fully expanded and will contract as it cools. If it is thoroughly knitted to the other metal when it cools it will pull apart or warp the other metal if that cannot give way to the pull of contraction. The idea, then, is to expand the other metal so it can follow the weld contraction inward when both cool.

WAS IT ONLY INSTINCT?

"THE following story from a Massachusetts paper, whose name we do not know, was sent us well vouched for:

"'Elmer West, who conducts a farm at Shaver Pond, near Grafton, ownes a pair of work-horses which he turns loose to pasture while he, West, goes on with his chores. The horses usually return before bedtime, and are locked in the stable over night. The animals have worked together for years, and are great friends.

"'One night recently one of the horses of the team returned without his mate, the mare. The horse made so much disturbance, snorting and pawing the ground, that Mr. West, who was busy with his chores, was diverted from his task.

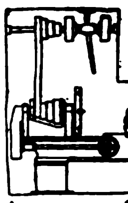
"'He put a bridle on the horse, and was then led by the animal across the pasture land to a swamp, where the mare was found mired to her haunches. West, with the aid of his farm hands, required six hours to dig the animal out.

"'The horse thus mired is twenty-seven years old. In spite of her age and harrowing experiences, she recovered rapidly, and was able to undertake the regular farm tasks on the succeeding day.'"—*Our Dumb Animals.*

Garden Gate of Wrought Iron

The Skilled Blacksmith Can Show His Expertness in Making this Gate

By Arthur W. Jordan.



THERE is shown in Figure 1 a wrought iron garden gate suitable for many positions and out of the run of the common type of thing. There is really nothing very elaborate about it but there is scope for some nice bits of forged work, such as a good craftsmith delights in.

The design lends itself to duplication so that it will do for a pair, or a single gate, as desired. It will be seen from Figure 1 that it is quite effective as a single gate while the view of it there given indicates also how well it would look in duplicate. It would then have a bold and striking outline and the parts not being too much cut up would not detract from it. As there is a fairly even combination of plain and worked portions there is a balance in the design that will help the general effect.

Size

The size of the single gate is five feet three inches high, by three feet nine inches over all, which it is believed will be found to be in suitable proportion. The size could be increased for a pair, if desired, by keeping the width a little over two-thirds of the height. up to say seven feet for the latter, or thereabouts. The sizes given for the iron in this article can be regarded as about right, for the gate proportioned to the smaller measurements mentioned above.

The gate in Figure 1 is shown hinged, but there is no reason why, in the case of a larger size especially, the bottom could not have a bearing pivot let into a stone, or an iron dowel fixed into concrete. If so, the main upright bar at that end could be carried down below where the horizontal bottom piece is fixed into it, the pivot being forged out of the vertical bar to a round section.

The sizes of iron may be modified somewhat even in gates of the same size according to the position they are to occupy and the work expected of them. For ordinary purposes, however, such a gate as that shown, of the height and width given, should have outer or frame bars of one and one-eighth inch by three-quarter inch. This gives sufficient boldness without heaviness. The bottom bars should be of the same size as the uprights. The two other horizontal bars may be of one and one-eighth by five-eighth inch which will be thick enough.

The Best Method

The best way to deal with these main uprights is to make them of one piece up to the point A in Figure 2 on the one hand, and to the forged taper join with the serpentine scroll on the other side, the iron of this vertical being bent and forged at the angle terminating the upright portion to the sharp deflecting point seen in Figure 1. It is as well to say here that on this short deflected portion depends the correctness of outline of the whole to a greater extent than on any other portion of the same size—small though it be—especially if there is to be a pair of gates. It is therefore well to take some pains here.

The top serpentine scroll which unites the ends of the two uprights should be of the same size of iron. Both joints afford an excellent chance for the smith to show what sort of a hand he is at fancy forging. The left hand one may be spread out to form a flat "cheese-head" union as shown in Figure 1, this being preferred by some, or more cut in as shown at A Figure 2 which gives scope for even finer outline. Probably the shape of the serpentine scroll is more important in the sweeps at the end than at any other point.

The small scrolls immediately under this are shown at the top of Figure 2 and sufficiently explain themselves. They, like other scrolls in the same illustration, are shown with ends forged to a taper. This, of course, is a counsel of perfection, which can only be followed in every case, if the price includes such work. The iron for these may be one and one-eighth inches wide if desired to match the enclosing portions, but there is no reason why these scrolls chould not be recessed a little on each face, and then three-quarter inch, by one-quarter inch would be about right. The play of shadow on them would be a sort of relief and would mark these scrolls out as more delicate than those elsewhere.

Where desired the center downward scroll in this group can be forged out, as shown at B Figure 2, and in enlarged section at C. This gives a little more life to the composition but it is a matter of price like the forged ends. Again all joints are shown as welded. In every case this is possible if only the customer is sufficiently educated to know good work, and rich enough to afford it. Of course, it makes for strength and where this is absolutely necessary, one can scarcely afford to take the strap or rivet in its place.

The S scrolls below should be of one and one-eighth inch by one-half inch. As shown at D Figure 2 they require nothing more than proper bending to shape and tapering at the ends, which in the case of these scrolls is quite imperative. These ends catch the eye at once, and the scrolls being heavy, need filing down at the extremities to make a presentable eye.

A Matter of Taste

The panel at the bottom of the gate is shown as one scroll, but that is a matter for the smith to please himself about in the making. Really there need be no welding together of parts in this case. The whole could be formed of separate parts strapped, riveted, or screwed together at points which suggest themselves to any practical man very readily. Such treatment is better, to the writer's mind, than welding and filing up to look like one piece with a regularity and uniformity that makes the whole indistinguishable from a cast pattern, a thing always to be avoided.

Fig. 1. View of Gate in Position

Whether a design is treated in one way or the other, the file should never be used to obliterate hammer marks. The smith's work should proclaim itself throughout, and the smith's chief tool is the hammer; it should be so used that he is never ashamed of the evidence of it at any time. However, a nice smooth face effect obtained with the hammer is proof of good workmanship wherever found.

In Figure 2 it will be noticed that an alternate treatment is shown for the centre part of the principal scroll. Now while this will look quite well in the square, there is a superior way of treating it. This is shown in line elevation below the full scroll with sections blacked in at E. To make these clearer an enlarged section is shown at F of the point G if this alternate treatment were adopted.

There it will be seen that the top scroll is formed of a flat capping piece and a thicker bar resting on the small under scroll. When formed in this way such a scroll is very effective and shows off among the square and more regular shapes of iron to advantage. Again it is a matter of price. Where this is not much of an object, this scroll could be treated in a yet more expensive way and made from one piece of metal; the underside could be fullered out to a taper from a top square, or rounded edge as preferred—scope for a charming piece of work such as many smiths take the greatest pride in doing.

However, supposing the section is to be at F, the top piece should be of one and one-eighth inch by three-sixteenth inch and the under bar should be three-quarter inch by one-half inch, the latter being the thickness

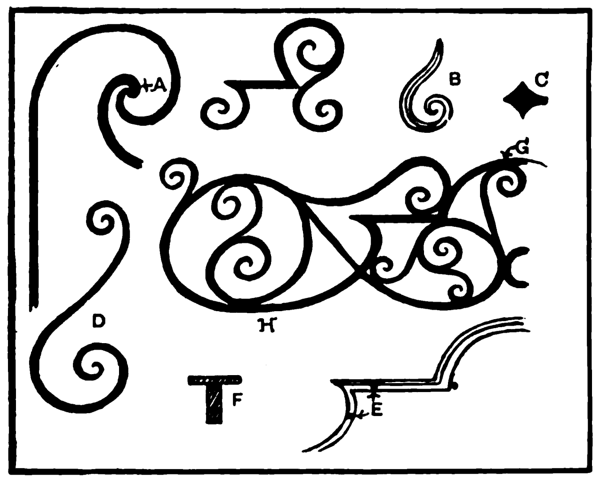


Fig. 2. Details and suggestions

and the former the depth. Some nice forging is called for in this scroll, first at the point near E and then down below to bring the section to a five-eighth inch square near H and be welded on to the remainder of the scroll which could terminate in the circle above, or on the flat bar near the centre of the panel, whichever may be preferred. For this five-eighth inch square may be retained throughout. This allows for a little recessing from each face and emphasizes the subordinate position of the panel with good effect.

The centre scrolls should be of the same thickness as the scroll immediately above whatever treatment may be adopted for this. If the section at F be adopted, then it will be one-half inch square, but providing a plain scroll is used five-eighths of an inch should be the dimension, and this may be the size for the entire panel. If the section at F is preferred, then these under scrolls must be "jumped up" and forged to a five-eighth inch thickness to fit in between the other scrolls of that size at the point of joining. Before crossing the main scroll it should have been tapered to its proper one-half inch square section again making the change barely perceptible.

PREMEDITATED

"Really," gasped the automobilist, bending over his victim, "really, I didn't hit you intentionally."

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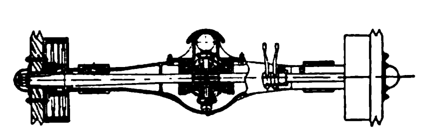
National Worm Drive Axle

We illustrate herewith the National Worm Drive Axle which is made by the National Axle Co., of Benton Harbor, Michigan, with sales office at 140 S. Dearborn St., Chicago, Ill.



The driving shafts in this axle are drop forgings of alloy steel, heat treated and ground to proportion aiming at a uniform stress throughout. The housing is of one piece, machine molded and said to be free from blow holes and shrinkage cracks.

The worm and worm wheel are accurately fitted by a special machine which makes them interchangeable with new ones. The worm is of alloy steel while the worm wheel is of alloy steel-bronzed.

The differential is of the four-pinion type with drop forged gears and spiders. Timken Roller bearings are used throughout. Each axle is equipped with two pairs of internal expanding brakes.

National axles may be had in a number of gear ratios to suit the size of truck they are to be used upon.

Vanderpool 1922 Five Cavity Vulcanizer

This sectional view illustrates the patented improved Vanderpool Springs on the Vanderpool 1922 five cavity vulcanizer.

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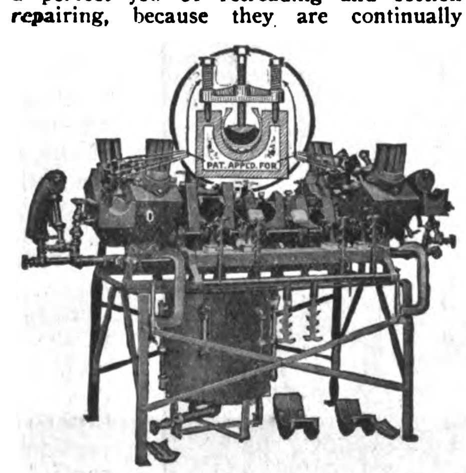
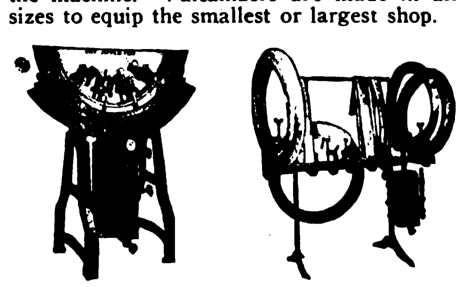


forcing the rubber into the molds as fast as it softens, automatically giving the proper pressure. This is claimed to be much better than the uncertain and time-wasting method of continually tightening bolts.

Sand and air bags are used in section molds and sand bags in retread molds with Vanderpool patent springs that compress 4000 pound in the section molds and 8000 pounds in the retread molds. This constant and even pressure not only guarantees the best possible work but also permits the use of sand bags on most jobs which is quite a saving over air-bags and will in time pay for the machine itself.

Nine tires and five tubes can be repaired and retreaded at one time, which easily explains the financial success of its many users.

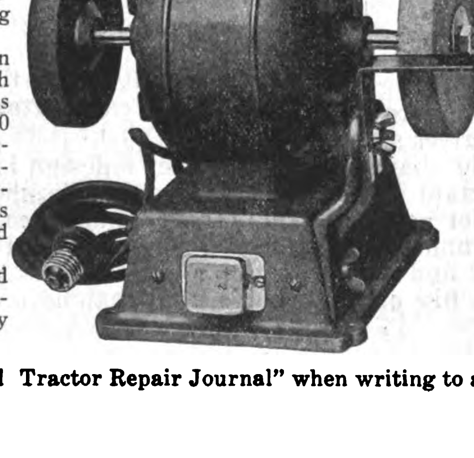
Another practical feature that appeals to tire repairmen is the speed with which steam can be gotten up for a quick job. Steam can be shut off of all or any parts of the machine. Vulcanizers are made in all sizes to equip the smallest or largest shop.



The Vanderpool Company have been making Vulcanizers since 1912 and will send to anyone interested, an illustrated instruction book. Address Vanderpool Vulcanizer Co., Department A—4 E., Springfield, Ohio.

Luther Electric Bench Grinder

We illustrate herewith the Luther electric bench grinder manufactured by the Luther Grinder Mfg. Company. There are a number of features about this grinder which make it worthy of attention. It is suitable for use in small shops for sharpening and polishing tools. The specifications are as follows: ¼ h. p. single phase motor 110 volts, 60 cycles, 1750 r. p. m.



Complete information relative to t grinder and the other grinders which th manufacture may be obtained by writi to the manufacturers. Their claim is th "there is a Luther grinder for eve sharpening purpose," and that they ar th "oldest and largest makers of tool gr ers in the world." Write to Dept. R, Lut Grinder Mfg. Co., Milwaukee, Wis.

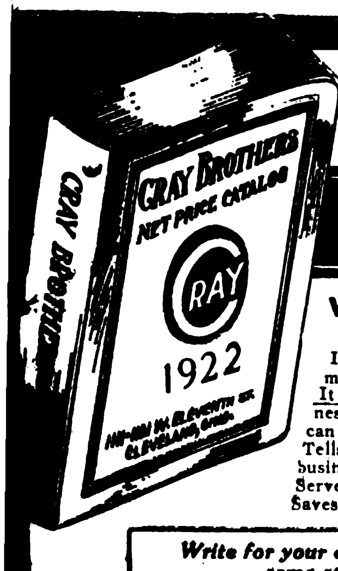
The Springfield Circle Cutter

In every garage or repairshop a ci cutting machine is a very useful tool a we illustrate herewith the Springfield Ci Cutter No. 2 which is manufactured by T Shawver Company of Springfield, O This tool is extremely handy for cutt lamp glass, soft sheet copper and rub

gaskets, felt and fiber washers, etc. It l a capacity for cutting any size of circle to 14 inches. This machine may be mou ed on an ordinary table or work bench ha ing a smooth, level surface. An adjusta clamping arrangement is provided that w securely hold the work in place during process of cutting. A positive measuri scale accurately determines the size of openings. This scale is graduated in fr tions of ⅛ inch.

The Tool Carrier is so arranged t many different kinds of tools may be us such as tools for engraving, marking, so ing, embossing, etc. A sheet of heavy ca board or plate glass may be used un the work as a cutting foundation.

All cutting attachments are the same on oval cutters which can also be furnis by the same company. The weight of circular cutting machine is 30 pou shipped. Readers who are interested sho write for particulars and prices direct The Shawver Company, Springfield, O and mention this magazine.



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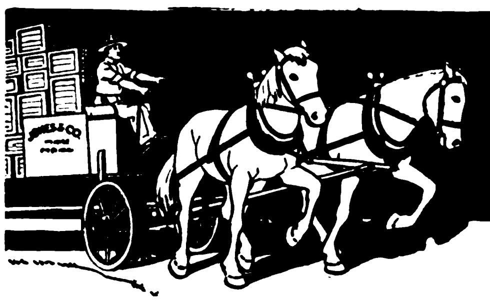

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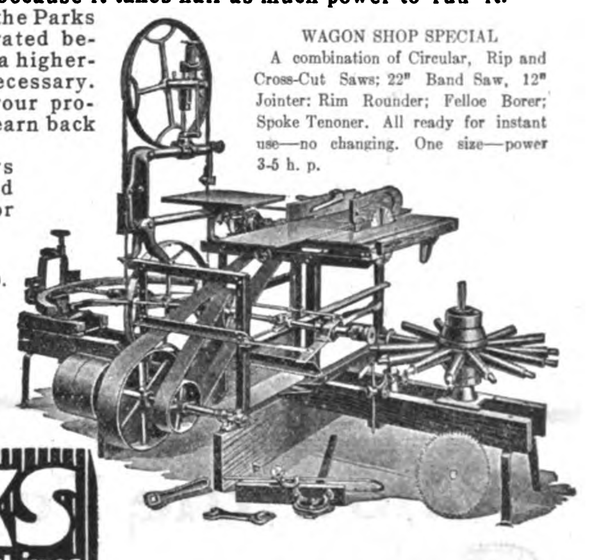

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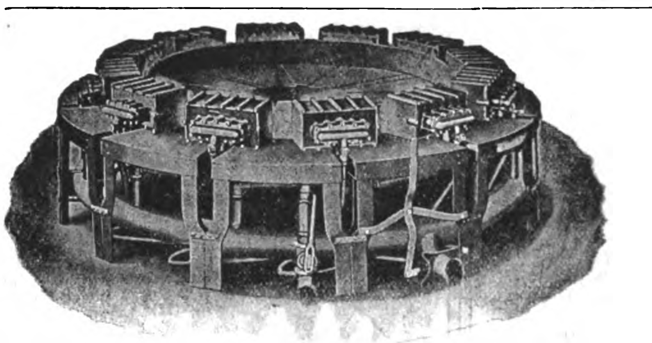

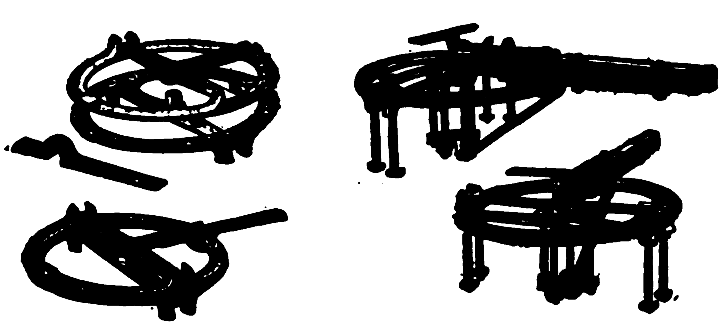

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County of New York,
State of New York. ss.:

Before me a notary public in and for the State and county aforesaid, personally appeared Frank L. Avery, who having been duly sworn according to law, deposes and says that he is the business manager of The Blacksmith and Wheelwright and Tractor Repair Journal, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, M. T. Richardosn Company, 16-22 Hudson Street, New York City, N. Y.; Editor, M. T. Richardson, 16-22 Hudson Street, New York City, N. Y.; Managing Editor, F. L. Avery, 16-22 Hudson Street, New York City, N. Y.; Business Manager, M. T. Richardson, 16-22 Hudson Street, New York City, N. Y., and F. R. Whitten, 41 Pinehurst Avenue, New York City, N. Y.

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F. L. AVERY, Managing Editor.

Sworn to and subscribed before me this 17th day of March, 1922.

(Seal) ROBERT R. W. SCHMIDT, Notary Public.
(My commission expires March 30, 1922.)

BLACKSMITH AND WHEELWRIGHT
and TRACTOR REPAIR JOURNAL

Vol. LXXXV. No. 6 JUNE, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

Various Systems for Determining Hardness of Steel

By J. F. SPRINGER

Shore goes at the matter differently. He drops a little weight that is provided with a point underneath that is not too sharp. The weight is dropped a standard drop of a few inches. Consequently, it hits the metal with the same force, however hard or soft the sample may be. It rebounds from the impact. The rebound will fall short of the drop. But the higher the rebound, the harder the steel is said to be. Shore provides a scale and one can use numbers to indicate how high on the scale the rebound is.

Both systems have come into use—one is slow and uses a blunt ball; the other is quick and uses a sharper point. In the one case, it is rather the resistance to a steady pressure that is measured; while in the other the thing that is measured seems to be largely the elasticity of the sample.

Systems in Use

At any rate, whether you and I agree with these systems or not, they have come into general use. We may speak of the Brinell hardness of a piece of steel and give the Brinell number. Or, we may speak of the Shore hardness and give the Shore number. The two numbers will generally be different. I am not aware that any one has worked out a successful rule by which one number can be made to produce the other. In other words, the two numbers probably mean different things—different descriptions of hardness, I suppose.

However, in either system, as long as we do not compare different kinds of metals (as silver and steel) and do confine ourselves strictly to one metal, the numbers are generally to be regarded as reliable indications of "hardness." That is the higher the number, the "harder" the steel. But three times as big a number is not to be taken as indicative of a steel three times as hard.

The file is a rough, but ready, way to test the hardness of steel. This is, in fact, the scratch method, as we use the file to scratch or cut the steel. We could doubtless get, with practice, a pretty good working idea of the hardness of steel by observing closely the readiness with which the file takes hold.

Carbon Produces Hardness

Now, whatever method you use to determine the hardness, remember that carbon is the principal thing that produces it. Pure iron is not especially hard. I do not mean it is soft like lead. It is harder than lead, but it nevertheless has no great degree of hardness. But steel, annealed steel, containing a good deal of carbon is much harder. Carbon makes the steel harder and stronger. There is, however, a striking difference. The two go along together, the strength increasing steadily, and the hardness increasing steadily as carbon is added. The two go along steadily increasing until the steel begins to be a tool steel—that is, until the steel has a carbon content of 0.90 per cent—and then a distinct difference appears. The strength goes on increasing, but it adopts a slower rate. The hardness keeps right along at the old rate.

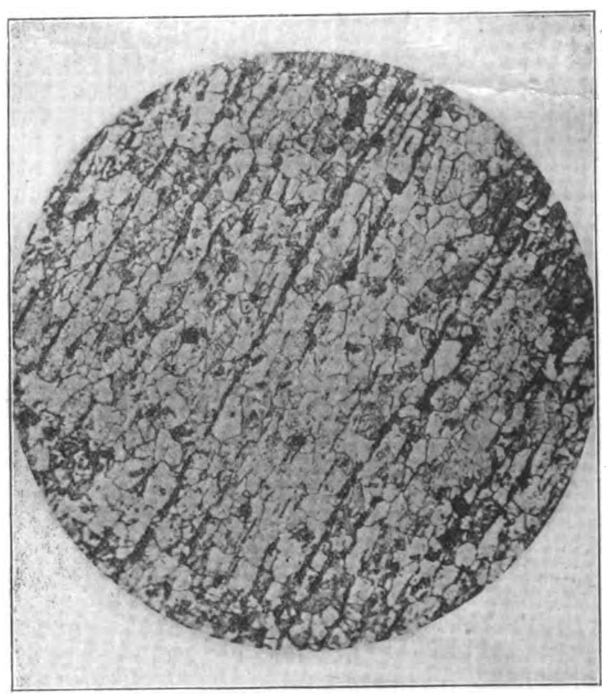
This condition of affairs continues until a pretty hard and strong tool steel is reached—that is, until the steel contains 1.20 per cent of carbon. The two have been increasing from the start—hardness and strength—but the strength changed the rate and the hardness made no change.

Now, at this point—that is, at the point where the carbon percentage is 1.20—a very curious thing occurs. The strength starts in to fall and it continues steadily to do so as the carbon percentage is increased. But the hardness never wavers. It keeps right along, steadily increasing, as more and more carbon is added.

Wrought Iron

It is perhaps right to say that the steadiness of the hardness increase depends more or less upon normal opinion. In the text I have followed the diagram given by Bradley Stoughton, p 325, *Metallurgy of Iron and Steel* (1908).

We have learned in what has preceded that the ordinary steel, which is in a normal—or, annealed—condition, consists of a mixture of two different things. One of these is cementite, and the other is ferrite. It is with regard to ferrite that I now propose to write. But before doing so, let me say a word as to cementite. Then the reader will, perhaps, be better prepared to consider ferrite.



Wrought Iron 100 diameters

Cementite is a chemical combination of two elementary substances, iron and carbon. That is, it is iron carbide. The chemists have a formula for this combination. It is

$$Fe_3C$$

Let us not be alarmed at this. It only means that there must be 3 atoms of iron (Fe) associated with one of carbon (C). However, as an atom of iron is to be regarded as having a weight of 56 and an atom or carbon a weight of 12, we gather that the three atoms of iron will weigh three times 56 and the one atom of carbon will weigh 12. Thus we get

$$Fe_3 = 168$$
$$C = 12$$

So that, Fe_3C will weigh 180. We can now get something useful. The iron in cementite will weigh 168/180 of the whole weight; and the carbon will weigh 12/180 of the whole weight of cementite. This means that in any lump of cementite, the iron amounts to 168/180 of the whole lump—that is, 14/15 of the whole. The carbon will weigh 12/180 of the whole lump—that is, 1/15 of the whole.

This cementite then consists mostly of iron, and only 1/15 is carbon. Nevertheless, this small amount of carbon changes the character of the iron and makes it much harder.

For example, suppose we have a 15 pound lump of white iron. This is cementite, because white iron is cementite. Of this 15 pound lump, 14 pounds consist of simple iron—that is, ferrite. The remainder, 1 pound, is carbon. The 14 pounds of simple iron and the 1 pound of carbon when combined together give us white iron—that is, cementite.

Cementite is hard. Try your file on a piece of white iron and see. And this cementite is what gives hardness to normal steel. In general, the more cementite, the harder the steel. We may speak, if we like, of the cementite as made up of ferrite and of carbon. While this is the case, we are not to think of cementite as a mixture of these two, but as something more than a mixture; just as water is not a simple mixture of the two gases, hydrogen and oxygen, although it is composed of them, and of nothing else.

Ferrite

Now let us go back to ferrite. Ordinary steel in its normal (annealed) condition, is made up of ferrite and cementite. The more ferrite there is, the softer the steel; and the more cementite, the harder the steel. This is a good broad rule. Now ferrite is nothing else than simple iron—wrought iron, if it is pure. Ferrite is comparatively soft. It may be beaten out into sheets, or drawn out into wire. In fact, it possesses these two qualities in a high degree. That is, ferrite, is very readily beaten into sheets and is very readily drawn into wire.

Now when a metal or other material may be beaten out into sheets, the technical people say it is *malleable*. And if it lends itself to the wiredrawing process, the technical people say it is *ductile*. Ferrite is both of these. In fact, ferrite is a good deal like copper. There is no trouble to roll either wrought iron or coper into sheets nor to draw either into wire. These qualities help to make wrought iron a suitable material for horse shoes and horse shoe nails. What is usually called Norway iron is a wrought iron that is very pure. It is good ferrite.

Horse Shoe Nail Consists of Ferrite

The horse shoe nail is soft. It should be, because it consists of ferrite. It lends itself to hammering, even in the cold state. This is true also because ferrite is the material of which it is made. It may be bent without breaking. That is, it is ductible, as ferrite should be.

Microphotography

Ferrite is, as we have found, the principal thing in steel. Even if we take the extreme case where the steel is really white iron, 14/15 of the whole consists of ferrite. For steels containing less cementite, the amount of ferrite is greater. In fact, as we make the steel have less and less cementite, we make it have more and more ferrite. When we get down to the point where there is no cementite at all, then the whole consists of ferrite. This is the case with wrought iron.

Ferrite, or wrought iron, is not especially strong. It will withstand a pull of, say, 40,000 pounds per square inch. That is, a bar, square in section, of one inch size will sustain a weight of 40,000 pounds. But, instead of a bar of this size, it may be only a wire which holds the weight. This wire may be no bigger than ¼ inch in diameter.

This wire, if cut across, will show a circular section. The area of the circle is 0.05 of a square inch. Consequently, with a wrought iron wire ¼ inch in diameter, we should not expect to hold up more than this area indicates. For a full square inch, the load may be 40,000 pounds. But this circle is only 0.05 of a square inch. Consequently, the permissible load may be no more than what the following calculation shows.

$$\begin{array}{r} 40{,}000 \text{ pounds} \\ \times \quad 0.05 \\ \hline 2000.00 \text{ pounds} \end{array}$$

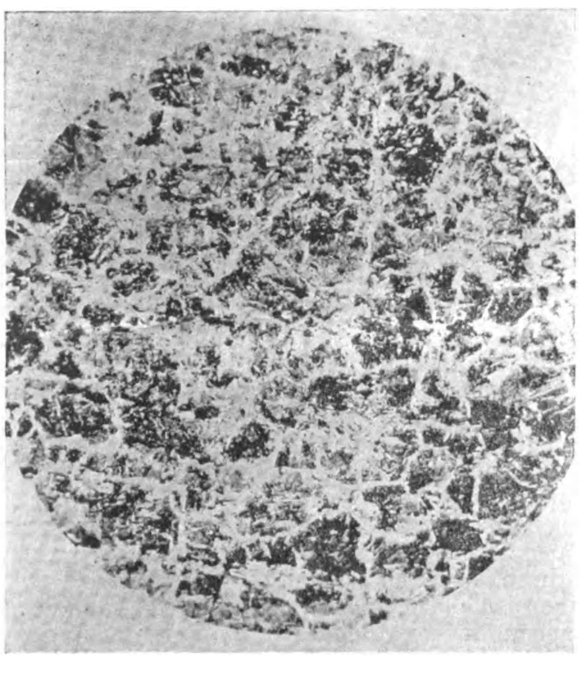
That is, the ¼ inch wire should be strong enough to sustain 2000 pounds, but no more. This does not mean that the wire is made of weaker material than the 1 inch bar; but only that, being smaller, its load is also naturally smaller.

Wrought iron, or ferrite, is accordingly not wonderfully strong. Compared with steel containing 0.50 per cent of carbon, it is not at all strong.

Nor is ferrite hard. It is comparatively soft—something like copper.

Consequently, when we want a hard and very strong material, we turn from ferrite and go to steel.

But, if we want a pliant material rather than a hard or very strong one, we can get it in ferrite. Not only is wrought iron much used in manufacturing horse shoes and horse shoe nails, but it is frequently used in making steam boilers, apparently for the very reason that it is ductile.



Steel, hot worked magnified 50 diameters. Tool steel of 1.30 per cent carbon.

Now the fact that ferrite is soft and cementite is hard may be taken advantage of when we desire to distinguish the one material from the other *underneath the microscope.*

For example, suppose I smooth off a piece of steel that I propose to put under the microscope with the purpose of noticing how things are with respect to the cementite and the ferrite. If I do nothing more than file off the surface, I will probably not be able to tell the one material from the other. But, if I follow up the file and polish the surface in the following way, I may expect better results. That is, I polish the steel surface on a piece of rough parchment that has been made damp. The rubbing back and forth exercises a wearing action in the steel—that is, on the ferrite and the cementite.

Now the fact that the one is soft and the other hard leads to a difference in the wear produced by the polishing action. The soft ferrite wears faster than the hard cementite. That is, wherever the ferrite is, there will be valleys; and wherever the cementite is, there will be mountains. Instead of using the damp, rough parchment, we may employ chamois skin. A piece of this material is to be stretched over a block or stick of wood. The wooden surface is to be flat, and the chamois skin is stretched over this, and may be tacked in place on the sides of the piece of wood. Some considerable amount of rubbing may be expected, because we have to wear down the resistance set up by the ferrite. Still another procedure may be used. It requires a piece of parchment (not specified as "rough") to be stretched over a piece of soft wood. Notice that the wood is to be soft. Then one obtains from the druggist or from some other source a small amount of ammonium nitrate. One must find out what the strength is, as what will be wanted is a 2-per cent solution. With a little of this 2-per cent solution, one dampens the parchment.

When the steel surface, that has been thoroughly treated by one of the foregoing methods, is rinsed off and put under the microscope, the ferrite and the cementite will appear different, because the light will be reflected to the eye differently from the valleys than from the mountains.

There is another way of getting at this matter. Instead of relying principally upon rubbing, one may resort to chemicals. Thus. if we put an acid to work that will affect the ferrite differently from the cementite, we may get what we want. Now, it has been found that nitric acid is suitable for the purpose. The acid is not to be used in a strong condition, but in a weak one. A 2-per cent solution is what has been recommended.

When this dilute acid gets to work on the steel surface, it eats away at the ferrite and leaves the cementite comparatively or altogether alone. Evidently, the acid regards the cementite as a tough proposition. The result of this difference in action, however, gives us what we want—the ferrite eaten down and the cementite standing unaffected. Instead of the dilute nitric acid, one may use the ordinary tincture of iodine. After using either of these chemicals, the steel will appear as follows under the microscope.

"The ferrite is seen in darker grains and the carbide (cementite) in bright thin plates." "When the two (ferrite and cementite) are intimately associated in minute grains, as in pearlite, the carbide (cementite) appears bright and the ferrite dark, because eaten away below the surface by the reagent.

It may be gathered, from what has now been set forth, that if we can by rubbing or otherwise dig out the ferrite and leave the cementite, we shall get a surface under the microscope which will consist of bright and dark places. The bright places will represent cementite, because this material is standing up in the light. The dark places will represent ferrite, because at these spots the soft ferrite has been rubbed or eaten away and nothing but dark valleys remain.

This is the normal result. There may, of course, be exceptions, where some other thing has entered the game.

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"WALT, you surely get my goat," drawled Mort Buxton as he slid out of his coat and put on his apron. "When you took hold here six months ago, I sure thought you would 'go broke' right away. But I'll be darned if you aren't picking up blacksmithing and the shop is making money right now. It beats me how a greenhorn in the business could do it."

"I'll tell you just how it is," said Walter Langley, "I picked a mighty good teacher to begin with and I followed his instructions and advice as well as I could."

Walter had seen a wagon load of broken shovels in a contractor's yard about a month before this conversation took place. He had also seen a machine shop worker using the oxy-acetylene welding torch and Walt at once made up his mind to have a welding outfit of his own, the same as that used in the machine shop.

He bought an outfit as well as the wagon load of defunct shovels and had them hauled to his blacksmith shop. The welding outfit consisted of torch, gages, etc., together with the usual number of torch tips or nozzles but Walt had included a cutting torch with the other instruments as he very much admired the way in which the jet of oxygen would cut its way faster than a saw through soft steel even of considerable thickness.

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The welding outfit finally arrived and Walter took to it like the proverbial duck to water. He first got out the cutting torch and learned to use that instrument. It took but little time to get the hang of it and in a few hours Walter was able to cut thin steel with the cutting torch as well as he could cut thin paper with a knife.

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Neither Walt nor Mr. Buxton tried to weld cast iron.

Repairing the Shovels

Fig. 1 gives an idea of the appearance of such shovels as Walt had purchased. The point of the shovels had been worn off, in fact it had worn down as thin as paper and then had crumpled up as soon as it hit a stone. One of the straps, the upper one, had been broken off at the first rivet hole and the lower strap is shown badly bent.

The bent straps were easily straightened on the horn of the anvil; the broken off strap was repaired by welding on another piece of metal probably another or perhaps the same strap which had been broken from this shovel.

Repairing the Shovel Point

In repairing this shovel, Walter first used the cutting torch and drew it along the point of the shovel as shown by the double dotted line. But before using the cutting torch Walter placed a piece of old shovel plate underneath the broken shovel as shown; then, when the cutting torch was used, it cut into and through both pieces of the shovel plate in such a manner that the one would fit snugly into the other.

Walter fitted up several shovels in this manner then passed them over to Mr. Buxton who made a nice smooth weld where the double dotted line is shown. After that weld had been made Walter used the cutting torch again for trimming off the piece of old shovel so as to leave a nice smooth new end on the shovel. After several shovels had thus been repaired they were taken to a grinding wheel and the new ends smoothed up and the weld along the double dotted line smoothed down flush with the shovel blade.

Walter used about the same method when repairing the broken off strap. When an old strap was available it was placed in position

the rivet holes came opposite each Then the cutting torch was used to oth the old and the new strap pieces, 'ere then welded in about the same as described for the shovel point. to hold the new strap piece in exact Walter placed an old shovel handle on between the straps and pushed a f wire nails through the rivet holes straps and the handle. The old cept the straps in perfect alignment e weld was being made. To prevent ning of the wooden handle two or hicknesses of asbestos paper were between the strap and handle during ding operation.

A Shovel-Strap Jig

Walter found it profitable to forge a black steel to the shape of a shovel and to use the forged bit of steel in an old handle, as a jig upon which to he shovel straps during the welding on.

times Walter found a shovel with and point in good condition but with le split or more or less broken at the n of blade and strap. When such a was found, the blade and strap were red into shape, provided they had been or otherwise distorted. Then the ras welded solid.

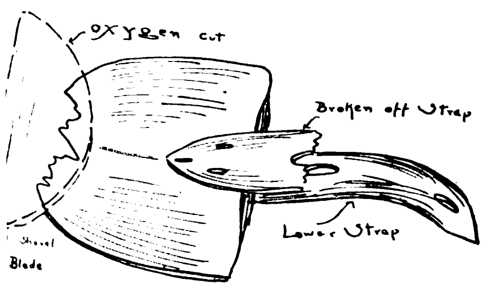
engraving shows that the shovel blade le at its end next to the strap for a pace on either side of both straps. shovels are forged double and others double by riveting on a wide lower In either case Walter found it nec- to fit a three cornered wedge into the on either side of the wooden handle, point where it entered the shovel point. ok Walter and Mr. Buxton a surpris- short time to repair a dozen shovels, when completed, looked as good as d Walter was able to sell these shovels ntractor at a very slight discount be- e price of new shovels.

ter says that as soon as he becomes amiliar with oxy-acetyline welding he g to try his hand at welding pitch-fork nd steel rake teeth and perhaps after e try welding automobile and wagon s.

owing Down the Fan Motor

day Walter found it necessary to run wer at quite a slow speed, even slower he lowest speed obtained by the rheo-

Buxton started to rig a crank on the shaft so as to turn the blower by hand. studying the matter of speed, Walter



Repairing a Shovel Blade

the crank of no use and brought in a tub the same as is often used to hold and lard. In the bottom of this tub ed an old casting after having a piece y insulating wire secured therein, it tened by slipping the wire into a hole casting and driving a metal plug into e beside the wire end. Another cast- found which would go easily into and then another wire made fast to e manner. Then a cord was attached a way that the casting was suspended cord, lying flat and level in the bucket touching the lower casting.

cord was run over an overhead pulley ught down within reach and securely d. Then the bucket was filled with nd a double handful of table salt into it and stirred up.

er then cut open one side of the circuit leading to the forge blower and twisted the cut wire around the wires leading to the castings in the bucket. This finished, he threw the switch to start the motor but found it would not move, so he stirred the salt and water in the bucket a bit more, loosened the cord and lowered the upper casting until the castings nearly touched each other. Then he found the motor would run but the speed was still too high when the rheostat lever was in the slowest notch. Walter left the rheostat lever in the low notch and pulled on the cord a little, raising the upper casting slightly.

The further up it was, the slower the motor ran until in a few seconds he had placed the upper casting at the required height and the motor ran at the required speed. Walter found this contrivance very handy in many cases but he also found that it had the disadvantage of wasting a lot of current. In fact as much current passed through the water rheostat as would be required to drive the motor at full speed.

Painting the Shop Interior

Walter soon found that the work could be done quicker and better in a light shop than in a dark one. He started to paint the interior of the shop with white lead and oil, but he found it very much too expensive, so he only painted a portion of the wood work.

Then he experimented with whitewash and even borrowed a whitewash machine and found the whitewash worked fairly well but that it seemed more pleasing when tinted to a light slate color.

Walter was about to mix a little lamp-black with water and stir enough of it into the whitewash barrel to make the white the desired color, when he was told by a friend that paint or whitewash tinted or colored with lamp-black would absorb a large portion of light instead of reflecting it as was desired. This friend also advised Walter to use instead of lamp-black some dry vermilion red and some very dark green powder, mixing a small quantity of each in a little water until the lumps were entirely worked out.

Walter found that when he tinted or colored the whitewash with the combined red and green colors that it gave a very "warm" tone to the surface covered with that whitewash and was surprised, for he found that it reflected light better and made things far lighter in the shop than was possible when the whitewash was tinted with lamp-black.

AN AGING HORSE

MARY M. FANNING

He was hitched to a salvage cart,
He was patient and gentle and slow,
But his slender legs and narrow flank
Spoke of a different while-ago.

He was gathering up second-hand things
For an army of humble men,
But his graceful neck and delicate ears
Told of a different now from then.

He was drawing his load with tail hung limp
And his ears pressed close to his head,
For this was a different kind of work
From that to which he was bred.

Did this horse passè remember the track
And the shout as he crossed the line?
Was he once the pet of the equestrienne,
Or the prancing delight of a turn-out fine?

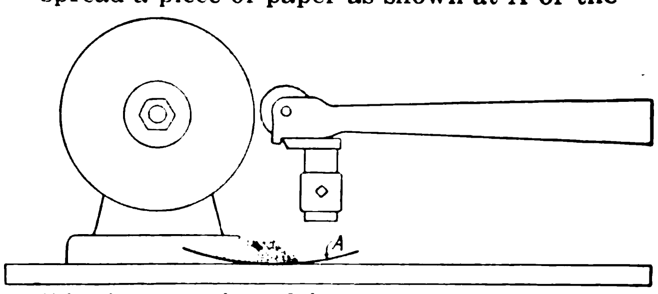
He is fallen now from his high degree
To a station both hard and low;
And with waning strength he suffers the pain
That only an aging horse can know.

I shudder to picture the next step down,
And pray that some kindly fate
May gather him into those unknown realms
Which those of his kind await.

—*Our Dumb Animals*

HOME MADE VALVE GRINDING COMPOUND

SUPPOSE you found that the valve gringing compound was all gone and it happened that the other places were out too—what could you do? Just this. Go to your emery grinder and first clean it off nicely. Then spread a piece of paper as shown at A or the



lid of a pasteboard box under the working side of the wheel. Next, with an emery wheel dresser, give the wheel a few applications, which will deposit a supply of clean, clear emery in your receptacle. Mix this emery with a little gear grease and you have valve grinding compound par excellence.

The term "emery" in this case is meant to include the various manufactured abrasive wheels sold under different trade names. Every place that has an emery wheel should have a dresser (and should know how to use it). It may be of the simple type that costs less than a dollar. Emery wheels need sharpening just as any other cutting tools do and when they get lopsided they have to be trued up—hence the need of a dresser. It is a good plan when this sharpening is done to catch the loose emery and save at least a spoonful against the time when it may be needed for emergencies or odd grinding jobs.

FORD REAR AXLE LUBRICANT

ONE of the mistakes often made in the lubrication of the Ford rear axle, and in fact other axles of the same construction, is in the use of heavy grease for the purpose. The owner of an old car finds that the lubricant in the axle tends to leak out through the ends and gum up the brakes. Under such conditions he decides that a heavy grease will obviate the trouble.

Unfortunately the usage of heavy enough grease to prevent leakage will probably result in the damaging of the axle. The very fact that the grease leaks through the axle bearings shows that it is fulfilling its duty. All of the bearings must be lubricated and the openings to the bearings are small.

The holes into the differential housing where the differential pinions, spider and axle gears are located, are comparatively small and if the grease is too heavy it will tend to pack into lumps and will not find its way into the differential at all. With no lubrication the gears will soon be destroyed.

The best lubricant for Ford rear axles is a product called "non fluid oil" or "semi fluid grease." This lubricant i sa stringy product which appears to be soft and almost liquid but when lifted on a stick will not run but "string out." There are many graphite lubricants on the market which come in the same class with the non fluid oils, they are soft to the touch but will not run.

If such oils as we mention will persist in leaking through the bearings to the brake bands do not use heavy grease but install a set of felt washers and metal caps between the ends of the bearings and the wheel hub. Do not bore holes in the axle housing to allow the grease to escape for this is poor practice.

CHANGING THE BASIS

"Mr. Smith," a man asked his tailor, "how is it you have not called on me for my account?"

"Oh, I never ask a gentleman for money."

"Indeed! How, then, do you get on if he doesn't pay?"

"Why," replied the tailor, hesitating, "after a certain time I conclude he is not a gentleman and then I ask him."

—*Harper's Magazine.*

strong. It will withstand a pull of, say, 40,000 pounds per square inch. That is, a bar, square in section, of one inch size will sustain a weight of 40,000 pounds. But, instead of a bar of this size, it may be only a wire which holds the weight. This wire may be no bigger than 1/4 inch in diameter.

This wire, if cut across, will show a circular section. The area of the circle is 0.05 of a square inch. Consequently, with a wrought iron wire 1/4 inch in diameter, we should not expect to hold up more than this area indicates. For a full square inch, the load may be 40,000 pounds. But this circle is only 0.05 of a square inch. Consequently, the permissible load may be no more than what the following calculation shows.

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That is, the 1/4 inch wire should be strong enough to sustain 2000 pounds, but no more. This does not mean that the wire is made of weaker material than the 1 inch bar; but only that, being smaller, its load is also naturally smaller.

Wrought iron, or ferrite, is accordingly not wonderfully strong. Compared with steel containing 0.50 per cent of carbon, it is not at all strong.

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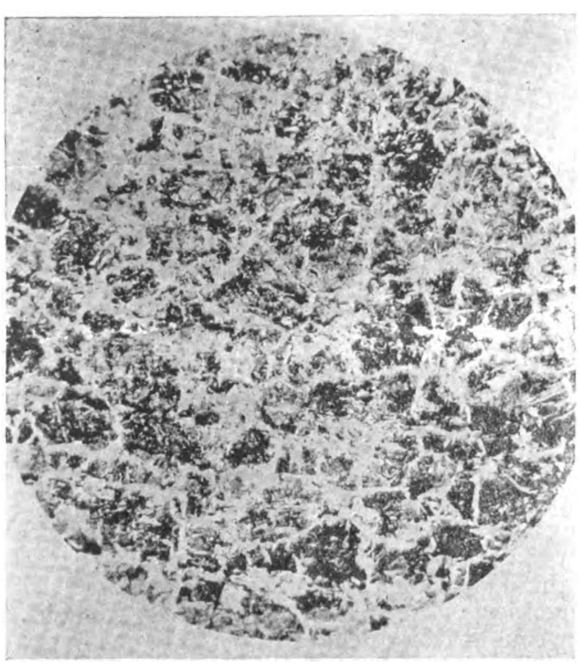
But, if we want a pliant material rather than a hard or very strong one, we can get it in ferrite. Not only is wrought iron much used in manufacturing horse shoes and horse shoe nails, but it is frequently used in making steam boilers, apparently for the very reason that it is ductile.



Steel, hot worked magnified 50 diameters. Tool steel of 1.30 per cent carbon.

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Now the fact that the one is soft and the other hard leads to a difference in the wear produced by the polishing action. The soft ferrite wears faster than the hard cementite. That is, wherever the ferrite is, there will be valleys; and wherever the cementite is, there will be mountains. Instead of using the damp, rough parchment, we may employ chamois skin. A piece of this material is to be stretched over a block or stick of wood. The wooden surface is to be flat, and the chamois skin is stretched over this, and may be tacked in place on the sides of the piece of wood. Some considerable amount of rubbing may be expected, because we have to wear down the resistance set up by the ferrite. Still another procedure may be used. It requires a piece of parchment (not specified as "rough") to be stretched over a piece of soft wood. Notice that the wood is to be soft. Then one obtains from the druggist or from some other source a small amount of ammonium nitrate. One must find out what the strength is, as what will be wanted is a 2-per cent solution. With a little of this 2-per cent solution, one dampens the parchment.

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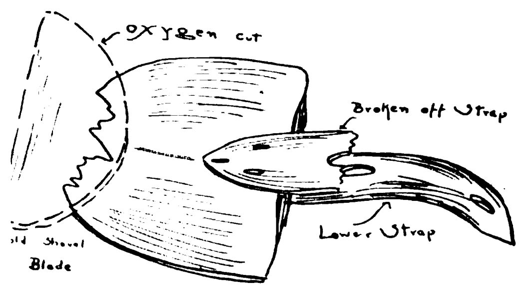

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But his graceful neck and delicate ears
Told of a different now from then.

He was drawing his load with tail hung limp
And his ears pressed close to his head,
For this was a different kind of work
From that to which he was bred.

Did this horse passè remember the track
And the shout as he crossed the line?
Was he once the pet of the equestrienne,
Or the prancing delight of a turn-out fine?

He is fallen now from his high degree
To a station both hard and low;
And with waning strength he suffers the pain
That only an aging horse can know.

I shudder to picture the next step down,
And pray that some kindly fate
May gather him into those unknown realms
Which those of his kind await.

—*Our Dumb Animals*

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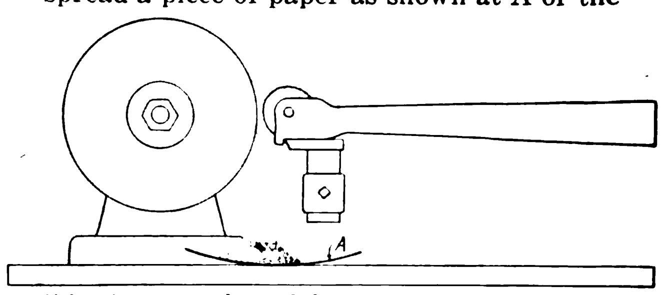

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CHANGING THE BASIS

"Mr. Smith," a man asked his tailor, "how is it you have not called on me for my account?"

"Oh, I never ask a gentleman for money."

"Indeed! How, then, do you get on if he doesn't pay?"

"Why," replied the tailor, hesitating, "after a certain time I conclude he is not a gentleman and then I ask him."

—*Harper's Magazine.*

strong. It will withstand a pull of, say, 40,000 pounds per square inch. That is, a bar, square in section, of one inch size will sustain a weight of 40,000 pounds. But, instead of a bar of this size, it may be only a wire which holds the weight. This wire may be no bigger than ¼ inch in diameter.

This wire, if cut across, will show a circular section. The area of the circle is 0.05 of a square inch. Consequently, with a wrought iron wire ¼ inch in diameter, we should not expect to hold up more than this area indicates. For a full square inch, the load may be 40,000 pounds. But this circle is only 0.05 of a square inch. Consequently, the permissible load may be no more than what the following calculation shows.

$$\begin{array}{r} 40{,}000 \text{ pounds} \\ \times \quad 0.05 \\ \hline 2000.00 \text{ pounds} \end{array}$$

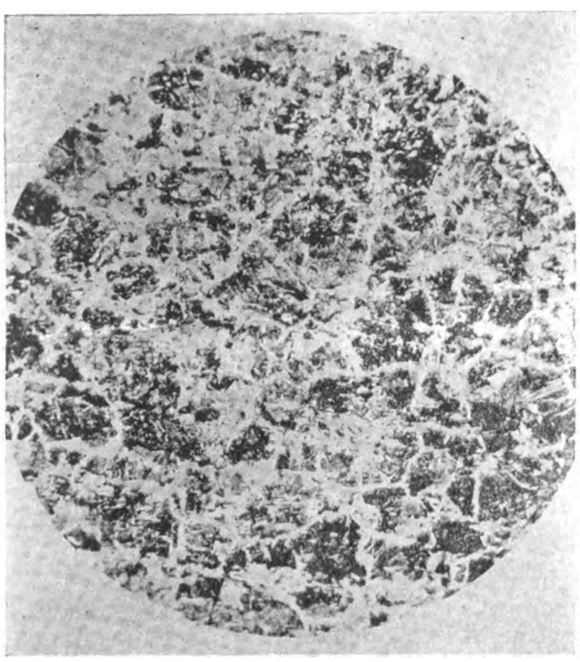
That is, the ¼ inch wire should be strong enough to sustain 2000 pounds, but no more. This does not mean that the wire is made of weaker material than the 1 inch bar; but only that, being smaller, its load is also naturally smaller.

Wrought iron, or ferrite, is accordingly not wonderfully strong. Compared with steel containing 0.50 per cent of carbon, it is not at all strong.

Nor is ferrite hard. It is comparatively soft—something like copper.

Consequently, when we want a hard and very strong material, we turn from ferrite and go to steel.

But, if we want a pliant material rather than a hard or very strong one, we can get it in ferrite. Not only is wrought iron much used in manufacturing horse shoes and horse shoe nails, but it is frequently used in making steam boilers, apparently for the very reason that it is ductile.



Steel, hot worked magnified 50 diameters. Tool steel of 1.30 per cent carbon.

Now the fact that ferrite is soft and cementite is hard may be taken advantage of when we desire to distinguish the one material from the other *underneath the microscope.*

For example, suppose I smooth off a piece of steel that I propose to put under the microscope with the purpose of noticing how things are with respect to the cementite and the ferrite. If I do nothing more than file off the surface, I will probably not be able to tell the one material from the other. But, if I follow up the file and polish the surface in the following way, I may expect better results. That is, I polish the steel surface on a piece of rough parchment that has been made damp. The rubbing back and forth exercises a wearing action in the steel—that is, on the ferrite and the cementite.

Now the fact that the one is soft and the other hard leads to a difference in the wear produced by the polishing action. The soft ferrite wears faster than the hard cementite. That is, wherever the ferrite is, there will be valleys; and wherever the cementite is, there will be mountains. Instead of using the damp, rough parchment, we may employ chamois skin. A piece of this material is to be stretched over a block or stick of wood. The wooden surface is to be flat, and the chamois skin is stretched over this, and may be tacked in place on the sides of the piece of wood. Some considerable amount of rubbing may be expected, because we have to wear down the resistance set up by the ferrite. Still another procedure may be used. It requires a piece of parchment (not specified as "rough") to be stretched over a piece of soft wood. Notice that the wood is to be soft. Then one obtains from the druggist or from some other source a small amount of ammonium nitrate. One must find out what the strength is, as what will be wanted is a 2-per cent solution. With a little of this 2-per cent solution, one dampens the parchment.

When the steel surface, that has been thoroughly treated by one of the foregoing methods, is rinsed off and put under the microscope, the ferrite and the cementite will appear different, because the light will be reflected to the eye differently from the valleys than from the mountains.

There is another way of getting at this matter. Instead of relying principally upon rubbing, one may resort to chemicals. Thus. if we put an acid to work that will affect the ferrite differently from the cementite, we may get what we want. Now, it has been found that nitric acid is suitable for the purpose. The acid is not to be used in a strong condition, but in a weak one. A 2-per cent solution is what has been recommended.

When this dilute acid gets to work on the steel surface, it eats away at the ferrite and leaves the cementite comparatively or altogether alone. Evidently, the acid regards the cementite as a tough proposition. The result of this difference in action, however, gives us what we want—the ferrite eaten down and the cementite standing unaffected. Instead of the dilute nitric acid, one may use the ordinary tincture of iodine. After using either of these chemicals, the steel will appear as follows under the microscope.

"The ferrite is seen in darker grains and the carbide (cementite) in bright thin plates." "When the two (ferrite and cementite) are intimately associated in minute grains, as in pearlite, the carbide (cementite) appears bright and the ferrite dark, because eaten away below the surface by the reagent.

It may be gathered, from what has now been set forth, that if we can by rubbing or otherwise dig out the ferrite and leave the cementite, we shall get a surface under the microscope which will consist of bright and dark places. The bright places will represent cementite, because this material is standing up in the light. The dark places will represent ferrite, because at these spots the soft ferrite has been rubbed or eaten away and nothing but dark valleys remain.

This is the normal result. There may, of course, be exceptions, where some other thing has entered the game.

A Young Blacksmith's Trouble

Walt's Study of Blacksmith Tactics Advances Rapidly

By JAMES F. HOBART

"WALT, you surely get my goat," drawled Mort Buxton as he slid out of his coat and put on his apron. "When you took hold here six months ago, I sure thought you would 'go broke' right away. But I'll be darned if you aren't picking up blacksmithing and the shop is making money right now. It beats me how a greenhorn in the business could do it."

"I'll tell you just how it is," said Walter Langley, "I picked a mighty good teacher to begin with and I followed his instructions and advice as well as I could."

Walter had seen a wagon load of broken shovels in a contractor's yard about a month before this conversation took place. He had also seen a machine shop worker using the oxy-acetylene welding torch and Walt at once made up his mind to have a welding outfit of his own, the same as that used in the machine shop.

He bought an outfit as well as the wagon load of defunct shovels and had them hauled to his blacksmith shop. The welding outfit consisted of torch, gages, etc., together with the usual number of torch tips or nozzles but Walt had included a cutting torch with the other instruments as he very much admired the way in which the jet of oxygen would cut its way faster than a saw through soft steel even of considerable thickness.

The Broken Shovels

"Good Night!" gasped Mr. Buxton as the car load of broken shovels were dumped into the shop door.

The welding outfit finally arrived and Walter took to it like the proverbial duck to water. He first got out the cutting torch and learned to use that instrument. It took but little time to get the hang of it and in a few hours Walter was able to cut thin steel with the cutting torch as well as he could cut thin paper with a knife.

Mort Buxton took great interest in both the cutting tool and the welding torch and like Walt, made such good use of his head and the welding torch, that very soon he could weld sheet steel quite nicely.

Neither Walt nor Mr. Buxton tried to weld cast iron.

Repairing the Shovels

Fig. 1 gives an idea of the appearance of such shovels as Walt had purchased. The point of the shovels had been worn off, in fact it had worn down as thin as paper and then had crumpled up as soon as it hit a stone. One of the straps, the upper one, had been broken off at the first rivet hole and the lower strap is shown badly bent.

The bent straps were easily straightened on the horn of the anvil; the broken off strap was repaired by welding on another piece of metal probably another or perhaps the same strap which had been broken from this shovel.

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In repairing this shovel, Walter first used the cutting torch and drew it along the point of the shovel as shown by the double dotted line. But before using the cutting torch Walter placed a piece of old shovel plate underneath the broken shovel as shown; then, when the cutting torch was used, it cut into and through both pieces of the shovel plate in such a manner that the one would fit snugly into the other.

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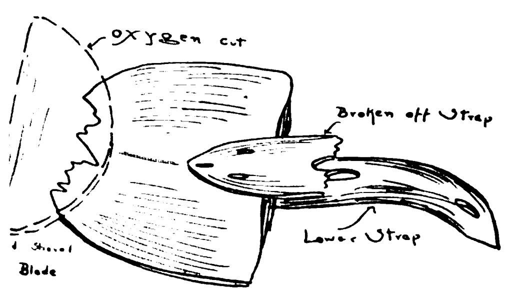

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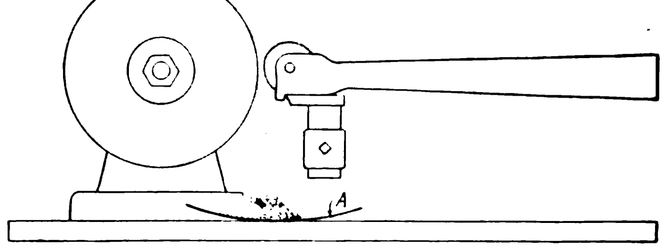

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Our Editor's Letter

I TOOK a trip up through New York State and into Massachusetts over the holiday and was impressed by the number of blacksmith shops which I saw. I had thought that the country blacksmith shop, in the east, was a thing of the past, probably because I had previously driven over the more frequented roads. But this time I went off the beaten highway and into the real country.

Although there were many smith shops there were but comparatively few horses and on nearly every large farm I passed there was the chug-chug of gasoline driven machinery. Tractors are fast becoming as essential to farming as automobiles are to pleasure hunting.

In talking with the blacksmiths I found that practically every one of them resented the idea of gasoline driven machinery. They fully realize that the gasoline engine is displacing the horse to a large extent, but are just as sure that the horse is necessary on the farm. But as soon as I could get them away from the argument as to whether the horse was coming or going I found out some valuable facts.

The average smith hates like sin to change his work—and I don't know as I blame him much, but most of us are obliged to do things at times which we do not like to do. But I found, when I had finally managed to get the men to talk a bit, that most of them were really yielding to pressure and getting away from "horse" work quite a bit.

I stopped for gasoline at one blacksmith shop and asked him how he found things; "Darn it all," he said, "you fellows keep me so busy selling gas and oil that I don't have time for my work." I noticed that his back yard was filled with wagons and farming implements and judged that he had all the work he needed. A little talk showed me that he had the right idea. In the Spring and early Summer he was kept working almost night and day, but later on the work fell off so that during the Fall and Winter he had many idle hours.

His idea was to concentrate on wagon jobs early in the season, get as much stuff as he could and get it out of the way. By having a gasoline and oil filing station he came in contact with automobile and truck owners and made many friends. As time went on, he expected to work up quite a business in automobile repair work for the late Fall and Winter.

You have no idea how many people you will meet if you establish a gasoline and oil filling station in front of your shop and if you give then quick service and a smile, (don't forget the smile), you may be able to get an overhauling or repair job from many of them for next Fall.

I had a long talk with one blacksmith, an old man with white hair who said he had worked at his trade for over fifty years. He was very bitter toward the gasoline engine and what it had done to deprive him of his regular work. But he said that last year he had decided to bury the hatchet and instead of fighting against Fate, fall into line and do truck and automobile work.

At first he tried to study and learn about gasoline machines, but as he said, "You cannot teach an old dog, like me new tricks." After lots of discouraging failures he finally realized that he could never learn to adjust carburetors, spark plugs, or fix up an electrical system and he quit the game, utterly discouraged.

And then one day there was an accident down the road, not far from his shop. A big, heavy truck bumped a nearly new Cadillac car and the latter machine came out of the wreck in much the same condition as a silk hat which has been sat upon. The owner lived in a nearby village and knew the smith so he asked the smith to tow the car to his shop and keep it until he could arrange to have it repaired.

The old blacksmith parked the Cadillac car in his barn and during the next week had plenty of time to look the car over. The beauty of the machinery captured him, the wonderful machine work and the elegance of the car so appealed to him that finally he hated to lose it.

And then, one day as he sat admiring it, he suddenly realized that here was just the kind of work he wanted, the kind of work that he had spent his life upon. He didn't know anything about ignition or carburetion but he did know how to straighten out the fenders and the frame, he knew just where to brace up the engine and he would have a lot of pleasure in putting the thing into shape. But, at first, his real wish was to keep that machine where he could see it for as long as possible.

So he secured the consent of the owner and for the next month he spent much of his time undoing what the truck had done in a few seconds. As the car gradually turned from a bruised and broken heap of metal into a fine automobile; as he straightened out the dents and the bends, the joy of making something out of nothing filled the smith. He came to realize that there is more pleasure in working upon a fine automobile than upon a lumber wagon.

The engine repairs he could not do but he could build new springs and he could repair the metal parts. That machine is running to-day, a monument to the old smith and represents his conversion of faith. He finds steady work of this kind. He has a reputation for making excellent automobile springs and he can iron out a mudguard until one cannot see the dents which once were in it.

I found many blacksmiths who wer
same mind as this old smith, men w
always pleased to do automobile wo
who take pride in repairing a broken
straightening a bent axle or patching
guard. These smiths are happy i
work, they keep their shops full ar
know that they will have a job as
they want to work.

But I also found many smiths who
at the automobile and the tractor a
said that they wouldn't want to w
gasoline buggies because they could
derstand them. I feel sorry for them.

It is true that an old dog cannot be
new tricks, but we must always re
that the old dog who knows an old tr
is just as valuable as a young dog
not do his tricks properly. And u
ately few of the younger automobile m
ics deserve to be called good workmen

Service and Satisfaction

AS business gradually gets back to
and competition grows more kee
will come a general move toward the
ization of prices. The blacksmith h
has always been more or less of a gar
many ways. It is true that the pr
certain kinds of work could be fixed
vance but these prices differed grea
different parts of the country.

The old cut-throat methods of doing
ness are gradually passing out and it
be long before every business man w
to get his business on the basis of
and service rather than upon lower
than his competitor.

There was a time when a smith
into a town, set up a shop and then di
at lower prices than the other smith i
town. Then the other smith would cut
to be followed by still further cuts fro
first man. For a time both smiths
hold out and lose money, or earn so littl
they couldn't make an honest living.
one of the smiths would be obliged to s
his shop and leave.

Just as soon as *competition* was re
the remaining smith would jump his
and try to get back what he had lost.
time enough and no new competition a
would be on his feet again. Such a p
dead wrong from the very beginning b
it antagonizes the customers and keeps
jumping up and down.

But with the coming of modern b
methods this old system of killing comp
by strength is fast disappearing and t
to-date business man realizes that he c
tain fair and honest prices if he give
value for the money.

Service and satisfaction are the two
that the farmer wants, he has come to
ize that the cheapest is not the best an
a cut in prices indicates a cut in quality

You can keep your customers, no
how keen the competition, if you will
them that your work is honest value an
you intend to make only a fair profit an
ary. Make a promise to have a job do
a certain date and then be sure to ke
Do not slight or skimp the work.

When you have managed to get your
mers into the frame of mind where th
around saying, "Smith charges good
for his work, but I can depend upon his
and can be sure that his work is well
then you can be sure that a cut-price
petitor will not push you out of business

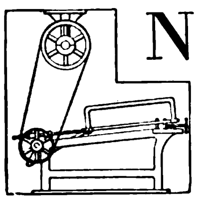
I see from my house by the side of the
By the side of the highway of life—
The men that press on with the a
hope
And the men that are faint with the
And I turn not away from their sm
their tears—
Both part of an Infinite plan—
Let me live in a house by the side
road,
And be a friend to man.

Sam. Walter

Home Made Bushing Stock

Detailed Description of a Method Which Has Proved Successful

By DAVID BAXTER



NUMEROUS methods have been devised for the casting of brass or babbitt bushing stock; all of which are more or less convenient. But some of them do not produce entirely satisfactory results in so far as clean, solid metal is concerned. It will therefore pay in the long run to employ a system that is not quite so crude as are many of these devices.

It is the purpose of this article to describe in detail a method that requires a few more tools perhaps, but which is entirely successful in every way if the work is properly carried out. In fact it is patterned after a system that has been in use for many years. In other words we might say it is borrowed from the foundry and changed enough to be entirely adaptable for use in any smith shop or machine shop. It can be easily mastered by the average mechanic.

First let us list the supplies and equipment needed. Then give a description of each item. Followed by detailed instruction for doing the work.

The former includes a quantity of river sand such as is used in mixing mortar or cement. Say twelve quarts, run through a medium fine sieve. Also a quart of common bread flour. These are for the purpose of making what is known as the core for forming the hole through the center of the bushing.

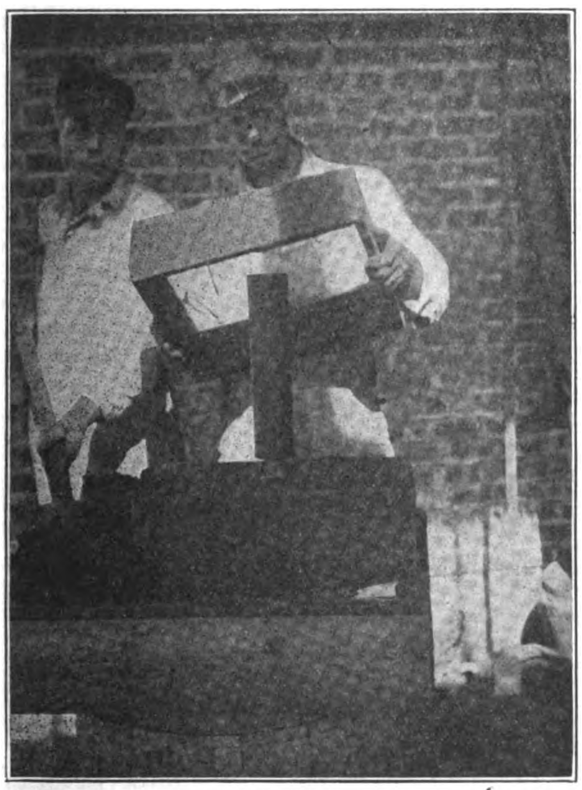


Fig. 1. The first section of the mold with the pattern in place.

Next on the list is a quantity of molding sand, say several bucketfuls; which may be obtained from any foundry. But if this is not convenient, common sandy earth such as is found in the garden will serve. It should, however, first be burned to remove all vegetable matter like grass roots or seeds, and moistened to a consistancy of freshly plowed ground; and sieved to produce fineness. This dirt is to form the mold or outside of the bushing.

Equipment

After these supplies, comes the equipment, which includes first, the core box, which is made by clamping two pieces of soft pine 2 x 4 together and boring a hole the desired size from end to end of them so half of the hole will be in one 2 x 4 and half in the other. This hole should be perfectly straight and smooth and of exactly the desired size. In fact there should be several core boxes with different sizs holes; all of which should be sand papered and shellacked to give best results.

An examination of the accompanying photos will aid materially in making the core boxes. An accurate core box is very essential, as it is in reality the mold for the core; which forms the hole through the bushing.

Next is the bushing pattern. In fact there ought to be several patterns of various sizes, in order to be able to make different sized bushings, thus saving a deal of metal and machine work. The length is not so particular but a foot is a good standard.

The pattern is really in two parts, viz. : the pattern proper and the core print as is shown in Fig. 1.

Size

For the sake of simplicity let us specify as to size. Then, the pattern is made by turning down a 4 x 4 of soft pine to three inches diameter. Which is accomplished quite readily on a metal lathe if no wood lathe is available. It should be turned smooth and be well sand-papered. In the exact center of one end a quarter inch hole is bored about two inches deep. This is for the purpose of attaching the core print to the pattern; or for making the core prints interchangeable.

The core print is for the purpose of forming a cavity in the bushing mold to hold the core in the center of the mold when the bearing metal is poured. It is made of a smaller block of white pine turned out on a lathe. When in place it is literally an extension of the pattern proper, and is attached by a wooden pin in the hole bored for this purpose. This core print should be very smooth and fit snugly to the end of the pattern body. Fig. 1 also shows the core print at the bottom of the pattern, resting upon the molding sand in one of the molding frames.

Next on the list of equipment is the mold frames. These are made of 1 x 6 planks sawed and nailed in the form of a square.

Fig. 2. Drawing the pattern from the completed mold.

The frames are also shown in Fig. 1 of the illustrations.

Now let us see how the bushing mold is made: First place one of the mold frames flat upon a bench or the floor. Fill it with the moist molding sand after being certain it is not too moist. Press the molding sand firmly in the frame and strike it level with a strip of wood or the edge of one of the other frames.

If the molding sand is too wet the molten metal will boil and fuss, perhaps be blown entirely out of the mold.

After the sand is struck level place the pattern upon it with the core print downward. And then place another frame section on top of the first, around the pattern. The operation is clearly indicated in Fig. 1.

Fill Second Frame

Fill this second frame with molding earth, firmly tamped down with the shovel handle, being sure to tuck it around the core print and beneath the lower end of the pattern. This earth should not be rammed heavily as it will tend to make the molten metal boil when the mold is poured. Which often results in a porous or dirty bushing. However, on the other hand if the mold is not firm enough the bushing will swell in the soft spots.

Now, the third frame section is placed on top of the second and well filled with firmly pressed molding sand. This last section should now be level with the top of the pattern. The surplus earth is scraped off flush with the top edge of the last frame. The mold is then ready for the pattern to be drawn.

Moisten the earth around the pattern with a little water dripped from a sponge or a handful of waste, not too much water; just enough to keep the molding sand from crumbling when the pattern is drawn. Then insert a sharp spike in the top of the pattern and rap it lightly sidewise in all directions

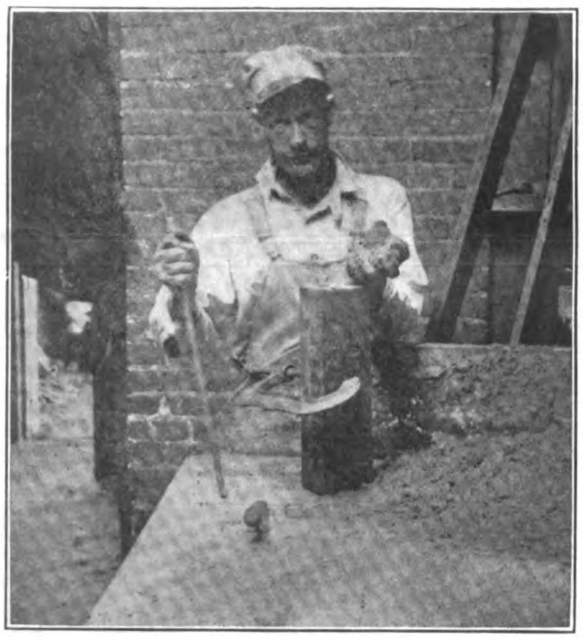


Fig. 3. Making the sand core; note the clamped core box.

to loosen it so the drawing will be easy. Then with the same sharp spike or with a long screw, the pattern is carefully and slowly pulled out of the mold.

It should be rapped lightly as it is drawn, to keep the sand from adhering to the pattern around the core print. Fig. 2 shows the completed mold with the pattern being drawn out.

We now have the finished mold ready for the core to be inserted. It is nothing more or less than a cavity or impression the exact shape and size of the pattern and core print. The core print leaves a smaller impression at the bottom of the mold, into which the core can fit so it will be held in the center, to insure the hole being through the middle of the bushing.

If the pattern and core print is not smooth it may leave a little loose dirt in the mold which should be cleaned out before pouring in the molten metal.

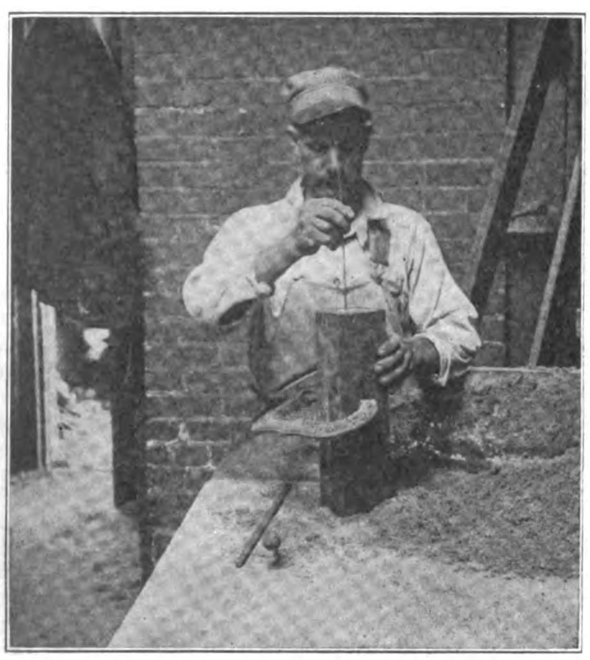


Fig. 4. Pushing the vent wire through to the completed core.

Before describing the setting of the core let us first see how it is made: The twelve quarts of river sand and one quart of flour are thoroughly mixed, so that every grain of sand is in contact or covered with the flour. This is in ratio of twelve to one so that the total quantity may be decreased or increased if the proportions are maintained.

After mixing, the core sand is moistened a little at a time until it will hang together when packed but still not be wet enough to be sticky. This is much a matter of experience so the novice may have to practice some before he is able to judge the proper moisture content of a batch of core sand. The proper wetness may in reality seem very dry to the beginner. If it is too wet the core will not roll out of the core box but will flatten out or crumble.

When the core sand is right, the two halves of the core box are clamped together as shown in Figures 3 and 4. A common cabinet makers clamp is used. The clamping should be done on a level surface of the bench.

Putting in the Sand

After the clamping, a handful of the core mixture is dropped into the core box and tamped firmly down with an iron rod, as is indicated in Fig. 3. Then another handful of sand is dropped in and tamped down. Then another and so on until the whole length of the box is tamped full. The sand is put in a little at a time in this way to insure an evenly packed, solid core. Then the top end is pressed and rubbed smooth with the fingers.

The next step of this process is shown in Fig. 4. This is what is called venting the core and consists of pushing a fair sized hole through the column of sand before removing the core box. The large, perfectly straight wire is pushed down with a twisting motion through the entire length of the core, and then carefully pulled back up again with the same twisting movement to leave a clean round hole.

The Vent

This venting is absolutely necessary, as it is the only means by which the gas can escape from the core. When the flour binder burns it must escape in the form of gas, either through a proper vent or through the fluid metal. The latter course nearly always results in ruining the bushing.

Now the next step is where the novice nearly always falls down. At least his success is almost sure to be poor the first few trials. It is the getting of the core out of the box upon the plate to dry. However, the box is rapped smartly but lightly to loosen the core. This is done before removing the clamp. Then the box is held tightly with one hand while the clamp is removed. After which the box is turned horizontal and the upper half lifted off. Then the box is held with both hands to the edge of a square, flat plate of cast iron as is indicated in Fig. 5. And the core is slowly and evenly rolled out

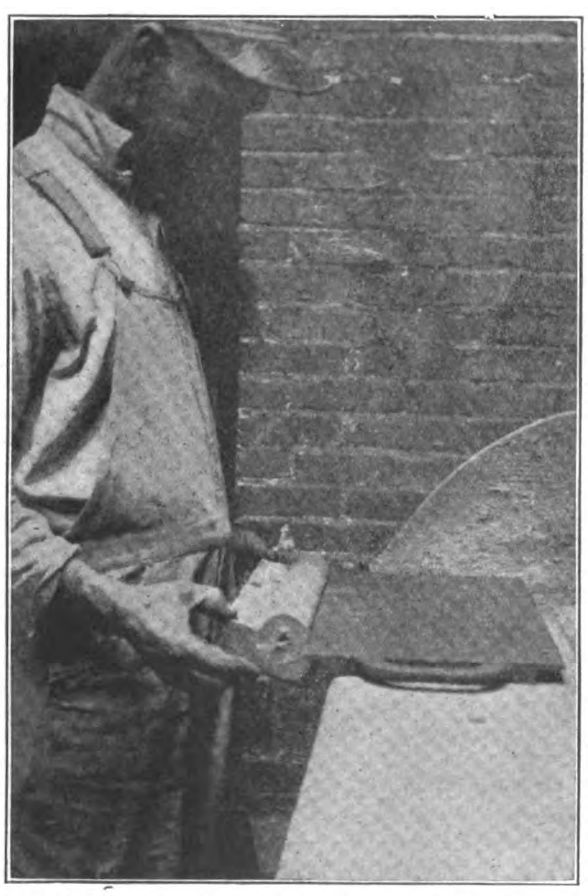


Fig. 5. Rolling the core out of half of the core box onto the drying plate.

upon the plate. The mechanic can soon learn to do this dexterously.

The plate is what is termed the "drying plate." For the core is placed in an oven or over a fire on this plate and dried or cooked until it is firm and brown. In fact the core is better if it is burned a little. That is, it is best when dried almost black; not burned enough to be crumbly, however. This excessive drying eliminates a great deal of the

Fig. 6. Lowering the dried core into the mold.

gas caused by the burning flour; the flour burns when the molten metal is poured around the core. The core should be a little longer than the pattern and print so it will stand above the mold, say about a quarter of an inch. When it is cold enough to handle it is lowered into the mold as shown *in Fig.* 6. Be sure it enters the core print mold at the bottom of the bushing mold, also that the vent hole is free from obstruction and that no metal can enter it at the bottom. If the molten metal enters the vent it is liable to shut off the gas escape and cause the metal to blow hollow.

Then a weight is arranged to hold the core in the center of the mold at the top. The weighting arrangement should be such that it will not only center the core at the top but will prevent it from floating when the molten metal is poured into the mold cavity around the core.

The mold is now ready for pouring, which should be started slowly and finished rapidly if babbitt or other composition metal is used.

When the metal sets hard enough to handle the mold is torn apart and the molding sand moistened and preserved for future use. It may be used over and over indefinitely.

The core, however, can not be used again, so it is well to always have on hand several cores of different diameters, for use in rush jobs.

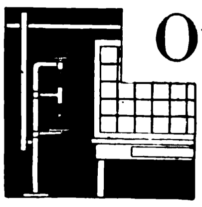
THE READY ANSWER

A city business man was very keen on having proficient clerks in his employ. Before a clerk could enter his office he was required to pass a written examination on his knowledge of business.

At one examination one of the questions was: "Who formed the first company?"

A certain bright youth was a little puzzled at this, but was not to be floored. He wrote: "Noah successfully floated a company while the rest of the world was in liquidation."

He passed.—*London Answers.*



OBVIOUSLY one cannot expect to operate a machine shop without some source of power. Hand or foot driven machine tools are as impractical as cast iron chisels. We have already described our machine tools, the lathe, the saw and the drill press. In the average repair shop where only small work is to be done the power equipment need not be especially large.

We have suggested that the small shop might send out the larger jobs such as trueing flywheels and facing off cylinder blocks not only because time may be saved but because heavy tool equipment costs more money than it is usually worth to the average repair shop. Under such conditions a three horse-power electric motor will answer the purpose.

Since we are to describe our power unit in this issue it might be well to consider the whole question of power at this time and have the thing settled once and for all.

High Powered Motor Not Necessary

In working metal the question of power is not especially important, unless the time element is considered. A ½ horse power motor will do enough work, given plenty of time, for the ordinary repair shop. If, for instance, you wish to true up a 16-inch flywheel you can gear the lathe to its lowest speed and take a light chip. With the ½ H. P. motor the job may require four or five hours and the motor will furnish only power for this work. But with a higher powered motor you could cut the time down considerably.

The same thing applies to milling and drilling and, in fact, most any kind of automobile metal work but when it comes to wood working the speed cannot be cut down without affecting the work done. The circular saw, jointer and planer require certain speeds and if the machines run below these speeds, the work will not be smooth.

For the small shop one should figure on installing a driving unit which will furnish at least ½ H. P. for a 10-inch lathe; ½ for the drill; 1 H. P. for a milling machine and 2 H. P. for wood saw, 10 inch blade.

If two or more machines are to be used at the same time, naturally a larger motor will be required. But the small shop can be so planned that but one machine tool need be used at one time.

Electricity Used

Electricity is usually the cleanest and easiest power to use. Each machine may be unit driven and the line shafting and belting eliminated. No excess power need be used and the motor absorbs only as much current as necessary to develop the amount of power used.

In our machine shop we were, unfortunately, limited to the size of motor we could use. The shop is located away from the main power lines and we were limited to 25 amperes of current. The line voltage is 110, alternating and since an alternating current motor absorbs a large amount of current for starting, we could not install a machine larger than ½ H. P.

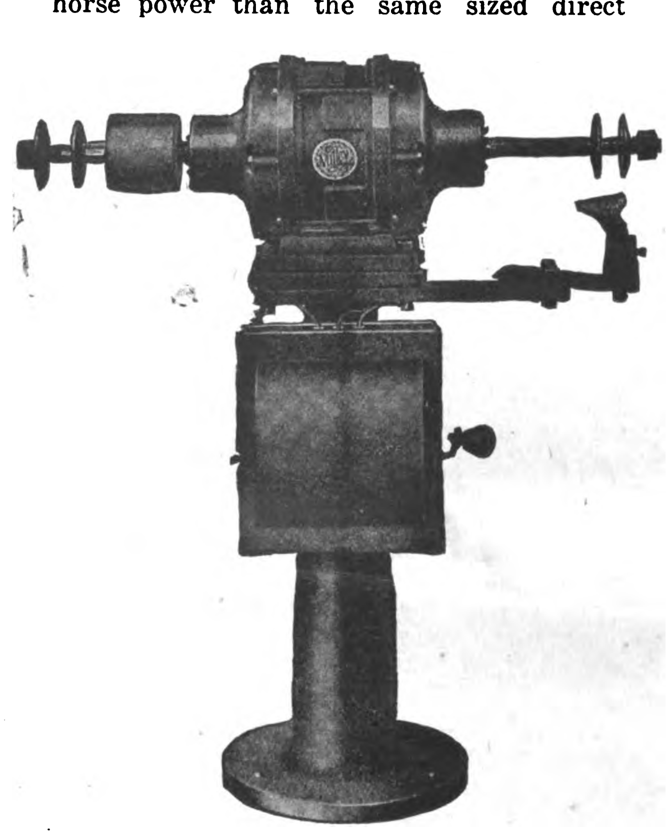
We were fortunate in obtaining a motor made by the Valley Electric Company of 3159 South Kingshighway, St. Louis, Mo. The motor is designed for grinding and carries a ¾ inch spindle with space for two grinding wheels.

The Valley motor, we understand, may be purchased in any size from ½ to 5 horse power and after trying out their small machine we can say that we cannot find anything to criticize in it.

The bearings are double-row, self cleaning, SKF make and are provided with large housings in which a sufficient amount of oil may be carried to last for many hours of running.

Being absolutely dust tight there is no chance for dirt, dust or grit from the grinding wheels to work into the machine. The machine which we have is designed for heavy duty work and all of the parts are large and massive.

As many of our readers are aware an alternating motor generates more heat per horse power than the same sized direct



The Valley Electric Motor-Grinder Made by Valley Electric Co. of St. Louis, Mo.

current machine. For this reason it is customary to ventilate the armature, but if the armature is ventilated, there is chance for the grinding compound to work into the windings and bearings and damage the machine. With the Valley motor, however, such troubles are virtually impossible.

We have operated the Valley motor in our experimental department for more than four hours continuously and most of the time the machine was operating under its maximum load, though at no time did the machine show any signs of heating, being only pleasantly warm to the touch at all times.

Our motor is fitted with a six-inch grinding wheel on one end of the spindle and with a three-inch driving pulley on the other. The driving pulley is belted to our circular saw, which has been previously described. Arrangements have been made so that the motor will drive our 12-inch Champion lathe.

This would seem to be an ideal installation for the repair man who cannot afford but one power unit. The one thing to remember, however, is that an alternating motor of this type must be started under a light load and the maximum load put on by means of sliding belts or clutch pulleys.

The machine runs at 1800 R. P. M. on single phase 110 Volts, 60 cycle current and when belted through the counter-shaft to the lathe will operate that unit at between 300 and 400 R. P. M. which is the proper speed for this machine.

C. B. N. A. ANNUAL CONVENTION

THE Carriage Builders' National Association will hold their annual convention this year at the Hotel McAlpin, New York City. It is only fitting that this particular convention be held in America's largest city because it marks the passing of a milestone in its life, for it is the fiftieth anniversary of its formation.

For fifty years the Association has carried on and flourished and if the signs of the times have any significance we may look forward to many more successful years. A few years ago the automobile seemed to be pushing the horse off the map, but within the past year there has been a great revival of the horse drawn vehicle. The hobby of horse back riding is being renewed and there are but few small towns in the East which do not boast of a riding school.

In the same way there are but few towns where one does not see several fine carriages. The carriage building industry is on the up grade again and we predict that in a few short years it will be back again to where it was ten years ago.

This year's convention will be held from October 9th to 13th. The various meetings will take place in the ball room of the hotel and the Exhibit will be shown in the Winter Garden.

Those of our readers who desire to attend the meetings should make reservations early and any information regarding the convention or exhibition may be obtained from Mr. G. W. Huston, of 130 Opera Place, Cincinnati, Ohio.

WHERE MOTOR CARS WERE PROHIBITED

MOTOR vehicles were strictly prohibited on the Island Prince Edward from 1908 to 1913 after which automobiles were permitted to be driven on the streets of Charlottetown and one other small town on three designated days per week. Practically all these restrictions were removed in 1919 except that motor vehicles are not allowed to operate outside of towns and cities during the month of April when the roads are very soft from spring thaws.

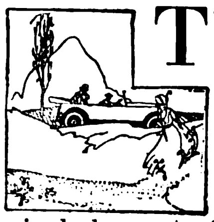
Progress has been remarkable since these restrictions have been removed, says Consul Crosby, in a report to the Department of Commerce, and today there are 1753 passenger cars registered in the Province, which has a population of 88,000 people. There are only 70 trucks registered in the province and most of those are of ¾ ton capacity or smaller, due to the poor country roads. It has been intimated that efforts will be made to limit the capacity of trucks in the Province, but no definite decision has as yet been reached.

It is estimated that there are 58 wheel type and 26 caterpillar type tractors in use, but on account of the small size of the farms in the Province the owners of the tractors are of the opinion that they are not an economical success. Three motor propelled fire-fighting engines are in use in Charlottetown, it being the only city in the Province which uses self-propelled apparatus.

Sixteenth Century Blacksmithing

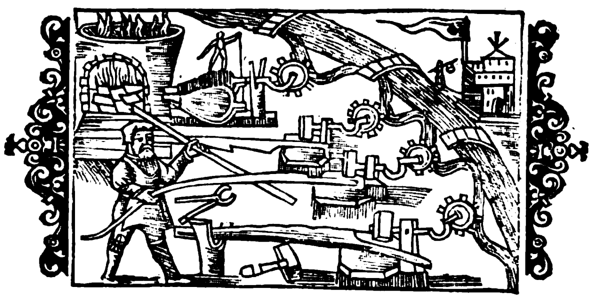
Crude, But In Some Cases Effective Methods for Doing Work of Olden Days

By H. H. MANCHESTER



TOWARD the end of the 16th Century progress in the use of simple machinery in engineering generally and in metal working shops, led to the first of a number of engineering and machinery books, which taken together include most of the practical ideas and some of the impractical ones on the subject for the next two centuries.

The first work of the sort is that by Jacques Besson which was entitled "Theatrum Instrumentorum" or in a literal trans-



De arte, & ingenio fabrorum.

A 16th. Century Artist's Idea for a Water Power Driven Blacksmith Shop.

lation "Theater of Instruments," which was published in 1578. In this case, however, the word "theater was used in the sense of panorama, or moving pictures, and was intended to indicate that the machines were explained mostly by illustration. The word instrument was intended to include anything in the way of a machine concerning which the engineer thought he had an idea worth depicting.

The title "theater" seemed "to catch on," and was frequently used afterwards to denote a work in which the inventions were profusely illustrated.

Besson's work represents what may be considered as a stage half way between hand work and the full applications of power. Most of the machines pictured in it are run either by hand power, or by foot power, but are nevertheless constructed to apply this power with a regularity or force impossible with simple hand work.

A Heat Engine Applied to a Rolling Mill; Unique but Wholly Impractical

Thus the devices run by hand power are frequently driven large enough to give continuity and smoothness to the action. The machines driven by foot power made use of plied in new ways.

The use of the fly wheel for hand machines was illustrated in the case of a tilt hammer, where the action desired was apparently a fairly rapid succession of comparatively equal strokes rather than greater power.

Besson's Idea

Besson also pictured such a fly wheel to be used in a sawing machine, and in a stamp mill for various materials.

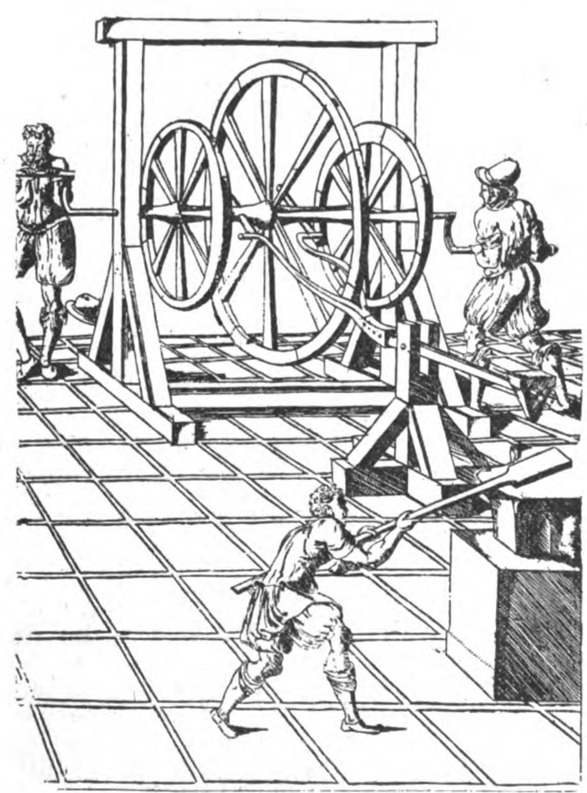
Although the lathe had been invented several centuries previously, Besson gives the first complete and detailed picture of such machines. He pictures three different a treadle which was not new, but being aplathes, two of which were driven by a treadle. A rope from the treadle to a bow in the ceiling raised the treadle after it was pressed down by the foot.

One of the machines was driven by a weight which was previously wound around a drum. One of the lathes is noteworthy as designed to cut a screw. They were all probably intended for use only on wood, but it must be kept in mind that most of the metal machines were adapted from others first invented to work wood.

About 1580 Jacob de Stada pictured a horse turning a mill with belts running from the shaft to grind stones, which were used for sharpening tools. This is one of the first Mediaeval pictures demonstrating the use of belts in this way.

Ramelli's Book

In 1588 the engineer Ramelli published a book of engravings of many machines used for engineering purposes. Most of these were for pumping or other water works, but there were some for blowing the bellows, and others for sawing. One of the most in-



A Hand Driven 16th. Century Hammer and Not Such a Bad Idea at That.

teresting details in this work illustrates the use of roller bearings.

In England at this period we hear of a wind mill used to drive a saw mill, a machine for cutting iron into small rods to serve in the making of nails, and in France a small combined rolling and stamping machine for use in the making of coins.

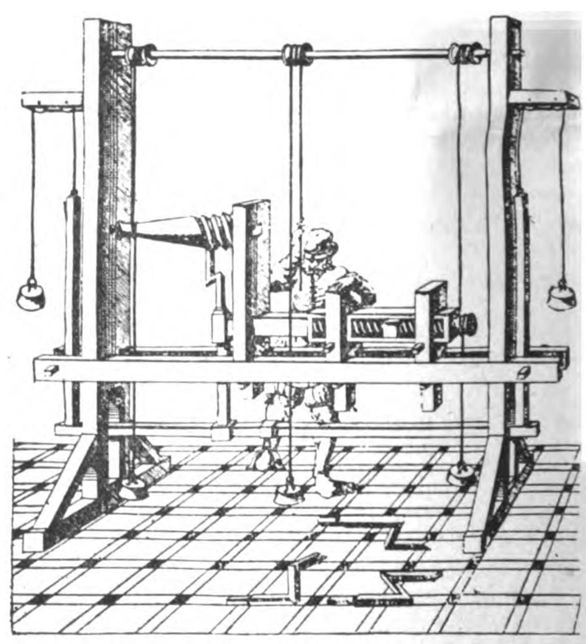
The "New Theater of Machines" by Zonca, published in 1607, illustrates machines for burnishing armor, and sharpening tools, some of which were run by water power. He likewise shows water power employed in driving, stamping, and pulverizing machines.

It should be noted that of the great engineers thus far developed in the early Modern period, Leonardo da Vinci, Biringucci, Ramelli, and Zonca were all Italians This is possibly because the Renaissance, which first began in Italy, acquainted scholars and archaeologists in Italy before those of other lands with the great engineering works of antiquity, led them to attempt more than elsewhere, and to speculate upon the use of machines in accomplishing the work.

Another Italian, who seems to have been the originator of several amazing ideas was Giovanni Branca, who published his little book "Le Machine" in 1629. This contains a picture of the hot air from a fire being used to drive a wheel, or turbine, which furnishes the motion for turning a small rolling machine. One feels that the power would not be sufficient for the purpose, but the general conception is one of great importance.

Another picture which is even more astounding, though not so directly in our fields, is that of a turbine driven by steam, and used to run a small stamp mill. These two pictures seem to entitle Branca to the credit of first conceiving the possibilities of the turbine, and of some such force as vapor or hot air acting upon it.

In still another illustration Branca shows a blackhmith's furnace being driven by compressed air which is formed in large vessels by means of rising water. This also



A Treadle Driven Screw Cutting Lathe Which Was Actually In Use at a Later Date. Note the Master Screw at the Left.

is probably not practical, but contains the germ of various blasts which are used at present in the great mills.

Influence of Engineering Science

At about this period the influence of the developed science of engineering began to make its way into other countries. We find a work published by Salomon de Caus, the title, of which might be translated as "The Principles of Forces," picturing sawing, boring, and the blowing of bellows by water power.

Between 1612 and 1636 Heinrich Zeising published six parts of a work called the "Theatrum Machinarum." Most of the illustrations were practically direct copies from previous works, but Zeising, in them, emphasized the use of water power to work the bellows, grindstones, and tilt hammers, and helped to spread the knowledge of various machines in Central Europe.

Rules of Use to Blacksmiths

Method of Determining Weight of Bars of Given Diameter

By W. F. SCHAPHORST

BLACKSMITHS and other users of steel rods and bars frequently want to know the weight of bars of given diameter and length and they want to know quickly. Tables are not always available and "accurate" formu- ; are used with too much difficulty. Here e some quick and surprisingly accurate les based upon Hyman Levine's formulas:

Rule 1—Hexagon Bars

Square the distance across flats in inches. vide by 4. The answer is the weight per ch of length.

Rule 2—Round Bars

Square the diameter in inches. Multiply 2. Divide by 10. Add 10 per cent of the sult. The answer is the weight per inch length.

Rule 3—Square Bars

Square the distance across flats in inches. ultiply by 3. Divide by 10. Subtract 1/20, 5 per cent. The answer is the weight per ch of length.

EXAMPLES

cample. 1—
Hexagon bar, 100 inches long,
Distance across flats = 2 inches.
Applying Rule 1—
$2 \times 2 = 4$
$4 \div 4 = 1$ lb. per inch of length
$1 \times 100 = 100$ lb., the weight of the hexagon bar.

cample 2—
Round bar 100 inches long.
Diameter, 3 inches.
Applying Rule 2—
$3 \times 3 = 9$
$2 \times 9 = 18$
$18 \div 10 = 1.8$
adding 10 per cent
1.8
.18
1.98 lb. per inch of length
$1.98 \times 100 = 198$ lb., the weight of the round bar

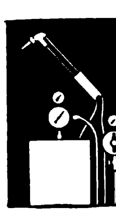
xample 3—
Square bar 100 inches long,
Distance across flats 1.5 inches.
Applying Rule 3
$1.5 \times 1.5 = 2.25$
$2.25 \times 3 = 6.75$
$6.75 \div 10 = .675$
1/20 of $.675 = .0337$
Subtracting
.675
.0337
.6413 lb. per inch of length
$.6413 \times 100 = 64.13$ lb., the weight of the square bar.

It will be noticed that each one of the above operations is very simple—so simple that most of them can be performed mentally—such as multiplying by 2, dividing by 10, dividing by 20, squaring, etc. Also, they are easily remembered. A rule of thumb isn't much good unless it is simple and unless it can be remembered.

In case one should happen to forget the above rules here is an excellent one by Professor Merriman which the writer has carried around in his head for 16 years—"A bar of steel one inch square and one yard long weighs 10 pounds." This rule is good because it is easily remembered and it is easily remembered because it is so simple. Remembering Professor Merriman's rule it becomes useful at any time as a basis on which to figure round, hexagon, or any other kind of steel rod.

A BLACKSMITH'S HANDY CHART

By W. F. SCHAPHORST



HERE is a chart that will be found handy by blacksmiths for computing the weight of any round metal bar. Simply lay a straight edge across the chart twice as indicated by the two dotted lines on this chart and the answer is immediately found in Column "C."

For example, what is the weight of a wrought iron bar whose diameter is 0.5 of an inch and whose length is 20 ft?

The table below shows that the weight of wrought iron is 485 pounds per cubic foot. Then using the chart, simply connect the 0.5 (Column "A") with the 20 (Column "D") and locate the intersection in Column "B." Then from that point of intersection run over to the 485 (Column "E") and the intersection with Column "C" gives the answer immediately as very close to 13 pounds.

By checking this up in "longhand," which you will find to be a very laborious process as compared with this chart method, the exact weight will be found to be 13.2 pounds. In other words, the error is only 0.2 of a pound which means that the chart is within 2 per cent of being accurate, which certainly is close enough for all practical purposes.

The weights of common metals are as follows:

Aluminum	165 lbs. per cu. ft.
Brass	534 " "
Copper	556 " "
Wrought Iron	485 " "
Lead	710 " "
Nickel	537 " "
Mild Steel	487 " "

This same chart can be used "backwards" as well as forwards. That is, if it is desired to know the length of a bar that is required to weigh a certain number of pounds the reverse process would be used. In other words, knowing any three of the four values given in Columns "A," "C," "D" or "E," the unknown is easily and almost instantly determined.

THE FARM, THE HORSE, THE TRACTOR

PROF. O. G. LLOYD, Chief of Farm Management Department, Purdue Agricultural Experiment Station, said at the 1922 meeting of the Indiana Draft Horse Breeders' Association:

"Our 1919 studies in Indiana on 74 farms, half of which made use of tractors the other using horses only, disclosed that farms depending exclusively on horses for farm motive power made more than $900 per farm more that those which used tractors. In 1920 the difference was more than $800, and was again in favor of farms using horses exclusively."—*Our Dumb Animals.*

DEUCEDLY CLEVER

A young Englishman was walking up and down the platform of a country railroad junction, trying to see a car that had a vacant seat. He didn't find it, and, assuming an official air, he walked up to the last car and announced in stentorian tones: "All out here; this car isn't going." There were exclamations low and deep from the occupants of the car, but they all piled out and made their way to cars ahead. The smile on the young man's face increased as he took possession of a seat and appropriated another for his luggage.

"Ah," he murmured, "it's a grand thing to be born clever! Now I wish they'd start."

By and by the station master put his head in the door: "Are you the smart young man who said this car wasn't going?"

"Yes," said the clever one, smiling.

"Well," said the station master, with a grin also, "it isn't. The brakeman heard what you said and he uncoupled it. He thought you were a director."—*Boston Globe.*

From the laconic United Press: "Mr. F. S. D.——, Cedar Rapids, Ia., passing through this city last night, en route on an automobile tour, lit a match to see if his gas tank was empty. It was not. Age 47. Cedar Rapids papers please copy."—*Chicago Tribune.*

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

BLACKSMITH AND WHEELWRIGHT

and TRACTOR REPAIR JOURNAL

Vol. LXXXVI. No. 1 JULY, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

How to Get a Better Understanding of the Microphotographs

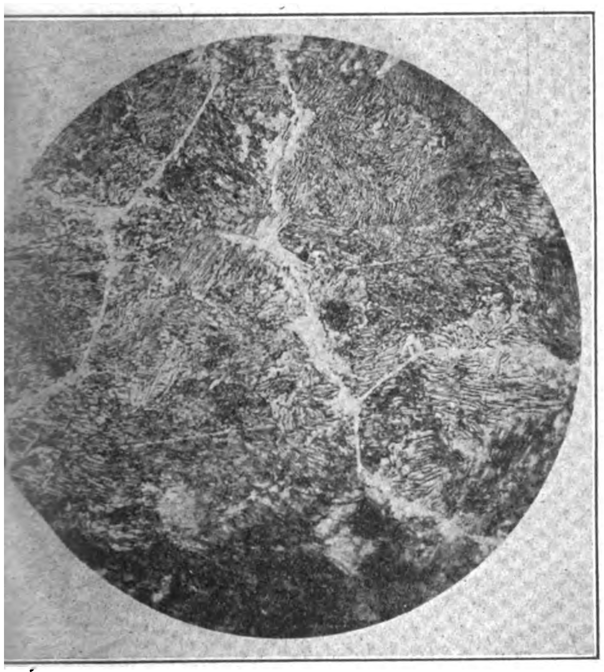
By J. F. SPRINGER

SOME of the things that may be seen under the microscope do not require a very high power. Thus, with a microscope capable of magnifying 50 times, a good deal may be seen. A magnification of 50 times means that everything s 50 times as broad and 50 times as long. f you measure what you see in the microscope, then you must divide all the lengths and breadths by 50 in order to get the actual engths and breadths as they exist in the steel.

I am now about to explain a matter which will enable the reader, once the explanation s thoroughly understood, to get more out of such microscopic views as those being published in BLACKSMITH & WHEELWRIGHT. It s rather necessary when looking at a microphotograph to know what the black represents and what the white. Mistakes are very apt to occur. The observer then gets a wrong mpression about the steel.

Find Carbon Percentage

The first thing to find out is the carbon percentage. If this carbon percentage is 0.90 per cent, or a little above or a little below perhaps, all of the steel will consist of pearlite, provided it has been annealed properly. This means that we should see black and white stripes. These stripes may be quite regular and a genuine zebra-effect be apparent. Then, again, they may be more or less intermingled. If the magnification be very high—say, 1000 to 1500 diameters—then the photograph will represent a very



g. 1. High Carbon Steel. The white streaks of considerable width are cementite honeycomb. Note the Zebra effect in e large grains. The pearlite grains are large because the steel has been magnified 400 diameters.

nall patch of steel indeed. And this must be borne in mind.

For example, suppose that the photograph just 3 inches wide and that the magnification is 1500. This means that the photograph represents a patch that has a breadth n inches) given by dividing 3 by 1500. That is, the breadth of the patch is only 0.002 inches wide. This is not far from the *thickness* of the white paper on which BLACKSMITH & WHEELWRIGHT is printed. It takes just from 333 to 340 sheets of that white paper to make up one inch, so that one sheet has a thickness of just about .003 of an inch. If the photograph is 3 inches high as well as 3 inches broad, then the whole patch is really a circle, or a square (as the case may be), having a diameter of 0.002 inch or being 0.002 inch on a side. Think of a sheet of paper of the right thickness. Then, think of cutting a strip having the same width as thickness. Finally, think of looking on the end or point of this hair-like strip. This will give you an idea of the size of the patch of steel shown in the microphotograph.

A Test of the Imagination

Think now what must be the fineness of the ridges and valleys of the metal that are represented by the white and black stripes. They are, in fact, wonderfully small. The dark stripes are to be understood as ferrite and the white ones as cementite. A good plan is to compare several photographs of all-pearlite steel (0.90 per cent carbon), which differ in magnification.

For example, if the reader has before him two microphotographs, one showing a magnification of 1000 and the other a magnification of 500, he must reflect that everything in the latter is twice as broad and twice as high as in the former.

All the carbon steels below the all-pearlite, consist of grains of pearlite more or less surrounded by a honeycomb of ferrite. In the microphotograph, there will be, say patches surrounded by a net-work. Often these patches will be dark and the network light. This is, perhaps, different from what the reader would have expected. Naturally, pearlite is not as hard as cementite, because pearlite contains alternate layers of ferrite.

At the same time, it is harder than pure ferrite, since pearlite has its ferrite interleaved with the hard cementite. In short, ferrite is soft, pearlite less soft, and cementite hard. Nevertheless, in the microphotographs showing pearlite patches and ferrite network, the network seems to resist the rubbing or the acid better than the network of ferrite. In short, the white network is to be regarded as ferrite and the dark patches as pearlite.

Difficult to Explain

As to an explanation, I am somewhat at a loss. However, this is to be borne in mind. In the pearlite, the leaves of iron and cementite are to be regarded as wonderfully thin. The thickness of the network is probably much greater. It would seem then that the ferrite network is able to resist because it is a solid mass of one and the same material. The pearlite may not resist so well because of the existence of such excessively thin layers of material. The rubbing wears away the pearlite not so much because of softness as because of the wonderful thinness of the layers. They are broken off, as it were. However, whether this explanation is the right one, we are to regard the white network as ferrite and the dark patches as pearlite.

Again, a microphotograph of a steel containing more than 0.90 per cent of carbon is apt to show white network and dark patches. The white network is to be regarded as cementite and the dark patches as pearlite. The reader should have no difficulty here, as cementite is certainly harder than the mixture known as pearlite.

In fact two microphotographs, one of steel containing less than 0.90 per cent of carbon and one of steel containing more than 0.90 per cent, may look a good deal alike. Both may show dark patches and a white network. In both cases, the dark patches are to be regarded as pearlite. But, the white network in the one represents ferrite and in the other cementite. The reader may now reflect that it really is necessary to know the percentage

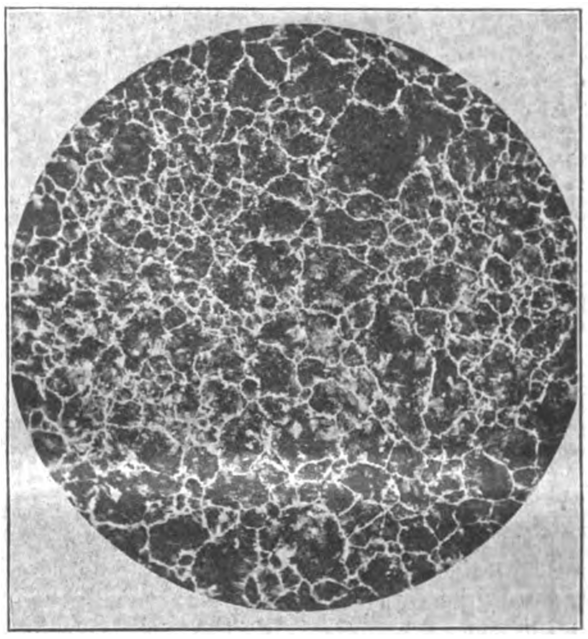


Fig. 2. This photomicrograph shows a high carbon steel magnified 100 times. The white lines represent the cementite honeycomb. The black places represent grains or groups of grains of pearlite.

of carbon in order to tell exactly what he sees in the microphotograph.

An example of this kind is afforded by a low-power microphotograph of a 0.40 or 0.50 per cent carbon steel and a low-power microphotograph of a 1.50 per cent carbon steel. Both are assumed to be annealed samples of steel. The two photographs will look very much alike, indeed; so much so, in fact, that one entirely inexperienced might mistake the one for the other.

Now, all these things are so important, if one wants to understand microphotographs of prepared steel surfaces, that it will well be worth while to run over some of the prominent matters.

In the first place, the steel surface is prepared in such way as to show ridges and depressions. This may be done by polishing the surface or by applying a chemical. In either case, the action is assumed to result in depressions and elevations. Under the microscope, the elevations are assumed to show white, while the depressions are assumed to show black.

If there are only two things to be considered—namely, soft ferrite and hard cementite—then the development of white and black is to be assumed to show the ferrite black and the cementite white. However, to get these results from a piece of annealed pearlite steel it will probably require the attention of an expert, since the leaves of ferrite and cementite that are alternated are so excessively thin. Similarly, too, in the cases of low-carbon and of high-carbon steels, to bring out the zebra effect in the pearlite patches will probably call for a high degree of expertness.

On the other hand, these high-carbon and low-carbon steels may be shown in the following way and probably with a less degree of skill. That is, suppose we seek to leave the patches of pearlite simply as patches; and so do not attempt to bring out the zebra appearance. Then our problem is to show the patches and the network. These may be shown with comparatively low-power magnifications. Even magnifications of 50 or 100 are sufficient to bring out these appearances. In almost all such cases of low-carbon and high-carbon steels, the dark patches are probably patches of pearlite. The whole of each patch is black, because the magnifying power (and perhaps the skill applied) are insufficient to bring out the zebra effect. The white network is ferrite, if the steel contains distinctly less than 0.90 per cent of carbon. And the white network is cementite, if the carbon percentage is distinctly greater than 0.90 per cent.

An Unusually Fine Job

I have seen a printed reproduction of a microphotograph taken with a magnifying power of 500. The job was done so well that the white and the black of the pearlite is shown. In this case, the steel had a carbon content of 0.59 per cent. There is a big central patch of pearlite showing fine lines of ferrite, and cementite intermingled. This patch, which appears to run off the view on one side, is about 2 inches high and perhaps 1-1/2 inches wide at the widest place. This height of 2 inches is, however, to be divided by 500. We thus get 2/500. This is equal to 0.004.

It means that the patch of pearlite in the steel was only about 0.004 inch high. The width was less yet. All round most of the patch in the photograph is a white river, as it were. It averages perhaps 0.25 inch in width. This is also to be divided by 500. We thus get $0.25/500 = 0.0005$ inch. This is pretty narrow for a "river." It means that the pearlite in the steel was in a honeycomb of ferrite that was only 0.0005 inch thick.

Now, if this photograph had been taken with a magnification of, say, 100 instead of with a magnification of 500, the two inches of height would have been only 1/5 of 2 inches —that is, 2/5 of an inch. That is the reason why, with low magnifications, a 3-inch circle will show a lot of pearlite patches. Each patch only requires something like 2/5 of an inch, so that quite a number can be shown in a 3-inch circle. The "river," which in the one view is a quarter of an inch wide, will in the other view be only 1/5 as wide,—that is, 1/20 inch $= 0.05$ inch. So, in the 3-inch circle, there will be narrow lines of about this size running round the pearlite patches and forming the network. These will be "rivers" of ferrite.

Pearlite Grain Small in Steel Sample

We have found in the foregoing that two inches is a proper dimension for a pearlite patch, when the magnification is 500. The actual height is gotten by dividing two inches by 500. We thus get 0.004 inch. It will be seen then that, *in the steel sample itself*, the pearlite grain was not a very big affair. In fact, it is so small that we use micrometer calipers and the like to measure such amounts.

In a low-magnification view, the grains appear fairly big. Thus, when the magnification is only 40 or 50, the grains seem to have dimensions not far from 0.25 inch. Dividing by 50, we get $0.25 \div 50 = 0.005$ inch. This agrees very well with the height of the big pearlite patch in the case where the magnification was 500. We then got for the 2-inch height in the picture a height of 0.004 inch in the steel.

It appears that when pearlite exists as grains in annealed steel, a dimension of 0.004 and 0.005 inches may be considered as representative of a fair sized fellow.

The foregoing, for quite a way back, is important. If the reader will take the trouble to read it several times in order to make sure that he understands, he will find himself gaining in his comprehension of the metal with which he is familiar. If he really gets a grasp of what I have been setting forth, I can promise him a good deal of satisfaction. He will enjoy understanding something of the inside of the bar of steel with which he works.

Now let us consider the network or honeycomb which surrounds the grains of pearlite in steels having less than 0.90 per cent of carbon and also in steels having more than 0.90 per cent of carbon.

This honeycomb consists of ferrite for the one class of steels, the class of relatively soft steels. Sometimes the honeycomb is a considerable part of the whole; sometimes it is an insignificant part. When the steel is *all* pearlite—that is, when it contains about 0.90 per cent of carbon—there seems to be no honeycomb at all. In fact, there is nothing to make it of. The cementite and the ferrite are all in the pearlite, where they alternate in layers, as has already been explained.

In short, the honeycomb consists of the excess of one or other of these two materials—ferrite and cementite. That is, all of these two materials goes into pearlite as far as possible. I have already shown in effect, how to tell how much ferrite and how much cementite are required to make up pearlite. The way to get at this matter is to start from a piece of pure pearlite—that is, pearlite with no honeycomb at all.

The carbon percentage is about 0.90 per cent. This means 0.90 per cent of the *weight*. Now *all* the carbon is in the cementite. Consequently, this 0.90 per cent is all in the cementite. It there constitutes 1/15 of the whole. So, then, this 0.90 per cent of carbon is 1/15 the weight of all the cementite. Consequently, all the carbon, which is 15/15 of itself, weighs 15 times as much as the 0.90 per cent. Multiplying 0.90 by 15, we get 13.5 per cent as the weight of the cementite. We learn, then, that in a lump of pearlite, 13.5 per cent of the total weight will consist of cementite.

We have made progress when we arrive at this point, that 13.5 per cent of a piece of pearlite consists of cementite. We know that what is not cementite is ferrite. That is, since pearlite is made up of alternating layers of cementite and ferrite, just as soon as we find out what fraction of the whole is cementite, we know that the ferrite will be all the rest of the whole. Now, 13.5 per cent of the whole of the pearlite is cementite.

(Continued next month)

Old Bill Testifies

A Short Story With a Distinct Moral

By D. H. TALMAGE

A COURT of justice was in session in the hills of the West Coast country one hot afternoon in July. Flies droned about the bench, and the justice, who in his private capacity was the village blacksmith, brushed the insects good-naturedly from his bald head in the intervals between naps. The other functionaries of the court—the village constable and a young man from the general store, who had been drafted to keep a record of the proceedings, frankly dozed. The court room was the blacksmith shop. The blacksmith sat in a chair set upon a box. The reporter occupied a stool, his book on his knees. The constable straddled a nail keg, his back to the dingy wall. Several private citizens, called to the scene by the unwonted prospect of a trial, stood about or sprawled in the shade of trees in the street. Two chairs stood before the bench. Presently a man and a young girl appeared in the big doorway, and the court bustled into action.

A Cordial Greeting

"Howdy, Jim," called the justice, cordially. "Howdy, Maggie. Sit down. Hot, huh?"

The man mumbled an unintelligible response and sat down, mopping his face with his shirt sleeve. The girl, a half frightened smile upon her face, courtesied.

The court was called to order. The charge against the man was read.

"Jim," said the justice, "you've heard the charge against you. What have you got to say for yourself?"

"Only this"—the man rose to his feet and cast a scowling look about him—"the whole thing's a trumped-up lie. It's spite work on the part of somebody, that's what it is."

"Then, I reckon, you plead not guilty."

"I surely do."

"All right. The complaint says you abused your horse—licked him—worked him without water—let him stand hitched to a plow in the field for two hours while you snoozed in the shade. 'Taint so, huh?"

" 'Taint so."

"Never licked him, huh?"

"Not enough to hurt him."

The court pondered. "Did you drive old Bill in today, Jim?"

"Yes."

"Tied outside, is he?"

"Yes."

"Henry,"—to the constable—"bring in the witness. Drive him right in, buggy and all."

Old Bill, meager of flesh and sightless of one eye, was presently in court. He stood in an attitude of dejection, half-heartedly switching flies with his tail.

The justice suddenly addressed the girl. "Maggie, do you like horses?"

The girl glanced timidly at her father, then nodded.

"Does your mother like 'em?"

Again she nodded.

"Where is your mother today?"

"At home."

"What doing?"

"Washing."

"Tub?"

"No, a machine."

"Heard you had one. What did your pa say when he took the machine home to your ma?"

The child hesitated and looked at her father, who stared doggedly at the floor.

"He said—he said the merciful man is merciful to his b-beast."

"Hm-m—heard he said it." The justice drew an apple from his pocket and tossed it to the girl. "Give that to old Bill, Maggie."

The girl obeyed. After the apple was disposed of, the horse nibbled affectionately at her shoulder, and she patted him on the neck.

"Sit down, Maggie." Another apple was brought forth. "Jim, give this to old Bill."

The man did not move.

"Jim," thundered the court, "give this to your horse."

The man stood up sullenly, snatched the apple and held it toward the animal. The horse's ears flattened instantly, and he backed away. Finally, the apple being forced into his mouth, he mumbled it with his lips and let the pieces fall to the floor.

Conclusive Testimony

"Sit down, Jim. You're guilty. Old Bill's testimony's about as conclusive as any I ever saw. For good honest testimony, give me a horse! What you got to say before the court pronounces judgment on you?"

"Nothing."

"Good enough. In your place, I wouldn't ither. I'm going to fine you, Jim—can't elp it. But I ain't going to compel you to ay the fine—till next time, and I'm thinkng there won't be any next time. That was beautiful sentiment you uttered when you ook the washing machine home, but it rasn't placed quite proper. I ain't saying ou didn't intend it all right, and that it on't do you credit. It does. But ain't you bit mixed, Jim? You didn't mean that our wife was a beast, did you?"

"No."

"'Course not; I knew you didn't. But, im, old Bill is a beast, and that sentiment f yours meets his case fine. He's a good ld horse. I ought to know, for I've shod im the last ten years. This court's going to vatch over the old fellow from this on. You know, I've got a sort of a—a sort of a what you might call a proprietary interest in him, and—"

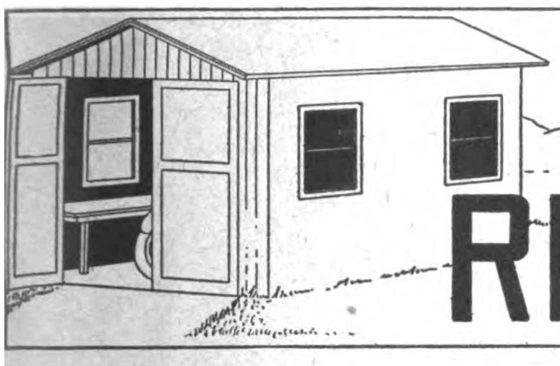
"I'm going to pay you sometime."

"Don't worry about that, Jim. Give the old horse a fair shake, and you'll find money will come in more plentiful. Now you and Maggie drive home and help mother with the washing. Court's adjourned."

The man and the girl stood up. The justice stepped down from the bench, and, placing a brawny arm about the girl, patted the man on the shoulder.

"Let Maggie boss the old horse, Jim," he whispered.

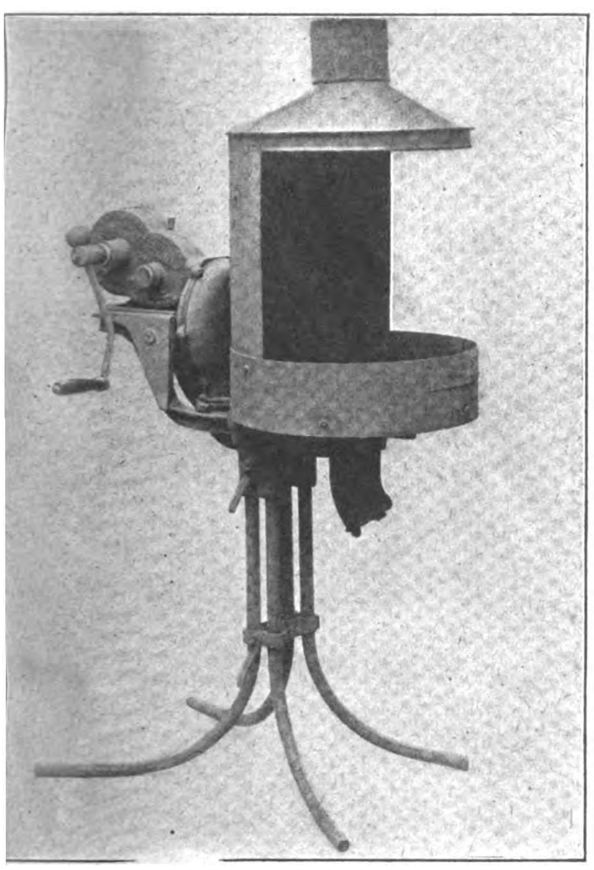
The man raised his face. "All right," he said. It sounded like a growl, but his eyes, as they shifted to his little daughter, suddenly filled with tears.—*Our Dumb Animals*



OUR OWN REPAIR SHOP

AS MANY of our readers are aware, the purpose of our own repair shop is to find out just what machinery may be necessary for conducting a successful automobile and truck repair business. It is also our plan to investigate those pieces of equipment which may not be essential but are of such a character that they will produce good returns on the investment.

Every blacksmith knows the value of a forge, but of just how much value this unit will be in a repair shop is an open question. In our opinion the forge is a repair shop necessity and with this idea in mind we obtained one. We feel that we have answered this question in this article.



Champion Blower & Forge Company's Number 402 Forger with Number 400 Blower

Our experimental department forge was furnished us by the Champion Blower & Forge Co. of Lancaster, Pa. and though a larger forge might find a place in a service station, we feel that the unit which we have is ample for the average garage.

Assuming that there is much forge work to be done, then it would be entirely practical to install a number of small forges, for it is seldom necessary to heat large units in the average repair shop.

There are three important reasons for a forge in the repair shop. First, for the heating and tempering of small automobile parts; second, for the making of tools; and third, for brazing and welding jobs of certain kinds.

If the repair shop goes in for service and makes a specialty of rapid work, then the shop must be able to build certain parts such as wrist pins, small gears, studs, special bolts and so on without number.

The making of a wrist pin or special bolt does not stop with the production of the new part. The thing must be treated so that it will not wear to pieces immediately; either it must be given a thin, glass hard surface to resist wear or it must be made tough and strong enough to stand great strain. In many cases the part must be both hard and tough at the same time. Only by heat treatment is this work possible.

An ingenious workman with even a small sized forge can often accomplish wonders in the way of heat treating small parts. And unquestionably the investment in this small forge is small enough to warrant its use.

In no business in the world is the call for special tools so great as in that of automobile repairing. Go into any garage and you will find that the workmen all have unique and cleverly made tools of their own invention. Lathe tools must be made and treated or the profit in a job will be lost in the cost of the tools for it. And so a forge is a necessity for this purpose also.

Patches for broken parts, iron elbows for braces, special fittings for accessories and so on are things which the real repair shop should be in a position to make and for these the forge is practically essential.

For hammer welding and for many brazing jobs the forge is a mighty handy device and in its way it will serve in place of a blow torch for preheating parts to be welded by the oxy-acetylene flame.

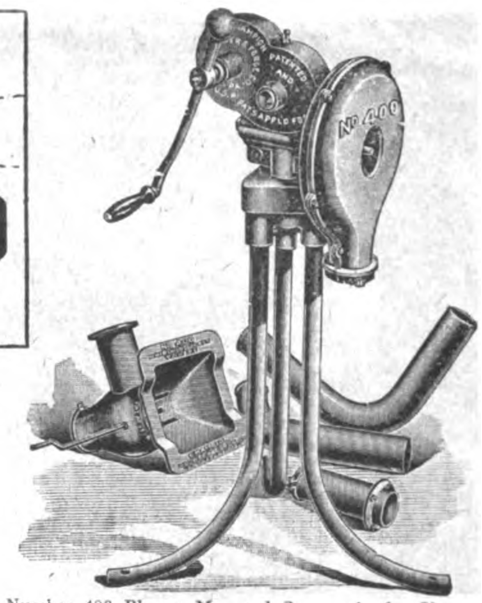
Our forge is amply large enough to take care of all of this work; it is light yet strong, and though the fire pot is of good dimensions it is not so large that it requires a large amount of fuel for operation. It can be regulated to give a small area of low heat or blown to give sufficient heat to melt many of the ordinary metals. For heating babbitt metal it is more economical than the gasoline stove.

The fire pot is made of heavy, rolled plate, the rim being riveted to the base. The inside diameter is 18 inches and the fire pot has a depth of five inches.

A piece of sheet metal, bolted to the fire pot, supports the smoke hood at the top. The sheet metal back extends about half way around the fire pot and the hood is 15 inches from the pot, thus leaving ample working space.

The forge is mounted upon four round legs which are adjustable both as to position on the floor and as to height. The distance of the forge fire from the floor is an important consideration for it is extremely tiresome for a tall man to stoop at a low forge and a difficult task for a short man to work at a forge on a level with his armpits. The Champion forge is so made that the fire box can be adjusted to as low as 35 inches and as high as 40 inches from the floor.

Our forge, number 402 is fitted with the famous 400 blower. This blower is mounted on ball bearings and fitted with an adjustable hand crank. The slightest turn of the crank develops a big stream of air for the fire and the effort required is extremely small. For a moderate fire it is only necessary to give the crank an occasional push and the fan will operate for a time under its own momentum.



Number 400 Blower Mounted Separately for Use with Brick Ovens and Forges

We understand that this same forge may be fitted with an electric blower if so desired. The blower is mounted on angle brackets, close to the side of the forge and the air is carried through a 3-inch pipe to the fire pot. Between the blower and the fire pot is but one joint and there is practically no chance for air leakage.

We feel that one word of caution may be necessary for our repair shop readers. Our subscribers who have had some experience with forges will hardly need our advice on this point.

A blacksmith forge is not a cook stove and, unfortunately, there is a big problem to be encountered in the disposal of the forge smoke. The smoke in a cook-stove cannot escape but through the chimney, hence it seldom puffs back into the room; but with the forge, the smoke will go everywhere but the chimney unless the latter is properly installed.

The forge hood will not collect the smoke unless it is provided with a good stack connection. For this reason the hood must be located as near the stack as possible and the connection made with the stack as high as possible from the top of the hood. A right angle connection with the forge is a smoky proposition.

Johnny—"Did Moses have dyspepsia like what you've got?"

Dad—"How on earth do I know? Why do you ask such a question?"

Johnny—"Well, our Sunday school teacher says the Lord gave Moses two tablets."

CONPOSITION ON RAGS

Rags make paper. Paper makes money. Money makes banks. Banks make loans. Loans make poverty. Poverty makes rags.—*Pure Oil News.*

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Our Editor's Letter

ONE of my New England subscribers has just asked me a very vital question, he wants to know if he is justified in bringing his son up to be a blacksmith, and it seems to me that the same question might well be voiced by hundreds of blacksmiths all over the country.

Before I answer his question directly I want to say a number of things about boys in general. A few of us can remember very easily that we, ourselves, were once boys; but I'm afraid, many of us cannot put ourselves in the shoes of the boys and try to see the question as they see it. Now I'm one of those fellows who tries to understand the boys and though I'll admit it seems pretty hard to do so when a base ball comes crashing through a window, or some of my apples walk away beneath a youthful blouse, in general I can sympathize fairly well with the younger generation.

Some one has said that each person must pass successively through all of the ages of civilization before he matures to a man. The baby is born with no more intelligence than an ape or kitten; as he grows into boyhood he becomes the primitive savage, killing birds, torturing dogs, playing war and taking intense joy from the noise of an old tin pan beaten with a hammer. Not until the boy passes into mature manhood, (and sometimes not even then) does he become a civilized and peaceful citizen.

Ask a healthy and happy boy which he'd rather be, President of the United States or Bluebeard, King of the Pirate Band and his vote will be cast gusto for the latter. My boyhood ambition was to be motorman on an electric car and even now I nurse a hidden longing to have just one try at this interesting occupation.

And since most boys are biased toward the exciting occupations of life it is not to be wondered at that it is a difficult matter for us grown-ups to see why our own sons cannot be enthused over being ministers, lawyers or great politicians, for we are civilized.

To my mind this is our greatest problem, *how* to interest the boy in what we want him to be, rather than *what* to interest him in. You cannot teach a plum tree to produce peaches, though you can produce apricots if you work hard enough. But the apricot is neither a plum nor a peach, and to my mind it is inferior to either.

This same thing applies to the teaching of the young man. So long as the boy is wholly interested in being a bold highwayman or pirate you are working against stubborn resistance if you try to make him into a minister.

But the resistance is even greater in some cases. I have one friend, a young fellow of about 15 years of age who is intensely interested in machinery. He comes over to my house to "play" with me as I work in my machine shop during my spare time. He can handle my power tools like a veteran and far better than the average man. He could be trained to be a wonderful mechanic and yet his parents insist that he become a teacher, just like his father is. Perhaps this explains why we have so many utterly poor teachers and so many bad mechanics.

That boy will never be a good teacher, for his interest will never be in his work but he would make an excellent mechanic. There are, doubtless thousands of boys who would make excellent teachers but their parents, who are interested in mechanics, insist that they become machinists.

The secret for success is not always ability—hard work will not always bring good fortune. The real receipt for making success is easily stated. Engage in some kind of work, any kind of work, that you like, a work which holds your intense interest, and only then will you make a success of what you do.

If the average boy put one tenth the effort into his work and study as he puts into his sports of base ball or football, he would be a prodigy. If he put that much effort into his work later in life, he could rule the business world.

The reason for his enthusiasm in his play is simply because of his interest. He will grub in the ground all day playing football, dance all the evening and spend the night reading an interesting novel and still feel fresh as a daisy the next day. If he would interest himself to that extent in his work—the answer is too obvious to state.

And so I advise all of you who have sons, to watch them carefully, try to find out what their interests are in and do not try to make poor blacksmiths out of good doctors, or lawyer material. Don't try to make an iron worker out of a boy who hates metal and loves cloth. If your son wants to be a tailor, is interested mostly in that work, see that he is encouraged and helped along this line, for you cannot make a smith from a tailor.

If your boy likes metal and finds fun in tinkering with machinery, then you can take steps to make a blacksmith out of him.

Now when I say blacksmith I really cover considerable more ground than the term usually covers. I really mean a man who works and knows metal. I can safely say that metal working is a wonderful trade and one which can easily be worked for a fortune.

Teach your son all you know about forging, welding and tempering. Make him interested in the metal itself and let him ask questions. Provide books for him to read on the subject. When he welds two pieces of iron together ask him why they stick and let him dig out the answer. When he tempers a piece of steel, ask him what happens inside the metal to make it harder on the surface.

A man who really understands iron and steel can command his own salary, for the heat treatment of steel to produce toughness and hardness is one of the most important industries of today.

When your son knows the blacksmith game he has a good foundation upon which to build. I know of no better trade in the world to train a boy's ingenuity and muscle than this. Mentally and bodily the blacksmith trade is a help and when your son starts with a clear eye, a good constitution, a quick brain and the brawn to back him up in his work he is well fitted to fight the business world.

A Profit on Your Work

IN THIS issue we publish an article relative to the figuring of prime costs in the blacksmith business, written by Mr. A. W. Jordan. The article should be read carefully by every subscriber because it contains so many valuable suggestions. But though this article is complete so far as it goes, we feel that there remains much to be said and explained.

We have said much in the past about making time into money. An hour or a day of time is worth only as much as it can be sold for and unfortunately it is almost impossible for a blacksmith to keep busy every working day in the year. He cannot stop eating or breathing just because there is no work for him to do and his family must be supported during the dull times as well as when business is good.

And so the blacksmith must count upon selling his year's time for at least enough to keep himself and family alive. He cannot figure upon an arbitrary value for each hour, he cannot say that his time is worth any particular sum of money unless he knows just how many hours he will be working.

There is but one way to fix prices for your labor and that is to decide upon what you must earn for the year and *divide it in such* a way that each job done bears its proper proportion of this charge.

Unless you do as Mr. Jordan suggests you cannot know, for sure, whether you are getting enough for your work or not. You *think* that you should charge a certain price for mending a plowshare, you have been influenced by the price of some other smith who is also guessing at the cost and possibly he is wrong. If you know the prime costs, the lowest price at which you can possibly afford to do the work, you cannot make a just charge against your customer.

"But," you will ask, "how am I to meet my competitors when they undercut me?" The question is natural but we feel that we can give you a satisfactory answer.

Suppose you are in possession of all the facts relating to your business and can fix your prices absolutely at their lowest point to make money. You can go ahead with your work knowing that you cannot go bankrupt or lose money so long as you keep the prime costs in mind. Let your competitor do the work which he is cutting the price upon for he is losing money on it and taking the quickest way to destroy himself. He cannot hold out and do business at a loss nor can he undercut all of your prices and still survive long.

Stick to your prices at which you can make a fair profit and do not hurt yourself by doing work at less than cost and in the end you are bound to beat the other fellow.

Something for Nothing

THE writer has but recently interested himself in the pastime of truck gardening. Just why anyone should ever think of applying the word "truck" to this art is hardly clear, rather it should be called "basket" gardening for the proceeds hardly would fill a berry basket, much less a truck. But then, as we think the matter over, perhaps the "truck" part refers to what is put into the garden rather than what is taken out and if this be so, then our editorial garden is by way of being a twin-truck garden for no single truck living is large enough to hold the seeds, fertilizer and time we have expended upon it.

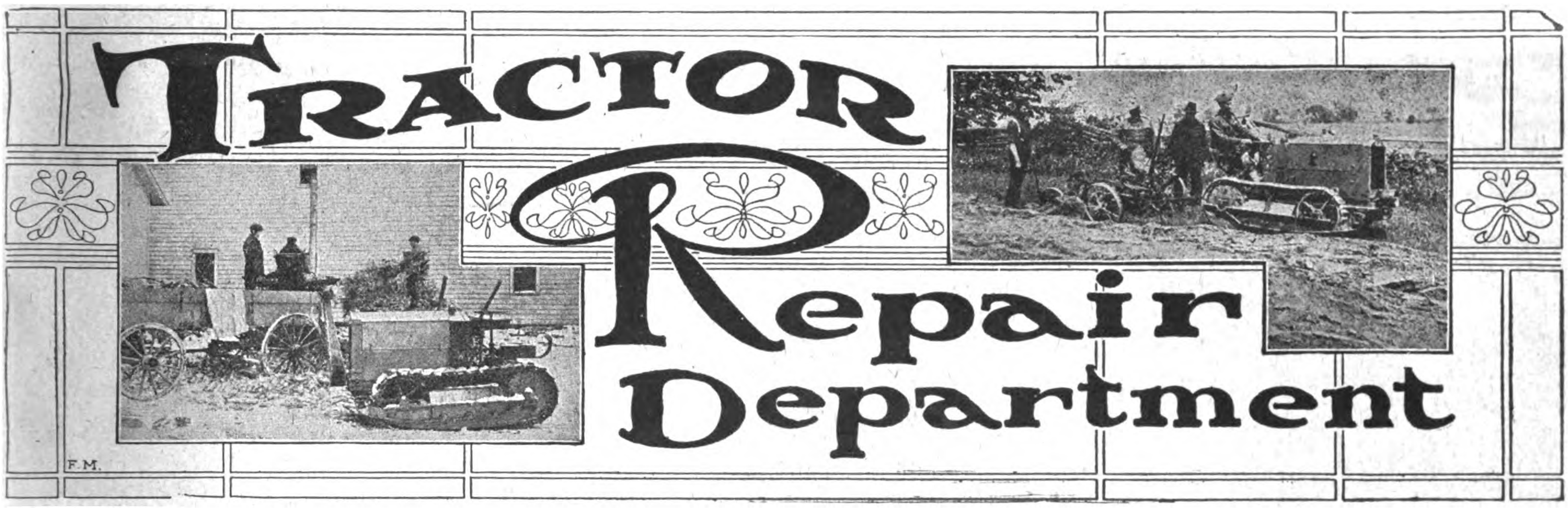
Perhaps the garden is up to normal production and we are not clever enough to reap the harvest. Most of the cut worms we dig up from time to time seem to be in excellent condition, but then, we do not care for worms as a general diet. Of course we might shoot the birds, those big fat ones, which seem to be so extremely interested in this same garden and in this way obtain some returns from our investment. A good, corn-fed-bird pie might go well, but even that diet might not satisfy and besides when one's appetite is all set for fresh string beans, a bean-fed robin tastes little different from one fatted upon worms.

If we could only train the robins to eat the cut-worms we would accomplish something, but this is not what we started out to say and we doubt if any but a real robin-tamer could help our garden much anyway. What we started to say was that among other things, lime and bone meal and acid phosphate and paris green and seeds and so on we were forced to purchase such things as hoes, spades, forks and goodness only knows what not. It takes as many garden tools to cultivate ten square feet as an acre.

And that brings us right down to brass tacks, why couldn't the blacksmith make considerable money out of his junk pile by converting it into garden tools? Take the ordinary lawn edger, for example, it is nothing but a half circle of steel mounted on a wood handle. An old disc from a harrow would make two such edgers and we doubt but what a good smith would spend more than 20 minutes on the job.

And what's the matter with making spading forks from the steel arms of old horse rakes? One rake blade should furnish enough steel for each fork, and a good fork costs nearly $2.

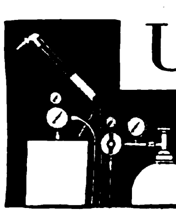
If we were anything but just a mere Editor we'd spend our spare time reclaiming the junk from a blacksmith's junk pile rather than in our truck garden fighting everything from birds to mosquitoes.



Filler Rod Manipulation

Little Attention Very Often Paid to This Important Part of Work

By DAVID BAXTER



USUALLY the student welder is taught a great deal about adjusting, regulating and manipulating the welding torch and its flame. He is cautioned again about keeping the flame regulated, and as a general rule no pains are spared to instruct him in the art of handling the flame in relation to the melting metals, and in its relative size according to the weight and kind of metal to be welded.

In fact, it can be truthfully said no doubt, that every apprentice welder and every student of the welding schools graduates with a fair knowledge of this part of the oxy-acetyline welding trade. As a result probably all beginners have a good working knowledge of the action of different molten metals under the welding flame.

Other Items of Importance

This is all very important and as it should be but there are other items so closely allied to flame manipulation as to be almost a part of it; in fact of very little less importance. They seem, however, to form a subject which is often neglected by welding instructors. Some of them seem to take it for granted that the beginners will naturally assimilate the idea as they go along, or that the only thing necessary to know about manipulating the filler metal is that it is to be fed into the melting weld.

For it is to that we refer: The manipulation of the filler rod. All welders should know that there is a certain technique in handling the rod just as much as there is to the operating of the torch and flame; that the placing of the filler metal is just as important as selecting the right size and kind for the job at hand.

Using Filler to Advantage

The beginner may learn that the filler rod can be manipulated to an advantage or adversely to the interest of the finished weld. That is, he can handle the rod in a way to make the melting easier, and better, besides avoiding the chance of spoiling the weld. Not only will he be able to make the work less laborious but will be able to gain strength and solidarity in the joint. The laying and mixing of the filler is equally important with the melting of it.

Fig. 1. The brazing rod resting its weight in a vertical position.

Now it is with the foregoing ideas in view that this article is written. An effort has been made to correct what may be a wrong impression and at the same time furnish a basis for working out a better system of instruction in filler rod manipulation, in the depositing and saving of metal as well as the factors of time and labor.

Consider first generalities: The novice usually grips the filler rod with what might be termed a death grip. He exerts considerable muscular power and as a result soon tires. If long continued, the action puts him in such shape that he cannot obtain the deft touch so often needed.

The continuous tension of his fingers and arm muscles renders his movements jerky and uncertain and he is unable to execute the rhythmic rotating or twisting motion necessary to make the molten filler mix with the melting weld metal. Even though he finally becomes accustomed to the strain he probably will not acquire the sure touch so essential on many jobs.

The whole idea might be compared to writing, since anyone knows how tiring it is to write with a tight grip on the pencil and the muscles contracted. The action is cramped and the writing poor, without rhythm and without deftness.

An experienced operator holds the filler rod in his fingers lightly, almost with a show of nonchalance. His muscles are normally loose, but ready for instant action when it is necessary. He is ready to flirt a bit of slag out of the bath, or employ the quick knitting twist necessary to break up the oxide and flow the metals together. Usually the rod is held in the left hand, which makes it that much more difficult to guide when the arm and hand muscles are tired.

Another part of the technique of filler rod manipulation is the holding of the rod at a certain angle or in a certain position. Some authorities urge the holding of the rod at a certain angle to the flame and molten bath while others recommend some other angle. Some favor a sawing movement in preference to twisting or churning.

With due regard for preference the writer of this discussion does not favor any particular one as a fixed rule. In fact he does not believe the beginner should permit himself to become "set" in any form of rod manipulation, but should endeavor solely to make the filler work in harmony with the flame and with the melting condition of the weld.

Watch Flame and Weld

In other words, he should watch the flame and the melting weld and adapt the manipulation of the rod to their actions. Sometimes it may be necessary to hold the rod perpendicular, sometimes at a wide angle, and other times almost parallel to the line of welding. If the weld melts slowly or rapidly, or readily, or with difficulty, the rod should be handled to suit that condition.

The feeding of the new metal to the weld is a matter of some little skill, too, in spite of the general indifference which seems to be the custom. The rod should be fed into the melting groove of the weld as gradually as possible, with no prodding or twisting as long as it is flowing freely. The filler is fed in where the weld is ready to receive it and not forced to pile up where the job metal is in no condition for it, and when essential to clean the weld of dross or slag it should be thoroughly done and the feeding process resumed.

If the rod size is correct and the proper size flame is employed for the kind and thickness of the job, then the filler should flow in systematically and precisely, not haphazardly, in splotches.

Brazing as an Illustration

The best illustration of this, perhaps, is in brazing. In that case the filler metal must be spread evenly and quickly. It must be applied when the fracture is in the right receptive state. It must be applied freely, since brazing is merely an adhesion; where the filler metal is not mixed with the casting metal. The filler is often piled up along the joint to lend added strength.

In brazing it is essential to hold the rod lightly and manipulate it deftly. The weight of the rod itself is usually sufficient, with only movement enough to spread the molten bronze. When possible, the rod is held in a vertical position and allowed to rest with no other pressure on the casting. Then the flame is manipulated to prepare the surface of the casting and at the same time melt the rod.

This is well illustrated in Fig. 1 which shows the brazing of a wire wheel hub. The rod is balanced on end while the flame spreads it out over the surface of the hub. Movement sufficient to keep the brazing continuous is all that is employed, with now and then a quick dip in the flux pot, which is handily placed within reach of the torch operator.

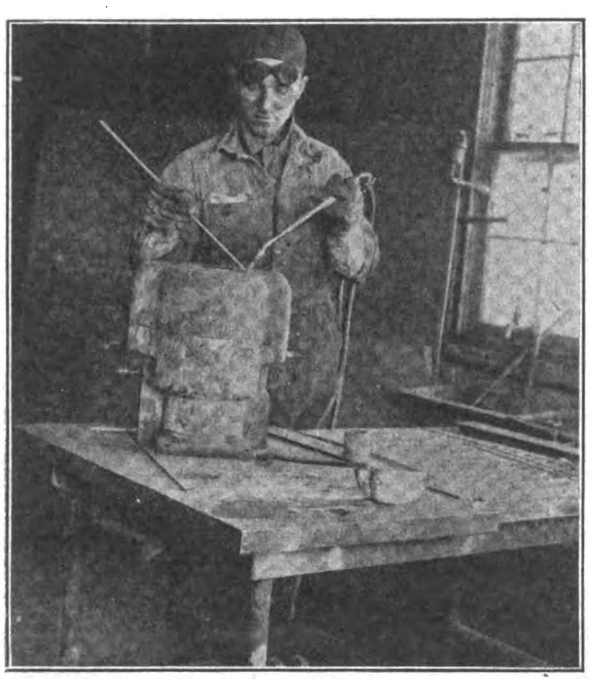


Fig. 2. Method of holding the rod at a wide angle with the torch in the left hand.

Of course in overhead brazing or vertical work, the welder must grip the rod, but even then he can catch it nearer the middle where it will balance and thus relieve the strain. Where an extra quantity of brazing filler is needed the rod is allowed to drop to an angle to one side or the other while the flame is played directly upon it, or the rod is moved farther away from the flame, when a smaller amount of filler is needed. These, however, are merely cases of making the flame and filler work in harmony as mentioned above.

A "Stunt"

Sometimes an ingenious welder will shift the torch quickly to his left hand and manipulate the rod with his right. This is illustrated in a posed picture captioned Fig. 2. The position of the rod at a wide angle is also clearly indicated. Such a device is often employed on a heavy job where it is not feasible for the welder to change positions, or in close quarters where he must make the weld all from one direction; he cannot melt properly without shifting the direction of the flame and so must shift the torch to his left hand.

The wide angle approach is employed principally where the V-groove is deep. It permits the operator to melt larger quantities of the filler and at the same time twist the melting rod into the molten sides of the sloping groove; an effect which is sometimes gained by holding the rod parallel to the line of welding but still in a wide angle position, rolling it gently over in the trough as the two metals melt. Meanwhile the flame is played over both to bring them to a molten state in unison.

Weld Worked Downward

Fig. 3 shows the relative positions of the torch and filler rod when welding a vertical seam on sheet metal where the sheets are butt-welded. In this the weld is worked downward with the torch leading the filler. This is no doubt the best method, since the metal may be all kept alive and thus prevented from dribbling down over the part already finished as it tends to do when the direction of the welding is upward.

The rod metal is applied to the joint only as fast as it is needed and the force of the flame is utilized to guide and shape the molten metal. Thus in blowing upward it tends to prevent the filler from running down to clog the unwelded portions of the joint.

Deft Filler Manipulation Necessary

Then sheet metal welding, particularly the butt-welding style, requires exceptionally deft filler manipulation. If the rod is clumsily handled, or pressed too heavily upon the joint, the weld will present a rough, unpleasant aspect and will be more apt to warp. There is also great danger of melting a hole through the sheet; or at least pushing it through with the rod if this is handled stiffly and awkwardly.

Practice Required

Most of the ungraceful handling of a filler rod is overcome by practice. The torch operator acquires self-confidence and graceful poise by the right kind of practice after he is given the idea of how to go about it. The flame and filler swing in harmony until they seem to be almost a part of each other. The operator becomes so accustomed to handling the torch that he unconsciously swings the flame without effort at precision. The flame advances and retards with the application of the filler.

Difference of Opinion

As stated in the beginning of this discussion, one welder will advise one thing while another favors the opposite. Where one prefers to weld toward himself along the fracture, the other prefers to weld away from himself. Still others weld sidewise along the joint with the filler rod leading or following according to their custom.

Generally it seems to be only a matter of personal opinion, although there are arguments in favor of either course; there are times when one or the other is the best. Probably the position of the casting requires certain methods, or some projection may interfere with other procedure.

No Set Rules

It is these things the student should be taught as well as the actual mechanical elements of the trade. He ought to be able to adjust himself to unexpected situations without loss of time.

The best advice to beginners in regard to filler rod manipulation may possibly be not to form any fixed habits but to handle the metal according to the way the metal reacts to the heat of the oxy-acetylene flame. That is to manipulate the filler rod in conjunction with the flame and according to the needs of the melting.

In other words, adopt no special method of handling a filler rod for all clases of work. Be ever ready to shift from one style of

Fig. 3. Relative position of rod and torch when welding down a vertical seam.

technique to another several times during one job if necessary. Above all, the novice should be cautioned that the manipulation of the rod is a part of the trade as much as regulating the flame or handling it.

By watching the conditions of the flame and metals the welder can often save a deal of time and worry. He learns to handle the weld by instinct, as it were. He makes the necessary changes without conscious effort. He knows the proper angle to hold the filler without having to stop and reason it out. He shifts from one position to another with no mental effort, so to speak. Then he has mastered two of the main elements of the oxy-acetylene welding process.

THE REASON

"Why do you carry that umbrella, little boy?" said the kindly old gentleman. "It is not raining."

"No, sir."

"And the sun's not shining."

"No, sir."

"Then why do you carry it?"

"Well, when it's raining, pa wants it, and when the sun's shining, ma wants it, and it's only this kinder weather I can get to use it at all."—*New York "Sun."*

STUNNING RETORT

When the woman motorist was called upon to stop, she asked, indignantly, "What do you want with me?"

"You were traveling at forty miles an hour," answered the police officer.

"Forty miles an hour? Why, I haven't been out an hour," said the woman.

"Go ahead," said the officer. "That's a new one to me."

TRAGEDY RECIPE

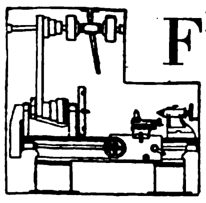
Take one reckless, natural born fool. Two or three drinks of bad liquor. A fast, high-powered motor car.

Soak the fool well in the liquor, place in the car and let him go. After due time, remove the wreckage, place in black satin-lined box and garnish with flowers.—*Pure Oil News.*

Prime Costing for the Smith

Read the Editorial Regarding This Article. Then Read the Article

By ARTHUR W. JORDAN



FROM correspondence in this journal from time to time, one finds a great disparity in the prices charged for the same work, and the temptation to doubt the necessity for this becomes very strong. Much stronger grows the doubt whether many smiths go to the trouble of finding out their prime costs for any of the jobs they do. If they did this, and did it carefully, there would be surer grounds to go on when pricing and the disparity referred to would very largely disappear.

Unfortunately many smiths treat this matter very lightly even when they do consider it. They say, "My rent, taxes and expenses are so much, I have a wife and so many children to keep and I have one or more assistants to pay. I find my balance at the bank is a bit more now than it was this time last year and having lived well and paid my way, I suppose my business pays." And there the matter ends.

"Armchair Work"

But it should not do so. What is wanted on this job is a bit of armchair work. Many will say they have not enough time for this, but it is of no use to work as much as a horse through thinking as little as an ass. If the armchair is only properly used it will save time, money, and disappointment with one's labors. Here are a few nuts to crack in that easy chair and it will be just as well to crack them and get out the kernels, then to well chew them over and assimilate them. Then perhaps the costing question may assume a different aspect.

First of all you have been saying you have a wife and "umpteen" children to keep and *you* have fancied that is quite an important matter. Nothing of the kind! What is more important to you is that your competitor has only one child to keep or is a single man. Even that ought to have nothing to do with the matter.

It is not a question of children, but of men and what they can do and the time they do it in. Neither is it one of the wages you pay but of what you get for them, although it is up to every employer to pay a proper wage—not a mere living wage but one on which a man can live a self-respecting life.

Now having drawn the easy chair up and ruled the little ones out of the matter, let a few moments be devoted to considering some points blacksmiths too often overlook. First of all do you keep any books at all? If not, why not? You can read and write, of course: Very well then, instead of using chalk on the door or a pencil on a slate, get a book and put down every job you do next week. Do not put anything else down just for that one week except the amount you are paid, or are to be paid for each job.

Does it Pay for Week's Work?

At the end of the week reckon it all up and see if it pays you for your week's work. If you keep a man or two take out their wages and see what is left. That is not much trouble and now you have got in your foundations for a proper understanding of the position and we can begin to build up a method whereby you can see if every job pays or not.

But the figures left after deducting wages are of little account yet. There is some material, iron, tool steel, fuel, etc., to be reckoned.

"Have not bought any this week," you say. Well, that will not do. If you had what is to be done with it? Most of it is unused so it cannot be dumped down to this week's account. If it were your week's work would not pay.

And that brings us to the first point the writer has taken this simple way to drive home. You cannot put down your materials for any week you buy them. The little book you have made up is misleading, yet that is the sort of thing lots of smiths do when they start bookkeeping. Nevertheless, it is a foundation so go on with your little book and enter down every job and the price you are paid for it.

Get Another Book

Now get another small book and go over your stock of iron, steel, fuel, oil, tools and implements of all sorts, plant, machinery, etc. Jot them all down under their several headings, drawing a line above each total. Under the latter enter up all new stuff you buy during—say six months. At the end of the six months add up all the items. Do the same with your men's wages and your own. Just a word about the latter. You will say, "Oh, what is left over is mine." Is it? Well, that is no way of doing the job. What would you have to pay for a foreman or managing smith if you employed one? Reckon yourself at the same rate, if that description fits you, and put it down each week and do not forget the boy, apprentice or errand lad if you employ one. All who receive wages must be included.

If your business is mostly small jobs carrying no great weight of material on any it may often have been a trouble to calculate what a job was worth.

A Rough and Ready Way

Here is a rough and ready way that will be fairly accurate and will prevent great differences between similar jobs when trying to arrive at the cost. At the end of the half year, reckon how many working hours your shop has been run. With a 48 hour week it will total 2496, less holidays when the shop is closed.

Now reckon up all your expenses—raw material, wages, including your own, etc., and total them up. The total is the cost of running the shop for 2496 hours and the cost per hour can be obtained from this. Having found that, it is easy to see if a job is paying from the time it takes. Of course, for big jobs taking much more material, something closer than this is necessary but this is an excellent rough and ready way that is fairly accurate for such repetition work as shoeing, resetting, sharpening plow lags, etc.

Wear and Tear of Machinery

Even if less material is used on some of these jobs to what there is on others, there may be more wear and tear of machinery and tools, so the time value hits both very close, although discretion is necessary in every case in reckoning up costs in such a manner. There are some little matters that need clearing up, however, to prevent mistakes in getting figures that may be misleading.

For instance when estimating the cost per year or half year for standing plant, tools, machinery, etc., do not forget to first take off these, whether newly bought or old stock, a proper amount for depreciation. For a year or so this has to be estimated, but after a period of five or six years this can be figured quite accurately from existing figures.

A fair amount for this is from 25 to 35 per cent. This is the cost per year of using such things because you still have them in stock and they could be sold for a certain sum according to condition, so you do not charge their value, whether new or old, up to cost, but charge all repairs, sharpening, etc. With material it is different. You add your buyings during the period to the old stock and from this total, you deduct what the total was last time. From these figures you get the value of the material used and these are the correct amounts in this case. With tools, etc., it is best to check over the percentage from actual figures after a lapse of time sufficient to provide them reliably.

Do not forget rent, taxes, lighting or other expenses. Keep these together, and you will then be able to see from year to year what these are and whether they get higher or lower. This is always a good thing to know and a part of the business to keep your thumb on. It is a good thing to measure these against your yearly turnover and to strike a carefully calculated percentage from it.

For instance, if your turnover is $5,000 and these expenses total up to $500, that is just ten per cent, and that will answer even if they do not quite reach that figure. Put this percentage on the cost of any special job it is necessary to find the cost of specially.

An Example

For everyday small jobs, suppose you wished to calculate the cost for a set of shoes that were a trifle out of the ordinary. You would simply reckon out the time to within five minutes and that at so much per hour would give you the cost fairly near.

It would be based on the average cost per hour it took to run the shop and would never let you down if the averaging had been properly done. To calculate the exact cost of every job a smith is called on to do is impossible and, indeed, unnecessary, but it is very important to have something to go on and this is better than most of the usual methods met with.

For larger jobs, taking days to do, the proper way is to take all labor costs separately, all materials, tools (if any used out on the job, if not an average), a percentage for expenses, together with any special ones such as car fare, etc. Do not forget to reckon your own time at so much an hour, for all your labor devoted to the job. Then add a reasonable profit according to the nature of the job.

Out of Common Jobs

If called out of bed in the middle of the night to enable someone to continue a journey after a breakdown, do not forget that deserves a very different rate of profit from a little humdrum job in the middle of the day. If a tool is used out or broken on a large job charge that up, and all repairing and sharpening made necessary by the nature of the work should be put down to cost, but not new tools unless used out. Do not forget fuel; too often this is overlooked with other minor expenses. Remember them all, or you may lose on the job.

RULES OF THE ROAD—TOKIO

(Posted in Central Police Station)

1—At the rise of the hand of the policeman stop rapidly.

2—Do not pass him by or otherwise disrespect him.

3—When a passenger of the foot hove in sight tootle the horn; trumpet at him melodiously at first, but if he still obstacles your passage tootle him with vigor and express by word of the mouth the warning "Hi Hi,"

4—Beware the wandering horse that he shall not take fright as you pass him by. Do not explode an exhaust box at him. Go soothingly by.

5—Give space to the festive dog that shall sport in the roadway.

6—Avoid entanglement of dog with your wheel spokes.

7—Go soothingly on the grease mud as there lurks the speed demons.

8—Press the brake of the foot as you roll round the corner to save collapse and tie up.—*Bus Lines.*

Smith Shop Auto Repairs

How Mr. Farley Overcame A Number of Difficulties

By JAMES F. HOBART

EBENEZER Farley wasn't an automobile mechanic. He didn't claim to be one but he did claim to be as good a blacksmith as he was a Yankee, and though that's saying a good deal, Eben lived right up to the work in good shape, as well as singing in the church choir Sundays and being "First Select Man" the rest of the week.

Eben claimed that he had been "pestered" with a lot of work from automobiles which wasn't smith-work at all, but he figured out ways of doing the jobs which came and soon found that he could get a deal more for his time on auto-work than he could at horseshoeing—when there was any—and that the more of the auto work he did, the quicker he was able to turn out such work.

One day a man brought into the shop a little air-pump from a 1914 Cadillac car; the whole affair didn't weigh two pounds and looked about as shown by the engraving. The customer asked Eben to dress the seat for the little ball valve which prevented air from blowing back through the pump. It was found that somebody had tried to dress the valve seat by cleaning it up with a common drill, the result being that the ball could not be made to seat tightly.

Correct and Incorrect Valve-Seats

As shown by the engraving, the ball laid in a tapered seat, thereby giving the ball-surface a very long leak-line, a surface which necessarily must have considerable width as well as length and is therefore, very hard to fit tightly to the ball and still harder to keep tightly fitted.

One of the small sketches shows a correct ball valve seat. It may be seen that the seat is flat and comes almost to a sharp corner where the ball bears. A ball seat should be fitted thus whenever possible, then the ball will have a very short and narrow bearing and will be easily kept tight upon the valve-seat. In this case, Eben did not dare to do much to the ball seat for fear of cutting through into the body of the pump as the hole had been cut in far too deep with an ordinary twist drill where a square-end tool should have been used, either a countersink or an end mill.

Not daring to square down the hole, Eben thought he would run in a drill about three-sixteenths inch in diameter, then square down the bottom of the hole to a sharp corner at the enlarged hole as shown by the lower small sketch. But tools had to be made for this and the car owner got into such a hurry that he could not wait for the tools to be made and told Eben to:—"fix it up someway, right off!"

Eben determined to grind the ball valve seat with emery and oil and thought of soldering a broken drill-shank to the ball in order that the grinding might be done quickly with a bit-brace for rotating the grinding tool. Before beginning the soldering, he thought of a bit of brass tube into the end of which the ball might be driven hard enough to stand under the stress of rotation.

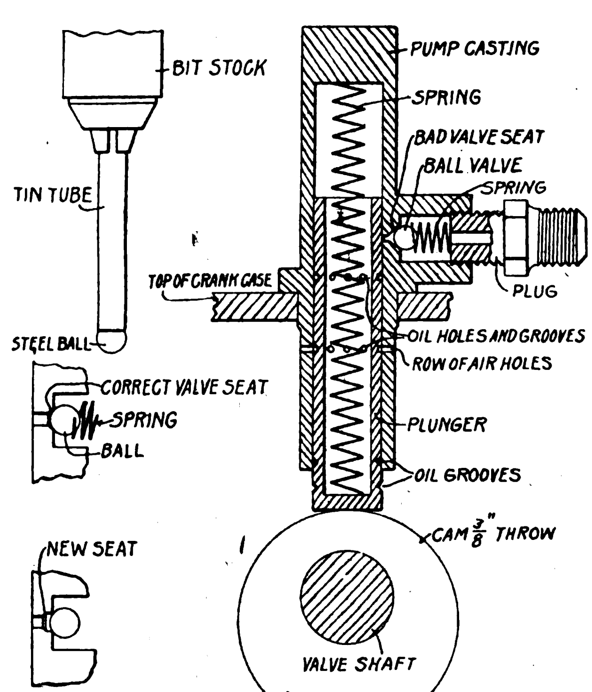
But no tube of proper size could be found, so Eben cut a strip of tin from an empty tomato can, rolled the tin into a tube and soldered it a little smaller than the ball, which was then driven into the end of the tube and the solder promptly tore apart and let the ball loose. Then Eben cut another strip of tin and gave the tube a quarter-inch lap, which was well soldered and did not tear apart when the ball was driven into place as shown by the upper left hand sketch in Fig. 1.

A bit of round steel rod of proper size was driven into the upper end of the tin tube which was placed in a bit-brace as shown and with the device, the valve-seat was quickly ground to a fit to the ball which was removed from the tube occasionally and turned around so as to offer new and fresh surface to the seat, lest the ball be ground away so much that the valve-seat would be given a distorted surface. A new ball was used as a valve.

Eben found that when the tube-end and the ball were daubed with the grinding material the ball hung in the tube-end much more tenaciously. Coarse emery was used at first. Eben had one of the handy short round tin boxes with a screw cover on each end and a partition midway in the length of the box. One end was filled with coarse grinding material, the other end, with finer material with which the finishing touches were given after the coarse emery had roughed the valve-seat down to a fair condition. These double-end grinding-dope boxes should always be procured. They are very much more handy than having two grades of valve-grinding material in two separate boxes.

A Remarkable Air Pump

"That ball valve won't stay tight on its seat very long" Eben cautioned his customer. "There's too much valve-seat for the ball to fight tightly very long. But you don't need a valve there anyway. That air pump which maintains a couple of pounds pressure in the



Gas-Tank Air-Pump

gasoline tank is a mighty ingenious bit of mechanism and it can be made to pump up either pressure or vacuum as desired, and there is not a valve or a ring in the whole business!"

The little hollow plunger is at all times forced against a cam on the valve-operating shaft of the engine. The came as shown, gives the hollow plunger a movement of three-eighths inch and pushes the plunger in flush with the lower end of the pump-cylinder. There are two little oil-grooves on the lower end of the plunger and one of these grooves is always inside of the pump. The other groove is in the engine crank-case part of the time and is splashed with oil by the engine cranks.

There's a ring of small holes drilled through the pump cylinder and as shown, these holes come flush with a corresponding ring of holes through the walls of the hollow plunger and air is sucked in through these holes by the slight partial vacuum formed inside the pump cylinder and plunger during the outward stroke of the latter.

When the plunger is pressed inward again by the cam, the charge of air is compressed slightly as the plunger reduces the space inside of the cylinder during the inward stroke. When the upper row of holes in the plunger arrives opposite the hole leading to the ball valve and hollow plug, the slight compression of the charge of air sends it past the valve into the pipe leading to the gasoline tank. In this the little pump always maintains about·two pounds pressure to the square inch.

The pump can never work up more than two pounds pressure for the reason that the compression of the incoming charge inside of the cylinder and hollow plunger can never rise above two pounds, owing to the large clearance space inside of the apparatus.

"It's a beautiful bit of mechanism," said Mr. Farley to his customer. "By blocking up the pump body upon the crank case to a height of three-eighths of an inch, so the upper row of holes in the plunger will come even with the row of holes in the cylinder, the top end of plunger will come just fair with the hole to ball valve and plug, and operated in that position, the pump will exhaust air from the gasoline cylinder instead of maintaining a slight pressure therein!

"Yes, the device is surely an interesting one. Not a valve in it, and there should be very little leakage through the oil-filled space between cylinder and plunger, so it doesn't matter whether there is a valve in the pipe or not."

Locking a Pipe Coupling

A customer came several times to Mr. Farley with oil pipe troubles. There was a screwed coupling in the oil-tube, where a break had occurred some time or other and the coupling persisted in working loose, no matter how well it was tightened up. After several tightenings and getting loose again, Mr. Farley took down the coupling, unscrewed both ends and washed it clean with gasoline—not with kerosene oil—then he daubed the threads and the parts where the coupling bore against the tubes, and anointed those parts thoroughly with the emery and oil used for grinding-in valves. He used the coarser mixture and then screwed the coupling home upon the tubes with the mixture between them and in the threads. Later, he told the writer that the coupling had never come loose again.

Forcing Obstinate Screws

Frequently it is very convenient to have a screwdriver with a squared body or shank instead of a round one. Then, when obstinate screws are met with, they may be started by slipping a wrench over the squared portion of the screwdriver and thus applying more stress than is possible through the usual wooden screwdriver head or handle.

Mr. Farley had two very good "kinks" in this direction. Some of his screwdrivers had a metal ferrule fitted tightly around the wooden head or handle and a three-eighths hole had been drilled through the handle and the ferrule. The steel bar used with a socket spark-plug wrench fitted the drilled hole which was made purposely of that size, and with the steel bar slipped through the screwdriver handle, a great stress could be exerted to start a refractory screw and the steel bar also permitted a greater holding power to keep the screwdriver in the slot of the screw.

Mr. Farley used other screwdrivers which had regulation round shanks and wooden handles, with great turning power by simply gripping the round steel shank with a pair of pliers, taking hold as close to the rivet as possible. He found that in this manner he could almost break or shear screw-heads or even break them off, so great was the turning power obtained by the handy plier-leverage thus brought into use.

When Mr. Farley had to remove screws which had slots so badly worn that the screw-driver kept slipping out, he wasted no time with them, but took the screw-driver in both hands, pressed it solidly into the slot, braced his full weight against the tool and called his assistant to turn the screw-driver with a wrench applied to a squared spot on shank of the tool.

In this way, the worn screw was quickly backed out until it was an eighth of an inch above the surface surrounding it. If other worn screws were found, they were all treated in the same manner, then Mr. Farley dismissed his assistant, took down a hack-saw and sawed each screw-slot just a little deeper so the screw-driver could get hold of square shoulders at its point, if nowhere else.

Mr. Farley had another hack-saw handle which he kept at all times with two saws fitted therein, side by side and close together. When a single blade was too thin to "clean out" a screw-slot, the double saw would do the business in short order.

For a screw with a very wide slot, a strip of thin tin was slipped between the saw blades and for screw-slots too wide for a single blade and too narrow for the double affair, Mr. Farley would hold a strip of tin in the slot and run the hack-saw down beside the tin. It was badly scratched and scored by the saw, but the slot was cleaned up on one side and when the operation was repeated with a thicker bit of tin, the other side of the screw-slot was cleaned up also.

Clean the Screw-Slots

As stated, "cleaning-up" the screw-slots was done with the screw-heads protruding about an eighth of an inch from whatever they were driven into. Thus each screw was held as firmly as if in a vise, which tool doesn't always hold screws firmly without flattening them a bit. This, of course, does not improve their driving at all. When Mr. Farley had to use old screws with bad slots after the screws had been removed from their holes without sawing, he squeezed each screw between two bits of hard wood, in a vise, and was then able to square up the screw-slots with his hack-saw in short order and without in the least damaging a screw and without its slipping in vise-jaws under stress of hack-saw pressure.

MR. SHEEHAN'S SHOP

We print below a circular Mr. Wm. Sheehan sends out.

IN AUGUST, 1914, William Sheehan, coming here from Ely, Nevada, opened the first Oxy-Acetylene Welding plant in the State of Idaho.

Eight years ago, there was little demand for an expensive plant of this character, and it took several years of patient effort to demonstate the great economic value of such a concern in the Upper Snake River Valley. Not only were people skeptical of the value of this kind of machinery repairing, but there was little volume of this kind of work in this section of the state. Mr. Sheehan did a great deal of constructive advertising, was conscientious in his work, and gradually demonstrated the greatness of the saving to machinery owners that could be effected in the repairing of broken machinery parts.

The business has grown rapidly, until today he receives business from Red Rock, Montana, to the Cache Valley in Utah, and from Jackson, Wyoming to Challis, in Central Idaho.

This shop is today one of the best equipped welding and radiator shops in the intermountain country. This plant is prepared to handle the largest and the smallest of castings and broken machinery.

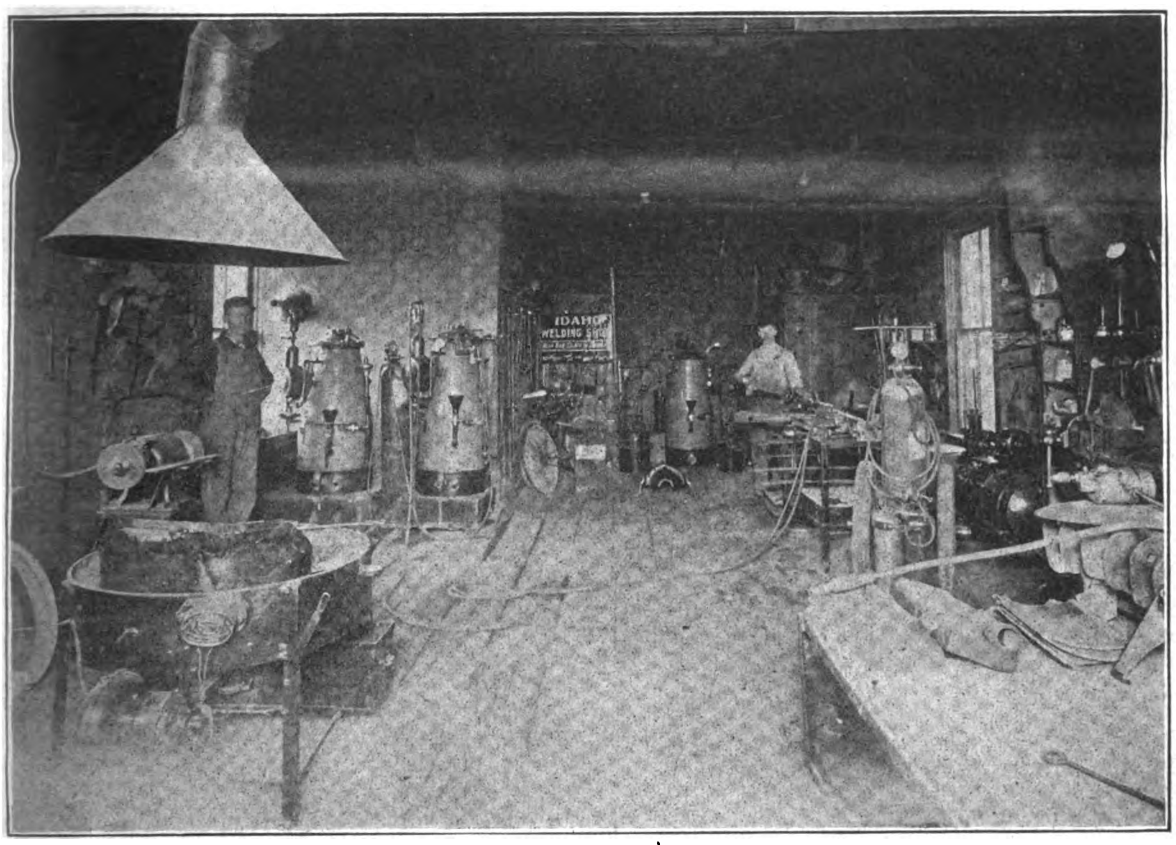
The radiator department is prepared to install radiator cores of four of the best guaranteed makes on the market.

Mr. Sheehan has, in the past few years, repaired castings and heater sections, weighing tons. Broken auto frames can be made as good as new; he builds up scored cylinders, without heating; welds Ford motor heads without warping, and in fact has prepared himself to handle the biggest to the smallest sort of metal that can be economically repaired.

This service of Mr. Sheehan's has meant a big economic saving to every machinery owner in the Snake River Valley. Frequently parts have been welded and repaired, that ordinarily would need to have been thrown away and new parts installed, that would have cost hundreds of dollars. The repair bill amounted to little or nothing in comparison.

Recently a new addition has been built to his building and auto and truck owners can drive their cars into his shop and have broken frames or other parts welded in short order.

Mr. Sheehan has built up a fine business and developed his plant to its present efficiency through following a policy of charging a reasonable price for his work and giving the public a square deal at all times. A strict guarantee goes with all work turned out of the plant, and he cheerfully makes good any work that does not come up to standard.

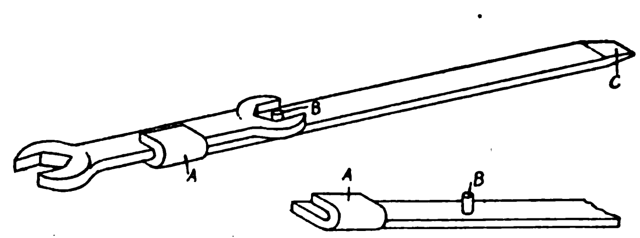


A photo of Mr. Sheehan's Shop

WRENCH EXTENSION HANDLE

By Chas. H. Willey

A VERY useful tool for giving added leverage to double end wrenches can be very easily made, as shown in the sketches.



A piece of flat stock A is cut and bent over at the end to hook on the wrench and a pin B is riveted into it to bear against the jaw of the wrench, as shown. The other end C of the tool, if made wedge or chisel shape is handy on tire work and prying.

EVIL BE TO HIM ETC.

"Sister Henderson," said an English deacon, "you should avoid the appearance of evil."

"Why, deacon, what do you mean?"

"On your sideboard you have several cut-glass decanters, each half filled with what appears to be ardent spirits."

"Why, deacon," said the hostess, "it isn't anything of the kind. The bottles look so pretty on the sideboard that I just filled them half-way with some floor stain and furniture polish just for appearances."

"That's why I'm cautioning you, sister," replied the deacon. "Feeling a trifle weak and faint, I helped myself to a dose from the big bottle in the middle."

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

WANT ADVERTISEMENTS

ADVERTISEMENTS of SHOPS FOR SALE or TO RENT, SHOPS WANTED or SITUATIONS or HELP WANTED

will be inserted under this head at 3 cents a word, including the address, for each insertion, payable in advance; but no advertisement will be accepted for less than 60 cents, however small.

Remittances may be made in postage stamps where the amount to be sent is less than $1.00. Address

M. T. RICHARDSON CO., Advertising Department,

16-22 Hudson St., New York. Publishers of the Backsmith and Wheelwright

Patents

PATENTS FOR INVENTIONS.

H. W. T. JENNER, patent attorney and mechanical expert, 622 F Street, Washington, D. C. Established 1883. I make an examination and report if a patent can be had and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions. Trade-marks registered.

For Blacksmiths

Toy's Modern Methods doing hard jobs easy will help every smith make more money. Will make a blacksmith of a good helper or handy man. Forging or solid welding, hardening and tempering to standard with colored tempering charts. All for one dollar. Samples free. W. M. Toy, Sidney, Ohio.

For Sale

Blacksmith Shop and Garage. Two sets of tools complete.

One frame building in L. shape, 40 x 40 x 20 I will sell either for one-half cash or less if party agrees for same. Only one blacksmith in town. Work for two men all the year around. Address J. W. Kesler, Orrin, N. D.

FOR SALE—Power Blacksmith Shop in long staple cotton belt. Write to, A. Barton, Annona, Texas.

For Sale—Second hand circular rip saw in good condition. Address Michael Fleck, 15 Depot St. Salem, Ohio.

Wanted

Wanted at once: A good blacksmith for a country shop. Steady job and good pay to the right man. C. L. Graf & Sons, Waterville, Ohio.

MANDRELS NOT ALWAYS NECESSARY

By W. F. Schraphurst

ONCE ridiculed the idea of using a special mandrel for babbitting bearings, and in ıost instances I am still against such prac-.ce, because in my experience I have never ad a failure by using the shaft itself as a ıandrel and pouring the babbitt directly round the shaft. In general, the way to do ; properly is to do it quickly. Take all the ime you want for preparing the moulds, and repare them in such a way that the babbitt an be poured almost instantly.

By pouring quickly all sides of the shaft re heated simultaneously, expansion is the ame all over, and there is no spring in one lirection. The danger that must be over-:ome is the danger of warping, which will ıccur when the babbitt is poured slowly and ın one spot on the shaft. That spot becomes .ighly heated, expands, and springs the shaft n such a way that the hot spot will be on the onvex side. Before the shaft can spring ıack, the babbitt solidifies and holds the shaft n a bend condition. Sometimes this bend is ery slight, so slight that the shaft can be urned any way, due to the clearance allowed, ıut the bend can be actually "felt" with the ıand, because in one position it turns more asily than in any other.

To prepare the shaft for the mould it is a good plan to burn some oily waste and create ın oily soot on the shaft. This soot serves ı double purpose. It provides the necessary :learance medium, and it is a good insulator ıgainst heat. If you have ever had anything o do with boilers, you know how effective ;oot is as an insulator. If you fear that the ;oot isn't thick enough, wrap a thickness or nore of thin paper around the soot. Then rou will have a double insulator. A string .ied around the paper further forms oil grooves that are generally of value in a bearing.

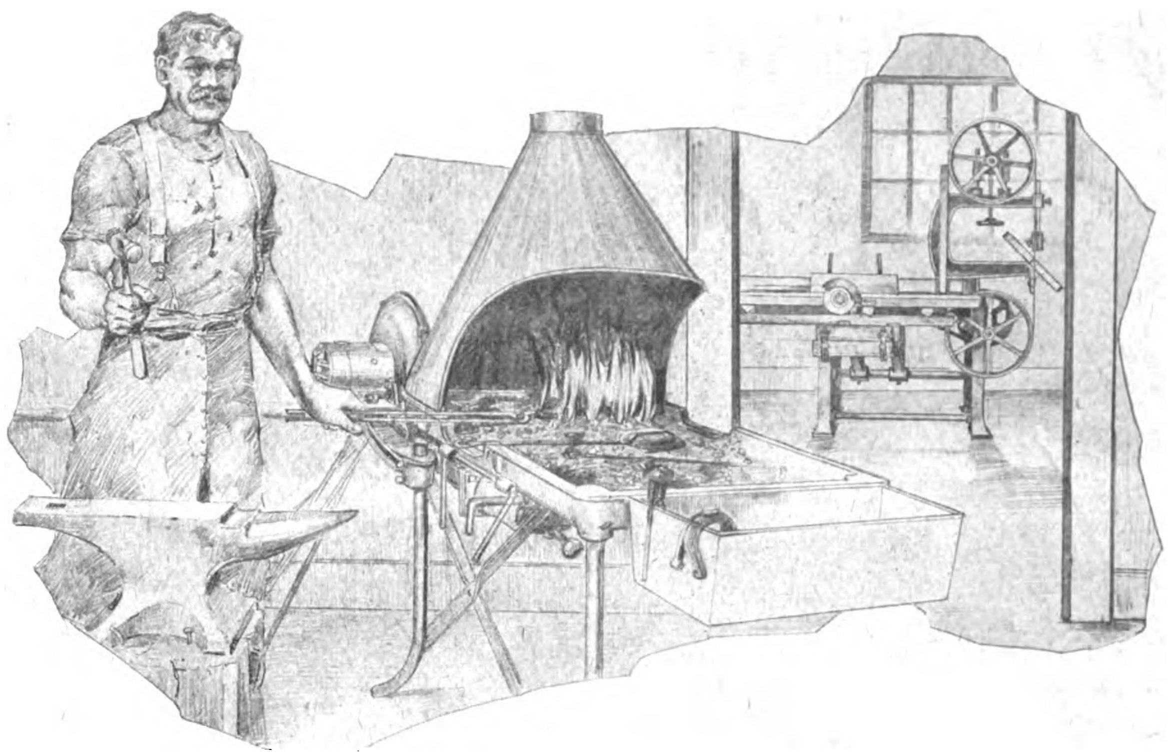
Another difficulty that attends the use of a separate mandrel is that the shaft wears with ıse, whereas the mandrel doesn't wear. That is, if we have a 2-inch shaft to begin with, ınd a 2-inch mandrel sawed off that same shaft, we can do a very good babbitting job the "first time," because we are absolutely :ertain that the mandrel is the same size as :he shaft. We then grease and lay the man-lrel away for future use. But the shaft runs 'or a year and wears slightly. Then in bring-ng the mandrel back into use for rebabbitt-ng the bearing, the finished job may come ıut too loose.

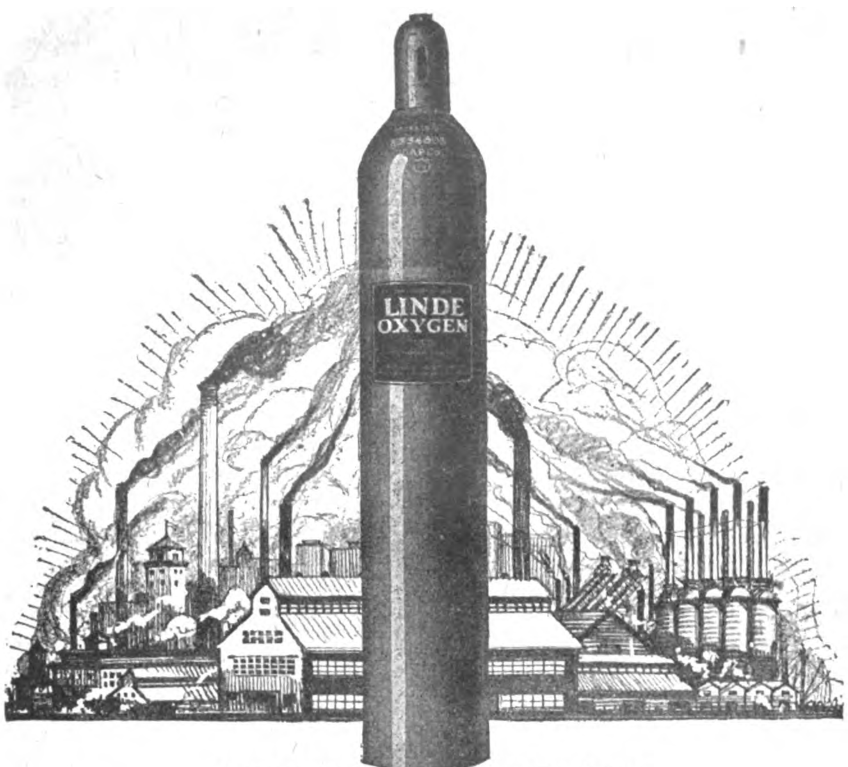
To avoid this difficulty, first-class mill-vrights make special wooden mandrels for :very important job, modelling the wooden nandrel to the exact size of the metal shaft. t is well enough for manufacturers to use nandrels. I would use them myself if I were ı manufacturer. But the millwright should ıse his own judgment as to whether or not a nandrel is necessary on special jobs or if it vould pay to make one.

TRUE MAJESTY

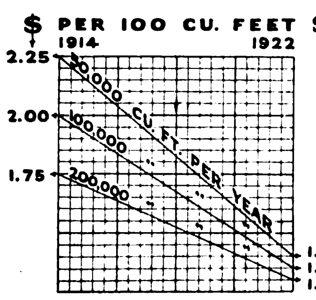
Louella C. Poole

I LOVE the sense of power that a horse
Bred to rude service—some great Normandy
Or Percheron teeming with strength and force—
Gives to me as he pulls so easily
His mighty load along the city street.
His flashing eyes, wide nostrils, tossing mane,
The shaggy fetlocks dangling round his feet,
His surety of movement, show his grain
And mettle, as unflinchingly each day
He serves mankind; and when I thus behold
This noble Titan marching on his way
With such true majesty, my head I hold
Higher a bit, step livelier through the crowd,
And with new sense of power am endowed.
—Our Dumb Animals.





A POLICY AND ITS RESULTS



In 1914 when the oxygen industry was in the early stages of development the LINDE COMPANY adopted as two important features of its sales policy:

First: A definite schedule of prices based on consumption.

Second: A reduction of prices as rapidly as increased volume warranted.

The accompanying chart shows typical prices applying in 1914 as compared with those applying under our new 1922 schedule. This illustrates clearly the benefits to LINDE users of the continued application of these two features to the large increase in production since 1914.

The 1922 prices shown for the respective consumptions are the average for the entire chain of 30 plants and 50 warehouses through which LINDE OXYGEN is distributed today. Slightly lower prices prevail at the plants in districts of heavy oxygen demand. Higher prices prevail where shipments are made from convenient service warehouses, or where undeveloped consumption does not permit large scale plant production and distribution.

No oxygen user, large or small, should close an arrangement for oxygen supply without first securing 1922 prices from the nearest LINDE District Sales Office.

THE LINDE AIR PRODUCTS COMPANY

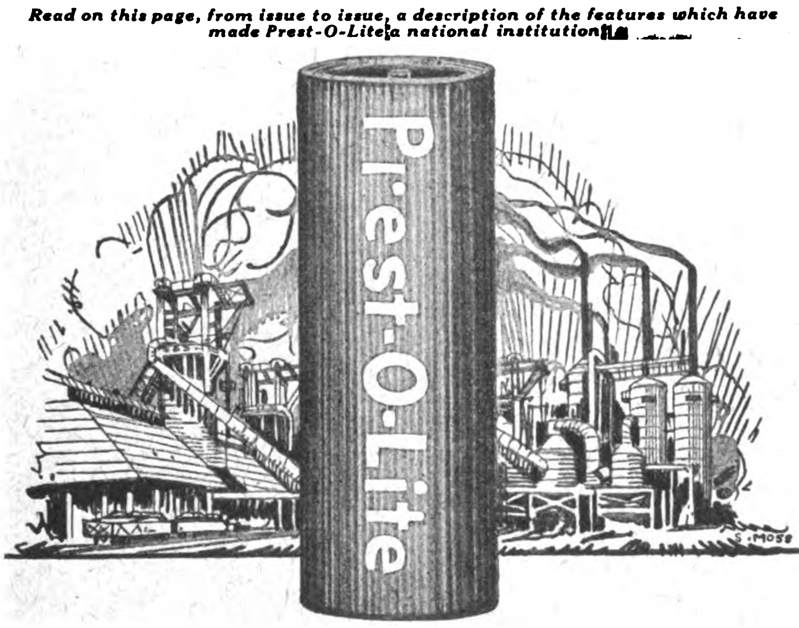
Carbide and Carbon Building, 30 East 42nd Street, New York

District Sales Offices in these cities: ***Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dallas, Detroit, Kansas City, Mo., Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco***

THE LARGEST PRODUCER OF OXYGEN IN THE WORLD

2281-22

Read on this page, from issue to issue, a description of the features which have made Prest-O-Lite a national institution.



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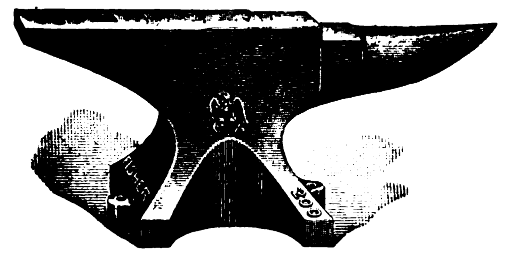

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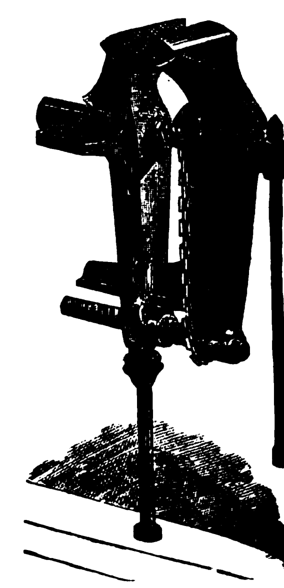

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Vol. LXXXVI. No. 2 AUGUST, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

Finding and Computing the Contents of Various Kinds of Steel Mixtures

By J. F. SPRINGER

WE have made progress when we arrived at this point, that 13.5 per cent of a piece of pearlite consists of cementite. We know that what is not cementite is ferrite. That is, since pearlite is made up of alternating layers of cementite and ferrite, just as soon as we find out what fraction of the whole is cementite, we know that the ferrite will be all the rest of the whole. Now, 13.5 per cent of the whole of the pearlite is cementite. Consequently, all the rest of the 100 per cent is ferrite. The ferrite is, then, 86.5 per cent of the whole of the pearlite. If the reader has trouble in following the calculation, he may take it from the writer that in any piece, big or little, of pearlite, the two things will occur as follows:

Cementite .... 13.5 per cent
Ferrite .... 86.5 per cent

Or, roughly,

Cementite 2/15
Ferrite 13/15

These figures, however, refer to pearlite, and not to steel in general. But, if we know the carbon percentage of an annealed steel, we can tell what part is pearlite. Follow with me, now.

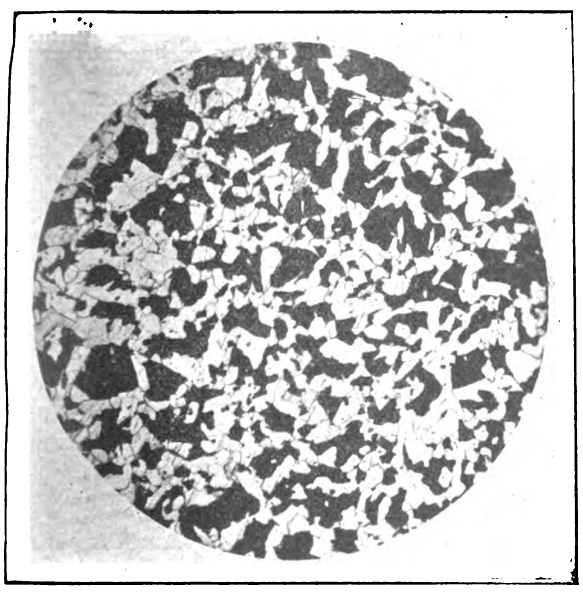


Fig. 1. A photomicrograph showing a piece of steel which is 0.50 percent carbon and magnified 100 times.

The steels below 0.90 per cent of carbon consist of ferrite and pearlite. There is ferrite in the pearlite, as well. Remember these statements.

All the carbon in this non-tool steel is in the cementite. In short, the carbon weighs 1/15 and the ferrite (in the cementite) weighs 14/15. Consequently, if we know the weight of the carbon, we can multiply by 14 and get the weight of the ferrite that is in the cementite.

An actual example is the thing now. Suppose, our non-tool steel contains 0.40 per cent of carbon. Then 14 times this amount will be the ferrite in the cementite. This means that the cementite has swallowed up 5.6 per cent of the whole block of steel in the form of ferrite. Consequently, 5.6 of the weight of the block consists of ferrite *in the cementite*. All the carbon in the block is in the cementite; so that 0.40 of the weight of the block consists of carbon in the cementite. We have now for the two substances in the cementite:

Carbon, 0.40 per cent of the total weight of steel.

Ferrite, 5.60 per cent of the total weight of steel.

Adding these together, we now have 6.00 per cent of the total weight of the steel in the weight of the cementite. This may also be obtained simply by multiplying 0.40 per cent by 15, in accordance with the rule that the cementite is 15 times the weight of all the carbon.

Proportion of Cementite

Now, if the reader will look back a few paragraphs, he will find that cementite makes up about 2/15 of the weight of the pearlite. We have just found that the weight of the cementite in this 0.40 per cent steel is 6 per cent of the total weight. Consequently,

2/15 of the pearlite=6 per cent of total weight of the steel.

So then,

1/15 of the pearlite=3 per cent of the total weight of the steel.

Finally,

15/15 of the pearlite=45 per cent of the total weight of the steel.

We have now reached the point where we find that 45 per cent of the total weight of the steel is in the form of pearlite. All the rest—that is, 55 per cent—must be in the form of a ferrite honeycomb:

Ferrite honeycomb=55 per cent of the total weight of the steel.

Pearlite grains=45 per cent of the total weight of the steel.

This may have seemed to the reader a long road; but we can shorten it, if we omit details of explanation. Try another one. Let us shorten it as much as may properly be done.

Suppose the steel to be one containing 0.05 per cent of carbon. We have an illustration for this; so we will have something to look at when we get through.

The cementite is 15 times the carbon. That is, 0.05 times 15. This gives us for the cementite, 7.5 per cent.

The pearlite consists of cementite to the extent of 2/15 of itself. Therefore,

2/15 of pearlite= 7.5 per cent.
1/15 of pearlite= 3.75 per cent.
15/15 of pearlite=56.25 per cent.

We now learn that the pearlite in our sample of steel (containing 0.50 per cent of carbon) weighs 56.25 per cent. Necessarily, then, the ferrite honeycomb weighs 43.75 per cent.

Now look at the engraving. The steel shown contained 0.50 per cent of carbon. The microscope magnified a spot so as to multiply its dimensions 100 times. The black is *pearlite;* the white is *ferrite*. This ferrite, we have just learned, is 43.75 per cent of the whole; and the pearlite is 56.25 per cent of the whole. The honeycomb of ferrite is not half; but it is very nearly half. Consequently, when the honeycomb amounts to so much, it will not be so thin, and the picture will not show narrow white lines.

The reader may perhaps think that the calculations are too hard. At any rate, let us take a rest, and do some easy work. The black spots and the white spots are 100 times longer than what they are in reality in the steel. And they are also 100 times broader. It will not be difficult then to see that, in the steel, the pearlite spots (black) were rather small. Look at one of the big black spots. Pick out the one that is nearly round and is fairly close to the edge.

It is not really round, but has five sides (not counting anything but the principal sides). The average diameter is not far from 0.20 inch. But this diameter is 100 times the right size. So then we divide 0.20 inch by 100 and get 0.0020 inch. This is a fairly small lot of steel. Two thousandths of an inch is not much, and yet it is the diameter of a fairly big grain of pearlite in a piece of steel containing 0.50 per cent carbon.

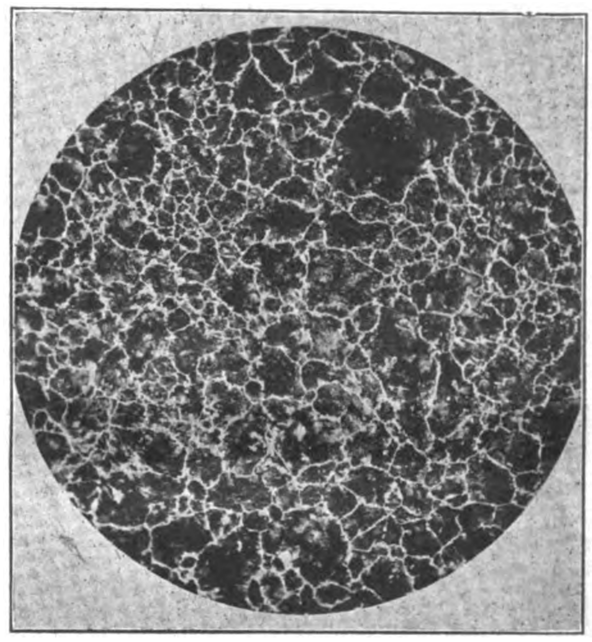


Fig. 2. This photomicrograph shows a high carbon steel magnified 100 times. The white lines represent the cementite honeycomb. The black places represent grains or groups of grains of pearlite.

Some of the black spots are longer. It is difficult to tell whether a long irregular black spot really represents one grain. There may, in fact, be films of ferrite dividing it up. These may have been worn down or eaten down when the specimen was prepared for the microscope.

The white spots are ferrite. There is so much ferrite that the honeycomb effect is nearly lost.

In another one of the views, we have a high-carbon steel. This steel contained in fact, 1.25 per cent carbon and was therefore presumably suitable for penknives and the like. It had been heated to 1517°F. and then allowed to cool off as the furnace itself cooled. That is, it cooled slowly and evenly, and was annealed. Here we have a complicated network in white. This consists of cementite and the black is pearlite.

As a matter of fact, some of the cementite in this sample is in the network, and some is in the pearlite, pearlite consisting of layers of cementite and ferrite.

The total cementite may be found by the rule that it is 15 times the weight of the carbon. Consequently, we multiply 1.25 per cent by 15 and get 18.75 per cent for the weight of *all* the cementite. But we are now embarrassed by the fact just noted that some is in the network and some in the pearlite patches. However, if *all* the cementite in the steel amounts to 18.75 per cent, then *all* the ferrite should be the balance. Thus, we get 81.25 per cent for the total ferrite. Now, none of this is in the network since that consists of cementite alone. All is in the pearlite. So, then, 81.25 per cent of the total weight of the steel consists of ferrite.

If the reader will now look back, he will find a rough statement to the effect that pearlite is made up as follows:

Cementite 12-15
Ferrite 13-15

We are now able to set down,

13/15 of the pearlite=81.25 per cent of the total weight of the steel.

If we divide by 13, we get

1/15 of the pearlite=6.25 per cent of the total weight of the steel.

15/15 of the pearlite=93.75 per cent of the total weight of the steel.

We now learn that *all* of the pearlite in the steel containing 1.25 per cent of carbon weighs 93.75 per cent of the total.

Naturally, the cementite honeycomb is the balance. That is, the cementite honeycomb weighs 6.25 per cent of the total steel.

Let us set down what we have learned as to this steel containing 1.25 per cent of carbon:

Pearlite..........93.75 per cent.
Cementite honeycomb.6.25 per cent.

Now, let us look at the microphotograph. The fine network represents the cementite honeycomb which weighs 6.25 per cent of the whole. We see only the edges and the like; so we are not to expect the picture to correspond exactly with the 6.25 per cent. However, we now understand, better perhaps than before, why the honeycomb seems so fine and thin. In reality, it is only a very modest part of the whole—6.25 per cent=1/16 of the whole.

Pearlite Largest Constituent

The pearlite constitutes 93.75 per cent of the whole. This is 15/16. This 15/16 is represented by the black patches. Some of these are quite small; and a few appear rather big. It is possible, perhaps probable, that these big black patches are as big as they are because dividing ridges of cementite were worn down or eaten away when the specimen was prepared for the microscope.

However, any black patch which may represent an undivided piece of pearlite is 100 times as long and 100 times as broad as the true pearlite grain in the very steel itself.

The reader may wonder what takes place inside steel when it is forged and rolled—that is, when the hot metal is mechanically treated. Naturally, we cannot apply the microscope very well to hot steel. Besides, a piece of steel usually has to be rubbed over with an abrasive or treated with some corrosive substance, in order to get it ready for the microscope. Red hot and white hot steel are of course in an unsuitable condition either for the preparatory work or for the microscopic examination itself. The next best thing appears to consist in "freezing" the steel suddenly, applying the water while it is still hot.

"Freezing" the Steel

People have talked of freezing the smile on one's face or the like, the idea being to hold things just as they are. This idea may be carried out in connection with iron, steel and other metals. If we want to know how things are inside a piece of steel when it is at a light red, we simply heat up a piece of annealed steel to the red heat and then suddenly quench it in water or oil.

It is assumed also that, if annealed steel is heated up and then allowed to cool slowly, say, in the air or in the furnace itself, it will remain in some respects just about the way it was when the temperature stopped going up. This point is probably more an assumption, because it would seen to admit of proof in the following way. Two indentical samples of annealed steel are both heated to the same heat, say, a good light red; and then the one is suddenly quenched and the other is allowed to cool off with the furnace. If the assumption I have stated is a true one, these two samples when examined under the microscope should appear the same.

Let us assume for the present that it doesn't matter whether we cool suddenly or slowly. We will assume that in either case we get in the cold steel just about what we have in the hot. Doubtless, there are exceptions, and we would find that sudden quenching did make some difference. However, we can't examine the steel while it is hot, and will have to be content just now with the same steel when it has cooled off.

SO far we have described only the machinery in our repair shop but there are other branches to the trade which are, in a measure, more remunerative than actual repair work. A lathe or a drill press cannot give returns unless someone is operating it and in these days of short working hours, machinery is a dead investment one-third of the time unless the shop is operated night and day.

One of the big branches of automobile repair work is that of repairing and rebuilding storage batteries. This off-shoot of the industry has become so important that it has assumed a business foundation of its own and is so large that it is entirely self supporting.

The average blacksmith will not find it practical to combine battery service work with his regular business but if he happens to be looking for another line of work, then we can safely recommend battery service, for it is a business which is not over-crowded and one which pays excellent returns on the investment.

Although we have said that battery service work is not a business which can be combined with blacksmithing, there is one branch which the blacksmith can pursue and make good money at it. The investment need not be great and the work can be learned very easily. We refer to battery recharging.

The car owner will also find it to his advantage to invest in a small battery charging device such as we describe herein, so that this article deserves the attention of every reader.

Type Chosen

In choosing a battery charging device for our machine shop we were influenced by many facts, chief among them being the dependability of the product. We chose the F. F. battery booster, made by the France Mfg. Co. of Cleveland, Ohio, because this company produces a representative line of charging machines, large and small. We felt that if the machine, which we have, would give satisfaction, then it is fair to assume that their other machines would also work out to advantage.

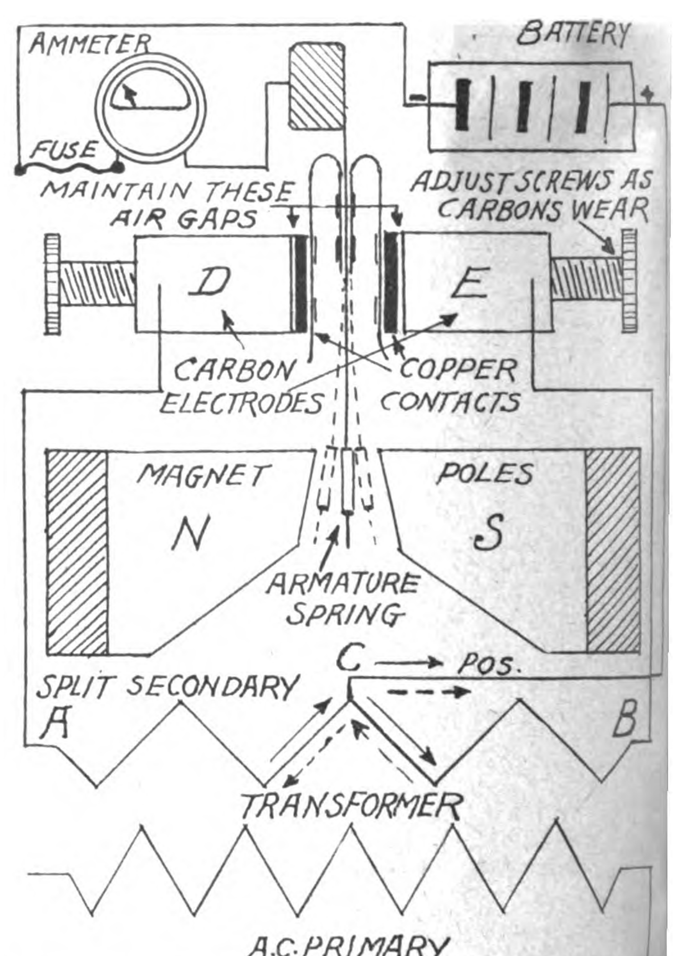
In order that our readers may be able to appreciate the various factors which enter into this simple subject of battery charging, let us outline, briefly, the various types of charging devices in use at the present time.

There are two types of current available, direct and alternating, and in charging a storage battery the current must be of the direct current type. For this reason there are two classes of charging devices, in the first class the device operates upon direct current and merely reduces the current to such an extent that it may be utilized for battery charging. In the second class the but changes it from alternating to direct.

In general most houses and shops are supplied with alternating current, so that we need be concerned principally with the second class of charging devices.

Alternating current chargers may be divided, roughly, into three classes. First, comes the motor-generator in which a motor is operated on the full line voltage and drives a generator which produces a low voltage direct current for charging the battery. Such a combination is best fitted for a service station because it is very flexible. It will charge as low as one battery at a time or as many as it is designed for and do its work economically.

Second, come the tube and mercury arc rectifiers. These devices merely convert the alternating current to direct and a certain amount of resistance must be used in the battery circuit to control the charging current. Tube rectifiers are entirely efficient



Internal Wiring Diagram of the F. F. Battery Charger.

and are to be recommended both for the individual and the service station because with them it is possible to charge a number of batteries at one time, or a few, and still obtain efficiency. The first cost is low and brings them within reach of the individual.

Third, comes the magnetic rectifier and this class may be divided into two parts, full wave and half wave rectifiers. The full wave rectifier utilizes all of the alternating current entering it while the half wave only transmits one directional current. This means hat in the half wave rectifier only half of he entering current is used.

The F-F battery booster which we have s of the full wave type and is extremely simple in construction. The main unit of he device is an induction coil, the primary of which is connected with the source of current; 110 volts, alternating in our case.

The passing of the alternating current through the primary windings induces a current, in the secondary winding of a low voltage which is then rectified through a mechanical-magnetic vibrator and passed on to the battery which is being charged.

The Secondary Wiring

The secondary winding is divided into two parts, which, for purposes of illustration we will call the "left" and "right" sides. (Refer to the diagram accompanying this article.) In our illustration A, refers to the left side, while B refers to the right. The winding, then, has three wires leading to it, A, B and C, C is the "neutral" wire and when A is positive C is negative, while when B is negative, C is positive.

Since it is necessary to establish a known polarity in the line in order to connect the battery properly we may say at this point that the mechanical vibrator is so operated that C must always remain positive. Let us explain further.

The passage of the alternating current through the primary winding magnetizes the center core of soft iron wire and naturally the polarity of this core changes with the change in the direction of the alternating current.

Surrounding the coil is a large horse shoe magnet with fixed polarity, shown in our diagram and marked "N" and "S." When the iron core is magnetized in one direction it helps the permanent magnet and when it is magnetized in the opposite direction it neutralizes the magnet. Thus the armature, which is mounted to swing between the poles, *must* vibrate in tune with the change in direction of the alternating current.

As the armature vibrates it makes a connection, first with the carbon pole D and second with the carbon pole E. If the alternating current is 60 phase, then the armature will touch the electrode E 60 times a second and also touch D the same number of times.

The Secondary Current

Now let us see what happens to the current which is passing through the split secondary coil. First, let us assume that we are considering the current as it passes toward the right from A to B. The current strengthens the N pole of the permanent magnet and attracts the armature spring so that it makes a connection through the carbon electrode D. (The circuit through E is, of course, broken.)

The current flows through the left side of the split secondary coil, out of C to the battery, through the battery and ammeter to the armature and thence through the electrode D back to the left side of the secondary coil. The current which is set up in the right side of the secondary coil passes as far as the electrode E but finding no outlet cannot escape, so that this part of the coil is practically dead.

On the next half of the phase the current in the secondary coil changes its direction and flows from B to A. This results in the attraction of the armature spring toward the right and contact with E is made and D is broken. An entirely new circuit is set up which we can trace as follows:

Current flows toward the left from B and passes out at C to the battery, through the battery and ammeter to the armature and thence through E back to the right side of the secondary coil. The current in the left side of the coil cannot escape.

It can be seen that the current continues to flow from C, so that C is virtually a positive terminal all of the time. No matter in which direction the current flows in the secondary and primary coils there is an uninterrupted flow of current through C to the battery and back to the coil.

The device utilizes practically all of the current, the only loss being that required to operate the coil and the armature, which is extremely small.

Within reason the machine will operate upon a changing cycle and changing voltage. This is a big advantage in country towns where neither the cycle or the voltage can be depended upon absolutely. We have found that the voltage in our shop fluctuates between 100 and 112 and the current cycle varies somewhat as the light load on the service line changes. (Causing the generator at the power station to increase or decrease in speed.)

Dependability

A second advantage of this machine for country use is its dependability insofar as battery protection is concerned. Should the current from the supply cease for any reason the armature comes to rest at a point midway between the magnets and the battery circuit is immediately broken. As soon as the current commences again the battery begins to charge.

Within certain limits the charging rate can be controlled by the electrode adjustment. When the carbon electrodes are adjusted away from the armature, the latter unit "cuts the phase" so that the charging rate falls down to as low as four amperes. When the carbon electrodes are properly adjusted the charging rate is between 10 and 15 amperes.

The machine is semi-automatic in one respect in that it delivers a lower charging rate as the battery is filled. When the battery offers no resistance to the passage of current the charging rate is high, but as the battery voltage builds up and backs against the secondary coil the charging rate decreases. Thus the battery may be left on charge for over-night with no fear that it will be overcharged or discharged itself.

The F-F battery booster weighs less than 15 pounds and can be used without disconnecting the battery from the car. It is only necessary to find the polarity of the battery, connect the charging wires and screw the plug into a light socket. An ammeter on the charger shows the amount of current going to the battery.

In connecting the battery, to find the polarity, the two battery leads are touched to the battery poles. The armature is swung to contact with either of the electrodes and the ammeter will indicate either "charge" or "discharge." If it indicates the former then the connections should be reversed, but if it indicates "discharge" then the connections are properly made.

The machine is fool proof and the only parts to wear out are the carbon electrodes and possibly the armature spring, either of which may be replaced at a nominal cost.

We feel entirely safe in recommending this device to our readers.

A Horse Shoe for Luck

One of the Oldest of Superstitions And One Which Is Difficult to Kill

BY DAVID WATSON

MASCOTS and charms possess interest for thousands of men and women today. The skeptical may question their value or scoff at their supposed potency, but whether on sentimental grounds, or from downright superstition, the fact remains that an amulet, a talisman, or some quaint symbol of good fortune is more cherished than one might care to admit, and that, too, for reasons which it would be difficult to explain.

The horseshoe is of all tokens of luck, the most popular. When it was first adopted as such is one of those matters which antiquarians can only speculate. In any case, horseshoes stood for good, their great merit lying in the protection which they offered against witchcraft.

Thus it was that the timorous or belated traveler whose heart might sink as the shadows of night lengthened, or who, on some lonesome road pursued his journey by the pale light of the moon, would hail with joy the cast horseshoe lying on the highway. Possessed of that he need fear no molestation from the malignant or uncanny sisterhood, who, like the weird hags in Macbeth "so wither'd and so wild in their attire" might meet him.

In the fastening of horseshoes to the doors of houses we have the same idea. The dwelling, thus adorned, was immune from the evil machinations of witches.

There was one time when, according to Aubrey, the majority of houses in the West End of London had horseshoes fixed on lintels or threshold. In Monmouth Street in 1813 there were 17 houses with horseshoes, although in 1855 that number had dwindled to 7.

Gay, in one of his fables refers to the horseshoe as "each threshold's guard."

In 1251 some Crown land in the Strand occupied by a farmer was made over to the Corporation of London on nominal terms, the sheriffs being required to tender annually as rent, six horseshoes and nails.

The first instance of nails in horseshoes was in the year 481 when at the burial of Childeric I, that monarch's horse was entombed in the same grave as its owner. It had shoes fastened with nine nails.

The tyrant Nero, if we are to believe Suetonius, had his mules shod with silver. Camels, according to Aristotle, were shod with undressed leather.

There is a singular German saying in some way connected with the horseshoe charm. Probably the idea came from the stumbling of a horse on its shoe becoming detached. A damsel who has had a slip is said to have lost a shoe—"Ein Mädchen das ein Hufeisen verloren hat"

Horseshoe clubs were in the 18th Century formed by judges and barristers in circuit. They were, so to speak, movable festivals and were held at some suitable place in the provinces, when their lordships and members of the bar, throwing aside judicial restraint devoted themselves to a convivial evening. Why they should have been called "horseshoe clubs" is unknown, but a letter from Sir Thomas Plummer, written at the beginning of the nineteenth century before he was made Master of the Rolls, says, in connection with a circuit in Wales, "We had a delightful reunion last night at the Horseshoe Club."

Many years before that when in 1778 Sir Thomas was just admitted to the bar, he alludes in his private diary to a Horseshoe Club where the proceedings ended in a glorious carousal. It had been an important day. The club ordination sermon was preached by Jones the "Grand Vicar" who was evidently happy in his selection of texts as he took two, one from Isaiah, "And there were 29 knives," and the other from the Proverbs of Solomon, "As iron sharpeneth iron, so doth a friend the face of his friend."

As an iron sign the "Three Horse Shoes" is to be found in almost every county in England. Why three? No one can say, unless three being a cabalistic number is more significant or more magical.

(Continued on page 12)

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Our Editor's Letter

I HAVE just returned from my first real vacation. Heretofore I have always kept in touch with things and had the general feeling that unless I read the newspapers regularly, the world would stop moving, our country would become a land of strife and chaos and New York city would hold its breath for my return. So this year I decided to forget everything pertaining to my regular life and just lose myself.

The place where I went is probably well known to many of my Massachusetts readers, a little island bounded on the South, or approximate South, by "The Sow and Pigs"; on the West by "The Hen and Chickens" and on the other two points by blue water. The various references being to rocks and not live stock.

In my memory serves me correctly there are upwards of two dozen houses on the island, several life saving stations and lookouts, one fresh water pond and so many rocks that I didn't think it worth while to count them. Aside from these things the only element left on the island is sand.

It isn't much of a place for excitement and the nearest approach I saw to formality was a tall silk hat which drifted ashore from some passing boat. The only real swirl of wild dizziness comes with the ringing of the dinner bell when everyone sits down to a platter of fresh lobster or fish, (usually both).

My program of amusement was fairly simple, but extremely satisfying in every way; Eat, fish, sleep. On various occasions, for the sake of variety I would go to sleep while fishing and fish while eating.

I learned considerable of great value during this period. I know how to tie a square knot without putting my whole mind upon it; I can make a half hitch upon a fish-hook without trying more than six times and I learned that a certain variety of rock fish, called "cunners" by the natives has mastered the fourth dimension. At least it would seem that way.

This particular fish weighs anywhere from six ounces down and can take a bait from a hook painlessly Being somewhat versed in the art of holding to my own possessions I cleverly (?) baited my hook with a fine gauze bag in which I tied up the bait. But Gosh! Those darned fish would take that bait out of the bag without pulling on the line, and do it so cleanly that nothing but the smell would be left. It took me upwards of two minutes to put the bait in the bag, tie it up and get it back into the water and the fish would unbait it in less than four seconds.

But I figure that this wonderful ability comes from concentrating upon one thing and learning it well. I suppose that is why fish travel in schools and no fish's education is complete unless he is able to unbait a hook without getting caught.

The place was a regular blacksmith's Heaven because there is but one horse on the island. I liked it fairly well because there was but one automobile and I didn't have to worry about keeping that machine going.

But for two solid weeks I did absolutely nothing of any importance except sleep and eat and when I arrived in the office this morning I felt like a new man. So I say that this was my first real vacation and it's only the beginning. I'm going to take a real vacation every year after this.

The old saying that "All work and no play makes Jack a dull boy," just as true about the old boys as the young ones. When you are down in the mouth, when everything has a sort of pea-green appearance, and you get so grouchy that you kick the cat off the rug into a chair and sit down on the floor, just out of spite; then you need a real vacation.

Now the first thing to do, under such conditions, is to look up a place where they still think that the last war was with Spain and the only papers they receive are those which wash ashore from casual wrecks. When you have found such a place, pack your grip and go to it.

For the first two or three days you will worry about your business, you will wonder if the railroads are still alive and if the village store crowd is running the country successfully. But if you have the right idea you will forget everything but yourself in a few days and then start to accumulate a lot of joy. It is a good time to catch up on some of the sleep you have lost.

After about a week of absolute nothingless you will feel like hopping into the ocean and navigating a whale, like Jonah did. Or, if you are not a strong swimmer, you will be swinging cows and horses around your head, just for exercise.

It really takes a full two weeks to cure a real, complete, honest to goodness grouch, like I had. When I started off, two weeks ago, I had to put three spoonfuls of sugar in my coffee, for it tasted sour with only two. Every time I looked an egg in the face it turned black inside. I was so grouchy that I would wake up in the night and cuss the crickets for making such a racket.

And after two weeks of nothing to do except sleep and with no necessity for opening your mouth except to eat, you will go back to work all ready to swing the world by its tail. Instead of lifting up a horse's foot for the shoe you'll turn the horse over on his back and do the work right side up.

But the greatest improvement, which a real vacation makes, is to a person's disposition. Before you go you may find yourself with the mental disposition of a sour lemon, but after you come back you will feel like kissing the neighbor's hen that has just scratched up your truck garden.

A real vacation is the thing which puts red blood into your system and turns blue into red; it's good medicine.

Every reader should plan to take a vacation each year, it pays excellent dividends and is just as necessary to health as the time taken for sleeping or eating. And the best way to take that vacation is just as I took it without lace or feathers, without any news from home or worries from the business. Forget everything but the fact that you are alive and it's time for fun—and rest.

Knowing the Game

IT is not often that we moralize in our Editorial columns but there are occasions when a little sermon goes a long way toward teaching a lesson. But this is one time when we think we have an excellent point to make.

Most every sane man agrees that it is better to be safe than sorry; it is better to ask a few questions beforehand than to ask them in the hospital. The fellow who aims toward preparedness is usually safer than the one who jumps into trouble and then wakes up to the fact that he has made a bad error. Foresight is much better than hindsight.

In going through our "exchanges" a few days ago we came across a little story which well illustrates our point and is a sermon with a moral at the end. Credit for this little article belongs to a Chicago publication called "The Leader" and we repeat it only in part to save space.

"For twenty years two chess players met daily at Brown's Chop House and silently played their game. For twenty years a third man was punctual and sat by silently intent upon the progress of the game. And then, one day, the first time in the whole twenty years, one of the players failed to appear. His partner waited a few minutes and then asked the silent onlooker if he cared to play the game for that day.

"The silent on looker for twenty years semed a bit surprised and then replied, 'Sorry, but I don't know the game.'

"That man had followed every move for twenty years, but didn't know the game. He had watched a game for twenty years without seeing a thing, without speculating upon a single move or anticipating a single coup."

As we look about us in the public parks we find thousands of men who are in exactly the same position as the man who watched the chess game. These men sit upon the park benches, staring ahead and sensing nothing. As we go about our daily tasks we constantly come into contact with fellow workers who do not know the game: men who work at a desk, in the shop, or at a machine, many years without knowing anything about their fellow workers' jobs.

The lesson in this short story is clearly stated in the last paragraph of the "Leader's" article and we can do no better than to quote again.

"Placed in an office—at a bench—he would remain twenty years ignorant of his neighbor's job, his superior's problems, his own significance. When the opportunity for advancement came, he would have to say. "Sorry, but I don't know the game."

Oxy-Actylene Welding

WE have just received a letter from one of our readers which asks an important question, it is the second time within the past year that this question has been asked and we feel that our answer should be given full prominence upon our Editorial page. The question is. "Can I use oxygen and acetylene gases for welding, without using regulators?"

Our answer is "NO." A man with a light

cigar in a powder factory is fairly safe compared with a welder who uses the :ygen and acetylene gases without regula- rs.

If you were in charge of a steam boiler ıd suddenly noticed the pressure gage gradılly mounting from 180 to 200 and then :adually upward you would draw the fire ıd get away just as fast as your feet ould take you. But the oxygen in the :linders sold commercially for welding is ıder two or three times as much pressure ; that used in the ordinary steam engine. he acetylene is usually over 100 pounds to ıe square inch.

Acetylene is peculiar stuff; give it any exuse and it will go on the war path and when does, nothing will stop it. Acetylene gas ıight easily explode were any oxygen comıined with it.

And now let us see what the conditions ıre when using oxygen and acetylene for velding. The oxy-acetylene torch has two onnections, one to the oxygen tank, the other o the acetylene. The two gases mix near he top of the torch in a mixing chamber nade for that purpose and in combination low from the tip where they burn with an ntense, white-hot flame.

The only reason that the flame does not vork back into the mixing chamber is be:ause the gas speed is faster than the flame speed. In other words the speed of force of the gas is so great that it blows the flame away from the tip. If the gas speed is diminished by the placing of the tip too near the work, then a flash-back occurs and the flame works back into the mixing chamber, exploding with a sharp "pop."

Only a certain amount of mixed gas can pass through the tip. With this in mind it is easy to see what might happen if both the oxygen and acetylene gases were passed to the tip at full tank pressure. The oxygen pressure would be upwards of 500 or more pounds per square inch and would flow to the mixing chamber where it would meet the acetylene and mix. But the tip might be a small one and would not permit all of the gas to escape as fast as it ran into the chamber. The oxygen, with such a great pressure back of it would work back into the acetylene tank and then the excitement would commence.

It wouldn't take much oxygen in the acetylene tank to start things going. Probably the operator and those standing around would never know what happened. But those who happened to be standing in the street nearby would hear an explosion, (the acetylene tank) followed by a second one of terrific proportions, (the exploding of the oxygen tank). And even if the roof of the shop remained, there would be little left to the contents of value.

Properly handled the two gases are as harmless as water and though it is advisable to keep them from knocking against sharp objects or falling, they may be handled in the same way as barrels.

An ordinary valve controls only the quantity of matter flowing through it and not the pressure. In order that the oxygen and acetylene may be fed to the torch both at the proper speed and at the proper pressure, regulators are necessary. The first cost is somewhat high, but they will last almost indefinitely, so that when it is a question of safety, or even loss of life without them, it would be foolhardy to try to save money in this direction.

CIRCUMSTANTIAL EVIDENCE

The Bingville selectmen had held many sessions and formulated a set of auto laws that was the pride of the county. So the constable felt no worry when he stopped a motorist.

"Ye're pinched for violatin' the auto laws," he pronounced.

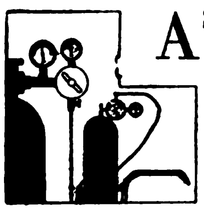
"Which one?" inquired the traveler.

"Durned if I know, but ye certainly hain't come all the way down Main Street without bustin' one of 'em."—*American Legion Weekly.*

Health Hints For Welders

If You Welders Value Your Health Read the Following

By David Baxter



As a whole the oxy-acetylene torch welder's trade is not an unwholesome occupation nor an unhealthy one. Nor is it particularly objectionable even in isolated instances where it is not possible to employ every precaution that tends to promote the operator's welfare. But then you will find men who will take a chance in spite of anything that can be done to eliminate danger or sickness.

One of the main elements which the welder uses is the oxygen. It is not unhealthy, even though it escapes into the welding room in large quantities. The welder may breathe it without fear of injuring his health. In fact it should be just the opposite; very healthy, since it is present in nearly everything on earth, constituting nearly eight-ninths of all the water on the globe and more than one-fifth of the air. It is found in the tissues and fluids of all forms of animal and vegetable life.

Always wear clear glass goggles when grinding on an emery wheel

So there should be no reason for it to be unhealthy in a free state.

Acetylene Gas Not Particularly Injurious

Nor is the acetylene gas particularly injurious to humanity, and when combined with oxygen it is no worse.

However, the two elements that go to make up the welding flame, in combination help to create conditions that are not always favorable to the torch operator. Many of these conditions may be minimized if not entirely eliminated. That is the welder can take steps to prevent the conditions from becoming unhealthy or unsafe.

Take the matter of injury to the eyesight. Here is one item which is a factor almost absolutely under entire control of the torch operators. The welding flame is detrimental in two ways. First by the blinding intensity of it and secondly through slow strain by continued gazing at the flame.

Colored Goggles Essential

No welder can afford to take a chance by welding without using colored goggles to prevent the glare of light from weakening his eyes. Even if the job is a short one his eyes will be affected to some extent, especially if a large torch is employed, and if he makes a practice of doing several short jobs every day he will soon begin to note the bad results of such foolish methods.

The continued strain will eventually weaken the eyes even if the glare could do no harm. This is on account of the strain set up through concentrating efforts to tell when the metal is not melting properly.

Both of these dangers are minimized, if not actually eliminated by the use of proper goggles.

It should then be an unalterable rule for the oxy-acetylene welder to always wear colored goggles whenever he is employing the welding flame for any purpose. That is not all: to get the most good out of the rule, the goggles should be worn according to the intensity of the flame. That is, the welder should not wear one pair of goggles for all classes of welding, although that is the very thing many welders do, thinking they do not have time to fool with more than one pair.

Three Types of Goggles

The scientific operator has at least three pairs each of different density. A deep pair for the large flame on heavy welding; a light colored pair for the smallest flame; and one in between for the average welding job. In this way he prevents the continued peering through dark glasses in an effort to see how a small weld is progressing. In the same way by selecting the proper lenses he reduces the danger of eye injury caused by welding heavy jobs while wearing light colored glasses. In short the goggles ought to fit the job just as much as the flame and filler are selected according to the weight and size of the work.

The office of welding goggles is not entirely to prevent eye strain, however. It is also to protect the eyes from flying particles of metal, slag, or other hot substances. These can be proved by an examination of any pair of goggles that have been in use for some time; the lenses will be absolutely covered with tiny pits or clinging bits of metalic matter.

This brings out another important point: the best, because the most economical, kind of goggles is the kind having two sets of glasses. An outer set of clear colorless glass, whch protects the inner or colored glass from the flying particles. These goggles are made so the outer lenses may be readily changed at any time, thus saving the expense of throwing the colored lenses away. A supply of clear glasses should always be kept on hand because they sometimes become blurred by the tiny pits in a remarkably short time.

A respirator is a useful device when welding heavy brass jobs.

Goggles of celluloid or composition should not be worn at any time while welding on account of the danger of taking fire. In this event the operator would undoubtedly lose his eyesight before he could remove the goggles.

Now even were there no bad effects, to the sight, of wearing no goggles while welding, the feeling of safety alone would more than repay the operator. This brings out the fact that the goggles should not only have lenses of the proper density but they should be comfortable otherwise. Ill-fitting goggles or those with metal frames often lower the welder's efficiency to a marked degree. The metal frames get hot and irritate the operator. Poor fitting goggles are a discomfort which cause him involuntarily to do a poorer grade of welding.

Before leaving the subject of goggles and eye protection it may be well to caution the welder about grinding steel, iron, aluminum or other substances. He should always wear some sort of eye shields when engaged in this kind of work. Fine particles of emery dust or bits of slag when thrown by the high-speed wheel are always very painful if not very dangerous. In fact emery dust alone when thrown into the eye will often cause severe inflammation and cause the victim to lose a few days' time, besides suffering and doctor expense.

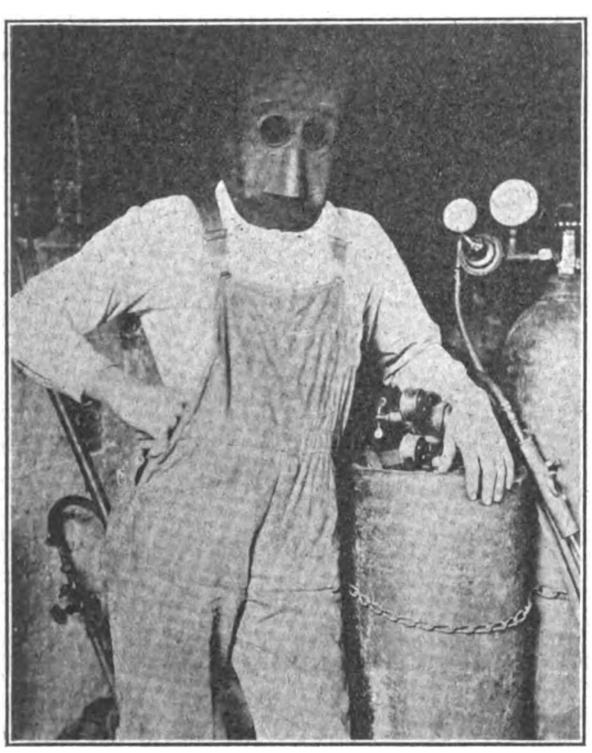
However, for grinding purposes a simpler and cheaper kind of goggle may be used; such as is shown in one of the pictures accompanying this text. These grinding goggles should have clear glass of good quality, especially where accurate grinding is essential.

After the welder's eyesight, his lungs are probably the most vulnerable point of attack by ill health, inasmuch as the lungs are the center of vitality. As the welder is forced to breathe heated and fume-poluted air a good part of the time he should do everything possible to avert the trouble.

When welding brass or other copper alloys the risks are increased and extra precautions are needed. The fumes arising from melting metals of this class are sometimes extremely injurious.

"Brass Chills"

Lead poisoning and "brass chills" are quite common in shops where lots of alloy welding is done. The victim often suffers several days from a single attack. Probably the worst feature of it is that he cannot tell when he has inhaled the poison until he has commenced to feel the symptoms, often several hours afterwards. Then his head will be racked with pain and every bone and joint in his body will ache. Sometimes nausea and vomiting will occur.



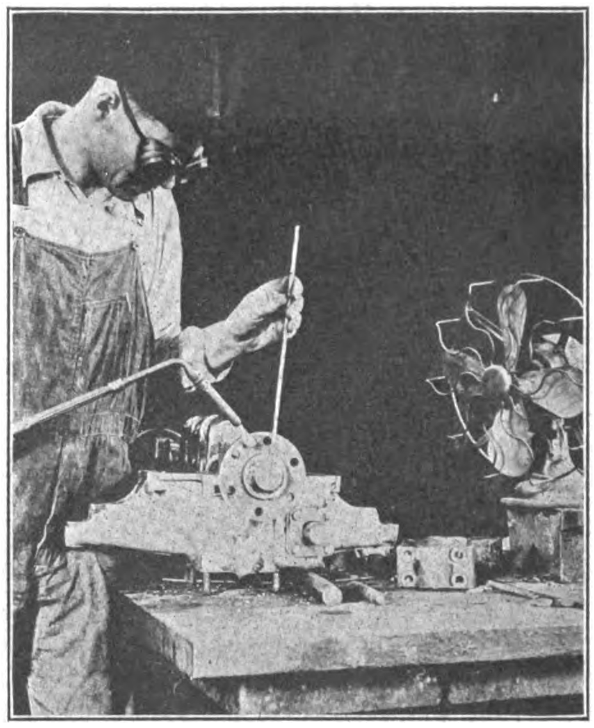
Not a Klu Klux; merely an electric welder's mask; very useful for a torch operator on a hot job.

Probably the most effective method of preventing brass poisoning is to install a suction fan over the welding table in such a way that it will draw the smoke and fumes away from the weld before they can reach the welder. This exhaust should carry the fumes out of doors.

Another method of combating the brass chills is to arrange a common electric fan so it will blow the fumes away from the torch operator, as is indicated in one of the pictures. This electric fan is also useful as a health hint in another way: when welding a long, hot job the fan is placed so the breeze will blow directly upon the operator, making the heat more bearable and thereby increasing his efficiency at the same time.

Care should be taken, however, that the wind does not strike the welded casting, as a current of cold air will oftentimes cause the weld to crack through the unequal contraction thus set up.

A remedy employed in brass foundries and welding shops where much brass work is done, for the purpose of counteracting the effects of lead, zinc, or brass poisoning is to drink large quantities of fresh milk; as a preventative it should be drunk before starting to weld: as a remedy it should be taken after the first symptoms shows. As much as a quart is needed in severe cases. Brass molders often drink that much with their lunch as a preventive.



An electric fan is useful in blowing the fumes of a brazing job away from the welder.

The fumes of the burning metal are inhaled to lodge in the mouth and throat, from where they are carried to the stomach. Then the milk counteracts the poison of the metal and thus keeps it from being carried to the whole system, to cause the head ache and ague.

Another device for eliminating the poisonous fumes of melting brass is what is termed a respirator. This is worn over the mouth and nostrils to prevent this oxidized metal from reaching the mouth and throat of the victim. Such an apparatus is shown in one of the accompanying illustrations and consists of a rubber cup containing a moist sponge to catch the atoms of oxide and prevent them from being drawn down the wearer's throat. An ingeniously contrived valve is inserted between the sponge and mouth piece to facilitate free breathing.

A device like this is peculiarly adapted to close quarters or in places where no other precautions may be employed.

Now, since heat is one of the worst enemies with which the torch operator has to contend, the electric welder's mask shown in one of the cuts is often very effectively employed by the torch welder as well. This device, which is in reality a black paper helmet, effectually protects the torch welder from radiated heat of the job and intense glare of the welding, in so far as his face and eyes are concerned. The large eye holes are provided with colored glasses to serve in lieu of goggles which are not needed when the mask is worn.

The rays of light from an electric arc weld are harmful to anyone not protected by a mask of this kind. In fact a slight exposure of the skin to the electric rays results in a burn quite similar to the well known sun burn even though the person is standing as far as fifty feet away from the welder. It is said the rays will even pass through thin clothing to cause a bad burn if long continued. As a result of the electric burn the skin will all peel off as it heals.

Mask Shields From Heat

However, the mask is not worn by gas welders for the purpose of protecting them from burns of this nature but to shield them from the intense radiated heat of a heavy welding job, especially where lack of room keeps them from utilizing other means of protection. The mask also serves to protect the welder's face from explosions of flying sparks or oxide while working in cramped quarters.

It might be well to add that the torch operator who works steadily every day at the welding trade should further guard his health and eyesight with plenty of sleep. Nothing will counteract the evils of overworked eyes more than sleep. Where the eyes are straining all day, through closely watching the melting white metal they should be given the opportunity to recuperate by sleep at least eight hours every night. The effects of watching the welding flame and molten metal day after day may not be apparent at first but the ultimate result is weakened vision.

Perhaps it might also be well to reiterate some of the cautionary measures needed in brass welding. Where the welder cannot see the fumes he is liable to think they are not present. This leads him to take a chance and breathe some of the poison. Then, if his system happens to be able to throw it off without trouble he will take a longer chance next time.

Perhaps the warnings given here are a little overdrawn but if so it is for the purpose of causing the welder to be careful. It must not be thought that every little job of brazing is dangerous, although the direct fumes from any alloy job are laden with poison and should not be inhaled.

Now the foregoing are just a few of the main health hints for the welder but they should disclose the fact that the torch operator must guard his body in order to attain the highest efficiency.

It may seem to take a little more time or a little more labor sometimes but the welder will be convinced it is money well spent after he has had a siege of the miserable brass chills once.

An officer was showing an old lady over the battleship.

"This, said he, pointing to an inscribed plate on the deck, "is where our gallant captain fell."

"No wonder," replied the old lady; I nearly slipped on it myself.—*"The Lightning Line."*

A HORSESHOE FOR LUCK

(Continued from page 9)

As stated at the beginning of this article, the origin of the horseshoe as a charm against evil is not known, but I recently came across an ingenious theory propounded by a Victorian student.

It was that in very old religious pictures of the Virgin or the Saints, it was customary to place on the painting, over the heads of the persons represented, a metal meniscus (a crescent shaped ornament or halo) and that, as in process of time, the portraits became faded or completely effaced, the devout people, accustomed to kneel in sacred adoration before this picture, continued to pay to the horseshoe-like meniscus that respect and belief in its saving power with which the patron saint had been credited.

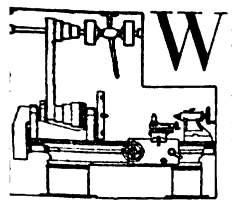
Hence the perpetuated faith in the horseshoe for luck.

It has to be confessed that although in Russia ikons or saint's pictures are decorated with metal and jewels the hypothesis is far fetched.

Spare Time Jobs

The Young Apprentice Smith Is Shown How to Turn Scrap Iron Into Good Tools

BY JAMES F. HOBART



WALTER LANGLEY came to the smith shop one morning and found his journeyman, Mort Buxton, sitting on a horseshoe keg, sand-papering a new handle in his forging hammer. "What's the rush, Mort?" asked Walter as he hung up his coat and put on his work apron.

"Not a thing, Walt" replied Mort:—"Last night, I cleaned up the last bit of work in the shop. If something don't come in this morning, we can go a-fishing or play checkers at the store!"

"Got all the shoes fitted up?" "Yes, every one of them. There are about three hundred new shoes all ready to fit and drive whenever they are needed, but the way shoeing looks now, that lot of shoes will sure last some time. Finished that wagon job too, and put new cinder rod in the forge, don't know of a single bit of work around the shop which needs doing."

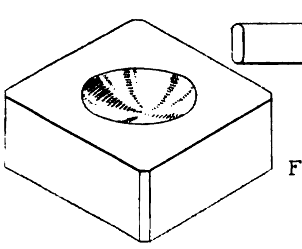


FIG 1

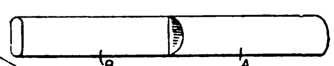


FIG 2

"All right, Mort, help me get these kegs into the shop." They brought two heavy kegs from Walter's buggy and dumped them on the shop floor. One keg contained half a dozen short "S" wrenches and a lot of bits of pipe of various sizes from eight to eighteen inches long. The other keg contained a couple of dozen of old chopping axes in all stages of disrepair, some with broken edges, some with heads crushed by sledge-driving as wedges, and several had their eyes split along one side.

"Why the junk, Walter?" asked Mr. Buxton as he looked over the sorry collection of old axe heads.

"Saunder's Hardware store is just out of chopping axes and was going to order a new lot. I happened to be in the store and told Saunders that next week, I would bring him two dozen of fine hand-made axes, and he is going to wait for them."

"Sufferin' Cinders" ejaculated Mort:—"I don't see any nice hand made new axes in that junk!" "But I do" said Walter as he went again to his buggy and brought in a bundle of new axe-handles—"there's some mighty nice axes in that bunch."

A Rounding Die

"Well, I'll sure be glad to see a few of them" said Mort. "But Walter, what's this 'ere contraption?" said Buxton, picking up a bit of steel with a cup-shaped cavity in its center, (as shown by Fig. 1).

"Oh that is a die for rounding the ends of some wrench extensions which we will make from these bits of pipe" said Walter as he kicked one of the pipe pieces toward Mort. "Mr. Saunders tells me that they are making the smaller sizes of drop forged solid-end wrenches so short that it is almost impossible to tighten or loosen nuts with the length of handle leverage supplied, and that he is continually being asked for longer light wrenches or for extension handles to use with the little short wrenches. And there is where we get off, Mort," who only said—"Well, I'll be darned."

Walter had the pipe end rounding die, Fig. 1, made for him at a machine shop. It could have been made in the smithy by drilling a hole, then chipping, filing and scraping the cavity to shape, but Walter did not see profit in working for five hours on a job which the machine shop did in twenty minutes.

Wrench Extension Swage

Mr. Buxton, after getting Walter's idea, forged several black steel shapes something like Fig. 2. A portion of the rods, which varied from three-quarter-inch to one inch, were forged flat at one end as shown at B. About six inches of length was thus forged, the rest of the rod at A, being left full size and round.

The thickness of flat, B, was made just enough that when a pipe was flatted down upon B, as shown at D, Fig. 3, the end of wrench F, would slide easily into the flatted pipe as shown by Fig. 3, one end of the wrench being hidden in flatted pipe D. Usually, one end of a small wrench as shown at E, Fig. 3, is made smaller and thinner than the other end of the wrench and Walter had the extension swages made as thick as thickest end of each wrench.

Length of Wrench Extensions

Several swages were required, and one was made for each size of wrench for which an extension was to be made. Walter found that when the thin end of any wrench was inside of an extension as shown by Fig. 3, that the wrench would wobble sidewise a bit. To obviate this feature, Walter found he could make extensions to fit the large end of one wrench and the smaller end of the next larger size of wrench and in this way he obviated the unpleasant side play of wrenches while in the holders.

When Walter set out to make pipe extensions for flat wrenches, he got the idea that for the short wrenches five or six inches long; that there should be at least ten inches length in the extension, and that it ought to slip over the S-wrench at least four inches.

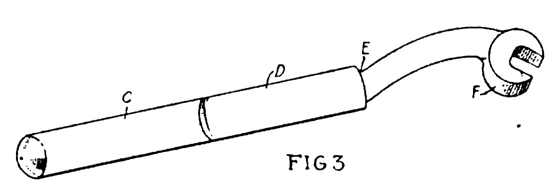


FIG 3

He made up a couple of extensions and tried them out in shop work and quickly found that only an inch or two additional length was necessary to give all the leverage that the wrench and the bolts whose nuts it would fit should stand.

Thus it was found that for the larger sizes of wrench, a holder as shown by Fig. 3 would be required, but for the smaller wrenches, simply the flatted portion of the pipe as shown at C, Fig. 3 was necessary and that a five or six-inch flatted piece of pipe was plenty long enough for the smaller wrenches and that both ends of the pipe could be used, one made large enough for the big end of a wrench, while the other end of the bit of pipe was flatted down thin enough to fit the small end of the wrench thus making it necessary to have only one very short flatted extension to fit both ends of any wrench.

When a wrench was to be in an extension, it was driven in so strongly as to bind the wrench at E and against its curved part at D, while the enclosed end of the little wrench bears against side of extension opposite to D, binding the wrench inside the extension so tightly that a considerable pull with F. in a vise, is required to remove the extension holder again.

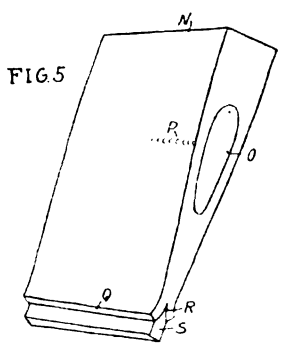
Such extensions as were made with one end flatted, the other end left round, were end-finished by heating to a mellow yellow and then quickly driving the pipe-end into the rounding die as shown by Fig. 1. But such extensions as were flatted along their entire length, were end-finished upon the grinding wheel.

An "Axe to Grind"

"Walter, that's hard looking thing to call an axe" said Mort as he picked up the object shown by Fig. 4. "What do you expect to make of that thing anyway?"

Walter grinned, put the "thing" into his forge fire and after a bit of heating and hammering, brought out the shape shown by Fig. 5. The old axe as shown by Fig. 4

FIG 5



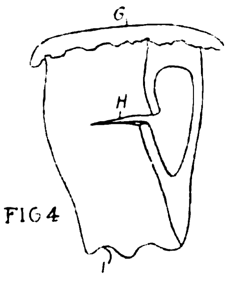


FIG 4

had its head all "broomed-up" as shown at G, the eye was cracked as at H, and the edge was broken off in two places as shown at 1. Walter knocked the thin edges back into shape at H, brought them together and then welded the crack with his Oxy-acetylene welding apparatus as shown at P, Fig. 5.

Walter gave no attention whatever to the eye of the axe while hammering the head or poll and the cutting edge into shape. He simply squared up the axe-head and upset the edge 1, Fig. 4, until there was thickness enough that the edge could be hot split with a chisel, as shown at R, Fig. 5. Then, a bit of good cast steel, of about 80 or 90 point carbon, was hammered thin on one edge and driven into split R, as shown at S. This operation requires that edge Q be made thick enough to stand splitting and still have enough metal after splitting, to hold piece S firmly in place when hammered against it from both sides.

Walter found that it did no harm to upset the cutting edge of the axe, for reason there was no cutting-edge there. What was to be the cutting edge is at present in the bit of new steel S, Fig. 5, therefore it did no harm to upset edge of the axe as much as was found necessary.

When it came to forging down the axe after new steel S had been welded in place, then Walter was careful not to "upset" any of the new steel. If the edge "drew-down" unevenly, he never attempted to hammer any of the steel back. He simply cut off and wasted the portions which were too long and and never drove cutting-edge steel back upon itself. He had heard it argued that no harm was caused by upsetting cutting-edge steel, but he never felt like taking risk enough to do so and then try out the upset steel.

Mending the Axe-Heads

Walter found most of the axe-heads to have plenty of metal in them so as to shape up square as shown by Fig. 5, at N. At the same time the eye was forged into shape,

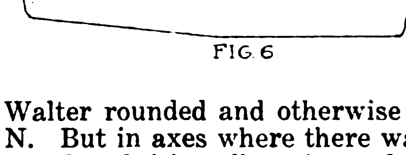


FIG 6

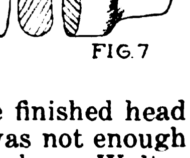


FIG. 7

Walter rounded and otherwise finished head N. But in axes where there was not enough metal to finish well to size and shape, Walter just "jumped" a piece of 60 or 70-point carbon steel upon the old head, making a butt-weld, then finishing the head to suit.

No attention being paid to eyes of the axes up to this stage, they naturally took all sorts of shapes, and as shown at O, Fig. 5, were hardly in shape for receiving handles. Walter looked over the bunch of new handles, also the eyes of the old axes, and decided to make all the eyes of the same size, and any axe which would not work to that size, would be scrapped or else reforged until the eye would come to standard size which was adopted to receive stock handles with the least possible amount of fitting.

Axe-Eye Swage

From a piece of 60-point carbon steel, Walter and Mort forged an axe-eye swage as shown by Fig. 6, tapering one end quite small and slim as at J, so the swage could enter an axe-eye, no matter how badly the eye had been battered. The swage is full size at K, and continues so to L. A cross-section of the swage is shown at M, and it may be noted how thin one edge and how the other—upper—and thicker end is carefully and symmetrically rounded. It is upon this tool, that the quality of an axe-eye depends.

Before Walter had straightened up half a dozen axes, he put the eye-swage in the forge fire again and drew down the large end as shown by Fig. 7. The swage is full size at L, same as in Fig. 6, but the end at N, has been drawn down so there is no possibility of its ever "brooming-up" under hammer blows, bad enough so it can reach and damage walls of the axe-eye—something which soon happened to end L of the swage when as in Fig. 6.

Axe "Hang" and Finish

Walter found that all the beauty, truth, and "hang" of an axe depended upon the use made of the eye-swage when finishing off an axe on the anvil. It is when the swage is in place in the eye, that the head or poll must be squared up exactly with the swage. Furthermore, the "bit" of the axe must also be trued very exactly with the swage or else the axe-handle will hang awry. Not only might the handle "hang" to right or to the left, hand "in" or "out," but the handle also have a most despicable twist—something which no good axeman will tolerate.

Walter and Mort found it quite a task to "true-up" some of the axe-heads, but by bringing separately, the head and bit of the axe to "jibe" with the eye-swage, that the three parts of the axe:—head, handle and bit—could be made to hang exactly as desired by the most particular axe-man. When finished and tempered—and here Mort was right at home, the axes were ground and polished and some of them finished with blue-lacqured heads with a bright space along face of the poll:

Carefully fitted with a waxed hickory handle, Walter found it easy to sell at good prices, all the axes he could get hold of to rebuild. And by standing in with the junk men and offering prizes to boys for old axes, Walter surely got hold of a lot of them.

WALL STREET BAIT

Attracted by the lure of a get-rich-quick concern, a farmer put some money into the enterprise. For a while he received dividends. When they ceased he wrote a sharp note, asking the reason for stopping the disbursement.

The reply was a literary gem. Three paragraphs apologized for the cutting off of dividend payments, adding that on account of the industrial depression and the fact that thousands of women and children in Europe were starving, it was necessary to conserve cash, etc.

"This is the greatest country in the world, bar none," the letter concluded. "Before long our industries will be working day and night. This will mean big earnings for the company and substantial profits for you."

"That is what I call a good letter," exclaimed the recipient. "In a measure, I'm sorry I wrote them."

But accidents will happen. The envelope also contained the original inquiry enclosed by mistake and on the reverse side was a faint pencil notation, probably a direction to some stenographer:

"Send this gink No. 6. That ought to hold him for a while."—*Wall Street Journal.*

The doctor's wife was entreating her husband.

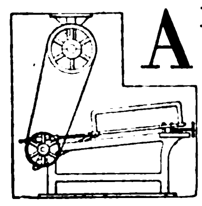
"George, dear," she pleaded. "I really must have a new fur coat to go with that new gown."

"Well," returned the surgeon. "I can't promise you definitely, but I will look over my list of patients, and if there is one with his appendix left, you get the coat."—*Exchange.*

An Ornamental Sign

What Could Be More Pleasing Than to Have a Sign Advertising Your Business?

BY ARTHUR W. JORDAN



ALWAYS busy is a state of things more often desired than attained. Times of slackness always come even in the best regulated shops, despite all the energy directed to keeping the flow of orders up. Why not devote the spare time to making a sign for the outside of the shop which shall be, at once a real sign of the good work done inside, a means of arresting the attention of passers-by and an indication of the position of the shop.

There is nothing more attractive than the swinging sign when it has some novelty about it or is of artistic value. The smith is often called upon to make a sign or some part of one for other people, why not one for himself? The one shown in Fig. 1 is at once artistic and attractive but has nothing in its make-up past the ability of a smith who can bend a few scrolls and fix them together. The leaf work can be omitted if desired and yet a good sign will result as the design is independent of the leaves, relying for its artistic effect on the outline of the scrolls and the signboard.

The first part to make is the back plate which is shown in Fig. 2. This should be of stout thickness, according to the size of the sign which may be anything desired. A more important factor to the design is the proportion of length of bracket to depth of backplate. If these are somewhat near in size to each other it will allow for the extra projection of the sign board to give that balance to the whole necessary for good effect.

Assuming therefore that the projection to the tip of the final is 4 ft. the backplate should be from 4 ft. 3 in. to 4 ft. 9 in. long —say 4 ft. 6 in., but it all depends on the height and position the whole is to occupy when fixed. These may modify the sizes somewhat, but the above will be a good substantial looking proportion, and that is important in this case. The width of the backplate should be about 3½ inches, and the thickness ¼, or ⅜ inch, the latter for preference.

There is a nice bit of forging work at each end of the backplate, as the discerning smith will perceive. These offer no difficulty, being fairly straightforward work but there are one or two points to be noted for good work. First of all, see the ends are drawn to a taper, in section. Next see that the division at the bottom is exactly in the middle and that scrolls are drawn out equi-distant from the centre. Finally note the crimping in of the centres of the rolled ends.

Fig. 3 shows the top scroll without the leaf, this being shown at Fig. 4. This scroll should be of strong section of iron, being with that shown in Fig. 5, the principal stress and weight bearers. The top scroll may be of 1¼ or 1½ inch by ¼ inch iron and that shown in Fig. 5 should be of the same thickness, but may be of the larger width whether the top is smaller or not in this respect. This difference in width, if desired, is permissible as the top scroll may be of lighter appearance as it is subsidiary to the other, and will then consort better with the smaller scrolls beneath as great width of these is unnecessary, but equal widths look best. The leaf shown in Fig. 4 is nothing very difficult for anyone who has had any experience in bumping up work. It adds a little distinction to the scroll and is given for those who wish for something more ornate than the plain bend. The outline should be cut out of sheet iron, not too thin in gauge as a sign bracket is always a substantial job and it is best to err on the heavy side, if at all.

The principal scroll is shown in Fig. 5. It should terminate at A the other scrolls being welded on. Two of these are shown but the lower one may be merely the leaf shown at C as there is nothing depends on this, the firmness and strength necessary in this portion of the bracket being got from the size of the main scroll and the fastenings at A and B. The leaf at the bottom is taken round to the fixing at the back of the scroll and is secured again to the scroll under the curl of the leaf. In a screen or anything for inside work such extra fastening would not be necessary but in this case the whole is exposed to the fury of wind and weather and no part can be made too secure. In Fig. 6 is shown the smaller scrolls which fill up the triangular space between the main scrolls and the backplate. These are quite plain scrolls and should be thinner than the others although many will prefer to keep to the same width of metal. This is not necessary, however, by any means and is a matter for individual preference. There are these advantages whichever size is adopted. If the full width is used the bracket looks additionally strong and substantial, and if a smaller width is taken, a certain lightness and delicacy is given to the whole. and as this can be given here without really sacrificing much in the way of strength, it is legitimate art to do so, if desired.

Presuming 1½ inch by ¼ inch iron was used for the main scrolls 1¼ or 1⅛ inch would do quite well for these and ⅛ inch or 3/16 inches at the most would be plenty for thickness. The strength they add to the main portions is by the fixings at each point, otherwise the bracket would be as strong without them. Their part is principally to ornament and so care must be taken to see that the lines they follow are graceful and that they are true to the design. The cresting on the little inside scroll is the flame tongue—an appropriate pattern for a smith's sign—and is shown in the same figure at A, a little enlarged for clearness.

The length from B to C would be in one piece the other scrolls being welded on as the design suggests. Care must be taken to get the main portion to correct shape and the smaller scrolls will then fall into place quite naturally. Failure to get the main lines true often results in a lot of extra work in a job like this and an unsatisfactory ending too "That'll do," never does do in work of this kind, that is only the difference between slop work and art.

The sign itself is partly shown in Fig. 7 with an end elevation and is of distinctive

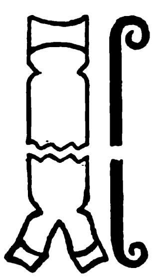


FIG. 2

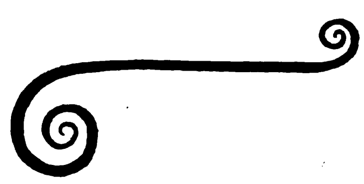


FIG. 3

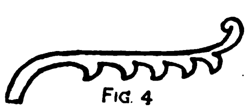


FIG. 4

FIG. 5 FIG. 6

character without being difficult to make. The best way to construct it is to use two sheets of iron fairly strong and make two separate signs as it were, with lettering complete. These should be screwed or riveted together through the square framing enclosing the lettered portion fixing the four thicknesses together at once. Or, if preferred, the sheets could be riveted together first and the framing on each side could be brazed on.

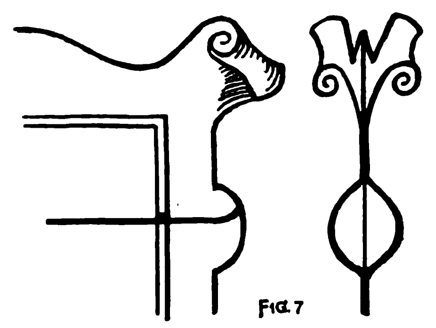


FIG. 7

If neatly done and nicely mitered at the corners the former is the better way.

A half round beading can be used for this framing, or any other pattern the smith has by him, providing it is not too elaborate in section. A bit of strip 3/8 or 1/8 inch by 3/16 inch will look quite well, it is generally to hand, and all the better for being simple. The two sheets come together at the edges nowhere but at the point where the ring for suspending goes through, this being more for convenience than for anything else. The edges curl away everywhere else and as this gives the character to the design it is important. A section lengthways is shown on Fig. 7. Note the curls at the four corners in the elevation.

The letters may be plain guilt—not blocked in any way that will spoil the sign—or they may be the plain polished brass letters which can often be bought at most hardware stores if the proper size is obtainable. These will require brazing on but will be more enduring. They will not keep their color so well as gilt letters which are more appropriate.

When finished the sign may be painted any color desired but nothing beats egg shell gloss black. With the letters gilt, and a touch of gold on the leaf scrolls, the sign would then have a superior appearance. In fixing up the four bolts shown on the backplate should go through the roll and be secured by nuts inside, and for an exposed position would be better if two of them go through the main scrolls also. This would mean spacing the other two bolts equi-distant.

All the fitting together of the parts should be done either by riveting or screwing. Clips are not strong enough for this job and brazing is too unsmithlike; the sign should tell in every line and fixing that it was made by a smith for a smith and should be the best advertisement for his work that he has around the place.

USE AND CARE OF TOOLS

How To Use Tinners Snips

Always make straight up and down cuts. When cutting, never twist the snip sidewise as this practice would have a tendency to dull the cutting blades. Never use blades for prying or bending and don't use for heavier work than ordinarily intended for their size. The joint and cutting edges should be kept well oiled. Another point to remember is never to use the cutting edges for wire cutters.

Before putting tools away, there is much to be gained by oiling the tools—'most any kind of oil will do. Nothing dulls the temper of tools more than rust, and by using a little foresight there is much to be gained in this way. Treat tools right. Never abuse a screw driver by using it for a cold chisel, or a wrench for a hammer. You owe it to yourself to give tools reasonably good care, and they will live up to the claims the manufacturers make for them.

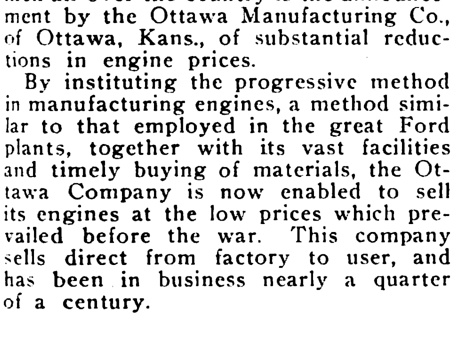
How to Use a Hack Saw

The one thing that makes for good cutting is the choice of a hack-saw blade of the proper kind for the work. For cutting cold-rolled, solid stock, machine and light structural steels, 14 teeth to the inch is recommended, and 18 teeth to the inch for general all around work. For sheet metal and pipe over 18 gauge, 24 teeth to the inch should be used. The 2 teeth to the inch blade is adapted to either thin sheet metal or tubing under 18 gauge in thickness. It is safe to say that the 18 teeth to the inch blade is the desirable one for all general processes. The best results are obtained from 50 to 60 strokes a stroke and lightly on the return. Don't start minute, pressing heavily on the forward a new saw in an old cut, because the set is wider on the new saw and the blade will stick.

The Ottawa Engine

Of interest to blacksmiths and shopmen all over the country is the announcement by the Ottawa Manufacturing Co., of Ottawa, Kans., of substantial reductions in engine prices.

By instituting the progressive method in manufacturing engines, a method similar to that employed in the great Ford plants, together with its vast facilities and timely buying of materials, the Ottawa Company is now enabled to sell its engines at the low prices which prevailed before the war. This company sells direct from factory to user, and has been in business nearly a quarter of a century.



Ottawa engines have stood every possible test under all conditions and in all kinds of weather. Even inexperienced owners have no trouble in starting and operating them. They use either kerosene or gasoline for fuel. Fewer parts, low fuel consumption and an abundance of surplus power are some of the special features found in Ottawa engines.

Ottawa engines are made in sizes ranging from 2 H-P to 22 H-P in stationary and portable types. On every engine sold, the Ottawa company gives a 10 year guarantee. An elaborate booklet on engines has been published and may be obtained without cost by writing to the Ottawa Manufacturing Company, Ottawa, Kans.

"Little Giant" Pipe Wrench Presented to the Trade

The "Little Giant" Pipe wrench, a new wrench with several interesting improvements has just been put on the market. The "Little Giant" wrench has the "end opening" feature which is familiar to users of machinists' wrenches. Its application to pipe turning can readily be seen by a glance at the accompanying picture.

The advantage of the "Little Giant" wrench over the conventional style is the ease with which it can handle pipes in corners, close to walls, and similar confined places.

The person using it can set it straight on the pipe as he would a pair of pliers, instead of having to fit the jaws on from the side.

The "Little Giant" wrench has only three parts; a handle and jaw in one piece, which is dropped forged and heat treated; a movable jaw, likewise drop forged and heat treated and a hardened steel nut. There are no springs, rivets, frame or pins, all these parts being eliminated. In spite of the absence of springs the "Little Giant" wrench takes hold and releases instantly at the option of the user.

The new wrench has been designed for maximum strength. The 14" size has repeatedly withstood stresses in excess of 4700 inch pounds without slipping or bending. Readers familiar with government requirements will recall that the army and navy departments require a test of 2800 inch pounds for a wrench of this size. Yet owing to the elimination of extra parts the "Little Giant," in spite of its extra strength weighs less than a Stillson type wrench of corresponding capacity. This is an advantage to users and dealers alike.

Another feature is the double set of teeth on the main jaw. The movable jaw can be engaged at the option of the operator with either of these sets of teeth with consequent lengthened life. On the large sizes, 14" and greater, two additional sets of teeth are provided, making four in all, and the movable jaw can be reversed to engage these additional sets of teeth, which are below the adjusting nut. This is very useful in connection with certain classes of work, besides practically quadrupling the life of the tool.

The "Little Giant" wrench is being manufactured in 8, 10, 14, 18 and 24" sizes, of which the three smaller sizes are already on the market.

A point of particular interest to dealers is the bright orange paint with which the panels in the handles are covered. Wholesalers and retailers appreciate the attractiveness of color, and this feature will aid in arousing consumer interest in the "Little Giant" wrench.

The new wrench is a product of the Greenfield Tap & Die Corporation, Greenfield, Mass., "Little Giant" is one of their trade marks, well known throughout the trade to all users of Screw Plates, Taps and Dies. The new wrench will be extensively advertised by its manufacturers.

Cleveland Top Enlarges Line

The Cleveland Top & Specialty Company, East 65th & Carnegie, Cleveland, Ohio is concentrating on a line of top covers for all makes of cars, marketing under the name of Re Nu Top Recoverings, extending the scope of a business which formerly catered to Fords exclusively.

The Ford top cover or slip-roof outfit has been very thoroughly introduced and is used by thousands of repair men as a quick and economical method of replacing worn tops and also, to some extent, by the Ford owners themselves.

The Re Nu line is offered in the belief that there is just as big a field for top covers in other makes of cars as in Fords, and that a very large part of the top replacement business could as well be done by the regular repair man as by the trimmer. Naturally, it is difficult to stock a varied assortment of top covers. Hence, The Cleveland Top & Specialty Company is planning to give prompt attention by parcel post to order for special shipment. The Re Nu line also embraces complete tops for Fords including one-man tops and an allweather top of the California type.

All Re Nu products are given an unlimited guarantee of quality and fit.

Dover Handy Oiler Set

If you are a repair man or machinist you will at once appreciate the new Dover handy oiler set which is being sold by the Dover Stamping and Mfg. Co. of 385 Putnam Ave., Cambridge 39, Mass.

This oiler set is something which the machinist trade has been in need of for many years for it is both a time and money saver. the set consists of six, ½ pint, copper-plated, steel oil cans and a heavy, black enamelled, steel shelf.

The oil cans are of the best grade with cut thread spouts and each can is marked with steel, raised letters, which indicate the contents of the can. The six cans are marked; "Gasoline," "Kerosene," Machine Oil," "Neatsfoot Oil," "Kant Rust" and "Lard Oil."

The whole assembly is mounted upon a convenient spot in the garage or machine shop and the mechanic can select, without a moment's loss of time, the can which he needs.

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

WANT ADVERTISEMENTS

ADVERTISEMENTS of SHOPS FOR SALE or TO RENT, SHOPS WANTED or SITUATIONS or HELP WANTED

will be inserted under this head at 3 cents a word, including the address, for each insertion, payable in advance; but no advertisement will be accepted for less than 60 cents, however small.

Remittances may be made in postage stamps where the amount to be sent is less than $1.00. Address

M. T. RICHARDSON CO., Advertising Department,
16-22 Hudson St., New York. Publishers of the Backsmith and Wheelwright

Wanted

Blacksmith experienced in tempering drill steel and machine repairing mining property South America, two year contract, good living conditions—high altitude, man under forty, single, preferred. State detailed experience, age, salary desired, etc. Include photo if possible. P. O. Box 654, City Hall Station, New York.

For Sale

FOR SALE—Small Farm Bargain, five big sunny acres; good for chickens, fruit or a summer home; located near Dyers Lake, Michigan. Price only $180.00. Terms $5.00 cash, $3.00 monthly; might throw in my tent and fishing outfit. Write Frank P. Cleveland, owner, 3955 North Robey Street, Chicago, Ill.

Blacksmith Shop and Garage. Two sets of tools complete.
One frame building in L. shape, 40 x 40 x 20. I will sell either for one-half cash or less if party agrees for same. Only one blacksmith in town. Work for two men all the year around. Address J. W. Kesler, Orrin, N. D.

Reduced prices on used lathes, millers, drills, screw machines and other tools. Bargains while they last. 2800 B Bicknell Mfg. & Supply Co., Janesville, Wis.

FOR SALE—160-acre good improved farm 2 miles from Topeka, Kans. Will take in part pay. Blacksmith shop, residence or garage in South East. Nebr. J. C. Karas, Table Rock, Nebr.

For Sale—Second hand Power rip saw in good condition. Address Michael Fleck, 15 Depot St., Salem, Ohio.

FOR SALE—Power Blacksmith Shop in long staple cotton belt. Write to, A. Barton, Annona, Texas

Patents

PATENTS FOR INVENTIONS.

H. W. T. JENNER, patent attorney and mechanical expert, 622 F Street, Washington, D. C. Established 1883. I make an examination and report if a patent can be had and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions. Trademarks registered.

For Blacksmiths

Toy's Modern Methods doing hard jobs easy will help every smith make more money. Will make a blacksmith of a good helper or handy man. Forging or solid welding, hardening and tempering to standard with colored tempering charts. All for one dollar. Samples free. W. M. Toy, Sidney, Ohio.

Peerless Automatic Bearing Devices

The Peerless Piston Ring Mfg. Co. of 3846 North Clark Ct. Chicago, Ill., is marketing a device which is said to do away entirely with piston knocks. The Peerless Automatic Bearing Device, as the accessory is called, may be applied to practically any connecting rod and when in place it automatically takes up all play between the crankshaft and the connecting Rod bearing.

The device consists of a double set of wedges which fit over the connecting rod bolts. One set of the wedges is under constant pressure from a heavy steel spring.

In assembling the device, the wedges are properly placed upon the bolts, the shims between the connecting rod, and cap being left out. The cap is next pressed against the bearing and a snug fit made by pressing the bearing around the crankshaft. One set of the wedges is pressed outward and the cap bolts screwed down by hand and the cotter pins inserted in the bolts.

Should any play develop in the bearing, the wedge shaped members immediately slide outward and thus eliminate all lost motion. The manufacturers claim that the bearing devices will keep the caps lined up correctly at all times and automatically compensate for all bearing wear. The bearing and journal cannot knock as long as there is any room for adjustment between the cap and connecting rod.

Amazon Trebles Output

Officials of The Amazon Rubber Company, Akron, Ohio, announce that production is now running 85% of the total capacity of the plant, and orders are in hand to such extent that it is imperative to increase production to total capacity immediately.

BLACKSMITH AND WHEELWRIGHT
and TRACTOR REPAIR JOURNAL

'ol. LXXXVI. No. 3 SEPTEMBER, 1922 TERMS ONE DOLLAR A YEAR

The Inside Story of Steel

What Happens to the Steel When It Is Quenched at Various Temperatures

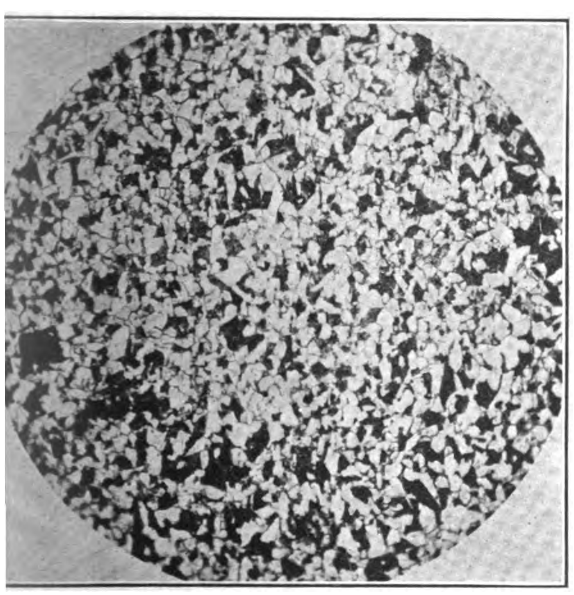
By J. F. SPRINGER

IT IS undoubtedly best, if we want to know what the situation inside a given piece of hot steel is, to quench it suddenly. Then we know that there hasn't been time for some things to change. Of course, the steel hardens y solidification, etc.

In one of the views (A), we have a microcopic view of a portion of metal in a steel 'ire made of steel containing 0.30 per cent arbon. This is a comparatively soft steel ontaining pearlite grains in a honeycomb of errite. The pearlite is black and the ferrite vhite. The magnification is very moderate, ieing only 100 diameters. This sample hown has been heated to 1607° F. and then llowed to cool as the furnace itself cooled. 3y the way, this is a good way, often, when it s desired to get a slow cooling of a piece of teel. The temperature 1607° F. is between *ight red* and *orange.*

Now the view (B) is a similar steel, conaining, as it does, 0.30 per cent of carbon. t hasn't been heated quiet as high, the temerature this time being 1562 F. But, and iere we have a big difference, this steel has ieen hot worked. The microscopic power is he same as before—100 diameters. The temerature 1562° F. is a *light red.*

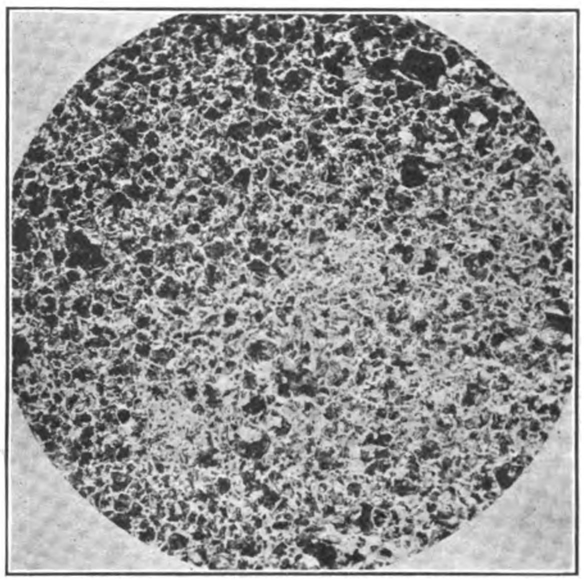
I think that we can compare these two 'iews, A and B, and note the effect of the hot vorking. In general, the structure is disinctly fined in the hot worked steel. There re two or three big black spots. These are robably grains of pearlite. Neglect the big lack spots in both views and consider the remainders. The hot worked steel shows, I hink, a much finer texture.



'iew A; Steel Wire 0.30 Percent Carbon, Heated to 1607 Degrees, F. and Furnace Cooled. (Mag. 100 Diam.)

Now it is generally assumed that the maller the grain the stronger the steel, other hings being equal. It will be clear then that his hot worked steel is better than the other, ecause it has been worked. The big black pots are perhaps locations where the workng did not do its full work. As this sample vas doubtless prepared by an expert, the eader may consider that in ordinary cases here would be a good many more black spots indicative of failure to break up the grains to the full extent.

In fact, hammering on the anvil, rolling in a rolling mill, drawing through a die on a draw-bench—all these are working operations in which the grains are more or less broken up and made small. I am speaking now of hot operations and am making no reference at all to cold working. It really is a marvelous thing that a blacksmith or other worker can improve a piece of steel by hammering it. A comparison of the views A and B, however, seems to corroborate the idea that he really does benefit the steel by forging it hot on the anvil.



View B; Steel, 0.30 Percent Carbon, Hot Worked, Heated to 1562 Degrees, F., Oil Cooled. (Mag. 100 Diam.)

I can not take up much space with the matter of forging; but the opportunity is too good perhaps to permit me to exactly throw it away. So, then, let me say a word or two on hot forging. In the first place, only those parts are benefited which undergo the breaking up of their grains. The smith's hammer may come down good and hard on a piece of hot steel; but that does not necessarily mean that all the steel between the hammer and the anvil is much affected. Down in the center, the core of steel may not feel the blow, or the reaction of the anvil very keenly.

What is required, however, is that the grains be broken up into smaller ones. Undoubtedly, this must be, if the steel is to be improved. Consequently the reader is to bear in mind that the object of the hammering is to break up grains, and that only where such breaking up occurs is the steel bettered. Turning the work over and over helps doubtless in attaining this object. Long continued pounding would also appear good. A second point concerns the moment of stopping. When is the hammering to cease? Naturally, the steel keeps on cooling off, as the hammering goes on. It may be taken as fairly well ascertained that the hammering should continue until a dull red is attained and should then stop.

It seems rather probable that hammering will not break up the grains to a size that is smaller than what is the proper size for the temperature at the moment. Perhaps the reader doesn't understand that the general rule seems to obtain that at every temperature above a *cherry* a piece of steel will have a particular grain size, this size being larger and larger as the temperature becomes higher and higher. So, then, when the smith is hammering away at a piece of hot steel, the size of grain at any moment is probably no smaller than the grain size of that temperature.

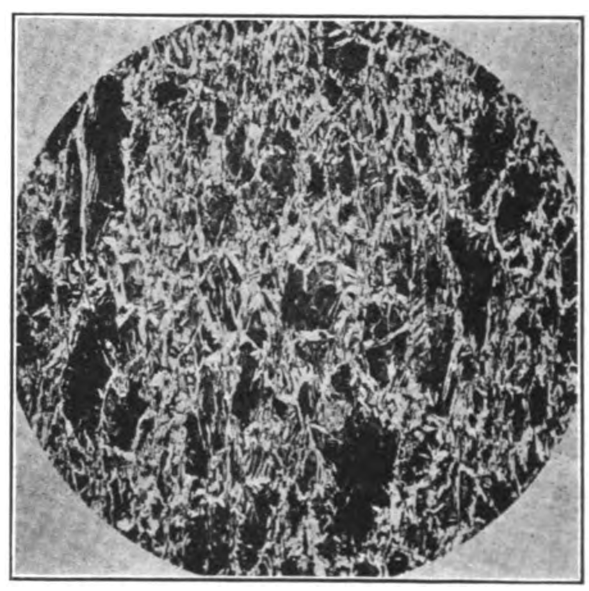
In fact, even if the hammer broke up some grains to a smaller size, the heat present in the metal would probably tend to convert these to the proper size for that particular temperature. Now, whether this talk has been correct or not, the reader will do well to assume that it is a fact that if hammering is stopped as the steel cools, the grain size of the steel when cold will be no smaller than the size corresponding to the stopping temperature. For example, suppose the smith starts with the steel at a *yellow* and stops with the steel at a *light red.* The grain size inside the steel is assumed to be no smaller than what properly belongs to a *light red.* Now *cherry* is to be considered as the heat at which all steels have naturally the smallest size. Consequently if the hammering stops at *light red* and so fails to go on until *cherry* is reached, we are to conclude that a part of the possible benefit has been lost. The grains will be bigger than they need be.

The thing for the smith to do is to keep the hammering going until a *cherry* is reached.

Perhaps I run the risk of making myself unpopular by pointing out this. It certainly is a good deal easier to forge steel at a higher heat. As the steel cools off on its way to *cherry,* it gets stiffer and stiffer. This means more and more muscle is to be exerted in order to overcome the increasing stiffness of the metal. However, I am just telling the reader how the matter seems to stand. He may choose to follow what I say or not to follow it. That is up to him. What is up to me is to explain what the facts appear to be.

Similarly, if the work is being worked in any other way than on the anvil, the time to stop working is at a *cherry* heat.

In view C, we have the microscopic appearance of a spot on a bit of steel wire made from steel containing 0.30 per cent of carbon.



View C; Steel Wire 0.30 Percent Carbon, Heated to 1022 Degrees, F. and Furnace Cooled. (Mag. 100 Diam.)

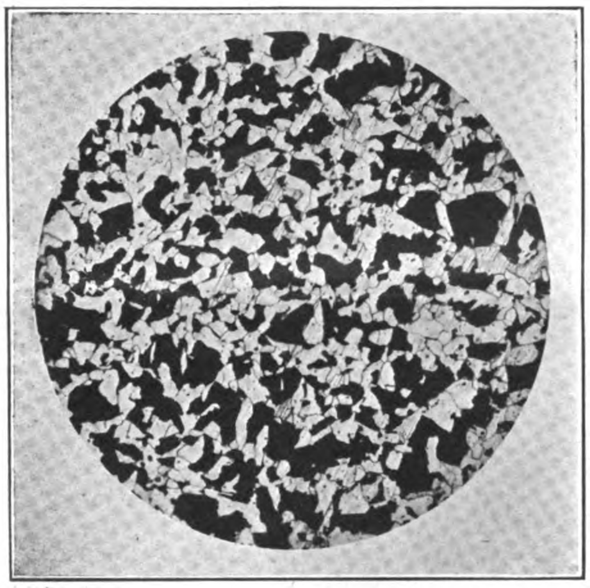
This is the same carbon percentage as for A and B. The magnification is also the same for all three views; viz., 100 diameters. But the steel C has only been heated to 1022° F. This is a *blood red* or a *dull red.* The size of the grains is to be regarded as just the same as it was before this steel was heated.

In short, heating cold steel to 1022° F. has no effect on the grain size. This steel was cooled in the furnace.

The white in C is to be taken as ferrite and the black as pearlite. It will be noted that there are some big black spots. Apparently, they are pretty big. But they are probably fairly normal for a magnification of 100. If this same spot had been magnified still more, probably the mass of white would show lines of division, and the whole circle would appear broken up into grains of about the size of the big black patches.

I have before me as I write a view showing steel containing only a little more carbon than that of view C. The magnification is, however, much greater, being 650 diameters. Instead of fine white threads, as in C, we have here coarse white bands. No doubt these heavy white bands are ferrite. In the view I have before me, white bands, broad and irregular, fence round a big dark spot. This dark spot is about 2 inches long and ¾ inch wide. It is perhaps a grain of pearlite. The spot is not all dark by any means. There is more or less white haze. When I put a hand glass over it, this haze begins to get an appearance which may be regarded as the beginning of zebra-like effects. Undoubtedly, the portion included is, roughly, one or more grains of pearlite.

The size of the grains in steel is a most interesting topic. It is generally understood that, in a given piece of steel, there is no change brought about by heating until a certain temperature is passed. This certain temperature is about *cherry red*. As the heat goes on up, the grains are understood to increase in size. But this is not so simple as the reader may have concluded. Let us consider a specific case.



View D; A photomicrograph showing a piece of steel which is 0.50 percent carbon and magnified 100 times.

Take, for example, a low carbon steel. We select a steel containing 0.20 per cent of carbon. We are going to assume that this piece of steel is, at the beginning, in a *normal* condition. That is, we assume it has cooled slowly and that 25 per cent of the whole is in the form of pearlite. This means that the balance, 75 per cent, is in the form of pure iron or ferrite.

No change of any importance occurs until the steel is heated to about 1337° F. This is a *full cherry red*. This point is called the lower critical range. It is worthy of note, because at this stage some change in the steel begins to take place, as the metal is heated on up. But, at this juncture, the pearlite is completely altered. Let us stop here a moment, and consider matters.

The reader will perhaps remember that pearlite is that part of annealed steel that has a zebra-like appearance under the microscope. Pearlite may sometimes appear different; but the usual thing is a zebra-like appearance. If the reader recollects, he will understand that this appearance is caused by layers of ferrite and cementite alternating with each other. First, say, a layer of iron (or ferrite) and then a layer of cementite; and then, another layer of ferrite and next a layer of cementite—this is what makes pearlite look striped like a zebra. I will now asume that the reader has recalled pearlite.

The piece of steel about which we are now concerned consists partly of pearlite and partly of ferrite. When this piece of steel is in normal condition, the ferrite will form a honeycomb in which are imbedded the grains of pearlite.

Let the reader now reflect that we have ferrite in two ways in this steel—(1) there is the honeycomb, which is nothing but ferrite; and then (2) there is pearlite, one half of whose layers are ferrite.

The Material Austenite

When the sample of 0.20 per cent steel is heated up, there will be no very important development, until a *full cherry red* (1337 F.) has been reached. At this juncture, the pearlite is altered, but the honeycomb ferrite remains as it was, in so far as its character is concerned. The altered pearlite has been given a special name. It is *austenite*. The old layers of ferrite and cementite are now merged into each other. The zebra-like appearance has gone. The austenite has a kind of indefinite appearance. When magnified 100 diameters, the grains will be seen to remain. But the pearlite appearance will be absent, though a higher power of magnification would be required to prove that the striped effect was not really there. The reader will perhaps remember that the individual stripes are exceedingly small. In fact, they require a rather high magnification to make them visible to the eye.

If the reader will now look at Fig. D, he will see a microphotograph of a low carbon steel, exhibiting the appearance when magnified 100 times. This steel contains something more than 0.20 per cent of carbon; but it is still a low carbon steel and resembles the appearance that the 0.20 per cent steel would disclose. This steel is in normal condition.

The black is the pearlite and the white is the ferrite. The grains are indicated by the black and the honeycomb of ferrite by the white. As the steel is heated up to the critical point indicated by the *full cherry red*, the black spots (pearlite) retain their size, but their character is changed. The white honeycomb of ferrite is not changed in character. However, the change in character of the pearlite grains is not to be expected to appear, unless a high magnification is used. Nevertheless, the change takes place whether we can see it or not. That is, the change from pearlite to austenite occurs at about *full cherry red* (1337° F.)

Now a rather wonderful thing takes place, as we push the temperature on up. This austenite into which the pearlite has changed continually absorbs material from the honeycomb. This is a curious thing, but austenite will absorb more and more of the ferrite honeycomb as the temperature rises above the *full cherry red*. This is what those say who have made a severe study of the matter. And this absorption goes on and on, until this sample of steel has been heated up to 1525° F. This is just about a *light red*. By the time the 0.20 per cent steel has been heated to the *light red*, the final bit of the ferrite constituting the honeycomb will be absorbed. The plain ferrite is now all gone.

Completely Changed to Austenite

When we began, the sample contained about 25 per cent of pearlite and about 75 per cent of ferrite. That is, the honeycomb contained three times as much material as the grains. And this condition was maintained until the *full red cherry* was reached. At this juncture, the ferrite represented by the white spots began to disappear into the pearlite grains—or, rather into the austenite grains, since the pearlite changes to the austenite at this temperature. Then as the heat was pushed on up to the *light red*, the original 75 per cent became less and less. At 1525°, the one-fourth had absorbed the three-fourths. So, then, at 1525°, the steel is *all* austenite. Now if the investigator wants to know just how matters stand at any point of temperature, he simply quenches the steel at that point, and then examines it under the microscope. The sudden chilling does not allow for anything much to take place.

The austenite grains into which the pearlite grains were transformed at the *full cherry red* ate up the honeycomb of ferrite, and did it completely by the time the temperature rose to the *light red*, although it was a case of one-fourth eating up three-fourths. Observe that it is the grains that eat up the honeycomb and not the reverse.

It will now be rather easy to understand that the grains get bigger and bigger as this absorption of the surrounding honeycomb takes place. The white is eaten up by the black.

Without the microscope, we should know just about nothing of the foregoing.

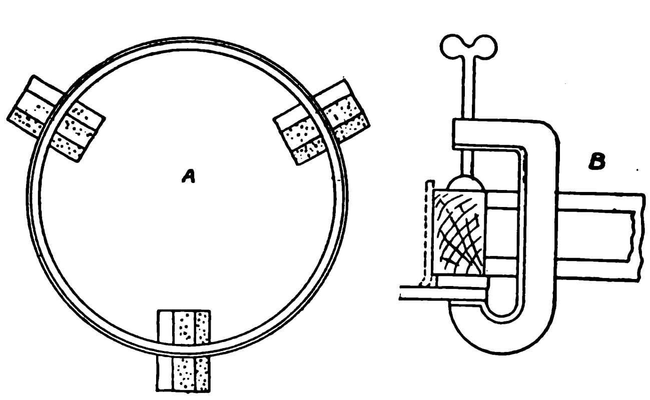
And yet it is necessary to know just this kind of thing, if one is going to heat-treat steel to the best advantage.

REPAIRING WOOD WHEELS

Shrinking on automobile felloe bands is not a common job in the smith shop but it does have to be done at times. Most mechanics have shrunk on small collars and other pieces that were required to be a tight fit upon a shaft or mandrel; and they have probably seen locomotive tires shrunk on wheel center in the railroad shops; in the former case, the piece was heated in any small fire—in the latter, special appliances were used to heat the steel band several feet in diameter before placing it over the wheel center to cool. And so it is but natural that the average person concludes that an automobile wheel felloe cannot be put on properly without special tools for the job.

But, no. Take the wheel and felloe out in the yard, far enough away from buildings and oiliness so there is no fire risk. Secure six bricks, ordinary bricks if no fire bricks are at hand. Space these bricks at three points, in piles of two each, placed on edge, and lay the felloe band on them. Then build a wood fire all around, under the band, just as you would when camping, and turn your attention to the wheel. Hurry too, for if you are a good fire builder, the felloe will be red hot by the time you get the wheel blocked up off the ground in such a position that the felloe can be dropped over it in a jiffy.

It is necessary to have a gauge, or stops, to properly locate the felloe as it is slipped on



—the wheel. These can be three little pieces of metal held on by C clamps, as shown in the illustration. Before setting the latter, the proper amount of overhang has to be determined or else the new felloe will space the tires too far in or out.

Setting felloe bands or changing them is a job that has to be done when wheel changes are made. It is not always necessary to get a whole new set of wheels when a different kind of tire fastening is desired: changing from clincher rims to some form of quick change rims taking the same size of tire involves the getting of smaller wheels or of turning down the old wheels and shrinking on new bands. Before getting new wheels, the owner should ascertain the prices on them and on the parts alone. If the latter are much cheaper, then measure up the wood wheel—if only a quarter of an inch or less has to be turned off the wood, the application of new felloe bands is so simple that it need not stand in the way of making that kind of a change.

Salvaging Your Junk Pile

Much Valuable Material Goes To Waste When It Might be Utilized

By F. L. PHILLIPS

WHEN I happen to visit a junk yard, as I occasionally do, I always leave the place with a feeling that we Americans are a wasteful lot of people. Always I think of the old saying, "There's always more in the garbage pails of the poor than of the rich." This old saying is rather crude, perhaps, but it's darned true, for one of the reasons why some people are poor is that they waste too much.

If America ever lacks any raw products she has herself to blame for she leads the world in her junkyards. I suppose that many people would raise the argument that a large number of junkyards is a good sign of frugality. It would indicate to them that all scrap metal is being salvaged and used over again; but I would differ with such people because, to me, scrap metal parts mean carelessness in handling the original machinery.

To illustrate my point I might mention my own experience in junkyard exploration. About eight years ago I was wandering through a very large yard in search of a casting from which I could shape a friction disc for driving a small pump when I was impressed by the number of automobile parts lying around.

Building a "What Is It?"

Now I have somewhat of an adventuresome nature and it suddenly occurred to me that I might get a lot of amusement out of *life* by building an automobile out of that junkyard. For the next few weeks I haunted that yard like a broken lawnmower and within four months I had found enough parts to get started. When I got through with my work of art I had the most comical thing you ever saw; coming toward you, you would get the idea that the thing was a Maxwell; passing, you would call it a Metz and if you still had the curiosity to look after the machine you would have wagered that it was a Ford. But had you raised the hood, crawled beneath the car or examined the equipment you would have had nervous prostration trying to give it a name.

But the car went almost as well as a cheap, new one and it always gave me something to talk about. Various junkyards had furnished me with everything but the tires.

What I want to show is that the junkyard usually carries a lot of stuff which is really not junk, but which has an actual value. The blacksmith usually has a great plenty of scrap iron and steel which would be worth good money if he but knew how to market it. As scrap, the stuff is hardly worth carting away.

In this article I want to make a few suggestions for using such scrap stuff. I am an automobile owner and do most of my own repair work, hence I will consider this side of the proposition first.

Tire Tools

I've tried all sorts of tire tools, patented and special shapes, some of them look good and work badly; others look badly and work fairly well, but the best of all are those which I have made from old springs. A good tire iron costs about half a dollar, no less and you should be able to make it from scrapped, spring steel for almost nothing.

You can afford to sell a set of two irons for 75 cents, if you happen to have the scrap stock. Take a piece of wagon or automobile spring, from 14 to 15 inches long and round off both ends. Ordinarily the spring will be tapered slightly so that the end will average to be about an inch wide; but it is not policy to have either end more than 1½ inches wide.

After you have rounded the ends and removed all sharp edges, bend one end upward about ¼ of an inch from the flat. The bend should start about ½ an inch from the end. This little curl is just the thing to push in back of the clincher bead and help release the tire. The bend also has a tendency to hold the iron in place while the tire is being pried loose with the other iron. The other end of this iron should be left flat.

The second iron should be made for "putting on" the tires. Prepare the iron in the same way as the first one, but instead of putting a long bend in the end, bend the end at almost right-angles to the iron and then bring the rounded end back just a bit so that it will form a hook. In putting on the tire, this iron is hooked over the clincher rim and used as a lever to stretch the tire over the rim. But do not make the hook too pronounced or there will be difficulty in getting the iron off the rim when the tire is on. The other end is left straight.

If you want to make a little specialty in the way of a combination tool you can combine one of the above tire irons with a valve lifter. But usually you will find it advisable to make the tools separately for you can sell more of them.

About the best valve lifter I have ever used was made from a steel rod, ½ inch in diameter and 12 inches long. The rod was forged flat at one end, back for one inch and then separated to form a fork. Between the ends of the fork there is a space of ½ an inch so that it may be slipped over the end of the valve. To go with this lifter you will need to make a fulcrum piece from 3/16 inch wire. This wire is bent into an S shape, the lower curl to fit around the lifter and the upper end to hook over the top of the engine. You will be obliged to fit the fulcrum to the particular engine upon which it is to be used, a matter of only a few minutes' time.

Be sure to make an allowance for the cylinder head, since the head is usually removed before the lifter is used. If you decide to combine this tool with the tire iron, you can split one end, (the thick end of the iron) and fix it up just the same as if it were round iron, forged flat. In place of hooking the fulcrum around the iron, bore a hole through the iron and fix the fulcrum piece so that it will slip through this hole from the bottom. Head over the fulcrum so that it will catch in the hole.

A Valve Grinding Tool

A valve grinding tool is an easy thing to sell. I made my grinding tool out of an old putty knife, but I don't imagine that the average smith has many putty knives in his junk pile. But that doesn't matter. Take a piece of dowel stock, five inches long, and split the end, with a hack saw, back about one inch. Into this slot slip a piece of thin sheet iron or steel, 1/16 inch thick.

There are two kinds of valves, one is fitted with a plain slot, the second is fitted with two or three holes, one at the center and two on each side. It won't pay you to make a tool for the "hole" type of valve, but the slotted type is easy. The piece of metal should be one inch wide with a point at the center. The point should be 3/32 wide at the top and taper to a fairly sharp end. The point should project ¼ of an inch and the owner can file it off if necessary.

Make up a few of these tools flat on the end with no points at all, then when a man wants to buy a tool for the hole type of valve you can file the tool to fit the valve. The blanks for this kind of tool should be 1½ inches wide on the end.

The matter of wrenches is one to which the smith can afford to give some study. Every automobilist who does repair work is in need of some special wrench, it may be a straight end or possibly an S wrench, but the regulation wrench will not answer the purpose.

Such special wrenches cost a lot of money, comparatively speaking, and the smith will find that he can do a better job at making them and at a less cost.

In these days of slick fingered thieves the spare tire, usually mounted on the back or side of the car is just like ready money to them. A sharp knife and a quick tug will often remove the tire and there is a ready market for a cheap lock of some sort.

The padlock and chain makes a fair kind of lock but the chain doesn't have a finished look for it doesn't belong with the car. The smith will find that he can usually rig up a very presentable hasp to swing around the tire and rim and to some bracket on the chassis. On many of the cheaper cars, with removable rims, the rims carry a set of lugs and you can fix the hasp so that it can be locked to the rim lugs.

In fitting the hasp to the car, be sure to fasten it to some permanent part. When you get it installed be sure to rivet over the bolt end so that the thief cannot come along with a wrench and take the tire, lock, hasp and all, off at a time.

Small Tools

Never yet have I been able to purchase, at a reasonable price, a decent center punch, drift or nail set. The smith knows just how to temper such tools and should be able to make them up from old pieces of steel. In making the drifts and sets, before tempering, strike the ends against a medium file so as to leave a corrugated surface.

Every automobile owner needs, (and knows it), several good cold chisels. He can get along with one, ¼ inch cape chisel, and one of the good old fashioned kind with a one inch face which will stand a lot of banging around.

The country blacksmith will often find he can build up a good business in garden implements. Hoes, lawn edgers and even rakes, if he has the time to make them. Old disc harrows can often be bought for a song and furnish excellent stock for garden tools.

I have found that it often pays to ask my wife or other housekeepers just what they need in the way of conveniences for the kitchen. My wife likes to have plenty of shelf room and we both detest those big, ornamental brackets which collect dust and spider's webs. So I bent up a number of plain angles from strap iron. If these angles are properly fastened they will hold almost as much as an ornamental bracket.

Of course no two smiths will have the same kinds of scrap stuff, for it all depends upon where the smith is located. But in any event, the resourceful man will be able, from my hints, to utilize a lot of iron and steel which otherwise might be discarded. Make your brain save you money. Don't throw anything away until you are sure that it is a total loss and cannot be salvaged.

HOW TO USE A GLASS-CUTTER

Dip the wheel in kerosene or turpentine. Place the cutter between the first and second fingers. Start the wheel on far side of sheet of glass from you, ⅛" from the far edge. Hold cutter erect so the wheel will revolve easily and will make a straight, even stroke. Press hard enough to make a fine hair-line on the glass. If you press too hard, the glass will flake; this is wrong. Draw the wheel entirely across the glass (allowing your cutting wheel to drop off the pane). To break the glass, hold the pane firmly between the first finger and thumb, with both hands (side nearest to you) then give the glass a slight bend it will break the entire length.

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Our Editor's Letter

MANY of my ideas of late have been obtained from a blacksmith right in my own home town who has been in the business for going on thirty years. We got acquainted about two years ago when I was hunting around for some man in my vicinity who was interested in bass fishing. Most everyone I spoke to advised me to interview this smith and so, when the time came right, I did and found that Mr. Johnson was a sort of Dr. Jekyll and Mr. Hyde sort of a fellow. Six days of the week he was Dr. Jekyll, interested only in blacksmithing but catch him on the seventh and he was a regular shark. He could almost talk the fish language. So we became friends.

But since my vacation started, in July, I haven't seen him much and it was not until last Monday that I visited his shop. Gosh! what a change. Gone was my favorite nail keg; there was no soft coal for me to fill my pipe with and friend Johnson seemed to be a stranger. In three weeks' time he has torn down his blacksmith shop and in its place erected a cement block edifice, two stories high and big enough to house 50 cars at one time. And all of this was done by a veteran, dyed in the wool blacksmith! It almost took my breath away.

Mr. Johnson's garage had opened for business the previous Friday and when I saw it, on Monday, there were four cars on the floor waiting for repairs. Now I know that Mr. Johnson is no automobile mechanic, that is to say, he has not had the necessary experience in repairing automobiles to qualify as a repair man, so I was interested in knowing just what he planned to do.

During the course of the next hour I was able to get the information I wanted and since then I have had the chance to learn more about Mr. Johnson and his plans for the future.

He says that for the past two or three years he has been worried about business. Our town is not in a farming community and the horse and carriage business has been dropping off steadily and he has had rather hard sledding to make both ends meet. As soon as he realized that he must get more work or give up his shop, Mr. Johnson worked his brain overtime trying to see some way out of his tangle.

Mr. Johnson realized his own limitations; he might have admitted that he was a good blacksmith, but he knew that he wasn't a qualified automobile man. To be a repairman one must have experience, but to get the experience one must be a repairman which makes a vicious circle.

Unfortunately he had not been able to save very much money and could not afford to spend a lot of time in learning, nor could he afford to attend an automobile school. If he didn't do something he would be bankrupt and if he wasn't careful he wouldn't have any business left.

After considerable thought he decided upon a line of action. For nearly a year he sold gasoline and oil as a side line to his smith shop business. He purchased an oxy-acetylene torch and every chance he got he experimented with it. Being familiar with metal working he was soon able to do a very creditable job. And then he built his new shop.

In Mr. Johnson's new shop everything is up to date, cement floor, big windows, and plenty of room. He has put his forge and blacksmith tools near to the big door and put a partition around this corner so that no casual autoist would get an idea that the place is a blacksmith shop.

He figures that all of his old customers will know him anyway so that he wouldn't need to display his blacksmith tools. When a horse is brought in to be shod it is taken into the "office" and doesn't hob-nob with the automobiles.

I think that Mr. Johnson's idea about blacksmithing and auto work is a good one. The automobilist hesitates to take his car into a "blacksmith" shop. Why this is I cannot say, but it is a fact; perhaps it is one reason why so many smith-auto repairmen have failed.

For a long time Mr. Johnson will do no automobile repair work himself for he has hired an expert mechanic. He aims to do welding, iron work and carbon burning only and to act as helper to his mechanic. He has nothing to lose because he still keeps his smithy, and yet he can spend his extra time helping the regular mechanic and learning the business.

From what I could see on Monday and since then and from what Mr. Johnson has told me, I judge that he will make a good thing of the business. So far he has kept busy all of the time, and though only four days have elapsed since he first opened his shop, the indications are satisfactory. When his work begins to advertise him a bit more he can count upon a more steady business.

His agreement with the mechanic is fair. The mechanic charges $1.50 an hour for work and $1.00 an hour for his "helper" (Mr. J.) when the helper does any work. The mechanic pockets what he makes and passes the "helper's" money to Mr. Johnson. When Mr. Johnson graduates from the helper class into the full fledged mechanic, he is to collect all the money he earns. At the end of one year, if business is good and Mr. Johnson is in a position to do repair work himself, he is to take the mechanic into partnership, the latter to invest an amount equal to one half the cost of the building and the machinery.

With this agreement in black and white, both Mr. Johnson and his mechanic are pleased for Mr. J. gets an education and a good business, while the mechanic is sure of getting all he earns and a chance to invest in a going business with which he is familiar.

If any of my readers are interested in this proposition I will be glad to publish an article covering costs, etc., as well as the various difficulties and problems to be met and overcome. Do not hesitate to answer this letter if you want to question me.

The Latest Fad

ALTHOUGH we doubt if very many readers have realized it, something has happened in the past month which will mark an epoch in the history of mankind. Over in Germany a man has succeeded in sailing through the air with almost as much ease and safety as a bird. Of course the thing has been done before; we have had aeroplanes for a decade, but our flying machines have been mere, bungling makeshifts as compared with the latest glider.

It can hardly be said that man has conquered all of the elements until he can fly without the aid of an expensive and high powered engine. Man is able to swim upon and under the water; able to walk upon the land but not until a month ago was he able to fly in the true sense of the word.

With the latest flying machine, the glider, man is virtually equipped with wings. He can hop into the air and with a certain amount of luck, combined with much skill, gradually rise to a fair altitude. It is to be supposed that he can control the direction of his flight to a certain extent and thus travel from one place to another at a fair rate of speed.

The glider remained in the air for over three hours and at the end of that time descended only because the operator wished to do so. At all times the machine was in perfect control; at times it would poise like a seagull and at others it would sail at high speeds.

There is as much to be said concerning this new invention for it has some wonderful possibilities. America is a land of quick and great enthusiasm. Seemingly in a day wireless grew from an infant to a mighty, husky man. But compared with gliding, wireless is as exciting as a game of chess.

The average American man is always in search of excitement and adventure. Give him the choice between a sure thing and a good gamble and he will usually choose the latter. He likes his sports in the same way and that is one reason why so few men are to be seen on the "carousal" or "Merry-go-round" as upon the "chutes" the "loop" and the "ferris wheel."

But this new thing, gliding, offers all of the adventure of any amusement ever invented; it promises well for transportation; and as a means of getting fresh air, it beats the electric fan to a stand-still.

An airplane is an expensive luxury, its first cost is prohibitive except to the wealthy; every whirl of the heavy propellor blows money into the air; and it is a very risky proposition. Once an airplane engine quits working it is a question as to whether the persons in the machine will be able to land without denting the earth. The construction of the airplane is a big task for it must not only be extremely light but much stronger in proportion to its weight than any other machine made. Strength must often be sacrificed to lightness.

But the glider is nothing more than a big kite, it does not have to stand the terrific strain of supporting a half-ton engine at speeds of from 60 to 120 miles an hour. Any clever carpenter can make one and though the thing may never leave the ground it might, which adds to the element of adventure.

It seems to me that, within a few years, gliders will be just as common as canoes, bicycles or kites. To fly like the birds has ever been man's ideal. We aim to teach our boys how to swim, why not see that they learn to fly? Possibly in another decade our children will flock around our schools like a lot of sparrows—who knows?

Health Hints for Welders

In Handling Welding Gases" the Greatest of Care Must Be Exercised

THE oxy-acetylene welder's trade is not particularly hazardous if a reasonable amount of care is taken in installing and operating the apparatus; in fact it is not as dangerous as a number of other lines of work. But at the same time it is not fool-proof, nor a plaything for careless or indifferent workmen.

Store the Oxygen Tanks on the Shady Side of the Shop and Keep the Metal Caps in Place over the Safety Plugs.

To insure maximum safety there are several rules which the torch operator must obey and a number of minor laws he will do well not to over-ride. He will find it pays in the long run to consider safety first. Not only safety to his person and to others around him but to his machinery and tools; bodily safety to himself and a longer life to his welding apparatus.

Take first the elements of the welding flame: oxygen and acetylene gas. In the average repair shop the former is no longer obtained by generation but comes ready for use compressed in steel bottles or tanks. And the use of tanked acetylene also predominates, although there are many shops that generate their own acetylene in special generators for that purpose. So we will touch upon the subject of both kinds of acetylene in order that the novice may be well posted on the two phases of gas supply.

In relation to the factor of safety in regards to oxygen, the welder is repeatedly warned to keep oil away from all parts of the oxygen apparatus. In other words, oil or grease of any kind should not be applied to any parts of the torch, regulator or valves, or gauges and tank connections. And to be absolutely safe this rule should include any kind of oils or grease, paint or white lead, and even soap. If parts do not work easily they should be rethreaded dry but never oiled. And if new parts are oiled when they arrive from the factory they should be thoroughly cleaned before attaching them to the oxygen supply.

Oil and Oxygen

The reasons for these percautions are that when oil comes in contact with oxygen under certain conditions of pressure and velocity it forms the ideal combination for spontaneous combustion and a violent explosion. Manufacturers continually caution welders against using oil on oxygen equipment.

By itself oxygen is non-combustible. It will not burn but is the greatest promotor of fire known, and for that reason the operator should be careful about greasy clothing and about allowing an accumulation of litter in the vicinity of the welding department. An accidental spark may ignite his clothing and result in a serious burn if the oxygen pressure comes in contact with it. The oxygen is under tremendous pressure, approximately 1800 pounds, so it is easy to understand the effect in event of a sudden leakage in some part of the equipment.

Oxygen expands when heated; in fact the pressure increases about in proportion with the increase in temperature. Which is not essentially dangerous because each tank is provided with a safety plug or core of soft lead, which, in case of fire, will melt out and permit the oxygen to escape before it can expand enough to become explosive.

But on the other hand excessively heated oxygen is bad for the welding flame; it will not operate according to specifications for the capacity of the torch; difficult welding and poor welding are the results.

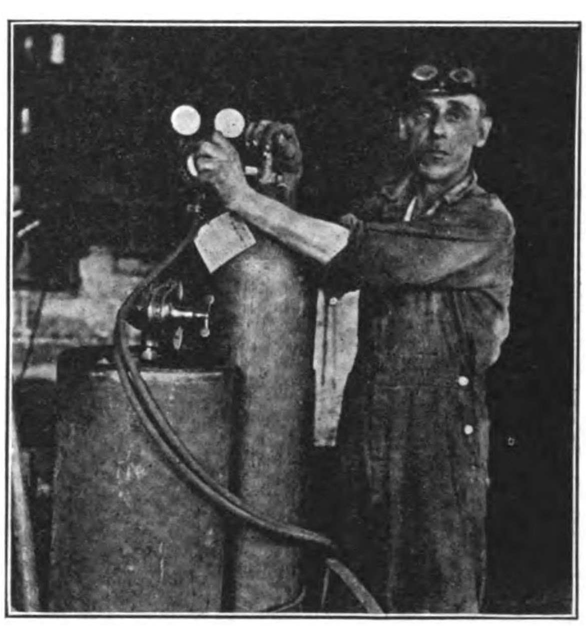
Store in a Cool Place

A little thought along this line should convince the welder that he should not store his extra tanks of oxygen in the sun or near a heater of any kind. Or, to put it the other way: Oxygen tanks should be stored in a cool dry place when they are full; and never used close to a fire.

And on the other hand the oxygen tanks should not be left out of doors in winter or stored in a cold place, because the normal filling pressure decreases as the temperature is lowered in about the same proportion as it raises when the tank is heated.

A certain amount of water vapor forms in the oxygen tank, due to expansion and other causes. This may collect in the valve and freeze. In which event the welder is particularly cautioned against attempting to thaw the frozen parts with the welding flame or other fire. The valves should be thawed with warm water or be allowed to thaw themselves in a warm room.

In event of water in the oxygen tank, it should be expelled before attaching the regulator valve. In fact it is a good idea to test all tanks whether there is doubt about water content or not. This testing is not a complicated process and may save considerable trouble later. It is necessary to merely invert the tank and allow it to remain thus for



Release the Regulator Screw with the Left Hand Before Opening the Tank Valve with the Right.

a few minutes so the water can collect near the valve. Then expel the water in jerks by successively opening the tank valve. These sudden gusts of pressure will throw out the moisture without wasting much gas.

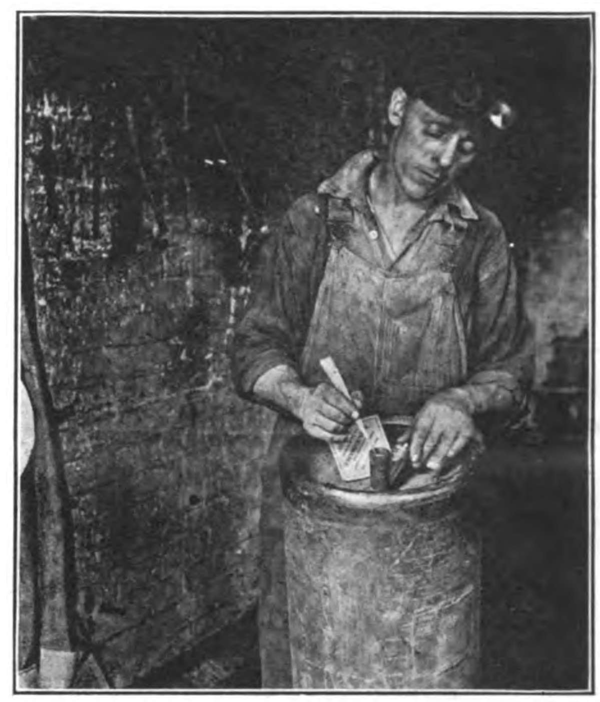
Sometimes a little dust or oxide gathers in the tank valve. It should be picked loose and expelled, in the same manner as the water, before attaching the regulator. The foreign matter is liable to enter the gauges and valves, even find its way to the torch; in either event having an adverse effect upon the welding flame and upon the quality of the fusion.

Under normal conditions there is small risk in dropping or jarring the tank of oxygen. But at the same time it increases the wear and tear and is likely to break some attachment.

Now in considering the other element of the welding flame we find that just the opposite condition prevails. The acetylene is highly inflammable and explosive and must be handled more carefully, particularly the kind that is generated at home. The acetylene generator should be isolated in a separate room. Or at least separate from the welding shop in order to preclude danger of flying sparks and sudden leakage.

No one should allow access to the gas generating department except the welder or the person designated as attendent to the generator. Fire, cigars, pipe, matches, or cigarette smoking is barred from the vicinity of the acetylene generator, especially when charging or when cleaning the tanks. And the operator should never go near the generator with the lighted torch in his hand; particularly with any intention of making repairs.

If the charging requires to be done at night



Clean Any Chance Sediment From the Tank Valve with a Soft Pine Splinter.

it should be done in the dark or by electric light; never with an oil lamp or lantern. An explosion may not *always* occur but the risk is great.

The operator should always follow his manufacturer's instructions explicitly in regards to cleaning and re-charging the generator tanks or hopper. To allow carbide residue to gather and pile up in the tank is to invite disaster like that shown in one of the accompanying illustrations. In this case the water was not changed at proper intervals as instructed, so the carbide built up on the thickened sludge to fall over into the water all at once and thus create a tremendous pressure suddenly. This terrific pressure blew the bottom out of the generator and threw the whole thing through the roof and side of the brick generator shed.

When cleaning out the generator tank the operator must not be content with merely opening the outlet valve and allowing the lime water to escape. He should keep the agitator moving, turning briskly while he pours large quantities of fresh water into the intake.

Now, as there is not space here to cover all phases of each subject let us consider the tanked acetylene. Which, everything taken, is no doubt the safest and best way to use this highly inflammable gas. It is not so particular about storing the surplus tanks except that they should not be kept close to a fire. Nor is it good practice to keep these tanks in freezing atmosphere, particularly after wet weather, as the valves may be damaged. Although as a whole the dissolved acetylene is not affected by lowering the temperature.

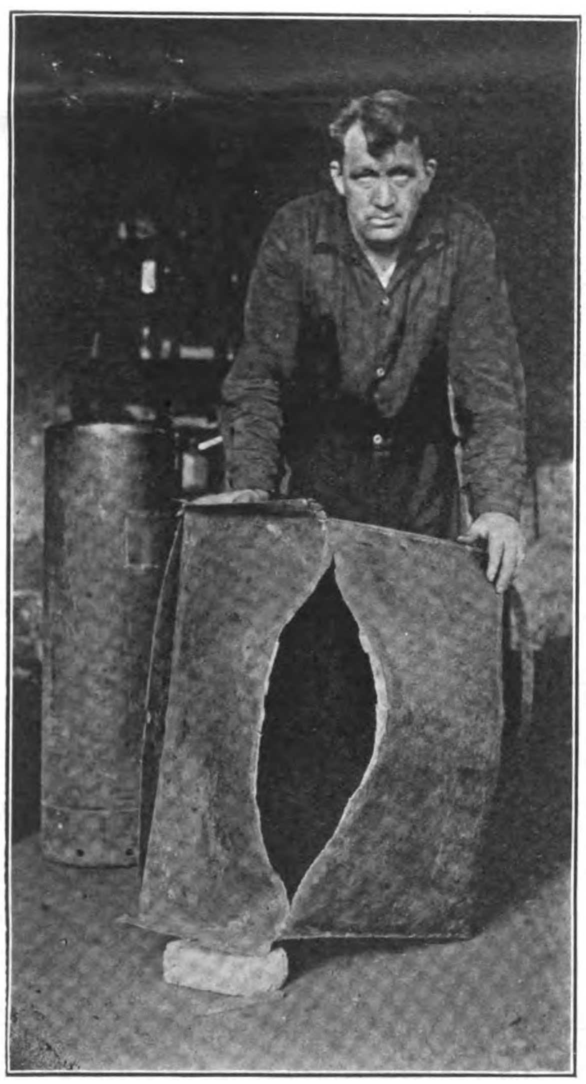
The welder should scrape and blow out any sediment which may have collected in the regulator attachment. This is done in the same manner as the oxygen except that it is not usually necessary to invert the tank.

The cylinder of compressed acetylene can be handled without special percautions. The welder simply avoids deterioration by violent shocks, falls and so forth. The valve end of the tank especially is protected. Each tank is supplied with a safety plug which will melt at a low temperature and thus permit the gas to escape gradually in case of fire. If there is a leak in the torch, hose, gauges or regulators the tank valve should be closed immediately. If the leak happens in the tank valve all fire should be immediately extinguished whether it is on the tank or in the vicinity. Usually an ignited tank leak may be extinguished by smothering it with a thick rag.

Lack of space again bids us cut down the amount of pointers which could be incorporated herein. Therefore let us take a list of important "don'ts." Without regard for classification.

Don't attempt to weld a steam piston without first drilling a hole in one head. At least one welding shop in the West had the entire roof blown off by an exploding steam piston. The drilled hole may be small and easily welded full of new metal after the main weld is finished, but it permits the pressure to escape gradually and thus prevents an explosion.

Don't weld oil barrels, gasoline tanks or other metal containers which have been used for oil, distillate, turpentine, or other gas generative liquid, without first filling them with water. Even though the container is known to have been empty for a long time it is risky business to weld it without filling with water before the welding is started and



The Result of Trying To Weld a Gasoline Tank Which Was Not First Filled With Water.

keeping it full during the welding process. It should be as nearly full as the location of the weld will permit.

When the barrel or other vessel is heated by the weld an explosive gas is formed to ignite when the weld is sufficiently hot. If there is no water inside the gas may generate in quantities sufficient to blow up the container. But the water keeps the container cool, and still more important, cuts to a minimum the space in which the explosive gas may form, thus cutting down the power of it.

One of the photos accompanying this article illustrates the result of attempting to weld a tractor gasoline tank without filling it with water. No one was seriously hurt in this particular instance; the torch operator's chin was lacerated and his throat and chest painfully scorched. The tank had been thoroughly washed out but was not full of water when the welding was done.

Don't open the oxygen tank valve without first releasing the extension spring of the regulator valve. Back the regulator screw out with the left hand and then open the tank valve by turning the hand wheel with the right hand. This method prevents the heavy pressure from injuring the delicate interior parts of the regulator and gauges.

Almost a Total Wreck! The Acetylene Generator Was Not Kept Clean from Carbide Sediment.

Don't stand directly in front of the gauges when opening the tank valves. The sudden entry of the heavy pressure may burst the gauge and injure the eyesight. This is more likely to happen with some cheaper grades of equipment than others but for the sake of safety first the operator will stand to one side when opening the tank valves.

Don't wear leather gloves when welding; the leather absorbs heat and holds it too long. Cotton gloves may be instantly cooled by dipping water, without damaging them.

Keep the Tank Capped

Don't neglect to keep the protecting cap in place on the oxygen tank when it is not in use. The cap not only protects the thread and seat but it also protects the fusible safety plug. This soft plug should be free to melt out in case of fire in the shop. Both the cap and plug are clearly shown in an accompanying illustration.

Don't do long jobs of oxy-acetylene cutting where a heavy pressure is employed without having a helper conveniently near to shut off the oxygen in event anything happens to cause the hose to leak or get unfastened at the torch or tank connection. The tank valve should be closed the moment trouble appears. This is particularly urgent if the operator is working in such close quarters he cannot escape.

Don't cool the welding torch by dipping it in water unless it is absolutely necessary. The sudden contraction is bound to affect the tight fit of the parts sooner or later. When it is necessary to cool the torch thus, the acetylene gas should be shut off entirely but the oxygen should be blowing through enough to prevent the water from entering the interior of the torch to rust or corrode it.

Don't use the torch for a hammer or crow bar. It is an instrument of delicate precision and should be treated as such if the operator expects it to measure up to standard.

Don't throw the welding tips around as if they were merely bits of scrap metal. A slight dent in the gas outlet may destroy the efficiency of the flame, causing it to pop out or to melt poorly.

Don't try to repair a damaged regulator unless you know how; send it to the factory or get a new one.

Don't try to put new packing in the tank valves unless you know your business. You may blow the entire contents out of the tank. The leaky tank should be returned to the manufacturer labeled with the reason for so doing.

Don't try to weld heavy jobs with a light torch and vice versa. Have two torches on hand or a heavy torch equipped for light work.

Don't allow the welding hose to trail upon the floor in the wet and grease; it will last longer if it is kept clean and dry. A dented hose soon becomes leaky and is liable to burst under sudden heavy pressure.

Don't risk burns by lighting the welding flame with a match. The patent spark lighters are safer and cheaper.

Don't be easily discouraged if the welding doesn't go as it should. Keep practicing and watching the effects of the flame on the various metals. It also helps to examine the bits of metal after they are cold; remembering at the same time exactly what took place during the melting.

And last but not least don't cuss the apparatus in your welding is not good. Examine your method and see if you are following every single detail of the manufacturer's instructions. Maybe you should cuss yourself instead of the torch.

EMPLOYMENT SERVICE OF THE FOUR NATIONAL ENGINEERING SOCIETIES

The Four National Engineering Societies, the offices of which are at No. 29 West 39th St., N. Y. C., probably maintains the best free employment bureau connected with any industry or profession in the United States. Members of many affiliated societies and organizations are available through this service bureau, so that it is in fact a National clearing house for engineering talent of all kinds.

The bureau has advised the "Blacksmith & Wheelwright" that readers who are officials of or connected with organizations in which a central personnel department is not maintained, are at this time given a cordial invitation to make free use of the bureau by advising the various departments in their organizations of the existence and usefulness of the Engineering Societies employment Service.

The bureau is in a position to furnish Mechanical, Designing and Sales Engineers, Superintendents, Purchasing Agents and other Executives.

The administration of the bureau is in charge of Mr. W. V. Brown, Manager, Employment Service, Engineering Societies Building, No. 29 West 39th St., New York City.

American Society of Civil Engineers.
American Institute of Mining Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.

PLACE FOR THE KNIVES

Most paint shops have the painters' knives all over the bench, all for want of a simple method of keeping them orderly.—Nail a broad strip of tin underneath the shelf directly in front of you as you stand at the "stone." See the nails are wide apart and that the tin is loose, not close.

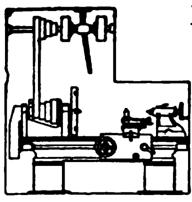
Now you can slip the point of the palette knife in between the tin and the wood. Next to it are putty knives and stripping knives, all with their handles in a row, ready for you to seize, and always conspicuous.

Coach and Motor Builder Melbourn, Australia.

Useful Oils and Greases

How To Mix Lubricants and Perservatives for Metals and Leather

BY ARTHUR W. JORDON



FREQUENTLY the great trouble for the smith is how to get rid of grease rather than the applying of it, yet the latter has to be done and then it should get the consideration it deserves. For applying oils and grease properly is not a matter of unconcern to the careful smith and the idea of this article is to afford a little help along these lines.

Where the old fashioned farm wagons and carts come in for repairs to wheels, etc., a good cart grease must be kept in the shop. Most of these are now bought ready made and some good brands are on the market. There are, however, many people who prefer to make up their own. A good recipe for this is worth having to the smith and wheelwright who has a large and regular business of this class and here is one of the best of them used in more than one shop, and never failing to give satisfaction in every one.

For every ten pounds of resin oil take one-half pound of palm oil, half pound of tallow and two pounds of common soda. Heat the resin oil gently to thin it, then add the tallow and when all melted put in the palm oil. Take the soda and dissolve in a quart of boiling water. Pour this carefully into the oils, stirring rapidly with a stick, taking care to add no more than will thicken it a little. Then take two pounds of plumbago and work it into the mass until all used up. A putty knife, or similar tool will be found useful for mixing these ingredients together when a very satisfactory grease results. It has good lubricating powers, works smoothly and does not wear rough on the parts it is used on.

Doping the Grease

In some cart greases, weight is given by the addition of such things as china clay, plaster of paris, etc., but these are of no use beyond giving bulk. Lime is also used at times for the same purpose and this is perhaps as innocent of harm to iron and steel as anything, but its lubricating value is nil.

In the above recipe the plumbago, which supplies bulk, is also an excellent lubricator in itself. The grease does not become too liquid in hot weather, good lasting qualities being one of its best recommendations.

Such a grease may be used for lubricating and slow moving machinery such as the axles of a "Tumbling" barrel, or grind-stone, but for fast revolutions something different is required. For these there are many specially blended brands of oil on the market, not all of equal value for general use. It is for the smith to give an extended trial to the best of these for the machinery he runs.

Only after such trial carefully, noting such effects and advantages as arise, can anyone say for certain which is the best for any specific purpose. When one comes to think of how much depends on the selection of a good oil for lubricating any machine, the need for careful choice requires little pointing out.

It must not be thought that any good oil is sufficient for all classes of machinery. While a grease such as that just given would suit heavy machines like a punching, or shearing press, it would be useless on a blower. For such a rapid mover as the latter a mineral oil mixed with one-third of olive oil is about right. When dealing with medium heavy machinery similar mineral oils with about the same proportion of rape, castor oil, or a lesser amount of palm oil may be substituted. Where a smith runs his machinery with an oil or gasoline engine he cannot take too much care in choosing the oil for the bearings or cylinders.

Many of the oils sold for ordinary engines are unsuitable for these. Gumming up is the frequent result when these are used on the engines referred to.

Some of the ordinary mineral oils—so useful for other purposes—are not suitable in this case. Cottonseed oil has given good results but many people prefer olive oil. This is not cheap, but neither is labor spent on cleaning sticky pistons, nor the annoyance it causes. In balancing the value of an oil, one has to remember the work and trouble it saves as well as its price.

One has also to remember the wear and tear of machinery. Some oils will wear out a bearing in half the time of others and that is an excellent reason to refrain from thinning down oil that is to be used for lubricating purposes with petroleum, kerosene, or similar products. On the other hand these are excellent for the oilstone mixed with a little neatsfoot oil.

Neither of these result in gumming up and each has sufficient lubricating power while the mineral constituent has good cutting or wearing properties, thus aiding the work of the stone to sharpen any tool ground up on it.

None of these petroleum oils should be used for preserving smith's bellows. Vaseline is one of the products of petroleum and this must not be forgotten. The application of this to leather work has caused it to crack and split in all directions, as the writer can testify from experience. For the preservation of bellows or leather work there is nothing better than castor oil, although palm oil is excellent for the purpose. When installing a new bellows it is always a good thing to first rub down the leather with one or other of these oils. After a summer's wear renew the dressing and repeat the application every fall. The extremes of climate conditions do not then do so much harm.

It seems almost old fashioned to talk of hardening with oils, not but what there is still plenty of it used for that purpose. It seems primitive, but notwithstanding this there is no better way for many articles and

(*Concluded on next page*)

The Oldest Horse in the World

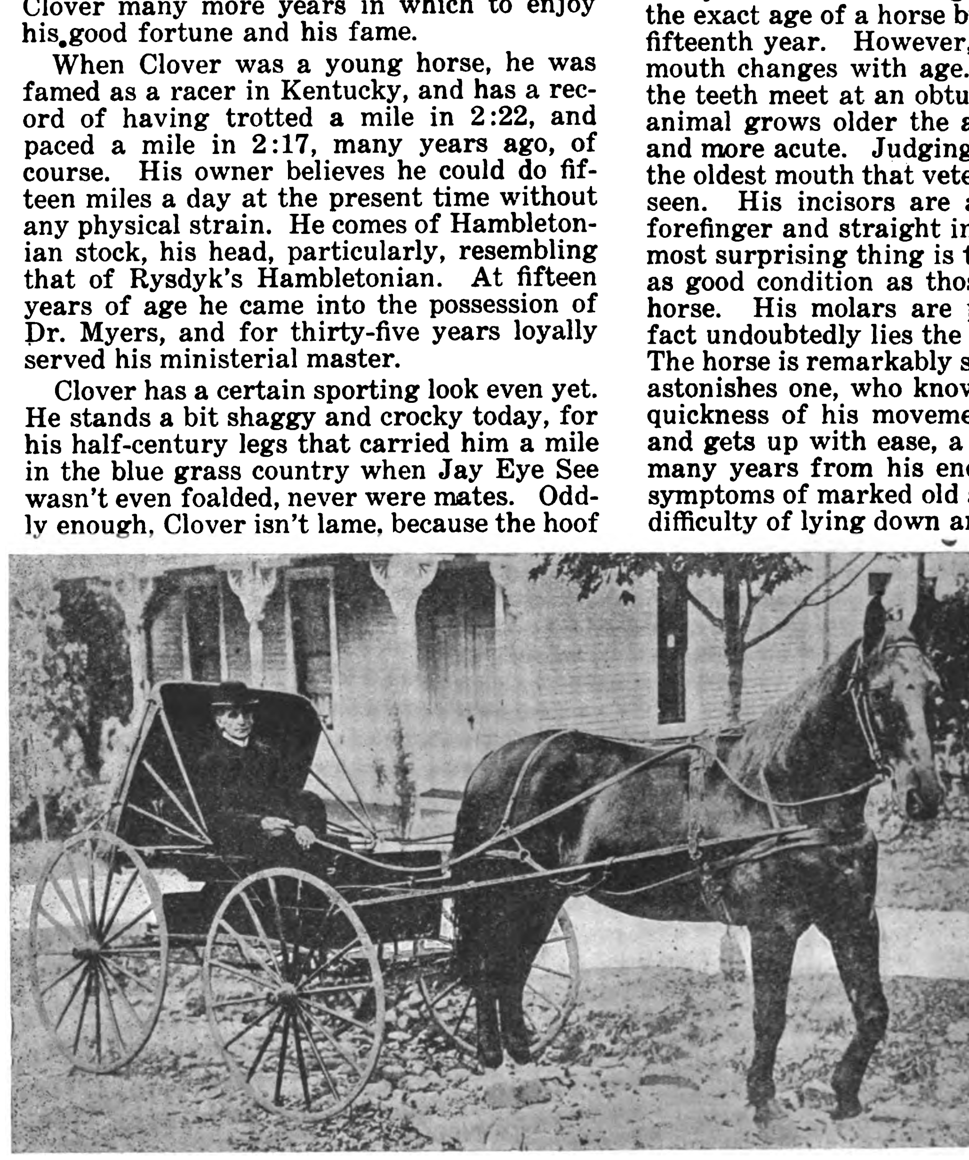
ROBERT H. MOULTON

THE ordinary span of horse life is twenty years, but there is a horse in Catawissa, Pa., the property of the Rev. Dr. Uriah Myers, which is fifty-one years old and rated the oldest horse in the world. As a matter of fact, there is no record of any other horse having lived anywhere near as long as this. A short time ago it looked as if the horse, named Clover, might have to be killed, because his owner could not afford to keep him. But the story of his extreme age and admirable character having gone abroad, gifts of money and offers of maintenance came from many sources, so that now Clover will be retired from active service on a pension. Moreover, an eminent veterinarian even promises Clover many more years in which to enjoy his good fortune and his fame.

When Clover was a young horse, he was famed as a racer in Kentucky, and has a record of having trotted a mile in 2:22, and paced a mile in 2:17, many years ago, of course. His owner believes he could do fifteen miles a day at the present time without any physical strain. He comes of Hambletonian stock, his head, particularly, resembling that of Rysdyk's Hambletonian. At fifteen years of age he came into the possession of Dr. Myers, and for thirty-five years loyally served his ministerial master.

Clover has a certain sporting look even yet. He stands a bit shaggy and crocky today, for his half-century legs that carried him a mile in the blue grass country when Jay Eye See wasn't even foalded, never were mates. Oddly enough, Clover isn't lame, because the hoof of the shorter leg is longer and equalizes its length to that of the longer foreleg. He stands sixteen hands and weighs about 1,200 pounds and his condition shows the excellent care his master has given him. His ration, twice daily, consists of one scoop of bran, one of middlings, and two of a mixture of oats, clover and molasses, topped off with three ears of corn. It takes him a long time to eat this, as he masticates slowly.

According to the veterinarian who examined Clover recently, the horse is sound in wind, and has wonderfully clean legs, and there is a luster to his coat that is remarkable in an animal so old. His only blemish is a cataract on the right eye, but this is not necessarily traceable to old age. It is hard to tell the exact age of a horse by his teeth after his fifteenth year. However, the contour of the mouth changes with age. In a young horse the teeth meet at an obtuse angle, but as the animal grows older the angle becomes more and more acute. Judging by this, Clover has the oldest mouth that veterinarians have ever seen. His incisors are as long as a man's forefinger and straight in the jawbone. The most surprising thing is that the teeth are in as good condition as those of a ten-year-old horse. His molars are perfect and in this fact undoubtedly lies the secret of his health. The horse is remarkably spry and playful and astonishes one, who knows his age, with the quickness of his movements. He lies down and gets up with ease, a sign that he is still many years from his end. One of the first symptoms of marked old age in a horse is the difficulty of lying down and getting up again.



This article and Illustration Is Here Reproduced by the Courtesy of "Our Dumb Animals."

A Picture of Our Friend "Clover" Who Is Said To Be Fifty-One Years Old.

USEFUL OILS AND GREASES

(*Continued from page* 13)

many a practical reader will say "hear! hear!" to that. One wonders sometimes if cracked tools and plates that have been hardened would be so numerous after a little strain, or extra force if they had been hardened in the old fashioned way with oil instead of in some of these new fangled ways with chemicals.

It has to be remembered that after all oil has a sort of affinity for iron and steel and never seems to disagree with them under any circumstances, but can one say that for some of the chemicals—chloride of sodium for instance? Hardly.

However, back to the oils, old fashioned and good, or not. For hardening most tools, cutting plates or shears there is nothing better than sperm or whale oil, but this is now too expensive for general use. This is extracted from whale blubber, and as this leviathan of the waters becomes more scarce his blubber and oil becomes more valuable. The great advantage of this oil and one reason for its success as a hardening agent is its freedom from acids—a most important matter in some jobs. Another good thing about it is its even temper in almost any weather, hot or cold affecting its viscosity but little.

Rape Seed Oil

A cheaper oil used for the purpose is rape seed which answers for some jobs very well. This is, however, adulterated with many other oils, not all so useful for hardening as for cheapening, cotton seed and mustard oils being the least harmful. Some of these adulterants quite unfit the oil for hardening purposes. Linseed oil and fish oil often are used, but the mention of these covers various qualities and constituents and so it is seldom that one gets supplies equally good regularly.

Most machinery and horses are driven by leather bands or reins but sometimes ropes specially made for the purpose are used for drawing both. In fact some people have been heard to declare they prefer the ropes. However, in case the smith is brought in continual contact with such ropes it may be as well to conclude this article with a recipe for a grease that may be occasionally applied to these ropes wit hbenefit to them. It may be used on those employed in place of reins, or for outside wear in any work, more frequently with advantage.

Take five pounds of tallow and melt it slowly until all is fluid. Then add one pound of linseed oil varnish, thoroughly mixing together. While still hot and liquid pour in 6 ounces of olive or palm oil giving the whole another good stirring to completely incorporate. Give the rope a good rubbing over with this and if repeated at frequent intervals, the life of ropes used outdoors will be lengthened very considerably. It prevents fraying and makes the rope unaffected by the elements while the rope is made easier to handle and less likely to chafe the skin of any horse with which it is brought into constant contact.

THEY CAME BACK

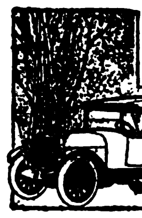
"When I was a little child," the sergeant sweetly addressed his men at the end of an exhaustive hour of drill, "I had a set of wooden soldiers. There was a poor little boy in the neighborhood and after I had been to Sunday school one day and listened to a stirring talk on the beauties of charities, I was softened enough to give them to him. Then I wanted them back and cried, but my mother said, 'Don't cry, Bertie, some day you will get your wooden soldiers back.'

"And, believe me, you lob-sided, mutton headed, goofus-brained set of rolling pins, that day has come."—*The American Legion Weekly.*

Assembling Battery Plates

Details Concerning the Use of the Torch for This Kind of Work

BY DAVID BAXTER



THE modern lead burning torch has been very appropriately called the "little brother of the welding torch" and in fundamental principle is practically the same. In fact the oxy-acetylene torch welder will have little trouble in mastering the intricacies of the lead burning instrument.

His chief trouble will be in remembering that he is handling heat in hundreds of degrees instead of thousands as is the case when employing the regulation welding torch. Where the welding flame has a range of approximately 6300 degrees the lead burning flame generates but a few hundred. Otherwise the two torches are almost the same in point of adjusting and manipulation.

As a matter of fact the name "lead burning" is a misnomer, strictly speaking, because burning the lead is the very thing the operator seeks to avoid the most. He employs every known device to prevent oxidization or burning of the lead, either the filler or the metal of the parts joined. To make a correct bond he endeavors to melt the metals without turning any part of them to oxide. In other words he endeavors to prevent burning the lead. A better name for the lead burning process would seem to be autogeneous soldering, except that in true soldering the metals are not flowed into and mixed with each other. In fact a definite line is drawn between the soldering and lead burning processes.

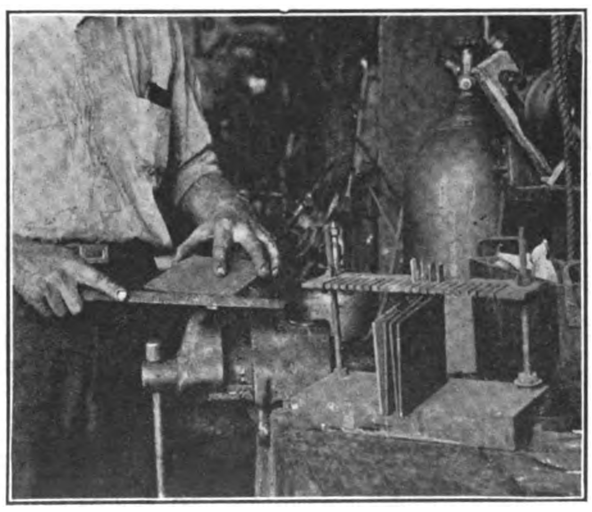


Fig 1.—Clean All Parts To Be Melted with a Scraper, a File or a Wire Brush.

To distinguish the method of joining lead parts from that of other metals, where it is necessary, the word lead could be affixed to the word welding, or placed in between the words autogeneous and welding thus: autogeneous lead welding.

Lead is not burned during the process if the work is properly done. If any of the lead is burned the result is a defective or inferior job.

However, since the name lead burning has become so closely fixed to the process we will make no attempt to change it in this discussion but will continue to refer to it thus.

Before the advent of the acetylene gas, lead burning was accomplished by means of a flame supplied with hydrogen through one tube and atmospheric air through another, using a pump to force the air through the tube. But the modern lead burning torch now uses the carbon gas or acetylene in connection with tanked oxygen or compressed air. And some of the torches now on the market use natural or artificial fuel gas instead of acetylene. Still others use acetylene alone, sucking the necessary air through a side opening.

The tanked oxygen and acetylene process is probably the most convenient method, on account of its reliable portability, a standard welder's oxygen tank being the commonest form in use.

The oxy-acetylene welder who has had no experience in lead joining nearly always tends to overheating, or in reality burning the lead. But the novice easily acquires the idea and only requires practice in order to become skillful. He has lots of things to learn but each of them is simple by comparison with the welding of other metals. Constant practice will soon make his fingers obey his mind quickly and cunningly.

There are a large variety of lead burning torches on the market. And they are used for all kinds of soldering, brazing, and the joining of lead parts. The main uses in the garage and auto repair shop are for radiator and battery work, the latter probably being the most common form.

To illustrate this and to instruct the novice in the art of manipulating the lead burning torch, let us take as an example the attaching of a group of battery lead plates to the strap and binding post, taking into consideration the fact that the construction and design of batteries vary somewhat in different types.

Parts Must Be Clean

In a job of this sort, the first essential is to be sure the parts to be joined are clean as in the welding of other metals, cleanliness is necessary in the lead process. The stem or strap of each plate in the group is cleaned until the bright metal is exposed. All of the air oxide is removed from the surface of each strap. And the coating of oxidized lead is also removed from the post strap; not only on the top and bottom but along the edge and in between the fingers or grid.

Lead oxidizes more rapidly when it reaches the molten stage and the skin of oxide is heavier. But this peculiar metal is also subject to rapid oxidizing attacks of the atmosphere. A short time after it is scraped bright and clean the surface tarnishes and is coated with a thin skin of oxide. The oxidized coating, due to exposure to the air, is not very heavy and serves to protect the metal and prevent more or deeper oxidization. In fact it is said that the first attack of oxidizing is a protector to the balance of the metal. And it is for this reason that lead does not appear to rust or corrode.

The necessity for cleanliness in the lead burning process is to prevent, or at least minimize, the amount of oxide that might become entangled in the melting lead. As in cast iron welding this oxide is detrimental if allowed to mix with the bond metal. If the bond does become impregnated with lead oxide the battery will have a defective circuit; in fact it will probably be short circuited. And after the new joint is cold it will

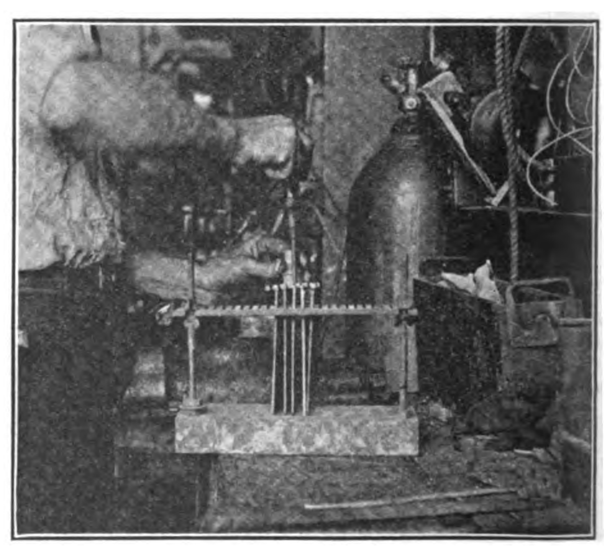


Fig. 2.—With the Plates Arranged in the Spacer, the Post Bars Are Fitted to the Plate Straps.

look badly; the defects will show up plainly and cause the work to appear amatuerish.

What Oxide Does

Of course the bond may be rendered defective by other causes. It may be oxidized or burned by the flame condition and manipulation in practically the same way as an iron or steel weld. When used in connection with oxygen and acetylene, the lead burning flame has the same adjustments as the welding torch; the excess acetylene flame; the excess oxygen flame; and the neutral flame; Either of which is regulated by adjusting the torch and tank valves. The flame presents in miniature a likeness of the big welding flame.

The excess oxygen flame tends to produce effects similar to the results of joining badly oxidized metals. In the words, joining the parts without cleaning. This flame oxidizes the lead, impregnating the whole bond, sometimes with flakes and sections of oxide. In a few words the oxidizing flame is too hot for the melting point of the lead. And in ex-

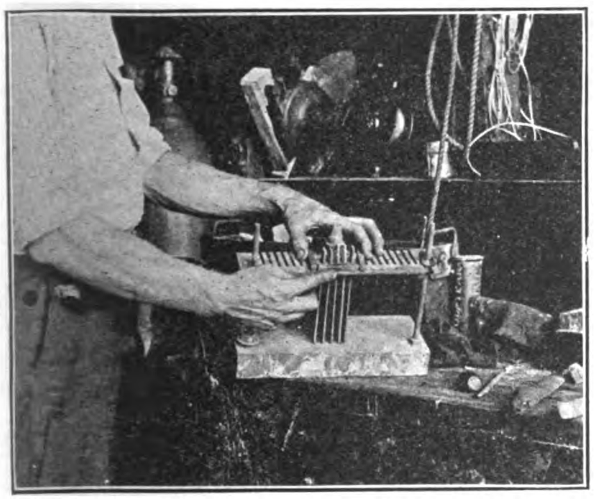


Fig. 3.—Showing the Arrangement of the Strips of Steel which Form the Mold for the Plate Strap Connectors.

tremes it carries more oxygen than can be consumed by the flame combustion; the extra oxygen attacks the molten mass with avidity to cover it almost instantly with a coating of oxide.

Perhaps the worst effect of the other wrong stage of the lead burning flame is that the metal is not melted sufficiently fluid to mix well. The separate parts of the joint do not become hot enough to flow together into one body. Of this can be said (referring to an extremely carbonizing flame and to a pure acetylene flame) that either one is not hot enough for the melting point of lead. Then a poorly melted joint is likely to have misconnected portions or to be "shorted." The lead must be all melted into one homogeneous mass for best results.

The Neutral Flame

The neutral flame is the standard working flame of the lead burning torch the same as it is for the oxy-acetylene welding torch. In fact it is a welding flame but not large and powerful enough for ordinary welding purposes. Where oxygen and acetylene are used, the different stages of the lead flame are attained, in principle, the same as in the welder's torch. The acetylene is turned on and ignited; it burns with a long, quiet, yellow flame, smoking at the end if too much acetylene is supplied. Then, the oxygen is turned on until the two gases combine to form a shorter, sharper flame, which is the oxidizing flame and of which there are a number of degrees. To attain the neutral flame, then, the oxygen and acetylene pressures are gradually cut down with the torch valves until the central cone of bluish white is short and clear. Which is the neutral working flame.

The length of this flame varies somewhat with the different styles of torch. But usually it is not much over half an inch long. It is then pale blue and has no ragged edges and no little flickering tongues of blue.

While the neutral flame is the correct one to use on lead burning it should not be thought to be perfectly safe for the making of good joints at all times since it may be manipulated wrongly and thus produce a poor job just as easily.

It is played upon the filler lead and the melting bath about the same as the welding torch would be on an iron weld. If it is bored into the bath or held too long in contact with the molten metal it is liable to burn the lead, with results as mentioned above. It is revolved or moved around according to the melting condition of the joint. It is revolved in tiny circles or moved in small arces as the melting filler feeds into the joint.

The pressure employed on some kinds of torch is about five to ten pounds, on each tank, which is governed by reducing regulators. If more gas is used it blows out and is difficult to keep ignited. Some of the more modern torches have sizes of tips for which the gas pressure is varied according to the size flame desired.

Grouping the Plates

After the first step, or the cleaning of all parts to be joined, the next thing is to arrange the group of plates in the spacer, which is shown in an accompanying cut. This spacer is adjustable up and down so the operator can obtain the correct length of the plate straps. And the spacing slots are arranged so the plates are always the correct distance apart. Such a device may be purchased from the factory; or it may readily be made at home by an ingenious mechanic.

The grid or post bars do not always fit the plates accurately but must be pried apart to permit the post to set level on the spacer. Some operators do not bother with trying to fit the post bars over the plate straps but simply saw them off close to the base.

At any rate after cleaning the post and straps, the next thing is to arrange the plates in the spacer, being careful to get the spacer grates the proper height above the edge of the group of plates. And incidentally the top of the spacer should be brushed free from rust and moisture before arranging the plates in readiness for the burning; this may prevent a bad burn, at least a poor joint. A moist spacer may be dried with the lead burning flame.

When the plates and post are in position, a mold is placed around the top ends of the plate straps as is indicated in one of the pictures illustrating the discussion. This mold usually consists of three pieces of smooth steel so placed as to form a frame or enclosure around the plate straps and post. The pieces of steel should be approximately a half inch square by three inches long and should be clean and absolutely dry when the lead is melted.

The Frame Mold

This frame or mold is for the purpose of preventing the molten lead from escaping. It is also to enable the operator to build up a

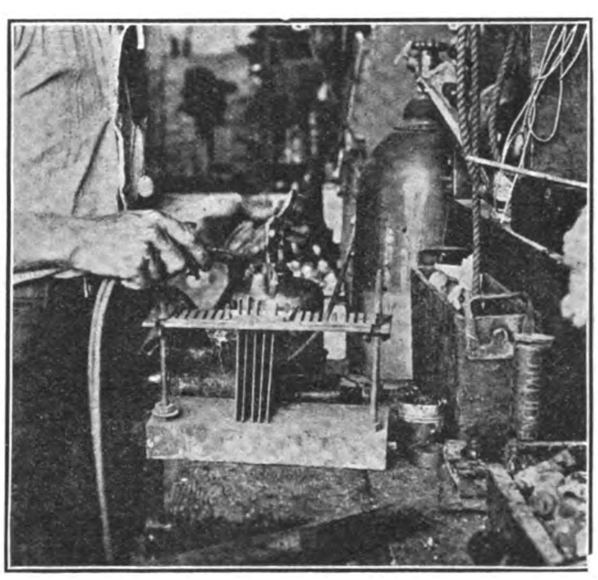


Fig. 4.—Filling the Mold with Lead To Connect the Plate Straps.

joint more easily; also adding much to the appearance of the job when it is finished.

The torch is ignited and its flame properly regulated before applying it to the lead. A filler rod is then taken up and brought close to the job in connection with the neutral flame. Then the part of the filler is melted around the plate straps and along the edge of the post. The flame is not held close enough to the lead to flare or to be thrown back; it is held close enough to barely touch the metal.

The flame is worked back and forth and around, melting the ends of the plate straps and the fingers of the post down level into one mass. When this bath is fluid and flowing together freely the lead stick or filler lead is introduced. At this time a close watch is kept on the molten bath and the melting filler to keep the latter flowing freely into the bath. The heat is deftly and cleverly regulated by the manipulation of the torch to prevent overheating. Also to keep from melting too much filler. The flame is played upon the work just the right length of time and then swung away, or gradually moved to another part of the enclosure. And thus a layer is

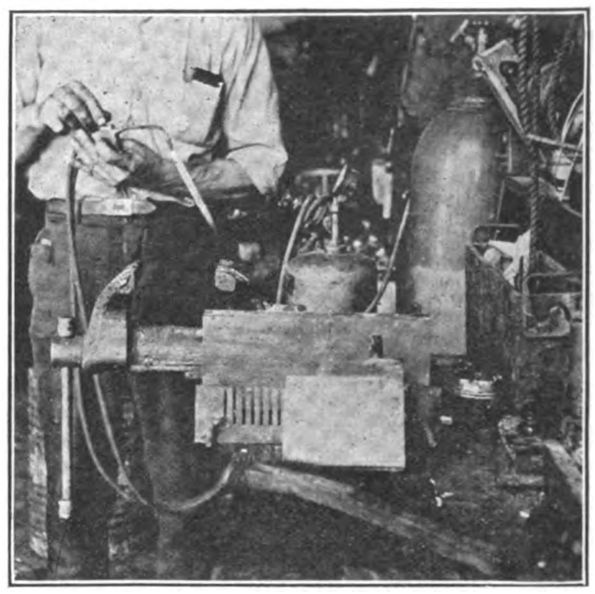


Fig. 5.—The Completed Job and the Lead Burning Torch Properly Regulated to the Excess Acetylene Flame.

made over the entire surface of the spacer.

If this layer is not thick enough more lead is melted into the bath to raise the upper surface of the bath well above any chance of being too thin. Usually the entire thickness of the newly melted section is no more than the thickness of a post strap. The making of which sometimes requires but very little added metal. The ends of the plate straps when melted down often nearly fill the mold to the required depth.

In the lead burning process, especially as it is employed on battery work such as is described herein, it is essential that the filler metal be pure; no mixture or solder will do. Strips cut from pure sheet lead will serve as well. Or the operator may melt old discarded battery terminals, straps, etc. This metal pours out in a fine stream along a flat metal plate. The ladle is moved backward along the iron plate as the metal is poured. And the iron plate being cold immediately chills the stream of lead into a long filler strip. No flux is used in any event.

Reverting again to the lead burning: After the steel mold is properly filled the desired depth, with lead, the surface is flowed smooth by the flame pressure; then the mass is allowed to cool and congeal.

When it is set solidly the group is removed from the spacer device and the rough edges trimmed smooth with a knife or other sharp instrument. Sometimes a little lead seaps through between the spacer bars. And sometimes a trifling surface imperfection is found on the lower side of the bond. The seepage is trimmed smooth and the defects remelted and filled again with a drop or two of filler lead. In the latter event the group of plates is turned upside down or sidewise while the rough portions are being remelted.

Then at last the group is ready to be inserted in the cell and have the terminal strap burned on. Which is also accomplished with the same wonderful little flame.

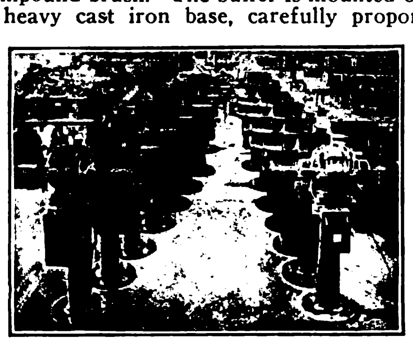
IS there anything finer to look upon in the animal world than a big, well-bred, well-kept horse, or anything that gives more value in return for its keep?" asks the editor of the *New Bedford Times.*

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

Big Shipment of Buffers

The Valley Electric Company, Kingshighway and Connecticut Street, St. Louis, manufacturers of electric motors, buffers, motor-generator sets, and battery chargers, report the sale of seventeen buffers to the Post Office Department of the Federal Government. These buffers have been shipped to the tire service sections of the Post Office garages in Atlanta, Detroit, Kansas City, Los Angeles, Memphis, Omaha, Cincinnati, Newark, Buffalo, Denver, Dallas, Norfolk, Grand Rapids, Jacksonville and Chattanooga. The Valley Buffer is a standard ball-bearing Valley Motor of 2 h.p. with the rotor shaft extended sufficiently on each side to carry an emery stone and a compound brush. The buffer is mounted on a heavy cast iron base, carefully propor-



tioned to give rigidity to the whole machine. The end plates of the motor are enclosed, keeping the windings free from dust. The buffer is 46 inches high and occupies 4 square inches of floor space. The Valley Company is also manufacturer of a small, flexible shaft buffer for bench work.

Marko Radio Battery

Most of our readers are familiar with the Marko Storage battery, made by the Marko Storage Battery Co. of Brooklyn, N. Y. so that we need not enter into details as to its excellence. However, we want to mention a new product made by this concern, the Radio Battery.

Owing to the big demand for a battery which would function properly for radio work it has been necessary to produce a special battery and we feel safe in recommending this new product.

The Marko Radio battery is made in a number of styles and sizes from four to twelve volts. The plates are made to stand the steady drain required in radio work the jars are of the best, highgrade, hard rubber and are provided with bridges to prevent shorting from deposits in the base. Each cell is tested separately and brought up to its capacity before being assembled in the box.

Two of the popular sizes for Radio work are furnished in "Rubellite" boxes. This type of case is moulded from one piece, including cell compartments and handles and are neat in appearance so that they can be used in the living room with the wireless set.

Adjustable Calks at Low Prices.

We wish to call the special attention of our readers to the advertisement which appears for the first time in this issue of the BLACKSMITH & WHEELWRIGHT from Donnelly & Company, 531-35 N. 4th Street, Philadelphia, Pa.

This company is making a special drive on adjustable calks for the Fall and Winter season, and it will pay any of our readers, who are interested in calks, to write for prices to this large and well-known jobbing house.

Donnelly & Company have recently acquired by purchase, the business of Day & Company. The consolidated concern will be one of the largest in the East in this line of business, carrying a full line of blacksmiths and heavy hardware supplies.

A Most Convenient Catalog

We have received from Foster, Merriam & Co., Meriden, Conn., manufacturers of the Bear Tite Piston Rings, a copy of their new 1922 catalog which contains a complete table showing number of cylinders rings per piston and sizes of rings required for all makes of cars. The catalog also contains other information for any repair man who installs piston rings. It is a valuable book of reference and should be in the hands of every repair man. It will be sent free to any in the trade who will write for it and mention this magazine

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Fur Lined Overcoats

The time is rapidly approaching when the cold blasts of winter with its driving snow and sleet will make you wish that you had purchased that good warm fur lined overcoat with the large fur collar to turn well up around your neck to keep out the elements.

On page 19 of this issue E. Hart, Manufacturing Furrier offers you the opportunity to secure just the garment you will need, a handsome black kersey cloth overcoat lined and collared with fur at one half the retail price, fully guaranteed as to quality and workmanship. You can order this coat forwarded to you for your inspection. You need not pay for it until after you have examined it thoroughly and found it entirely to your satisfaction and more than up to your expectation.

Seventeen years of selling direct to the consumer has enabled this concern to eliminate all middlemen profits as a result of which you get the benefits. Don't wait until the winter arrives with the possibility of an advance in price, but send in your order now. See advertisement on another page of this magazine.

BLACKSMITH AND WHEELWRIGHT

and TRACTOR REPAIR JOURNAL

Vol. LXXXVI. No. 4 OCTOBER, 1922 TERMS ONE DOLLAR A YEAR

Aligning Rear Axle Housings

A Repair Job Which Is Difficult Yet Which Is Often Necessary

BY DAVID BAXTER

OF all automobile repair work the straightening of warped rear axle housings is probably the worst. It is one class of repairing that many garage mechanics evade whenever possible. In fact it is one job where everything is against them and it is scarcely possible to secure perfectly accurate alignment no matter how it is done. The mechanics who attempt this work are lucky if they can closely approximate the original alignment. There are few special tools for the work and few instruments for measuring the distortion.

However, the garage that has an oxy-acetylene welding plant in its equipment is probably better fitted than those that depend upon a forge, since the heat of the welding flame is more readily concentrated just where it is needed, and with little danger of overheating. Just enough of the housing may be heated to take the "kink" out of it. That is, only the high spot of the bend is heated which is the part where the distortion bends both ways.

Method Applies to All Types

Of course there are several styles of rear axle housing but the theory as here described is practically the same for all. In other words the straightening can be accomplished under the same principle with a few changes in the way it is applied.

Therefore a discussion of one particular housing job should furnish the basis upon which the mechanic can work to devise other ways of straightening other kinds of housings. If he can grasp the main idea he should be able to fit the job to his own shop equipment.

Consider a housing like the one shown in the accompanying photograph. If it comes to the shop already removed from the car the first thing to do is to dismantle the brake rigging. Remove all movable parts to make the handling easier; a housing of this sort is quite heavy and is a bunglesome thing to handle even when the loose parts are stripped. Of course if the car comes to the shop with the housing in place the first thing to do is to remove it from the car. Then strip it.

The next step is to locate the kink, or kinks, but usually there is only one. In the instance under consideration this was done with a surface gauge such as is used by machinists in connection with lathe work.

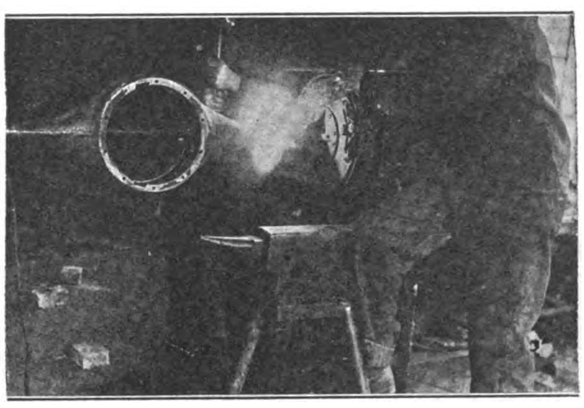
But first two stubs were turned out on the lathe; one to fit snugly in each end of the housing. These stubs were merely two pieces of shafting with three or four inches of one end turned down to fit the opening in the ends of the housing. These turned ends were made to fit the housing tightly without danger of swelling it. Several inches back from the machined ends of the stubs, two or three inches of the shafting were cut down to the size of the machined ends. That is, another portion of the stub was trued up to the turned ends. The details of the stubs are shown in a sketch accompanying this article.

Before driving these stubs into the ends of the housing a short iron rod was placed inside of it. This was for the purpose of backing the stubs out after straightening the housing. In other words the rod was to be jerked back and forth to drive the stubs out. This rod was half an inch or so smaller than the inside of the housing and was about a foot shorter than the distance between stubs, which afforded plenty of play for driving them out.

After fitting the stubs the job was arranged upon two V-blocks as shown. The machined part of each stub rested in a V-block so both would turn true. The V-blocks were arranged on tables at opposite ends of the housing. This permitted the whole thing to turn freely in the V-blocks, ready to be tested to locate the kinks.

This process hinges on the fact that the housing could not bend in the casting at either end on account of the brace ribs. In other words, the bend must occur between the ends of the castings where they join the steel portions of the housing. This is as close as the location can be approximated by eye. Therefore the mechanic must devise some method to find the high side of the bends.

In this particular instance a surface gauge was placed with the point of the indicator barely grazing the housing. Then the housing was slowly revolved several times so that the highest spot would push the indicator back. The housing was then revolved again several times to be sure there was no mistake. The spot where the indicator touched the housing was therefore the high side of the bend. Directly opposite this the indicator was the farthest from the housing, or the low side. A chalk mark was then made on the exact center of the high side.

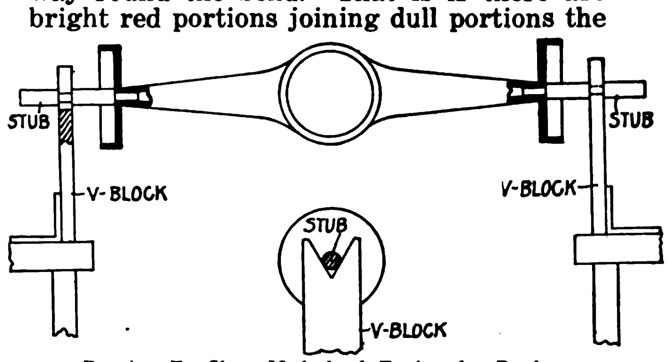


Heating the Bent Portion with an Oxy-Acetylene Flame.

Then without disturbing the V-blocks the surface gauge was moved to the other end of the housing. Here the revolving and testing process was operated with the surface gauge. Another chalk mark was made along the high part of this bend. This mark was found to be on the same side of the housing and directly in line with the first mark; indicating that the housing was bent in two places; one at each end where the tube joined the brake castings. There was no evidence of a bend in the middle of the housing, which would show quite plainly in twisted metal or cracks.

After both ends were tested a center punch mark was made in each chalk mark to prevent error in case the chalk was obliterated. This was also to cause the location of the bend to stand out clear when the housing was heated. The center punch would show plainly when the metal was bright red, while the chalk mark would not show at all. This is a good idea to remember when straightening or cutting other metal parts aside from axle housings.

Next the mechanic selected a large size welding tip and fitted it to a heavy duty welding torch. This was highly essential because a small flame would not supply enough heat to keep the bent axle sufficiently heated for straightening purposes. The bend must be red hot all the way round the housing to make the straightening accurate. This condition must be practically the same all the way round the bend. That is if there are bright red portions joining dull portions the dull portions will not bend the same as the hotter portions.



Drawing To Show Method of Testing for Bends.

A small flame will not keep one part hot and heat another part at the same time because the heat is conducted away too rapidly by the cold metal on each side of the heated spot. A welding flame supplies an intense heat but not a large amount. Therefore a large flame must be employed to heat a large area, everything being in proportion.

In this case the flame was adjusted to the neutral condition since this is the hottest flame obtainable without endangering the metal to oxidizing. In other words the flame to use in straightening bent axles is the same as for welding; it carried equal parts of oxygen and acetylene. Had either been in excess the flame would not have been neutral and would have lost part of its heating quality. A flame carrying an excess of acteylene would not furnish heat enough, and an excess of oxygen would endanger the steel of the housing to burning. That is, an excess oxygen flame will burn a hole through the side of the housing almost before the operator can realize it, due to its powerful oxidizing effect.

Therefore a large neutral flame was applied to one bent portion of the housing. It was played back and forth over about six inches of the tube. As the metal turned red the housing was revolved in the V-blocks. As fast as this occurred the flame was applied until a strip about six inches wide was heated entirely around the housing. To accomplish this the operator was forced to employ considerable deftness in order to get the whole surface the same color of heat.

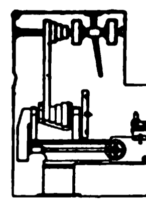
The housing was turned back and forth and the flame shifted from one portion to another according to the condition of the heat. At first the heat died out rapidly as soon as the flame passed on, but after awhile the whole section became bright red. Conduction caused the delay.

During this heating process a helper stood ready to press and hammer the crooked housing back to shape. By throwing his weight upon the ring in the middle of the housing and striking the high side of the heated bend he was able to force the housing back in close alignment. After a vigorous attack the surface gauge was once more brought in position; as quickly as possible to prevent the loss of heat. Then the housing was revolved until the amount of straightening was determined.

Melting and Casting of Brass

Describing Cheap Equipment for Producing Small, Brass and Bronze Castings in the Shop

BY H. L. WHEELER



THE tremendous increase in the use of tractors and trucks for farm and city work in the last two years makes it almost imperative for the blacksmith, machinist and auto repair mechanic to know how to melt and pour his own brass or bronze into bushings and bearing stock. There are so many different size bushings and bearings required for the wide variety of tractor and truck designs that it is not always feasible for the average repair man to carry a full line of factory made bearings. Therefore he must find some way to make them on demand.

Of course it is not practical for the small shop owner to install regulation brass melting and handling equipment, although it would be best to do so if he had large quantities to melt.

Particularly is it true that the village garage or blacksmith shop cannot afford to install modern melting apparatus just to take care of the usual run of trade, although this equipment is not entirely prohibitive by first cost if the shop draws its trade from an extensive district, that is, if the bearing trade comes from a large radius of surrounding country; possibly due to the fact that the shop is the only one in that section which makes bronze bearing stock.

However, while touching the subject of factory made brass melting furnaces, this article will deal principally with a crude "home made" outfit, such as nearly any repair man may possess if he is at all ingenious, even though his capital is restricted. In fact it is the intention to make this article an exposition of a simple but effective method of melting brass and other alloys of high melting points; using such parts of equipment as may be found in most towns.

A consistent effort will be made to adhere to the nontechnical side of the question as much as possible in order that any mechanic may be able to undertake the work.

In a recent issue of the BLACKSMITH AND WHEELWRIGHT, we discussed a simple method of making bearing stock molds; which, when taken with the present discussion, should enable the average repair shop to turn out bearings of nearly any metal. The other discussion referred to, was designed mainly for use in casting bushings of metal having a much lower melting point than copper alloy.

However, the same method and equipment may be used when making brass or bronze bearings. It will not be necessary to go again into the subject of molding; the reader will do well to hunt out the back numbers of this magazine and refresh his memory, if he does not recall all the details of the process of making a mold for babbitt.

The present writing concerns the melting and casting of copper alloys such as common yellow or red brass or one of the various bronzes, provided of course that the correct mixture of metals is used.

Incidentally, much could be written on the subject of brass and bronze mixtures and the scientific melting thereof. It is very doubtful, however, if the average repair shop owner is interested in technical instruction along this line. What he wants is a practical method which can be applied in the smaller establishments without going to any considerable expense.

In the first place, the average blacksmith shop usually has on hand a quantity of scrap brass, such as valves, fittings, and discarded bearings, which could be used in making new stuff if the worker knew how to melt them. Many a mechanic has learned to his sorrow that he cannot melt brass in a common babbitt or lead ladle.

Therefore, perhaps, the first instruction would be to get a graphite crucible for use in brass melting, such as is used in brass foundries, and which may be ordered direct or obtained through any equipment jobber. A crucible with thirty pounds capacity is about right for the average country shop. A larger one such as is shown in the pictures may be used.

Now, perhaps, the next important consideration is the melting facilities. Almost any blacksmithing forge can be employed, or if such is not a part of the regular shop equipment, a makeshift forge is easily constructed as is shown in Fig. 1, of the illustrations.

This device is made of a section of an old steam boiler, utilizing one of the flue sheets for a fire pot and a tee pipe for a tuyere. A motor driven forge blower furnishes the air blast through the tuyere, which is also provided with a dump grate as is clearly shown in the picture. The blower is mounted on a metal framework braced to the boiler sheet.

In absence of electric power the blower may be operated by hand, such as is the custom with many blacksmith forges. This is a quite tedious job as it often takes an hour or two to melt the metal hot enough to pour. The main essential in this process is to maintain a steady, continuous blast of air.

Other essential features are tongs with which to handle the hot crucible and some pieces of asbestos paper and sheet iron with which to protect the workman from the intense heat of the melting-fire.

Fig. 1 also shows another device that is imperative; a fire brick wall is built up around the fire at least to the height of the crucible top. To further confine the heat and protect the operator, the crevices of this crude furnace ought to be plastered full of clay, since the fire must be extremely hot and therefore liable to prove uncomfortable. The pieces of sheet iron and asbestos are spread over the top of the furnace during the melting operation to keep the maximum heat enclosed.

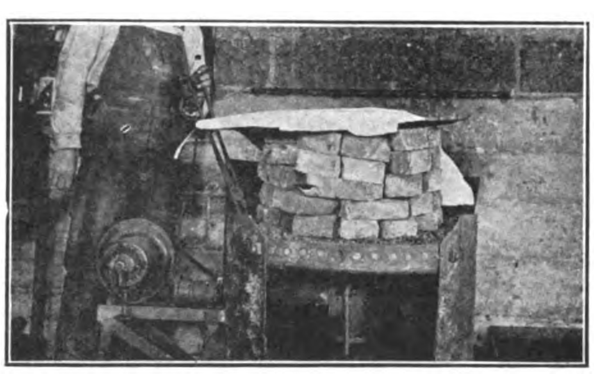


Fig. 1. A Home Made Forge for Melting Brass.

A few words concerning the intensity of the heat should be inserted here for the benefit of the absolute novice. To put it non-technically, the fire must be so hot that the novice may think the crucible itself is melting, although this is not possible in such a furnace. At any rate the entire enclosure must be almost white hot. In fact the crucible must be white hot before the brass scrap will melt and settle to the bottom in a liquid pool. The condition of the melting brass is ascertained by shifting the covering and poking the molten mass with a clean iron rod.

It is not entirely satisfactory to do the melting with coal and charcoal, although it is well to kindle the fire with this. Regular foundry or gas house coke is best. In fact a supply of either should be kept on hand if the melting of brass is to become a part of the shop's regular business.

This fuel should be broken into pieces about the size of a man's fist or smaller and should be fed into the fire as fast as it settles down during the melting process.

In the melting procedure, after building the wall around the fire, which, by the way, should be large enough in diameter to provide a space of from four to six inches around the crucible, the first thing to do is to pack the crucible with the brass scrap. If any attempt is made to grade the metal it should be done at this time. For instance, all discarded bearings are melted at one time in order to better estimate the nature of the new bearing stock to be cast.

If one is not so particular as to the nature of the metal, globe valves, fittings, etc., are used in the same melting. In the latter event all set screws, hand wheels, etc., should be removed from the brass, that is, all iron and steel should be stripped from the junk metal before packing the pot.

Fig. 2 Pack the Crucible with Scrap Brass Before Putting It into the Furnace.

It is important to pack the crucible before starting to melt as it will save time by melting quicker; and will also save lots of discomfort attending a process of introducing the scrap after the furnace is red hot. Prepacking the pot also tends to prevent oxidization because the scrap is in a more solid mass where the atmosphere cannot reach it.

In Fig. 2 is indicated the loading of a cold crucible. The pieces of scrap metal are placed as closely as possible together in the bottom of the crucible.

Then the fire is kindled inside the brickwork before introducing the loaded crucible. This is done in the usual way, after which a quantity of larger pieces of coke are spread over the fire. These pieces of coke should make a layer several inches deep in the bottom of the furnace.

Egg-size pieces of coke are then scattered in the crevices between the larger chunks. After this the blower is turned on until the coke becomes incandescent all over. Then a few more larger pieces of coke are thrown in to help sustain the weight of the loaded pot. It is next placed nearly in the exact center of the circle.

The space around the crucible is then filled with coke, to well above the top of it. The blower is again put in operation, after which the operator keeps a continual watch over the fire to keep it burning steadily. Fresh coke must be placed around the pot as fast as the other burns and settles; in fact it is often essential to punch the coke down around the pot because it is absolutely necessary to keep the fire alive on all sides of the pot.

Sometimes it is necessary to pull the pot up several inches a number of times during the melting process, in order to keep a hot fire beneath it. The pot is merely moved up and down enough to cause the coke to work its way beneath it.

The melting depends upon the condition of the fire. In a few words, the fire must be extremely hot on all sides of the crucible as well as beneath it during the entire melting process. This is a disagreeable job sometimes, but if carefully attended the mechanic is assured of success.

Above all he must not get discouraged because the brass does not melt easily, like babbitt or aluminum. He should keep in mind that the inner wall of the furnace is to be white hot before the metal will start to melt. If this is maintained it is only a question of time until the metal succumbs.

When it starts to melt the brass assumes a "cheesy" stage, when it may be crumbled with the poker. Then it gradually settles into a pool in the bottom of the pot. Then its pouring condition is ascertained by dipping a clean iron rod into the bath. If it comes out red hot and without any brass adhering, the metal is ready to pour. But if the molten brass sticks to the rod it is not yet fluid enough to pour.

If more scrap is added during the melting it should be put into the pot as the mass settles. All valves and such other brass castings should be examined to make sure they do not contain water when they are thrown into the heated mass; an explosion is sometimes averted thus. The additional scrap should be pushed beneath the dross that usually collects on the surface of molten scrap. It is an excellent plan to heat the pieces of scrap before putting them into the pot.

When the metal is melted ready for pouring, the worst part of the performance comes. It must be accomplished quickly and deftly, because of the intense heat and because melted brass soon chills and will not run out of the pot then.

Fig. 3 illustrates one method of taking the pot out of the furnace. Two tongs are employed because there is danger of breaking a piece out of the side of the crucible if but one is used. A red hot crucible if fragile is handled wrongly. Even when using two pair of tongs, the mechanic must be careful to pull straight upward.

But first a section is quickly torn out of the side of the furnace wall. A piece of asbestos paper is thrown on top of the pot to protect the mechanic while handling the pot. Then it is lifted out, set into the pouring shank and taken to the mold, where the dross is scraped or skimmed from the surface of the molten brass. After this the smoking metal is poured into the waiting mold, previously prepared.

Fig. 3 Tear Down the Furnace Wall Before Removing the Crucible.

The shank or pouring handle may be so constructed that two men may handle it if too heavy for one man.

If excessive smoke comes off during the skimming or pouring process it is a sign that the zinc is being burned out of the mixture. To counteract this, small quantities of zinc may be added; if it is added in sheet form. But too much at one time will chill the mass so it will not run into the mold.

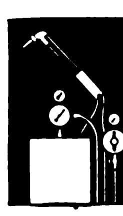
In Fig. 4 is shown a modern type of oil burning brass furnace and a pair of special tongs for handling the hot crucible. This outfit is comparatively inexpensive where a considerable amount of brass is to be melted regularly. Besides being a great deal safer it also makes a cleaner brand of metal if properly manipulated.

Fig. 4 Modern Brass Melting Furnace and Crucible Tongs.

For the average blacksmith shop where the melting would be done only at infrequent intervals the process described above is probably the cheapest that can be devised and still be dependable.

HOW TO WEIGH ATTACHED IRREGULAR PARTS

BY W. F. SCHAPHURST



OCCASIONALLY it is desired to know the weight of some part or other on a machine, but the part cannot be detached easily for weighing and it is too irregular to compute with ease. In such case the weight can be found indirectly by weighing water displaced by the part, if the part projects in such a way that it can be made to displace water.

For example, the writer once had to determine the weight of a flywheel governor weight, which was made of cast iron, and which could not be detached without removing the whole governor from the engine.

He turned the flywheel in such a position that the weight was at its extreme low point and then procured a rectangular sheet metal vessel and filled it with water. He weighed the vessel when it contained as much water as could be held in it.

Then he carried the vessel of water over to the engine and raised it so as to envelop the weighted end. Water was displaced of course, but that is what was wanted. The vessel was replaced until the water level cut the governor arm, the writer being sure all the while that the vessel was still holding as much water as possible while raised to that height.

Then he removed the vessel and again weighed it, this time with the remaining water. The weight of the governor end was then computed in this manner:

The first weight was 45.5 pounds and the second weight was 39.25 pounds. The weight of the water displaced was therefore

$$45.5 - 39.25 = 6.25 \text{ pounds.}$$

Now to compute the weight of the cast iron that displaced the water all that is necessary is to multiply by the specific gravity of cast iron which is 7.207, or

$$6.25 \times 7.207 = 45 \text{ pounds.}$$

The remainder of the arm was of rectangular cross-section, whose weight was very easy to compute on the basis of 0.26 pound per cubic inch, which is the weight of cast iron.

In case other metal parts are to be weighed in this manner here are the specific gravities of metals most commonly used in mechanical constructions:

Cast iron	7.207
Wrought iron	7.78
Soft steel	7.833
Steel castings	7.917
Cast aluminum	2.60

Should it be desired to know the volume of the piece of metal in cubic inches, divide the difference in weight (which is equal to the weight of the displaced water) by .0362. The result is the volume of the part in cubic inches.

This latter test will come in handy for finding the volume of any irregular substance that can be submerged in water without harm or without any absorption of water. Or, should one wish to find the specific gravity of coal, brick, rock, etc., this method, reversed, will serve the purpose.

Weigh the rock, say, and then weigh the displaced water (which can be done by subtraction as already explained). Divide the former by the latter and the quotient is the specific gravity of the rock or other substance.

COTTON PRICES CONTROL MULE MARKET

WHEN Eugene Mayer, Chairman of the war Finance Corporation, remarked last fall that in less than two weeks from the time cotton prices advanced in the southern states, the price of mules advanced to correspond,—he put the whole situation in a nutshell," said Dr. Reid, of Campbell & Reid, at the National Stock yards, East of St. Louis.

Hundreds of dealers and farmers, stockmen and ranchers in all sections of the country, are in communication with them. Speaking of the present horse and mule situation, Dr. Reid continued:

"The southeastern states need more work animals right now, but they have not had the money to pay for them, and, as a result, many of the farmers in the Carolinas, Georgia, Alabama, Mississippi, Louisiana and Arkansas are doing the work as best they can without enough work stock to handle it as well or as promptly as they would like.

"The rise in the price of cotton, however, has helped some, and if the men in these states get a fair crop and a higher price this fall, there will follow a decided improvement in demand for horses and mules. Our reports are to the effect that there is a strong reaction in favor of horse and mule use, especially in those sections where a good many tractors have been sold heretofore."

J. J. Searcy, associated in the same firm of Campbell & Reid, was also interviewed by a representative of the Horse Association of America, and, after confirming what Dr. Reid had said, Mr. Searcy added, "The scarcity of yearlings and two-year-olds is very evident in Iowa and Illinois. I look for the better class of farmers to take hold of the matter strongly this year. In 1902 to 1907, there was a similar scarcity of young stuff, and a very profitable plan was tried out.

"These farmers in Iowa, Illinois, Missouri, etc., with plenty of grain for feed, in response to the demand for work stock, shipped in good promising yearlings and two-year-olds from western ranches. They picked stuff carrying two crosses of draft blood, with possibilities for first class development, and on the abundant feed which corn belt farms provide, they grew out this young stuff into excellent horses of 1200 to 1600 pounds and more.

"Today there are yearlings and two-year-olds carrying three or four crosses of pure draft blood, available on western ranches, which farmers will probably be able to buy this fall very cheaply,—say \$35 to \$50. This is less than what they would have to spend to produce and rear colts to two years of age on corn belt farms.

"The supply of good young horses, is, of course, limited but many western ranchmen are hard pressed for money and must move some of their surplus stock. Farmers who buy such colts now and grow them out in good shape while doing farm work with them in their third and fourth year stages, will realize a substantial profit on such work stock by the time it is five years old. Horse and mule prices are going up. How rapidly they will advance depends entirely on how other farm products, which give farmers their purchasing power, rise in value."

FOR A HORSE-WHIPPER

A BOSTON driver, who recently whipped an old horse till there were ten ridges on his side, was put in court by an officer of the Massachusetts S. P. C. A. This is what the judge said to the defendant: "I wish the conditions had been the reverse that day you hit the horse. I wish you had been in the shafts and your horse had the whip. Then you would have known how he felt. I fine you $25."

The fine was paid promptly.

Our Dumb Animals.

Marketing Your Products

If You Want To Keep Busy You Must Let the Public Know What You Can Do

BY F. L. PHILLIPS

IF the average blacksmith were approached on the subject of selling his products and marketing his wares he probably would eye the questioner quizzically and ask him what insane asylum he had escaped from. A blacksmith is different from every other kind of business man, has always been so, and is supposed to be so. The smith has the same settled niche in life as a minister of the Gospel, as much of a fixture in the landscape as an oak tree of a mountain.

It is a peculiar fact that the blacksmith is in a far better position to make business for himself than the average business man. Luckily, the smith is an essential; horses must be shod, wagons mended, farm machinery fixed, and the smith is the only man to do it. But the smith seldom tries to go after business, he merely waits for it to come to him.

Without intending any offense I'm going to call upon nature for an excellent example of what I wish to illustrate; I'm going to liken the smith to a spider, sitting in his web, waiting for the flies to sit on his doorstep. If the spider has a good web in a fine location, then he has many visitors, and every meal is a full course dinner. But if the spider's web is in a dark corner, with no prospective victims, then he grows thinner and thinner, until at last a perfectly good web is wasted and has a "To Let" sign on it. If this last spider is wise he doesn't wait until he has starved to death but goes out to richer fields for his meals.

And now I'll go even further with my simile. Last week I went fishing and during the early afternoon, while it was so sunny and hot that no selfrespecting fish would have thought of biting, I thought I would take a nap. I was just about to close my eyes when about a sixteenth of an inch in front of my nose a gray moth flew down. Hardly had the moth hit the ground when a big, furry, black spider hopped out from beneath a leaf and onto that moth. There was a short struggle, the moth escaped and fluttered along for a few feet, landed again and the spider was right there. Anyway the spider had a good, full meal that day and the next.

That spider was what you would call a "go getter," he didn't sit on his doorsill and wait for his victims he went out and brought them in. He didn't spend a lot of time spinning a lot of cheesy webs in the chance that a fool fly would get a foot tangled in them, he went right out where the hunting was good and chased up the big game.

And when you come to think of it, isn't all business today, more or less of a "go and get it" proposition? The big manufacturer sends his men out after business; the retailer sends out letters to his prospective customers. Even the minister goes out after new people to fill up his church. But the smith too often sits in his shop, hoping that the customers will come to him.

I suppose that many of my readers, the more fortunate ones, will come forward to say that they have all the business they can handle. Well, that is a fine condition, but I cannot see why any man should quit trying for business just because he is satisfied for the time. The squirrel and the ant are always busy storing up food for the the future. The smith who has all he can do would be justified in going out after more, for he could hire someone to do the work while he was raking it in. Soon there would come a time when he could keep himself and his helper busy and then his business would be doubled.

All of this may be sound advice and you may admit that I'm right, but I seem to hear you ask me how you can get that extra business. How can you afford to take a lot of time off and hustle around the country on a chance that you'll get work? And who will do the work while you are away?

There are two ways of going after business, you can literally go out yourself, close up your shop for a day or so, or perhaps only a few hours, or you can send out a representative. By the last suggestion I mean that you can advertise. When the spider builds his web he just naturally makes it attractive to the game he expects to catch. The sheen of the silk, the many colors which it reflects, its very construction which tends to fool the fly and make him dizzy are all clever little advertising stunts which probably even the spider doesn't realize himself.

But we are not so gifted as the spider in many ways, we haven't any natural talents, all of our talents must be developed. And so we must use our brains, Nature herself won't work for us.

Now in this article I'm going to take up just one way of getting business, through advertising, because I do know that the average smith is not a good advertiser. Perhaps he is too bashful, perhaps he feels that he should be a fixture, perhaps he thinks that everyone knows about him, at any rate I never think of the smith as one who keeps himself in the minds of his possible customers.

There are three ways to advertise, in your local newspapers, signboards, and through the moving picture houses. The possibilities in each field are so great that it would be almost impossible for me, in one article, to cover everything. I can only give a few rules for your guidance.

If you are a small smith, small as far as the size of your business is concerned, naturally you cannot afford to advertise on a large scale. But your methods must depend entirely upon the size of the town in which you live and the traits of the people.

I know of one small town in the mountains, at which I have frequently stayed over-night. Every Thursday evening there are moving pictures at the Town Hall and the whole countryside turns out to see the entertainment. Now the smith in that town is missing a wonderful opportunity. He should make arrangements with the proprietor to slip in a slide, at each performance, giving the smith's name and address and just one or two advertising lines, perhaps.

If I were the smith in that town I would have about a dozen slides made up with cartoons and jokes on each, because I have noticed that any sort of humor was relished by the patrons of that weekly "movie." It might take quite a lot of time and perhaps a lot of reading to get just the right kind of jokes, but they must be personal, you must make the people laugh *with* you, not *at* you. Let me illustrate what I mean.

> Jones Says:
> "The only real difference between a Ford car and a mule is that the Ford kicks when you twist its starting crank, while the mule kicks when you twist his tail."
> But there's no kick at all where Jones' work is concerned.
> J. A. JONES,
> Turnpike Road,
> Blacksmithing & Metal Working.

In getting the jokes and the funny sayings, always try to have them fit you or your work. Try to get them from sources which are outside the magazines and papers that the people in your locality are in the habit of reading. Try to get new jokes, not old ones for the minute that you put on a few old chestnuts, all the people will groan and wonder, out loud, if you came over with Noah in the ark. It's a funny thing but a crowd of people are easily amused, but just as easily angered, and in the same way they are just as ready to hiss as to applaud.

But you don't always need to use actual jokes, you can often do better than that, you can make the people happy by making them think they are clever. Put out a statement that offers an opportunity for fun, for instance, and let them make the best of it. I'll illustrate this point in another minute or so.

Try to combine, occasionally, your wit with some prominent character for instance. The chief of police is usually so well known, so well accustomed to being joked with and at, that he is always ready for fun. Everyone probably knows him and if you can get your name associated with his, then the chances are you will be better known. And now to my illustration, a combination of wit and personality. We will assume that the Chief's name is William Henry.

> The Chief Says:
> "Jones sharpened a round harrow blade for me yesterday but he certainly treated me square."
> William Henry knows his business and when a thing is right, Jones treats every customer squarely.
> J. A. JONES,
> Turnpike Road.
> The sharp, square smith—always around.

The play upon words, round, square and sharp will usually get a laugh because each fellow who reads it will think that he is especially clever to see the joke.

Of course, it will not always be policy for you to be simply funny. Too much humor is received with about as much relish as too much candy, a little is fine but too much is sickening. For this reason it is policy to vary things by inserting other kinds of slides. Take an attractive picture of your shop, if you can, and put it on a reverse negative. Perhaps you can get a pretty picture of a landscape, a group of trees, or an ornate building and if it is near your shop, so much the better, merely put a line of explanation under it like this:

"Do you know where this building is? When you visit Jones, the blacksmith, you will see it from his yard."

From what I have already said you should have no trouble in working out some good ideas for picture advertising. The next thing to consider is billboard or signboard advertising. Of course, it would never pay

(*Continued on page 14*)

HORSE RIGS COME BACK AFTER FIFTY SUMMERS

Carriage Builders' National Association Comes Back To Its Birthplace To Celebrate Fiftieth Anniversary—And Don't Think For An Instant That The Auto Has Put The Buggy Out of Business

By *Dwight S. Perrin**

Illustration by Roy Williams

THE fiftieth annual convention of the Carriage Builders' National Association is going to meet in New York City early next month.

Carriage builders? Yep, honest!

And one of the objects of the convention is to show the country that the carriage business, despite the growing tide of the motor car, is far from defunct.

Statistics compiled by the careful statisticians hired for that purpose by the Carriage Builders' National Association have determined that there are in the United States 27,000,000 horses and mules—more than ever before. The carriage builders are engaged in the pleasantly profitable but ever hopeless task of manufacturing enough vehicles to hitch these animals to. They haven't yet been able to get abreast of the birth rate, but they're doing very well. This year they did better than last, and next year they hope to do better than that.

The forthcoming convention is billed as the Fiftieth Annual Convention and Exhibition of the Carriage Builders' Association—the golden jubilee of the oldest trade organization in the country. It will be held in the Hotel McAlpin from October 10 to 13. One of the attractions will be, as the prospectus puts it, "the annual exhibition of parts of vehicles, automobiles, models, new inventions, harness, horse equipment and materials pertaining to the carriage, wagon, automobile and accessories industries." Unless you scan that carefully the automobile item may escape you. To a carriage man an automobile merits billing with just that degree of conspicuousness.

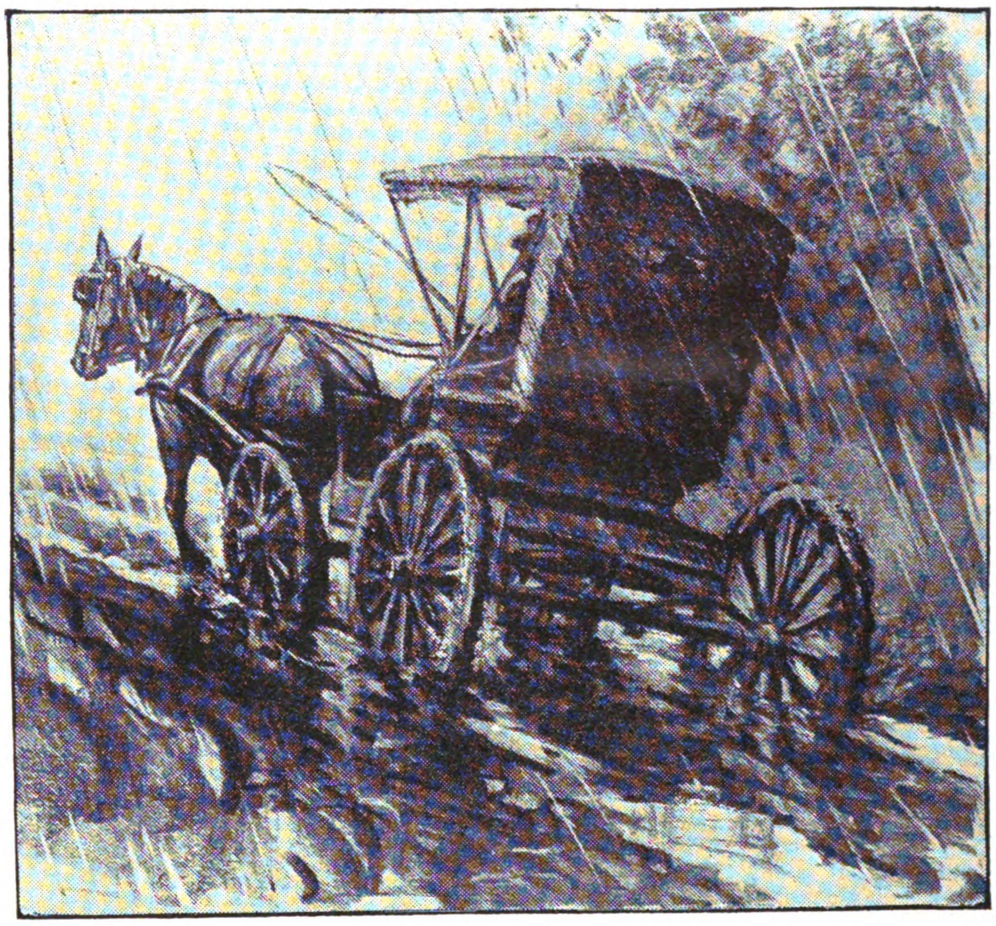
The feelings of the carriage manufacturer for his brother in the automobile trade are thus expressed in a summing up of the carriage outlook on the eve of the convention:

"It has been demonstrated in recent months that the demand for the horse-drawn vehicle is coming back—in other words, that there is a growing desire on the part of some to reconsider their past offenses and to make amends by once more using the type of vehicle that while it may not make as much speed as the other, can give in return some other desirable qualities.

Coming Back to Earth—and the Horse

"We are getting away from the inflamed idea that became so manifest during and immediately following the war days. We are coming back to earth and are taking note of things as they are, and not, as was too often demonstrated, of things as they seem. There are considerations being given today to just such trivials as cost, duration, lessened speed and to the desirability of the elements that help to make life more enjoyable. It is true that there are many who still maintain that life is not worth while unless it is filled with all that makes hustle and rush and bustle possible. It is also true that there are some who will persist that the horse is too slow to meet their advanced ideas of modern civilization. It would be utter folly to stem this tide. So it would be well to let matters take their own course and to get along as best we can without these individuals. But there are many who are coming to see the folly of their ways and to make amends by curtailing expenses and by again adopting the horse and the vehicles that are drawn by him."

A bit old-fashioned, perhaps, but sound enough, unless one wants to argue that, on the score of cutting down expenses, the argument leaks a little. The man who wants a horse and carriage must buy the horse and the carriage. The man who buys the gasoline gets his horse as part of this vehicle. He has no need for harness or a hitching strap, a muzzle or blinders or a whip or a net to keep off the flies.



While there are roads like this, and spring mud like this, the old oaken buggy will continue to hold its own against anything in gasolene.

There are as many carriages manufactured today, those who know say, as in the most prosperous days of the industry. The business has, however, with the passing of time, taken its way westward until its center is now in the Middle West and the Middle South rather that in New York and the New England states. The convention is coming to New York for sentimental reasons—because fifty years ago the association was formed here. But, instead of coming down on the New Haven or driving in from Long Island or Westchester, the majority of the delegates are facing long railroad journeys from Missouri, Illinois, Indiana, Kentucky and Ohio. The national headquarters of the organization are in Cincinnati.

For years the industry has slowly been working its way inland from the Atlantic seaboard. It is conceivable that in time it will cross the Rockies and come upon, in an unsuspecting moment, one of the most highly motorized states in the Union—California. Horses in even the smallest of California cities are as scarce as in Central Park. Facing this condition, if it ever is encountered, there would appear to be nothing for it but to turn about and work over the land already harvested.

The Happy Days When $450 Was Paid for a Buggy

But the carriage industry is used to ups and downs. There was a time, not so many years ago, when a Long Island manufacturer whose name now is a byward for elegant automobile bodies, made a buggy that sold for $450. A grand buggy it was, too—rubber-tired, glossy and as easy to ride in as a baby's crib. To own one was a mark of distinction approached today only by the fortunate possessor of a custom-built motor car. Then came evil days, when a sort of flivver-buggy made its appearance, at the height of competition, and sold at wholesale for $300 a dozen—a paltry $25 apiece.

There are still in New York, as a careful search of the parks and drives will reveal, a distinguished few persons of age and wealth who ride about in carriages in preference to motor cars. But they are so few that they have become curiosities. The only horsedrawn pleasure vehicles that exist in number are the hansoms and their more comfortable competitors, the giddy-glops, pulled by animals as quaint as their drivers and as unkempt as their seat cushions.

Gone into the limbo of things forgotten are the sumptuous brougham, the victoria, the phaeton. Gone, except from horse shows, are the agile footmen in forest green and brass who could, with not the slightest effort, leap backward from the curb with folded arms and land safe and sound on the cushions behind the mistress.

But this holds true only in New York. Elsewhere there are carriages and smart pairs, though, if the truth must be told, in no great number. But in Iowa and Nebraska and Kansas, it is safe to assume, the family phaeton still gathers dust between Sundays in the family barn, to be wheeled out on the Sabbath and dusted off for church or the afternoon drive. A salesman for a Kansas City manufacturer, working a part of Kansas, has sold 193 buggies since January 1 of this year, and he is only one of half a hundred employed by the same factory.

"Motoring to Our Doom" That's What We're Doing

If the carriage manufacturer had his way

(Continued on page 15)

* This Article Reprinted by courtesy of New York Tribune.

BLACKSMITH & WHEELWRIGHT AND TRACTOR REPAIR JOURNAL

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Member of the Audit Bureau of Circulations.

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All communications should be addressed to the New York City office at 16 Hudson St.

Our Editor's Letter

A FEW weeks ago, in the Saturday Evening Post there was published a short story which I think every iron worker in the world should read. I don't think that I'm trespassing upon the copyrights of the author or the magazine in giving the story a brief outline. At any rate I'm going to chance it because it carried such an excellent moral.

In a large manufacturing plant there was a man who had been brought up in the hardening room. He had started as a young boy and had finally worked up to the point where he was chief of his department. The men who were his superiors were in his class, in that they too had been brought up in the same school, consequently they shared his belief that he was the best hardening man in the country.

But a change in the management brought in a young engineer who was strong on theory but short, perhaps, on experience. The theories of the young engineer clashed with the experience of the chief hardener and after a few quarrels in which the hardener got the worst of the argument, the latter resigned.

The climax had come when the young engineer began to talk of various tempers as related to carbon percentage in steels. The old hardener, for thirty years had always gone through exactly the same motions when tempering tools; his steel had always been approximately the same and naturally his experience enabled him to get the best results. But the young engineer wanted to introduce different kinds of steel for different purposes and found that the old hardener knew nothing about the new stuff. And it was during this argument that the old man quit, but not until the young fellow had told him that he should get up-to-date.

The old hardener found no trouble in getting a new job but it was then that his troubles commenced. The steel in the new shop was quite different from that used in the old one. The old hardener went through the correct motions for hardening, but somehow or other the results were discouraging and his new employer had a heart to heart talk with him. And this meant another battle.

But in the end the old hardener was forced to admit that he was not up to date. He was still 30 years behind the times and his new employer was kind enough to keep him on until he studied and finally learned something about the business he had followed for the better part of his life.

The moral of this story is not difficult to realize,—keep abreast with the times.

I suppose that many of my readers, who are their own employers, whose time is their own and who can do as they please, will ask why it is necessary for them to keep up with all of these "new fangled" notions. The answer to this is easily given; if it pays an employer to have his workmen up to date, then his profits must be well worth while and it more than pays him to keep up to the times himself.

It is easy to see why some smiths are out of the running when a competitor enters the race, if that competitor is up-to-date. Such smiths may be so far behind the times that it not only takes them longer to do a certain job, but when the work is done it is inferior to that of their competitors.

If your competitor can do a job in half the time that it takes you, and his work stands the test of usage, then you cannot hope to get any business away from him. Just as long as you allow him to keep a few steps ahead of you, you are losing the race. Not only do you lose the race but you may not even come in for a second prize for usually in this kind of a race but one prize is offered.

It doesn't matter whether you are an employee or an employer you cannot afford to be a back number. If you are in business for yourself, and if you are selling your own work you must remember two things; first, that the quality of your work must be as good, or better than, the work turned out by your competitors; second, that your prices must be fairly competitive, in comparison with the prices of other smiths.

I know several people who are so extremely clever that they can command better prices than other men, despite the fact that their work is no better. But every one of these men are as up-to-date as a 1923 model automobile.

Not only must you be up to the times in so far as your work is concerned, but you must know enough about modern business methods to be able to keep yourself busy and your customers satisfied.

In order to keep up to date you must read trade papers and books dealing with all subjects in your line. You cannot afford to let some other fellow get ahead just because he is wide awake and you are not.

This pathetic letter recently reached a business house in Rochester, New York. It came from one of the firm's salesmen who was traveling in the West. Do you suppose he ever got his check at all, and if so how? The letter ran:

"Where did I tell you to send my check for this week? I didn't keep a copy of my letter, so don't know where you were to send it, but wherever it was to be sent, please send it there at once; only, how am I to know where it is so I can go there and get it, as I leave this town tonight and don't know where I will be next?

The Supremacy of the Horse

THERE was a time, not so very long ago, that a number of wiseacres predicted the doom of the horse. When Mr. Ford started to produce a machine which cost not much more than a good horse and buggy it looked as though the horse would soon be an animal to be owned by those who could afford a few, large, domestic pets. It seemed as though the horse would be viewed, by our grandchildren, in the museums only. But the horse has proved his supremacy, for the prices of good horses are advancing.

Many things which were once said about the horse, versus the flivver, are true. Old Dobbin is no longer the family pet, a means to carry the children to school and the church, for in his place is a thing of sheet metal and cleverly twisted wires which doesn't consume hay, but partakes liberally of liquid nourishment, namely gasoline.

When there is a load of eggs or hay to be carted to the nearest town is the horse put between the shafts and forced to travel many a weary, and slow mile? No! The farmer loads his truck and drives to his market and back again with the same ease which he visits his next door neighbor.

Old Dobbin as the family horse has disappeared but in his place will be found several of his grandchildren. Where but one horse was all which the farmer could afford a few years ago, now you will find several. Strange as it may seem trucks, tractors and automobiles have served to augment the number of horses necessary, but the answer to this seeming paradox of the gasoline driven machine taking the place of the horse and thereby necessitating more horses, is not so difficult to understand when all things are considered.

In times gone by, the farmer was contented with conditions in the same way as the cave man was contented with a warm, dry hole in the rock. But the automobile is a great civilizer, or rather a means for mixing people. The development of the gasoline engine has proceeded to such an extent that the farmer can have all of the conveniences of the city resident. The farmer has learned that his wife is no drudge and so has been led to install modern housekeeping machinery. He has found that he can lessen his own labors by the use of power driven machines.

The constant urge to "get somewhere" and not to stand still, to be classed as a human being rather than a mere grubber has forced the farmer to earn more money. In order to increase his earnings, the farmer must cultivate more of his land, and in order to make the most of his farm, he must have more horses, which completes the circle.

The tractor is a wonderful machine, it will do several times as much work as a horse—if—and that little word "if" is the crux of the situation. No tractor made as yet is capable of doing work on certain farms that the horse will do. The tractor requires room, plenty of open space and given this it will plug along at a 12 mile an hour rate, day after day without tiring. But put that tractor in a rocky field and it figuratively kicks up its heels, it is far more balky than the horse.

And then, again, the small farmer cannot afford to buy an expensive tractor for his few acres of soil. As a matter of fact he could not afford to keep the machine because it would lie idle a great portion of the year and this very idleness would cost money. With the small farm much of the space would be wasted in turning of the tractor which will not work up the corners in ploughing.

The motor truck is in the same class as the tractor. The small farmer can easily "Pool" his produce with other farmers and get it to market on a community truck much more cheaply than if he invested in an expensive machine himself.

Have no fear, brother smith, the horse will never be a museum exhibit, your children and grandchildren will see just as many horses in use as you have.

Making Cheap Lathe Tools

The Process of Welding Tips of High Speed Steel on Tools

BY DONALD A. HAMPSON

THIS article may appeal to the blacksmith who wants to save on his tool steel expense by utilizing his spare moments or to the shop man who wants a specially shaped cutting tool that may be prepared more easily by adding a previously formed blade to a shank than by forging or machining. Any kind of tool steel may be thus secured to any kind of a shank but the logical arrangement is to use a high-speed steel blade, or "tip," and attach it to a soft steel shank, providing one with a tool whose great body is of an inferior metal while the point is of expensive, high grade cutting steel.

We will deal with the method of brazing on these bits. The writer has used Laffitte brazing plates with marked success. It is a method open to anyone who has a forge. Lathe and shaper tools, drills, and special tools can be produced by tipping though it is advisable to limit the use of built-up tools to those where the cutting stress is continuous—not jarring and intermittent as in chipping or planing.

Fig. 1 shows the simplest job. A rectangular notch is cut at the top of one end of what is to be the tool's shank, the notch being the size of the piece of steel to be brazed on. A piece of the brazing plate is broken off to the size of the tip or a little larger. This is laid on the flat of the cut and the tool on top of it, which will bring the tool about ⅛" higher than its intended position. A piece of soft iron wire is wrapped around to hold the bit in place while handling.

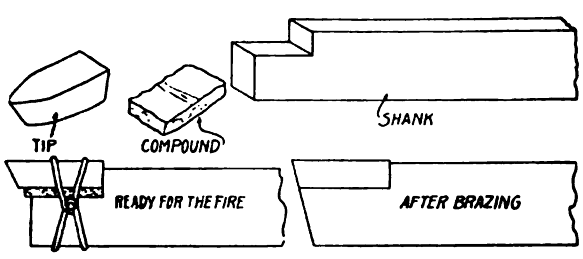
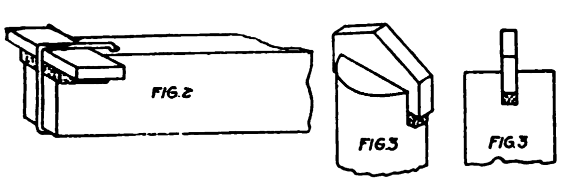


Fig. 1. Simplest Form of Welded Tool Tip.

The idea is to get the parts to a red heat; this will fuse the brazing plate and bring the steel pieces to a brazing heat. The compound contains all the ingredients for brazing and when a red stage has been reached, all that is necessary is to press the steel pieces together in the desired position.

The "trick" of the job is to balance and hold the tip in place while in the fire. When the parts get red, the compound melts and this lets the bit sink, releasing the grip of the wire which may or may not drop off, depending on how the piece is handled. When the compound melts, it runs and it runs up as well as down to some extent and in so doing spreads enough of itself over the vertical wall to braze there as well as on the flat. A flame of purplish, never to be forgotten, color is given off by the brass and flux as melting takes place. When this appears, the work should be quickly removed from the fire and given a tap or two with a hammer while resting on the anvil—this presses the bit firmly to its seat.



Figs. 2 and 3. Holding the Tip for Welding and a Boring Bar Tip.

If high speed steel bits are used, the work may be allowed to cool itself and will then be ready to grind, preparatory to actual service. If the bit is of ordinary carbon steel, it will be necessary to harden and temper the point for its particular use. The bits may frequently be odd or discarded pieces as old milling cutter blades, tool holder bits too short for service that way, or short ends from bars.

Almost any style of tool may be constructed in this way. Several examples will be given in the other illustrations. This method is sometimes very convenient for making a special reamer, using a piece of shafting with milled slots and blades brazed in them.

Fig. 2 is a tool having the bit placed crosswise of the shank. The projection makes it possible to use this for either a right or a left hand cornering tool—or such a tool could be made up with beveled corners for regular turning. Attention is called to the method of wiring on the bit.

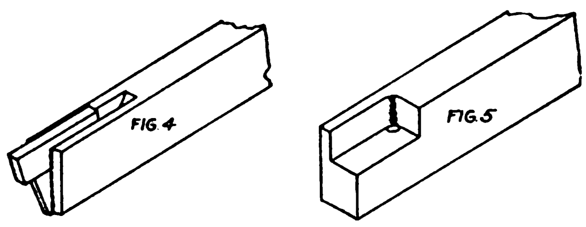


Fig. 4. Cutting Off Tool. Fig. 5. Side Turning Tool

Wiring is necessary in most cases for the hand movements of the process invariably displace the bit. The case of Fig. 3 is an exception for here it is possible to make a tight enough fit between the sides of the slot in the stem to hold the bit where wanted. This shows how a flat drill with high speed tip may be made. The brazing plate is laid under the bit at the bottom of the slot and several light grooves are cut in the sides of the slot to allow the molten brass to run better over the wide surfaces.

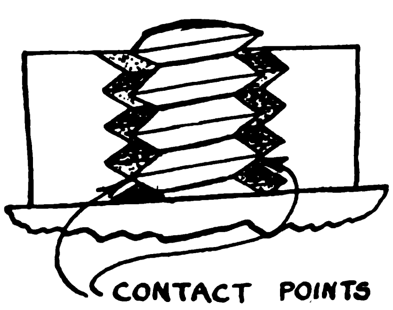
A cutting off tool is shown at Fig. 4 and at Fig. 5 a turning tool with a side shoulder to resist heavier cutting strains.

NUTS SHOULD ALWAYS FIT

Copyright, 1921, by W. F. Schaphorst

MANY amateur machinists never think of the fact that a poorly fitting nut should not be used on a bolt, especially if the function of the bolt is important, and if it must resist much of a pull. In fact, poorly-fitting nuts should *never* be used.

The sketch shows that a nut of one thread, say 12 threads per inch, can be placed upon a bolt of ten threads per inch. It depends upon the thickness of the nut. If too thick you can get it on only part of the way. However,



too many amateurs think—"Well, if it will go on part way, why doesn't it go on all of the way?" and then it is forced on with a wrench. In forcing it on the threads on both the nut and bolt are ruined.

In cases of this kind it is evident from the sketch that only one thread can be in contact, and that isn't in contact all the way around because of the varying pitches. And if the nut is so long that another thread comes in contact the second contact will be on the "other" side of the thread so that when the nut is forced on it does nothing more than "oppose its own self" and ruins both nut and bolt.

Nuts should not be used that are "too big" even though they have the same thread and "seem" to fit except that they are very loose. Where nuts fit in that way they are held by the "tips" of the threads only and it doesn't take much of a blow to shear those tips off, as you have perhaps learned through experience.

In a nutshell—use only nuts that FIT.

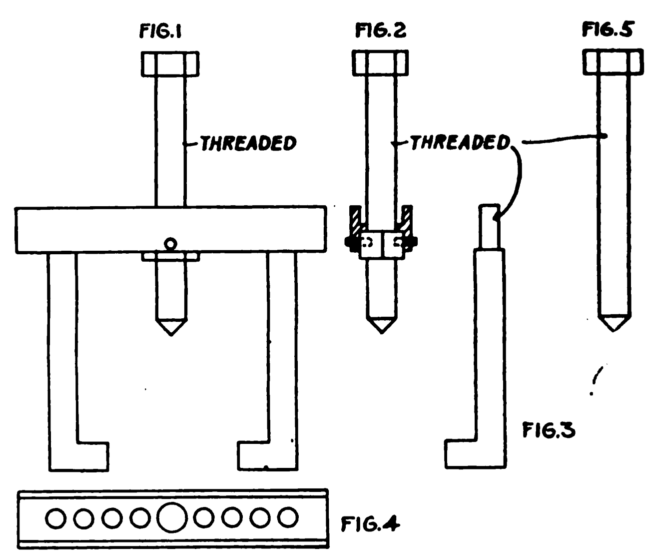
A HOMEMADE WHEEL PULLER

By Edwin Kilburn

ALL repair shops often find need of a wheel puller somewhat lighter than the usual heavy ones in use. I have found a home made one very useful which was built as follows:

First a piece 9 inches long was secured from a damaged front axle of a Ford. Through the web a series of 9/16 inch holes were drilled as shown in Figure 4, the center hole being drilled 13/16 inches. Next a piece of ¾ inch diameter cold rolled steel, 10 inches long, was threaded with the U. S. Standard Thread, pointed at one end, the other turned down to ⅝ inches, threaded, and a nut screwed on and the rod headed over as shown in figure 5.

Then the nut and point were case hardened, after which a nut was fitted to the axle piece as shown in Figure 2 where the screw, nut, and axle piece are shown, the nut being held in place by two machine screws. Two hook pieces were made as shown in Figure 3, being forged out of either ¾ or ⅝ inch stock, depending on whether they are to be used for heavy or light work. If for heavy, the end where the hook is should be upset, the opposite end reduced to ½ inch and threaded as



shown. The hook pieces are secured in the proper holes in the main bar as shown in figure 1, as the work being done demands, and the puller is ready for use.

We have used this puller on quite heavy work and have found it very satisfactory. Furthermore, it is an easy matter to make special hooks for it for unusual work, and at comparatively little expense.

A Dedication to My Flivver

You can talk about your car and all its
splendor,
Of its price which puts all other cars to
shame,
Of the shine upon its nose and its yards of
copper hose,
And the great depth of its special alloy
frame.
But me, I like my dented, time worn Flivver,
With its fenders seamed with cares of
many years,
For its twenty thousand rattles, tell of many
hard fought battles,
And its every squeak is music to my ears.
You can talk about your sixty miles an hour,
And how you take all hills in highest gear,
How she'll throttle down like magic, in the
slowest kind of traffic,
And run up two hundred thousand miles a
year.
But me, my speed is never more than thirty,
And then the flivver rattles like a bone,
She won't run slow in traffic, the engine acts
erratic,
But she always gets me back again to home.

MARKETING YOUR PRODUCTS

(*Continued from page* 10)

you to go into billboard advertising on a country wide scale, but a few small posters, tacked to posts and trees at convenient points, the intersection of roads and at sharp curves.

I am an automobilist and nothing makes me any more angry, in the way of signs than something like this; "Four miles to the J. A. Garage." Gosh, but it galls me to think of the good time and paint wasted in such a selfish effort. It is just as though the garageman had tried his utmost to say something that would help only himself, which would bring customers to him without doing any favors for any one else. Hundreds of times, in a strange territory, I have wished that the signs had only told me the name of the town where I could find that garage. Never put up a poster or a sign which does not give your full name and address.

Personally I've never thought that poster advertising, in the country, was of any use, in fact there are some kinds of poster and sign board advertising that grate so badly on my nerve that I'm rather inclined against the product advertised. This may need a little more explanation, for I don't want any readers to make a mistake about it.

On my last trip from New York to Boston, I drove through a very beautiful part of the country and made no attempt to stay on the regular state roads. In one case I was driving through a particularly fine scenic road when I noticed that nearly every big rock, tree and fence was gaudily painted in red and black or carried a red and black poster. Two or three times I wanted to get a particularly fine view for my camera but couldn't do so because of those gaudy posters. The landscape was ruined, and I understand that the same thing exists in the west where some of the scenery is particularly good, except for the gaudy signboards and posters.

If you feel that you want to put up a poster or a signboard, for goodness' sake be conservative, don't use red, yellow and green paint; don't turn beautiful scenery into eyesores; don't spoil the landscape with hideous signs. I don't know of any better sign than one which gives your name and address with the names of two or three towns and the mileage. Put your name and address at the top, then put the name of one town and the mileage to it, from where the board is to be located, and with an arrow pointing in that direction, at the bottom. On the other, lower corner put the name of the town ahead, its mileage, and an arrow pointing in that direction.

You will find that this kind of sign is welcomed by every stranger, for even if he has a road map he cannot use it unless he knows where he is. I'll never, as long as I live, forget an experience I once had with signboards. I was driving through a strange country road, was as lost as a needle in a haystack. The night was as black as the proverbial pocket and a light rain didn't help my temper a bit.

All at once I noticed a sign post beside the road and my oil headlights gleamed upon it showing it to carry a single line of letters. I tried to get my lights upon it stronger but couldn't, so I hopped out of the machine and waded through the mud to it. I could still see the line of letters on it but couldn't read them. So I climbed up it, spoiling a perfectly good pair of pants. Finally, when I had lighted a box or so of precious matches I managed to make out the words;

Smoke Premier Tobacco

If I could have caught the fellow who first invented Premier tobacco I would have wiped his nose in the mud which had ruined my shoes; I would have knocked his head against the post which had torn my trousers and then I would have passed him a few extra punches for good measure. Gosh! I didn't have matches enough to have lighted a single pipeful of the stuff, supposing I wanted to smoke it anyway.

If the signboard man had only had printed the name of the next town on that sign I would have blessed him—as it was I cursed him, and drove on, fuming at the mouth, soaked to the skin and muddy to my knees. And that's all I dare to say about signboard advertising.

When it comes to newspaper advertising you must use a lot of discretion. Don't throw away your money putting advertisments into a paper that none of your prospective customers read. If there is but one paper in your town, then your problem is solved, but if there are two or three dailies or weeklies, then you must find out which paper is the more generally read by the farmers.

Newspaper advertising is to be treated in much the same way as I have outlined for picture advertising. Make your advertisment different from the others in the paper. Remember that if you can make people think your advertising is clever, they will think that you are clever and your work, therefore, must be good.

Someone has said that advertising is merely a means to keep your name before the public. Don't believe that, for that is only a part of the story. Your name is worth nothing except to yourself and seldom means anything to anyone who does not know you or your work. What you really need to do is to tell the public what your business is, to make them think that you are helping them, that you are their servant.

So instead of merely putting your name and address in the paper, be sure that in every ad, you suggest something to the readers. Tell them that they don't need a new lawnmower every year, that you can save them money by fixing the old one. Tell them that it is your business to fix and make things, and that is advertising.

But remember one thing, you can never keep yourself and your men busy unless you let the public know you are alive. Make business for yourself, suggest things and then you will keep busy.

The Inside Story of Steel

How the Construction of the Steel Is Affected by the Carbon Percentages

By J. F. SPRINGER

A GOOD thing about the explanation that has already been given relative to heating up steel containing 0.20 per cent of carbon consists in the fact that it covers in a general way steels of all percentages of carbon from 0.00 per cent on up to 2.00 per cent. However, there are certain points to deal with.

All steels having less carbon than 0.90 per cent comes strictly under the preceding explanation, except that the pearlite is not always one-fourth of the whole, and the temperature varies which indicates that all the honeycomb has been absorbed. Sometimes, the amount of pearlite will be greater than one-fourth of the whole; sometimes, it will be less. It depends on the carbon percentage. Similarly, the temperature when the austenite has succeeded in absorbing the last bit of the ferrite will vary with the carbon percentage; sometimes it is more; sometimes less.

The percentage of carbon mentioned as 0.90 per cent is a kind of dividing point separating steel into two classes. There is some difference of opinion as to whether it is just 0.90 per cent or something lower. It may be considered 0.85 per cent, or perhaps even 0.80 per cent. It is a matter not yet finally cleared up, it seems. In the meantime, let us stick to the 0.90 per cent.

Now all steels having less carbon than 0.90 per cent will, in the *normal* condition, consist of pearlite grains and a ferrite honeycomb. In a microphotograph, the pearlite will generally be black and the ferrite white. But, the steels which contain more carbon than 0.90 per cent will have a cemenite honeycomb, though the grains will still be pearlite. All these are tool steels, and they are assumed to be in the normal condition.

Now, just as the pearlite grains before underwent a change in respect to the character of the pearlite at the time they were heated up to 1337° F. (=*full cherry red*), so now the same thing occurs and at the same temperature. That is, all tool steels contain, when in the normal condition, pearlite grains surrounded by a cementite honeycomb. When heated up to 1337°, the pearlite changes to austenite.

Before going on to the next point, let us return a moment to our low-carbon steels. We find that while *all* normalized steels below 0.90 per cent carbon have pearlite grains that change to austenite at 1337°, still they vary in respect to the temperature at which the austenite *completes* the job of absorbing the ferrite. As a matter of fact, the more carbon these steels contain, the quicker the absorption takes place. But, more carbon means more cementite, and more cementite means more pearlite. And more pearlite means less ferrite in the honeycomb. In short, if a low carbon steel contains more carbon than another low carbon steel, it will have more pearlite in it. This will mean more austenite, when the temperature is pushed up to 1337°.

Also, the more carbon the less ferrite in the honeycomb. That is to say, the situation is this: The steel will have more austenite to do the absorbing, and less ferrite to absorb. Consequently, it should not surprise us to learn that the more carbon there is in a low carbon steel, the less heating will be required to enable the austenite to eat up the ferrite honeycomb.

Or, put it this way: The less carbon *in* a low carbon steel, the higher will be the temperature required for complete absorption of the honeycomb. The amount of austenite will be less and the honeycomb will be bigger.

If the reader does not quite get all the foregoing, let him at least make sure that he gets the following: Low carbon steels, in a normal condition, when heated up to 1337° F., will have their pearlite changed to austenite. And the austenite will eat up the honeycomb of ferrite as the temperature is increased. It will complete this job at different temperatures, depending upon the carbon percentage. The less carbon, the higher the temperature required.

The importance of these facts is well illustrated in connection with annealing. The complete refinement of low-carbon steel that has not been highly heated and is being reheated to restore the quality will not take place until the austenite has *finished* the job of absorbing the honeycomb. This certainly is a matter of high importance. On the other hand, if the carbon percentage is quite low, it may become undesirable to reheat to the high temperature required, because of unwanted results. In annealing low-carbon steel to get the best results, the workman will have to make a compromise, especially if the carbon percentage is very low. The study of these matters of the austenite absorbing the ferrite becomes thus of great importance.

We have now learned that *all normal steels* whether below or above 0.90 per cent carbon act similarly when the heating-up reaches 1337° F. (*full cherry red.*) The grains of pearlite begin at this point to eat up the honeycomb. The pearlite grains, now changed into austenite, start to absorb the honeycomb. If the steel contains less than 0.90 per cent of carbon, the honeycomb to be absorbed consists of ferrite. If the steel contains more than 0.90 per cent of carbon, the honeycomb consists of cementite. All the same, the grains eat it up from 1337° on up, whether it consists of ferrite or cementite. The reader is urged to make sure of these points.

Note that the pearlite grains change into austenite (really into martensite, a transitional stage of austenite, at the *full cherry red*.

If the steel has 0.90 per cent of carbon, there will be no honeycomb of any kind; so that the only thing that happens is that the pearlite grains change into austenite grains.

Consider now a piece of steel known to have been originally in the normal condition. It has been heated to 1337° or a *full cherry red*. At once the pearlite grains change into austenite grains. All these grains then become austenite material. They are, in fact, in a state of *complete refinement*. But this only applies to the grains. The original grain *size* is just the same as before and the honeycomb will remain unchanged. In order that absolutely complete refinement shall exist in the whole body of the steel, it is necessary that the entire honey-comb be absorbed and thus converted into austenite. These remarks are of great importance in connection with annealing.

Where the carbon percentage is below 0.90 per cent but not below, say, 0.40 per cent, the honey-comb of ferrite is so inconsiderable that the steel has to be heated only a moderate number of degrees above *full cherry red*. But if the carbon percentage is much below 0.40 per cent, the amount of ferrite is such that a very considerable heating beyond *full cherry red* is required. There is so much honey-comb to eat up, that the heat has to be pushed up considerably.

Similarly, where the steel contains more carbon than 0.90 per cent, and consequently the grains of pearlite (changed to austenite) have the business of absorbing the cementite honey-comb, the temperature has to be pushed up high enough to enable the grains to do the job. It so happens, that the eating up of the cementite honey-comb is a greater business than the eating up of the ferrite honey-comb. The result is that the temperature required to finish the job becomes *rapidly* higher and higher as the carbon percentage increases beyond 0.90 per cent. In fact, it is only steels containing *no* more than 0.95 or 1.00 per cent of carbon that require only a moderate increase of heat beyond the *full cherry red*.

It may now be said that between 0.40 and 0.95 per cents of carbon, the steels corresponding may be *completely refined* by heating them a short or at most a moderate distance above *full cherry red*. The steels corresponding to carbon percentages *below* 0.40 and *above* 0.95 resist complete refinement. To get it, we have to use a fairly high heat—to go considerably above *full cherry red* in fact.

There are objections to doing this, as it produces undesirable results in the metal. A compromise has, accordingly, to be carried out for very soft steels and for pretty much all the tool steels.

Annealing

The study of steel carried out by means of the microscope has proved tremendously *practical*. If the reader really wants to keep up with the procession, he will have to learn some of the results at least, and put them into practice. *Annealing* is one of the processes that has been greatly affected by the new information. If the reader thinks it is rough sledding going through the things I am telling him, let him know that I am not telling him all there is; but am picking out, rather, what he really needs to know and what may be used to advantage in the shop.

This applies especially to the places in the articles where I point out how to make the information serviceable, or explain that it is important. When I say that such and such a thing is important, let the reader understand the remark to mean, generally, that it is *important in the shop that has to forge, harden, weld and anneal steel.*

First, what do we mean by annealing? There are several answers to this: I follow Bullens here more or less closely and enumerate the purposes in view in annealing steel:

1. To make the steel soft so that it may be more readily machined on the turning lathe and similar machine tools.

2. To relieve strains inside the metal that have been produced by hardening the steel, or working it under the hammer, or by some other operation, particularly a cold operation.

3. To get the best possible refinement in the grain in connection with high capacity for bending and the like.

Now the reader will do well to note the different purposes for which annealing is done. It will not do to say that annealing is merely annealing and let it go at that. Annealing is often a compromise. Not all the best things can be forgotten. The workman, or somebody, has to make a choice, or else he just stumbles along. We have had a hint in this connection already. When a very soft steel is heated up to a *full cherry red* (= 1337° F.), the refinement brought about *in the grains* by their change from pearlite to austenite is promptly accomplished. But the honey-comb of ferrite needs to be absorbed in order to complete the work. But, the considerable extra temperature necessary to finish the job makes it sometimes undesirable to push the matter through. However, if the smith, or other workman, doesn't care about the different purposes of annealing, he will not be alert to the necessity of choosing when to stop the rise of the heat.

Take one example. Suppose we select a moderately soft steel, one containing 0.40 per cent of carbon. We will assume that it is in a normal condition at the start. This steel, like all others, will undergo a change at 1337° F. (= full cherry red). The pearlite grains will become austenite grains. The heat is carried on up. The austenite will continually absorb ferrite honey-comb. At about 1425°; the job will be finished and all the ferrite will have been absorbed. The heat is carried on up 50° further. At this temperature of 1475°, the heating is stopped and furnace and steel are both allowed to cool down together, the steel being left inside. The resulting steel when cold will be in just about the softest and most capable condition for enduring bending that it is possible to get.

In general, annealing should never be carried much beyond the point at which the absorption of the ferrite honey-comb is completed. The reason for not going on further is that the grain size becomes larger, and this means loss of strength. In fact, the tensile strength falls off for all temperatures to which the steel can be heated above the critical point of *full cherry red*. That is, the strength is lessened and generally a good deal lessened by heating to a point beyond this *full cherry red* and then cooling the steel even in the furnace.

So then if we want softness and complete refinement, we get them at the expense of strength. If, however, we disregard such losses as that of the tensile strength, and heat the steel on up to a point about 50° higher than that at which the ferrite network is completely absorbed, we shall obtain the utmost fineness of grain. Further, we should also get the removal of all stresses and strains inside the metal. The steel should also be quite adapted to bending and the like.

In short, we have gotten full annealing and satisfied all the purposes enumerated under (1), (2) and (3). However, we have sacrificed strength, etc. A compromise might obviate some of the loss of strength, etc., and sacrifice somewhat in respect to the refinement of the grain size.

HORSE RIGS COME BACK AFTER FIFTY SUMMERS

(*Continued from page* 11)

the world would go back to the horse-drawn vehicle. He recognizes the motor car as desirable for pleasure and profit, but he wishes in his heart of hearts that there were fewer than 11,000,000 of them in the United States. And he doesn't hesitate to predict that there will be fewer and fewer when the public comes to realize, in the burning words of a carriage accessories trade paper editor, that we are "motoring to our doom." The editorial continued:

"To some of us this is a gay life. It is a heyday time, and the less regard we have for the rights of others and the more joy we get out of it the better do we like it. So we rush madly along—at least many who motor—caring little of what the present and future has in store for us. If we motor to our doom, why worry, life is made up of thrills and the more frequent these come and the greater the excitement the better do we enjoy sensation.

"For others who may happen to get in our pathway we have small consideration. If they are so unfortunate as to become the victims, albeit unwilling, of our making, well, the fault is theirs, and by no means can the blame be placed upon our shoulders. If the road is not wide enough for two of us, well, let the other fellow beware. We must not be interrupted in our mad career. Life offers so many delights to the man who has an eye for the fast and furious. If he is injured, or perhaps killed, or it may be we are made the victims of our whirlwind escapade, it matters little, the toll must be taken and the race was worth the price.

"Yes, many of those who are gayly motoring today are simply speeding toward their doom. They are mad with an intoxication of cyclonic fever, and come what may, they are willing to take the chances that are lying on every side, ready to engulf them. The figure of the grim monster ever and anon keeping the pace just ahead of the steering wheel is not seen by them. If it were, would they not laugh to scorn the thought that he would gain the mastery?"

"Shall this condition continue to obtain? Must we permit the mad orgy to be prolonged, endangering the lives of innocent beings, simply because we have lost all sense of honor, of right and of fair play for the other man? Are there not means within the reach of our courts to stay this continued slaughter, or must it ever be a menace to the well being of many who, as yet, are not so imbued with this form of insanity? Can we sit by and trust to our own good fortune in not being made the victims of this deplorable state of things? Let us stay the hand that would throttle the lives of innocent men, women and children, by making it at least reasonably safe for others to live without a continual fear of being thus slaughtered.

Unlike Autos, Dobbin Was Safe and Sane

"Of course we must advance. You would not want to see the hands of time turned backward and to say that progress is a meaningless thing. But at the same time we must come to place a higher value on the lives of our fellowmen. This is one of the evils of motordom. This is one of the costs of modern civilization, it would seem. Have we grown so lax in our sense of fair play that these things can continue without redress? This is the price that the public is paying for its mad race in the motor car. Yes, the automobile is a valuable asset to humanity. It has a place that is being filled with credit to the inventors, and this is well and good. But it should be made to remain within bounds if we are to even hope for a continued peace of mind in the future.

"No, such indictment was ever made about the horse and his vehicle. No, it was the exception that an accident was traceable directly to the old buggy with Dobbin in the shafts. There was less of a desire to race madly over the streets and highways, with a never-ending mania for still greater speed. He, the family favorite, was content to act with more decorum, and the driver was not given to the idea that life was nothing without its speed delights. And still we have advanced, and today we are advancing more, if we are to believe all that we read and see. But, honestly, can this be called a sane advance when life is held so cheaply?"

The answer, it goes without saying, is that it can't.

Index to Advertisers

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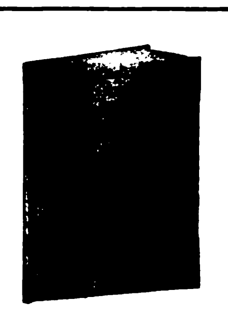

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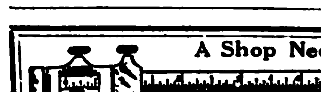

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Vol. LXXXVI. No. 5 | NOVEMBER, 1922 | TERMS ONE DOLLAR A YEAR

Carriage Builders' National Association Holds Fiftieth Annual Meeting

Golden Anniversary Meeting Elects Mr. E. E. Hughes President—Interesting Exhibit and Annual Banquet Features of 1922 Gathering

THE Hotel McAlpin, New York City, was the scene of the fiftieth annual gathering of the members of the oldest trade organization in the United States. The first meeting of the association was held in this city fifty years ago, in the St. Nicholas Hotel, on November 19, 1872.

President P. E. Ebrenz called the convention to order at ten o'clock on Tuesday morning. Following the President's address, the committee for the nomination of new officers was appointed and following the reports of other officers this committee went into session to prepare the nominations for the Thursday meeting. A feature of the Tuesday morning session was an address on the Tariff Regulations, delivered by Mr. A. R. Pearson, of the U. S. Chamber of Commerce. Mr. Pearson's address was of particular interest to many of the members present and served to present to all listeners an enlightening viewpoint of the subject. The second day of the convention was devoted to the *exhibitors* and much of the time of the delegates was spent in an inspection of the various exhibits on the 24th floor of the hotel McAlpin. The meeting on Thursday was devoted to Committee Reports, election of officers and new or unfinished business. The new President elected is Mr. E. E. Hughes, Lynchburg, Va.

The selection of a meeting place for the 1923 Convention was left to the Executive Committee, which will hold a meeting sometime during November to decide this and other matters, among which is the matter of continuing the Annual Exhibits of manufacturers. The closing event of the Convention was the annual banquet, which was marked by a large and enthusiastic attendance, on Thursday evening.

Brief Historical Facts

This aged, but vigorous organization first met Tuesday, Nov. 19, 1872, in the St. Nicholas Hotel in New York City. The meeting was called to order by John W. Britton of Brewster & Co., and Clement (Clem) Studebaker of South Bend, was installed as temporary chairman. Mr. Britton became treasurer, and Charles Richter secretary, both temporary officers.

A committee composed of W. D. Rogers, I. V. Lloyd and Benjamin Bruce was the nominators of the following elected officers:

President, Hon. Charles P. Kimball, Maine.

Vice-presidents, Geo. A. Ainslee, Richmond; John Curtis, Cincinnati; John Green, Wilmington, Del.; Henry Killam, New Haven; R. M. Stivers, New York; James Cunningham, Rochester; Wesley Fallon, St. Louis; F. D. Parry, Amesbury.

Treasurer, John W. Britton.

Secretary, Charles J. Richter.

These names and the circumstances are sketched because they mark the historical beginnings of the society and the character and positions of the men who were glad to come together to form an association that was almost sure of continued success because of the fundamental position taken. (Quoted from the *Call*, "To prevent any misunderstanding as to the object of this proposed convention, its originators desire to state expressly that it is not proposed to agitate, or even to touch upon, the question of labor and its reward.")

An interesting fact is that these leaders in the trade remained steadfast to the association aims and gave whole-heartedly of their interest to its success until their business activities came to an end. This is rather an unusual circumstance in an organization.

The *Call* set forth that "it is desirable for the carriage builders of the United States to meet together in general convention this fall, that we may become better acquainted with one another and form a more perfect union of sentiment and action."

Forty-three firms signed the *Call*, and it is very interesting to read the names now and murmur, how time changes things, or its Latin phrase equivalent if you prefer. Here is the list: Abbott, Downing & Co., Geo. A. Ainslie, Joseph Beckhaus, Wm. Bowers & Sons, Brewster & Co. of Broome Street, Geo. L. Brownell, Came Bros., Coan & Ten Broeke Carriage Mfg. Co., Geo. B. Coleflesh, Cooling & Lloyd, Peter Crocker & Son, John Curtis, Chas. F. Dibble, Geo. C. Eliott, Wesley Fallon, Jno. L. Freeman, Gardner & Fleming, Gregg & Bowe, Harvey, Morgan & Co., Hume & Morrill, R. H. Graham, Hugh Johnson, A. J. Joyce & Co., Chas. P. Kimball, Loos & Williams, J. B. McCrillis & Son, McDermott Bros., McLear & Kendall, Geo. C. Miller & Sons, Miner & Stevens, F. D. Parry, T. B. Patten, J. M. Quinby & Co., W. D. Rogers & Co., A. W. Sanborn & Co., O. H. Sargent, Sargent & Nelson, Shaw & Lippincott Mfg. Co., Studebaker Bros. Mfg. Co., R. M. Stivers, A. A. Wheeler, Frederick R. Wood, John M. Young, Jr. An outstanding fact is that the signatories were the men of light and leading in the trade. Real carriage builders whose busness was an art as well as a vocation, no mere "buggy builders" were thought to be within the pale Real carriage builders whose business was an builder" wrote "wholesale" in front of the phrase he was not highly regarded except as a mere man, certainly not having a look-in at the "art" of carriage building. It was the aristocracy of the business. This prestige it was that gave the association a momentum that has carried it far.

To this day the "art" of the carriage trade has carried on and become the mind force that has made its impress on the design and construction of that part of the automobile that is not a mechanical job.

The St. Nicholas Hotel in New York City, a very important hotel of the time, was the first meeting place, and there were more than a hundred who answered to the call of the forty.

This first meeting shaped the policy of the association. Such men as Mr. Britton and Mr. Kimball were very acute as political managers as well as business leaders, so the organization avoided all stumbling blocks that so often wreck the inception of the best conceived enterprises.

The result of the permanent organization for the first year was the installation of Hon. C. P. Kimball, president; John W. Britton, treasurer; Wilder H. Pray, secretary.

Here were the subjects of discussion at that history-making first meeting.

How Can We Induce Greater Uniformity of "Tracks."

By What Means Can the Present System of Guaranteeing Work Be Improved.

How Can We Mutually Protect Each Other Against Imposition.

The last touched on a tender subject that included false claims, bonuses (tips) to coachmen to keep the job in condition, instead of "queering" it to get the "missus" to buy where the commission to coachmen was more luscious.

The constitution was adopted. Mr. Kimball was continued as president; Mr. Pray remained secretary.

The third annual meeting was in the same city and hotel, Oct. 21, 1874.

At this meeting ex-Gov. Hawley of Connecticut, ex-Gov. Bigler of Pennsylvania and A. T. Goshorn, director-general of the approaching "Centennial," appeared and urged the builders to make an exhibit.

The executive committee report had this to say, "The membership has but slightly increased, owing chiefly, it is believed, to the embarrassment of the business of the country."

The fourth annual meeting was held in the Judges' Hall, Centennial Exposition Grounds. When the vote for president was counted (Henry Killam, New Haven, was chosen), the new president received fourteen out of the fifteen votes cast. Things looked blue.

The fifth meeting was in New Haven, Oct. 17, 1877, in the New Haven House, President Killam presiding.

Means were taken to give a new impetus to association matters. The constitution, etc., was doctored. The "initiation" was consolidated with the first year's dues. Again, "honorary members may be elected from any trade or profession upon the payment of initiation fee of $10, and they shall be admitted to all annual meetings, but shall not participate in the proceedings, nor be subject to any assessments or dues."

This let in the "accessory" or associate member, almost entirely recruited from the supply trades, and it became the main financial stay of the organization. By vote, July 19, 1876, honorary members may have all privileges except vote, including annual dinner, by payment of regular annual dues. The dues were, at the time, $5.

The executive committee was reduced to five members, president and secretary, ex officio.

The sixth gathering was in Boston, Oct. 16-18, 1879. The momentum was too much, by this time, for a one-day session. The attendance had mounted to 140. The meeting was lively. This meeting was noteworthy for the unexpected showing of banquet speakers developed from the mass of members. Some of them achieved great subsequent reputation in this difficult art. These names may mean something to readers: Kimball, Killam, Britton, Hale, Jones, Lewis, Scott, Sparks.

Mr. Britton was developed from the most fright-stampeded man before a public audience to a man of distinguished skill as a speaker. Captain John Scott was as good as Mark Twain. Phineas Jones was a convulsive revelation. They achieved stellar reputation at one bound and were equal to making good forever after. There were crankshaft welding. The carbon of the acetylene is carried into the melting weld causing it to be hard and brittle, often spongy or porous in places. This sort of weld will not machine up clean and will break easily when put back in service.

We see therefore that the neutral flame is the only safe one for crankshafts. Even then it must be manipulated deftly, with ever-changing pace to meet the requirements of the melting metal. If the weld seems to melt and flutter about too much the flame is drawn back a trifle, or advanced if the melting requires. This is probably the secret of good welding; watch the flame, filler, and weld, to see that they work in harmony. The weld should not be crowded nor should it be allowed to lag. Feed the filler into the weld when the weld is ready for it; have the filler ready to be supplied when the weld is ready to receive it.

Location of the Fracture

Now another factor of crankshaft welding should not be overlooked. It is that of the location of the fracture. Sometimes the break occurs in the round part of the shaft at its end. Sometimes it occurs in a journal near the shoulder, and sometimes it is located in the squared part. Each of these requires about the same treatment as described above in regard to flame and filler. In the preparation for welding and in the manner of adding the filler metal there is a difference, however. But in all cases the weld should reach the heart of the shaft.

Some welders prefer to melt out enough metal to reach the center while others prefer to cut away the metal previous to welding with a hack saw or grind it off on an emery wheel. Or the metal may be removed with the oxy-acetylene cutting attachment. The work should be separate from the welding, whichever method is employed. That is, the broken parts of the shaft should be chamfered previous to applying the welding flame for best results. The recommended procedure is to cut both sides of the break to form a wide V groove when the parts are fitted together. This should be done on two sides of the shaft so as to form a groove on each side which will meet in the center of the break, thus enabling the operator to weld to the heart from both sides.

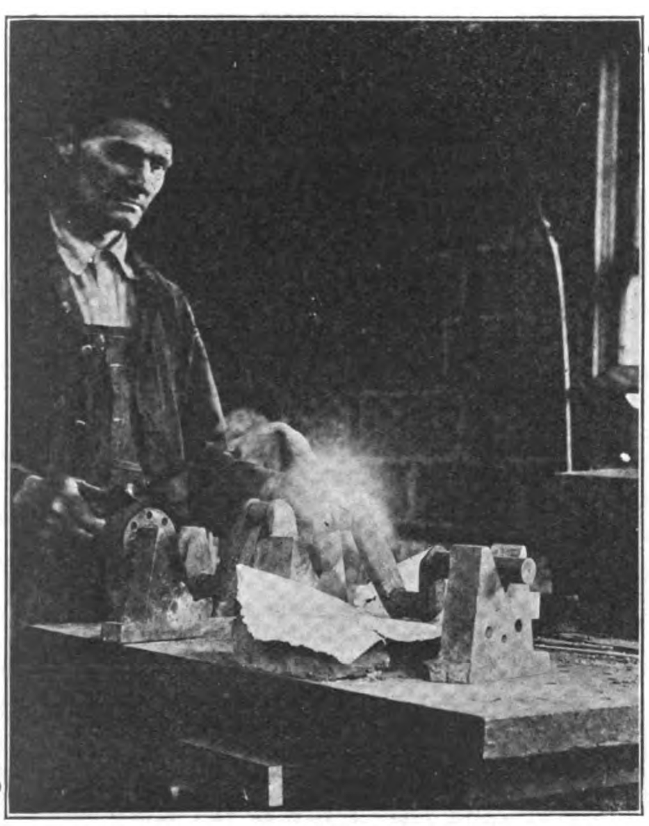

Fig. 2. The V-Block and Reflector Device Employed in Crankshaft Welding.

Aligning of the crankshaft is also an important factor, for no matter how carefully this is done there is always a certain amount of lathe work to be done. The contraction of the welds will pull the cranks out of line more or less, no matter how the welding is done, unless one considers a few exceptional instances, so, as a general rule, the shaft must be trued in a lathe. This is no drawback since the weld must be machined and polished anyhow, unless the weld has been made in a square part of the crank. The shaft could no doubt be worked down and polished by hand but it would be a slow tedious process, so the welder had best prepare in the start to have the lathe work done. He can do this the best by being very careful about aligning the shaft before welding, and trying to keep it thus during the welding.

Now, to make the foregoing instructions more easily understood, and to furnish more detailed information about crankshaft welding, let us take an example and follow it through the welding process a step at a time, from preparing the job to the finished weld.

Fig. 3. Indicating the Surplus Metal Added to the Finished Weld.

This treatment may be applied to all styles of automobile crankshafts in its fundamental principles, although the individual welder may make several minor changes in methods as are best suited to his shop conditions.

Preparing to Weld

First: The broken edges of the crank are ground wedge shape, the metal being all cut away but a narrow strip in the center of the shaft; this remains to assist in aligning the cranks. The cuts slope back from this narrow line to the outside diameter of the shaft. Each cut extends back on the shaft a distance about equal to half the diameter, and each meet in the center of the shaft to form a blunt wedge, as shown in Figure 1 of the accompanying photographs. Both parts of the fracture are beveled the same to form the wide V-groove on both sides of the shaft. This double groove helps to keep the shaft straight since the contraction is equalized or balanced on two sides of the break.

The next step consisted of placing the broken parts end to end on a leveling plate to secure the alignment and spot weld them together. A closely approximate alignment was secured with the aid of calipers and T-square in connection with welding. The spot welding or tacking, as it is often called, was accomplished by applying the welding flame to several small portions of the bottom of one groove, melting them together with an added bit of filler rod. These spot welds held the broken parts firmly in line until the main weld started.

When the spot welds had cooled enough to bear the weight of the shaft it was placed in a set of V-blocks so arranged that the shaft could be revolved at will and still not turn of its own weight. This device, which is shown in Figure 2, permitted the welder to turn the grooves upward one after the other at will. He could weld a layer in one groove, then revolve the shaft and weld a layer in the other. After which it could again be revolved to bring the first layer upward. Thus the shaft could be completely welded without danger of bending.

The white cone of the welding flame was applied to one end of the groove bottom, swinging in decreasing circles until a spot was melted. To this spot was added the melting filler rod, which had in the meantime been brought in contact with the welding flame. The melting filler was added to the melting weld as the flame worked along the groove bottom, care being taken to see that the sloping sides of the groove, as well as the bottom, were in a melting condition when the filler metal was added.

The bottom was filled with about half an inch of metal the full length of it; the flame and filler being kept in motion continually. As soon as the end of the groove was attained the flame and filler were worked back over the first layer to add another layer on top of it. This layer was wider but not so thick, extending from one end of the groove to the other, and was carefully fused to the lower layer.

The second layer filled the groove about one-third full at which time the operator revolved the shaft in the V-blocks to bring the other groove upward. This groove was welded about one-third full after the manner described for the first groove. Then the shaft was again revolved to bring the first weld upward. Another layer was added to this, being wider one way and narrower the other, gradually drawing it to conform to the rounding shape of the shaft. Then the other weld was turned upward and filled. Thus both grooves were filled a layer at a time until the welds were completed.

A surplus of metal was added to the top of both welds to furnish stock for machining the shaft. This is indicated in Figure 3. This stock metal also tended to make a cleaner weld since the impurities usually rise toward the surface of melted metals where they can be cut off in the lathe. After this surplus was added the shaft was allowed to remain in the V-blocks until cool enough so that there was no danger of sagging or warping. Then it was taken to the machine shop for aligning and dressing.

By referring again to Figure 2, it will be seen that a piece of asbestos paper is arranged beneath that part of the shaft being welded. This paper is for the purpose of conserving the welding heat by acting as a reflector to throw back to the weld the radiated heat of it. It is also a protection to the leveling plate upon which the arrangement rests; had the crankshaft been a heavy one the welder would have employed a pre-heater in conjunction witth the reflector, thus cutting down the welding time.

No Flux Required

No flux was needed on this, nor is needed on any crankshaft job. However, the weld was cleaned of oxide or dross by a flirting motion of the welding flame and by flicking the recalcitrant bits with the filler rod. The melting point of steel oxide is lower than the metal so that it melts and floats to the surface of the weld quite readily, which makes it comparatively easy to free the weld of its bad effects, while the melting point of other oxides is higher than the metals, causing them to require flux when welding. In connection with the production of clean crankshaft welds the operator will have better success if he melts with a "soaking" heat rather than to melt with a fierce closely applied flame. The soaking heat causes the weld to be melted deeper without danger of oxidizing. It is usually accomplished by holding the flame a little farther from the melting surface and moving it in slower circles over the weld. This affords an opportunity for bits of oxide that may be trapped in the weld to melt and come to the surface, or near enough to it that they may be removed when machining the shaft.

Reverting once more to this particular shaft: when working on the last layers of the weld the surface stock metal was given a sort of "hot finishing" by blowing the melted metal smooth with the pressure of the torch.

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The New Work

A FEW days ago we were talking to a blacksmith whose shop is located in the busy manufacturing section of a large nearby city. We were rather surprised, on entering the shop, to find therein some nine or ten horses awaiting their turn. The reason for our surprise is the fact that we knew a large proportion of the industries located thereabouts were doing all, nearly all, of their trucking by automobile. This particular blacksmith does no automobile repair work whatever, and he told us that he was kept busy by the horse owners of his neighborhood. Further talk developed the information that all of these horses were used in vicinity for short, heavy hauling, the kind of work that does not pay so well when done with the motor truck. There are probably many good sized cities where exactly similar conditions exist. Now, these facts may be of no importance or value to many of our readers, but they are nevertheless significant in the face of various reports concerning the decline in the use of horses for business purposes. Much has been written, and much has been said, about the future of the blacksmith trade, and elsewhere in this issue of our magazine will be found an article telling of the reduced number of manufacturers of horse-shoes, the fewer people engaged in that work. It is useless to deny these facts, but it is also useless to permit them to affect us to the extent that we become afraid of our very means of existence or livelihood. Today, as has ever been the case, the blacksmith occupies a peculiar position in the everyday life of the community of which he is a part. Whenever a man is confronted with a difficult piece of work in metal-welding, or forging, you are likely to hear him say: "Guess I'd better take that around to the blacksmith." There's a perfectly sound reason for this. The blacksmith is quite generally recognized as an authority on the handling of metals. It's his business. Of course there are a great many who have not kept pace with the development in the steel and iron trades, who have not an accurate knowledge of the most modern and satisfactory manner of treating and handling a variety of the latest products of the great steel industry, but take it all round, there usually isn't a man better qualified to do the work, located in the smaller towns and country sections.

On the other hand, there are many blacksmiths who have endeavored to step along with progress and modern development; who have made a point of studying the design and construction of the automobile, and its repair. The advent of mechanical farm apparatus has also been carefully noted, and these men have in many instances worked up an excellent trade along this line. We confidently believe that our blacksmith friends fully realize the possibilities for good business resulting from the adoption of automotive methods, both on the farm and in the cities and towns. We do not believe that they are trying to maintain an attitude antagonistic to these developments. There will always be horses to be shod, and wagons needing repair, but it will be admitted by all of us, we feel sure, that the automobile has not only come to stay, but that it has opened up a new field of work that the blacksmith, along with many others, will find, offers him a profitable line of business, without any appreciable expense outlay.

Strictly Editorial

THIS number of your magazine is the first to be prepared by the new editor. With the comparatively short time at his disposal, he has endeavored to make up as interesting an issue as possible. If you are pleased with it, or if there are things you don't like about it, we ask you to take your pen in hand and write us, telling us just exactly what you think about it.

It has been suggested to the editor that he establish a correspondence department, a department that shall be open to our readers for the expression of opinion on any subject of genuine interest to his fellow smiths. What do you thing about this idea? Do you consider it a good one?

Your editor is not one of those who harbors a fear that the days of the blacksmith are numbered. He knows some of the circumstances with which you are confronted and he has a mind to be of service to you in getting over some of the rough road that you may find it necessary to travel, in holding or increasing your regular trade. He would urge you to write him whenever you can find time to do so, and to send along any suggestions you may have to offer that will help to make your magazine more interesting and useful to all of our readers. He is confident that the blacksmith has before him a broad field for service to his community and feels that with your help this magazine can be a real aid to all of its readers.

America's Immigration Problem

The immigration policy of the United States, now in the making, may contain vital social and economic consequences for the future, the National Bank of Commerce in New York believes.

"The foundations of this republic were laid by northwestern Europeans," the bank says in its magazine, *Commerce Monthly,* for November. "They have constituted the preponderance of our immigration taken as a whole and, up to the last part of the nineteenth century, the major portion of the yearly influx. In 1870 of the total population, 14.4 per cent. were foreign born. The majority of these were northwestern Europeans, who composed 12.5 per cent. of the total population. Southern and eastern Europeans were unimportant in numbers. This relationship has not persisted with the passing decades. In 1910 the per cent. of our total population which was foreign born was about the same as in 1870, but northwestern Europeans constituted only half of the foreign born. If for a few more decades the sources of immigration should remain the same as in the pre-war years, this rapid change in the proportion would continue.

"In some of the older communities it has been found that after two or three generations in America a stock does little more than reproduce itself. Among the foreign born, birth rates are much higher. If this divergence should persist, the texture of our population could be changed in a few generations. America now maintains the highest standard of living of any great country. Accompanying and as a part of a high standard of living is a low birth rate and a low death rate. The countries from which a large part of present immigration comes have high birth rates and high death rates. It is in those countries in which income levels are the lowest that the greatest pressure for immigration exists.

"Important though it looms in the history of the past, immigration is even more important as a vital problem of the future. In the post-armistice period millions of Europeans were making their plans to emmigrate to America. The war-interrupted tide of immigration began to flow again with prewar vigor, threatening indeed an unprecedented volume. But the country was demanding that immigrants be restricted as to number, so the 3 per cent. limitation law was passed erecting a temporary barrier. However, the national immigration policy is still in the making. Its present expression in legislation is the work of many decades. During this time important changes have taken place in the character of immigration itself; tremendous increases have occurred in population. In the past sixty years density has increased three-fold, from 10.6 to 35.5 per square mile. Free hands are now a thing of the past, and more and more must cultivation be on an intensive basis.

"Because of the vast natural resources at hand for exploitation, increasing well-being long accompanied the rapid growth in population. Currently accepted figures for per capita income and wealth in terms of purchasing power show a startling growth since the middle of the last century. The increase was more rapid in the first decades of the half century. There is a noticeable showdown of late. Of course, sufficient time has not elapsed to justify a conclusion that a definite corner has been turned; that the rates of increase will become progressively smaller with the passing of the next few decades; that at some not distant date, if the population continues to increase as in the past, diminishing per capita income and wealth will be the rule."

Discussing the 5 per cent. law, whose quantitative restrictions on immigration have now been extended for two years to come, the bank says:

"The total yearly quota of 350,000 is about a third the size of the maximum yearly inflow of prewar years from the countries affected. Moreover, owing to the fact that northwest Europe will probably not exhaust its quota the total yearly influx will no doubt be measurably below the allowable figure. Peoples actually gaining admittance from some parts of the world will be small in proportion to the number desiring to come.

"Those who stand for restriction of immigration have always to contend with two points of view which have considerable support. There are those who oppose restriction on idealistic grounds. The United

States, they say, has always sheltered the unfortunate of other lands; population should be allowed to find its level without artificial interference. Then there are those who oppose restriction on economic grounds. The United States, they say, can only prosper with a cheap labor supply; when labor becomes Americanized, it loses its cheapness; the immigrant must supply the demand for cheap labor.

"Because of these various attitudes of mind, sober public reflection concerning a national immigration policy is essential; thoughtful leadership is indispensable. The immigration problem is plainly only a facet of the broader problem of population, and about population as a keystone is constructed the arch of civilization. The total contribution of the United States to civilization and its ultimate significance in history may be much influenced by the outcome of the national immigration policy now in the making."

Draft Horses Still in Demand

(Concluded from page 9)

the size of the State of Iowa, and only Percherons born within its boundaries are eligible to registry in the Percheron Studbook of France. Percheron foals, to be accepted for registry in the French book, must be registered during the year of their birth. The introduction of Percheron horses into the United States dates back many years. One of the early stallions brought to this country which exerted considerable influence on our draft stock was Louis Napoleon, imported in 1851 by an Ohio firm. Other Percherons were imported about this time and during succeeding years.

Percheron Characteristics

"The Percheron is not so large a horse as either the Belgian or the Shire, but as a class will probably outweigh the Clydesdale slightly. Good mature stallions in fair condition will usually weigh from 1,800 to 2,000 pounds, and there are many which weigh considerably over 2,000 pounds.

* * * *

"The Clydesdale originated and has been developed in Scotland and is practically the only draft horse found in that country. The breed is of mixed origin, and the early history is more or less obscure. It is probable that the blood of both Flemish and English horses entered quite largely into the breed during its early history.

"The Shire originated and was developed in England, and today is bred in all sections of that country. The real origin of this breed is more or less speculative. It is known that this type of draft horse existed in England in early times. It is probable that the early Shire was of very mixed breeding, but at the present time the Shire is bred very pure.

"The native home of the Suffolk breed is Suffolk County, in Eastern England, and the production of the breed in that country is confined almost entirely to that and adjoining countries. The Suffolk has not been bred for the heavy draft work of the city, but largely for the farm, and for this purpose it ranks high among the farmers of Eastern England, who consider it capable of doing a large amount of labor on a small amount of feed, and for longer periods than other drafters. The breed is used more exclusively for farm work than any other of our draft breeds."

More Horses—Less Shoes

NOTWITHSTANDING the fact that there are now more horses in the country than for some time past, evidently a good many of them are destined to go without shoes. According to Census Bureau figures, the number of horseshoe manufacturing establishments has declined from twenty to twelve, during 1919-1921 and the number of persons engaged in the plants from 919 to 306, while the value of the products turned out fell from over three million dollars to less than two million.

Varnishing

(Concluded from page 8)

knife into the smudge tins. Raw oil is not favoured by finishers for two reasons: It is hard to get it out of the brush, and the sediment of raw oil (the precipitates) show as grit on the job.

Raw oil is seldom washed out of the varnish brush thoroughly.

Varnish brushes kept in raw oil in busy shops have to be thoroughly cleansed of raw oil almost daily and time wasted. If they are suspended in varnish they are ready for varnish. If you put some samples of raw oil side by side in clear glass bottles, you will see greasy-looking white "foots" soon settle. This must affect the cleanliness of the brushes. Again, some raw linseed oil has been known to be adulterated with cotton seed oil, rape seed oil, and even fish oils. Keep brushes in slow varnish, and when you have finished your job, fill your brush half-full of the varnish you are using before lowering it into the varnish brush keeper. And above all keep the hair of the brushes several inches clear of the bottom when hanging in the tin. *From Coach & Motor Builder, Melbourne Australia.*

The Critical Point in Business Recovery

Business is better, and there is a growing undertone of confidence which approaches optimism. There have been considerable increases in the rates of production in most lines of manufacture. Today some industries are handicapped by the shortage of cars, and others, notably the automobile manufacturers and makers of tires and automobile accessories, are experiencing the usual seasonal slackening of demand. Considering the country as a whole, retail and wholesale trade probably are better than a year ago, but of course conditions vary a good deal in the different localities.

Thus far, business expansion has been on sound lines. Manufacturers and merchants have placed orders cautiously and only after the most careful consideration of probable future demands. The critical stage of the recovery from the depression of 1920-21 has now been reached, however, and some tendencies of a disturbing character are beginning to appear, among which are the rapid upward movement of prices and wages. During the ten years from 1903 to 1913, comparative peace prevailed throughout the world, and while temporary depressions were experienced, it is probable that the general level of comfort was higher than at any preceding period. During those ten years the rise in the general price level of the United States as measured by the wholesale price index of the United States Bureau of Labor Statistics was 18 per cent. Despite the general prosperity, and the fact that price increases were fairly uniform for the main groups of commodities, this rise in prices was regarded as so disturbing as to give rise to numerous investigations of the high cost of living and its resultant unrest.

The same wholesale price index shows an increase of 12 per cent in the eight months from January, 1922, to August, 1922. Wages are also rising. As individual employers and groups of industries bid against each other, wage increases are certain to be felt in stimulated retail and wholesale trade. There is danger that as a result of this and some other factors, the prices of consumers' goods will rise so rapidly as to present a mirage of approaching prosperity.

The hysterical pseudo-prosperity of 1919-1920 ran a long course because it was part of a world-wide movement. It is useless to harbor illusions about any similar movement which might develop now as a result of the present psychology of rising prices and wages. World-wide conditions are not favorable to any such development. The present upward movement of prices and wages in the United States is not and cannot be uniform, for the fundamental reason that prices of all those commodities and classes of goods, the surplus of which must be sold on the international markets, are determined by conditions in these markets. It is obvious that the farmer's purchases of implements, fertilizer, automobiles, dry goods and all classes of commodities are necessarily limited when the wages of a city laborer for one six-day week at $5 per day are equivalent to the gross selling price of two good hogs or twenty-five bushels of wheat.

It is now to be demonstrated as to whether the combined judgment of the business community of the United States is wise enough and farseeing enough to prevent developments which could only too easily nullify all the progress thus far made toward real prosperity.

Selling the Old Horse

J. EDW. TUFFT in *Farm Journal*

IF you don't mind, friends, I'll put in a word for the old horse—that old bay fellow, you know, with the enlarged knees. He has worked for you some twelve years, I understand, and has been satisfied with his board and room and a set of new shoes now and then.

During those twelve years, if I am rightly informed, nineteen hired men have kicked, got balky, and lain down on the job, but the old bay has never done any of those things. I am told that in the same length of time three hired girls have run away, but the good horse has never done that either. It is also said that you yourself have been away two winters, two months each time, but the faithful nag has stuck to the farm and kept things running until your return.

He is eighteen now, or is it nineteen? At any rate he is about as old in horse language as you will be at seventy in man language. He is still doing his best, but of course his best is not good, and, if I'm alive at the time, I'll say the same thing about you when you are seventy. What are you going to do with him?

I know what you are *thinking of doing* with him. You are thinking of selling him for $15, or $17.50 if you can get it, to the old garbage man in town. He could do the garbage man's work all right, you say, it would not be hard on him, you need the money for school taxes, and then—well, the barn is crowded, badly crowded. That's what you are thinking. Confess.

Say, friend, think again—and while you are thinking, look me in the eye. You know mighty well that old garbage man is so stingy he wouldn't stutter on account of the waste of breath, and will not feed himself enough, let alone a horse; you know he cusses like a pirate when he is mad, and he he is always mad; you know he never used a blanket on the last horse he had, and the beast died early in the spring from exposure and malnutrition. That's why he wants another horse now.

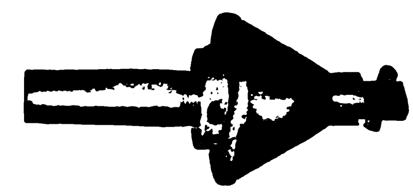
What's that? The garbage man is not s bad as painted? Well, granting that he i not; granting for the moment that he is near-angel with stub wings sticking ou through the holes in his sweater, don't forg that your farm is the old horse's home, an that he loves his home just as much as yo do, if not more. He grew to horsehood he and knows every corner and fence-post. you sell him to any one you will break hi heart. He depends on you, he has every con fidence in you. He has given you twel long years of his active life, and if he ha kept books he could prove you owe hi $2,400 at least. Don't break his heart.

Personally, I don't think your barn crowded. Why not slip those colts into th box stall and tie these two mares over in th double stall? Make room for the old fello inside when the weather is bad, and give hi the range of the pasture when the weather fine. In the two or three years that he h left to live you can pay him back a little that $2,400.

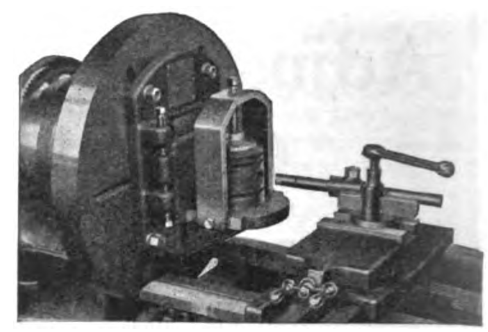
Make room for the old horse, friend. Whe you are his age—seventy in your case—t boys and girls will make a corner for yo and try to pay you back for the years th you labored for them without pay.

Extension Gap Lathe and Attachments

For many years we have carried in our advertising columns interesting announcements of their line of lathes from the Barnes Drill Co. of Rockland Ill., who makes a specialty of manufacturing extension gap lathes for garage and auto repair shops. This enterprising company has

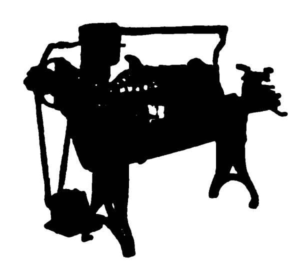


recently added several new and handy attachments, two of which are illustrated herewith. The piston vise attachment holes and centers, for reboring pin holes, all sizes of pistons up to 5 inches diameter.



This attachment not only fits the Barnes lathes, but can be used in full plate of any lathe.

The piston cone center and driver is universal for all styles and sizes of pistons up to 5 inches diameter. It has a



No. 5 Morse taper shank. Other tapers furnished at extra charge.

The attachments described above will appeal to any auto mechanic. Write for prices direct to the manufacturers and mention this magazine.

The Red Star Timer

The reason Red Star Timers are so well known to Ford owners and dealers is that they were the first timers to be nationally advertised. Their wide spread popularity has continued to increase, year after year, because they keep the Ford motor hitting on all four for thousands of miles.

According to the makers, Advance Automobile Accessories Corpn., 1721 Prairie Ave., Chicago, Red Stars are the finest timers produced, and made in the world's most accurate timer factory. Because it is recognized that the timer is the hardest working part of the Ford engine, special attention has been given to the development of roller and race—the two timer parts subjected to greatest wear and tear.

The roller is 100 point carbon tool steel, as accurately tempered as a fine tool. High carbon tool steel is used because it is the only material that insures absolute uniformity in hardness and wear. The roller is ground concentric to within .001 of an inch and polished to remove the slightest irregularity. This guarantees a smooth, even running roller that will not jump or chatter against the race.

The race is finest selected fibre, every bit tested for hardness and toughness. During manufacture Red Stars are tested nine times. Insures their standing up in service. A final electrical test guarantees they will never short.

WANT ADVERTISEMENTS

ADVERTISEMENTS of SHOPS FOR SALE or TO RENT, SHOPS WANTED or SITUATIONS or HELP WANTED

will be inserted under this head at 3 cents a word, including the address, for each insertion, payable in advance; but no advertisement will be accepted for less than 60 cents, however small.

Remittances may be made in postage stamps where the amount to be sent is less than $1.00. Address

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H. W. T. JENNER, patent attorney and mechanical expert, 622 F Street, Washington, D. C. Established 1883. I make an examination and report if a patent can be had and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions. Trade-marks registered.

For Blacksmiths

THERE ARE not enough blacksmiths and none learning the trade. Every handy young man can learn the trade and can make more money doing hard jobs easy. Forging and welding solid with Toy's Modern Methods of Blacksmithing. Hardening and tempering to a standard with colored tempering charts. All for one dollar. Samples free. W. M. Toy, Sidney, Ohio.

LAME BACK—Let an old horseshoer tell how he keeps his back strong. No drugs. Costs very little. J. W. JONES, Boone, Colo.

Salesmen Wanted

Salesmen to sell Welding Equipment and supplies as side line. Liberal commission. Superior Oxy-Acetylene Machine Co., Hamilton, Ohio.

For Sale

Blacksmith Wagon Maker Shop for sale. Doing good business but want to go farming. Gas vulcanizing in connection. Two story shop 26 x 40. Cement block and cement floor. Chas. H. Hesse, Cold Spring, Minn.

Blacksmith Shop and Garage. Two sets of tools complete.
One frame building in L. shape, 40 x 40 x 20. I will sell either for one-half cash or less if party agrees for same. Only one blacksmith in town. Work for two men all the year around. Address J. W. Kesler, Orrin, N. D.

FOR SALE—One West No. 4 Hydraulic Cold Tire Setter complete with two Pumps, 15 sets Dies for wheels 30" to 56" diameter. For further information address: Ness Bros. & Co., York, Pa.

FOR SALE—One 12" Defiance Rim or Felloe Bending outfit; including Forms, Bands, Tie Bars. Two (2) Jumbo Duplex Perfection Retorts each 12" long. American Self Feed Rip Saw Rim. Strip Planer. Equalizing Saw. Packing Buck, Etc. For further information address: Ness Bros. & Co., York, Pa.

FOR SALE—A No. 1 blacksmith and auto repair shop in beautiful city. Good cash business, fine healthy climate. For full particulars, address No. 9 Main St., Kissimmee, Fla.

From 2½ Days to 2½ Hours

James F. Reeves, a wagon shop builder of Philadelphia, gets out the frame work for an ordinary delivery body in 2½ hours with Parks Machines. This is a good 2½ days' work by the old methods of wagon building.

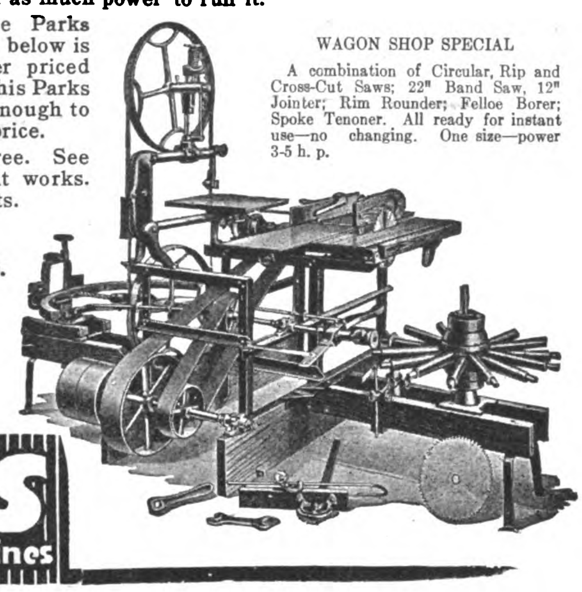
Mr. Reeves says he uses Parks machines for body work and that as time-savers they can't be beat. In his opinion a Parks Machine is much preferable to more expensive equipment because it takes half as much power to run it.

The price complete of the Parks Wagon Shop Special Illustrated below is but $250. Don't buy a higher priced machine; it isn't necessary. This Parks will increase your production enough to quickly earn back its purchase price.

Try a Parks for 10 days free. See what it does and how well it works. Write for catalog giving full facts.

WAGON SHOP SPECIAL

A combination of Circular, Rip and Cross-Cut Saws; 22" Band Saw, 12" Jointer; Rim Rounder; Felloe Borer; Spoke Tenoner. All ready for instant use—no changing. One size—power 3-5 h. p.



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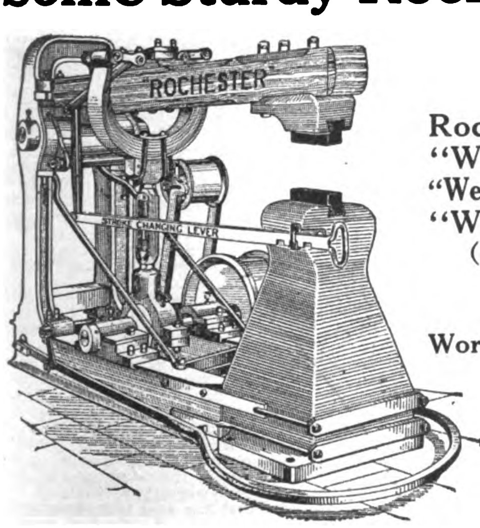

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Solid construction, simplicity and power. Flat and fits pocket. One of the best pistols made.

25 Cal. Vest Pocket Model—8 shots	**$15.00**
25 Cal. Regular Model—10 shots	**16.00**
32 Cal. Regular Model—9 shots	**18.00**
Mauser Holsters, either caliber	**1.50**
Mauser Ammunition, per 100, 25 Cal. **$4.50,** 32 Cal.	**5.00**
Mauser Rifle Ammunition, per 100, all calibers	**9.00**

Genuine LUGER Automatics

A reliable, dependable, hard shooting pistol under all conditions.

30 Cal. Regular Model—8 shots	**$27.50**
Luger Holsters, 30 Cal. **$2.50** **Ammunition** per 100	**6.00**

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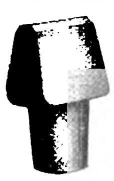

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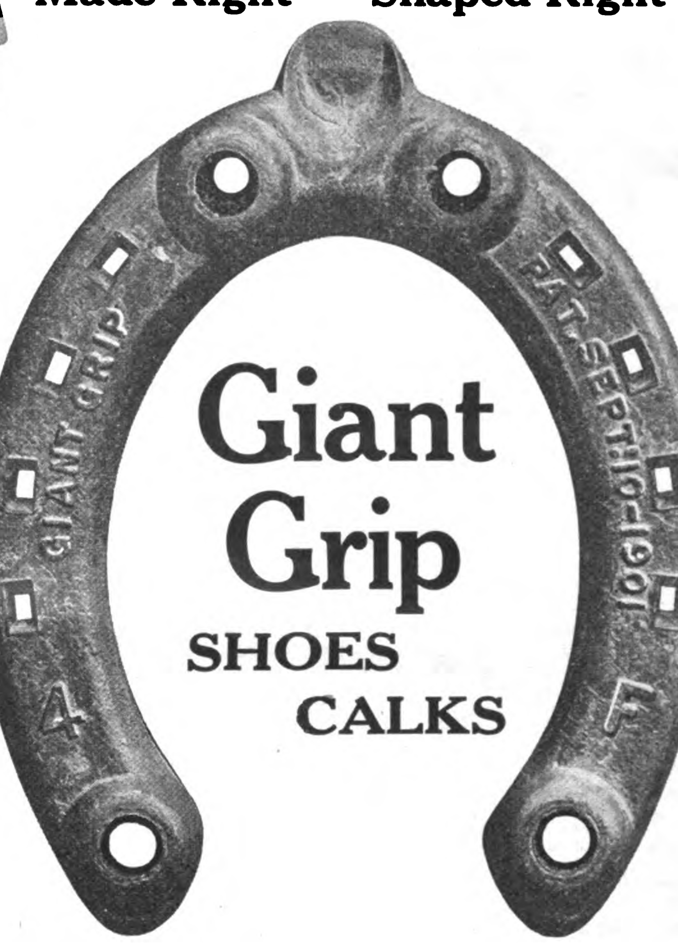

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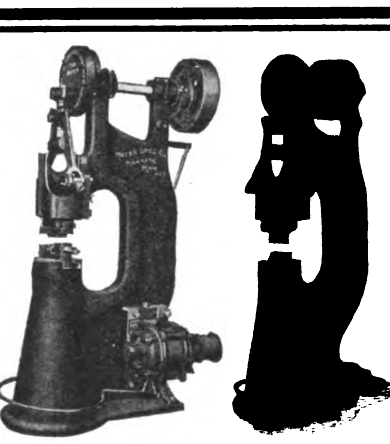
Giant Grip products are made with scientific accuracy, exact in every measurement. Service is built into them. Giant Grip shoes require less fitting than ordinary shoes, because they are made so accurately. Calk holes are strongly reinforced; toe clips are exceptionally strong. All standard weights and sizes.

Giant Grip Calks are made of superior quality heat treated steel—the kind that gives the most service. Every size and shape of blade.

If you haven't used Giant Grip Shoes and Calks, write today for complete information.

GIANT GRIP MFG. CO., - Oshkosh, Wisconsin



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25, 50, 100, 250, 500 and 1000 lb. Models

Belt or Motor Driven

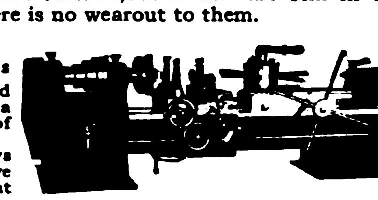
The smallest model will sharpen a 14-in. plow share in five minutes without re-heating, and do other work in a like rapid manner. It will pay for itself in ten days' steady plow work.

The first Little Giant Power Hammer made 29 years ago, and every one since sold —more than 12,000 in all—are still in use. There is no wearout to them.

Little Giant Combination Metal and Wood Lathes

Especially adapted for blacksmiths, garages and small metal and wood working shops. Have a great variety of attachments for every kind of metal and wood working.

All Little Giant Products are sold on 30 days trial and guaranteed FOREVER against defective material and workmanship. They can be bought on such easy terms that they pay for themselves.



LITTLE GIANT COMPANY
103 Rock Street **Established 1876** **Mankato, Minn., U. S. A.**

Index to Advertisers

CLASSIFIED BUYERS' GUIDE

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF The Blacksmith and Wheelwright and Tractor Repair Journal, published monthly at Cooperstown, N. Y., for October 1, 1922.

County of New York, State of New York, ss:

Before me a notary public in and for the State and county aforesaid, personally appeared F. R. Whitten, who having been duly sworn according to law, deposes and says that he is the business manager of The Blacksmith and Wheelwright and Tractor Repair Journal, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, M. T. Richardson Company, 16-22 Hudson Street, New York City, N. Y.; Editor, M. T. Richardson, 16-22 Hudson Street, New York, City, N. Y.; Managing Editor, G. H. Wilson, 16-22 Hudson Street, New York City, N. Y. Business Manager, M. T. Richardson, 16-22 Hudson Street, New York City, N. Y.; and T. R. Whitten ,41 Pinehurst Avenue, New York City, N. Y.

2. That the owners are: M. T. Richardson Company, 16-22 Hudson Street, New York City, N. Y. Stockholders: M. T. Richardson, 16-22 Hudson Street, New York City, N. Y.; A. J. Richardson, Ridgewood, N. J.; Mrs. A. Louise Girardeau, Jr., Monticello, Fla.; Mrs. Mildred Ulmer, New Rochelle, N. Y.; Mrs. H. L. Johnston, New Rochelle, N. Y.; W. F. Etherington, 50 East 42nd Street, New York City, N. Y.; F. R. Whitten, 41 Pinehurst Avenue, New York City; Cornelius Doremus, 66 Broadway, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person, or corporation for whom such trustee in action, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustee hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect in the said stock, bonds or other securities than as so stated by him. F. R. WHITTEN, Business Manager.

Sworn to and subscribed before me this 28th day of September, 1922.
(Seal) Eugene H. Mayerhofer,
Notary Public.
My commission expires March 30, 1924.

BLACKSMITH AND WHEELWRIGHT

and TRACTOR REPAIR JOURNAL

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The Inside Story of Steel

Annealing Temperatures and A Review of Some Important Matters

By J. F. SPRINGER

I WILL not go into this matter of compromise just yet; but will give the temperature to which steels should be heated for the purpose of getting full and complete refinement of the grain size and a higher capacity for bending.

ANNEALING TEMPERATURES

Carbon percentage of the steel	Annealing temperature in degrees F.	Annealing temperature in colors
.00— .12	1607—1697	Orange
		Dark to light
.13— .29	1544—1598	Light red to dark orange
.30— .49	1499—1544	Very full red to light red
.50—1.00	1454—1498	Very full red

The temperatures given in colors are rather indefinite and are not to be regarded as quite as reliable as those given in Fahrenheit degrees. The table given above (but not the colors) is substantially that recommended by the American Society for Testing Materials.

How to Heat

Some operators seem to realize, when they are pushing the temperature of a big piece of steel up to the required point, that the inside or core will probably be cooler than the outside. They can't see the inside, of course; but they just about know that it must be behind the outside, since the heating is done from the exterior. Among these persons, it seems to be a common practice to heat the furnace up past the required point with the idea of driving the heat in to the

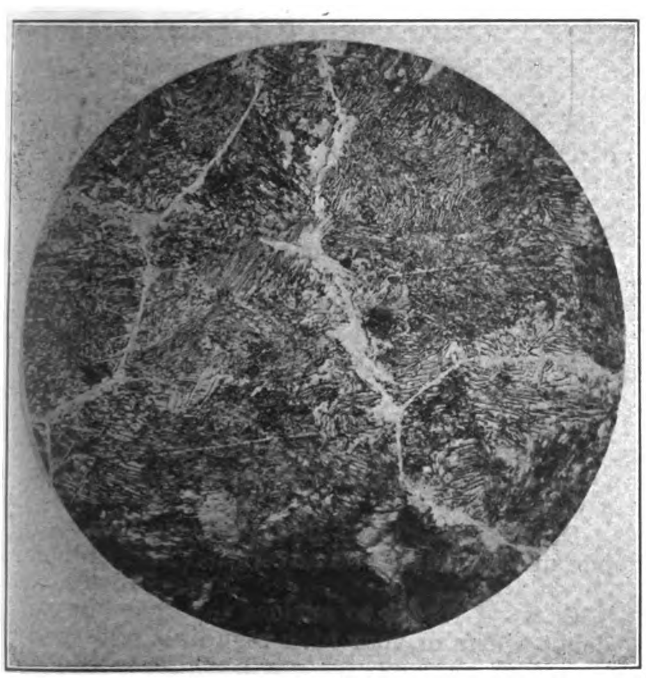


Fig. 1. High Carbon Steel. The white streaks of considerable width are cementite honeycomb. Note the Zebra effect in the large grains. The pearlite grains are large because the steel has been magnified 400 diameters.

core. "This is a great mistake. It is far better to take the extra time required to heat more slowly as the proper temperature is neared, thus bringing the steel to a uniform temperature throughout. If this were not done, the exterior of the piece might be carried beyond the proper temperature—and, in general, a needlessly high temperature is injurious and tends to re-coarsen the grain. Expressing this matter in a different way, we may say that the furnace in which the metal is being heated for annealing should in no case be run at a higher indicated temperature than the maximum temperature to which the metal itself is to be heated."

I have been quoting from Bullens. He goes on to illustrate the point by means of a die block. It will serve our purposes too, so I continue the quotation: "To illustrate: A piece of steel, such as a die-block, heats, cools and decarbonizes on the corners first. The life of the entire piece of steel is no greater than the life of the corners. If the die-block is placed in a furnace which is at the final working temperature, the corners are apt to reach the final temperature long before the major part of the mass. If the temperature is higher, as it is frequently in a futile attempt to gain time, the corners are overheated before the center of the mass is saturated (with heat) to the proper degree. From this commonplace example there should be indicated the necessity for slow, soaking heats in order to prevent overheating the corners of the metal, and further, the necessity of soft, hazy heats, to prevent oxidation or de-carburization of the expired edges."

A Review of Some Important Matters

It is not often that people absorb new ideas at once. It is generally necessary to go over the ground again. The reader could do this for himself, in a way; but I am skeptical of many readers going over these articles time and time again. I scarcely think I can persuade myself that this will be done. Moreover, sometimes a reader does not get the idea, the reason being that it was not put to him in the way he could get it. He needs the matter from another angle. At any rate, experience has shown that reviews are very valuable. This is to be regarded as especially true, if the review puts matters in a different way, and singles out the "high spot," as it were.

I am going to try the method of question-and-answer.

1. What two things are required in order to make steel? Iron and carbon.

2. Is there an example of iron in common everday life? Yes. The horse-shoe nail is almost pure iron. Then, there is Norway iron. It is also nearly pure iron.

3. How about carbon? Is there any carbon round about where one can easily get a look? Yes, charcoal and coke consist of carbon principally. The graphite used to make lead pencils is also carbon. Then there is the diamond. It is very pure carbon, only the carbon is in a crystalline form. Soot is carbon.

4. Is there much carbon in steel? No. The amount of carbon is almost insignificant. The steels that contain the most, only have 2 per cent of the total in the form of carbon. The 98 per cent is iron, However, usually there is more or less impurity; so that a little of the 98 per cent will consist of impurities. Two per cent of the steel may be carbon. This is determined on the basis of weight. It means that the carbon weighs 2 per cent of the total weight. A 100-pound piece of such steel would contain 2 pounds of carbon. This is certainly a very small relative weight. Ordinary tool steel contains only half as much as this; for a 100-pound block of steel containing 1.00 per cent of carbon would consist of about 99 pounds of iron and 1 pound of carbon.

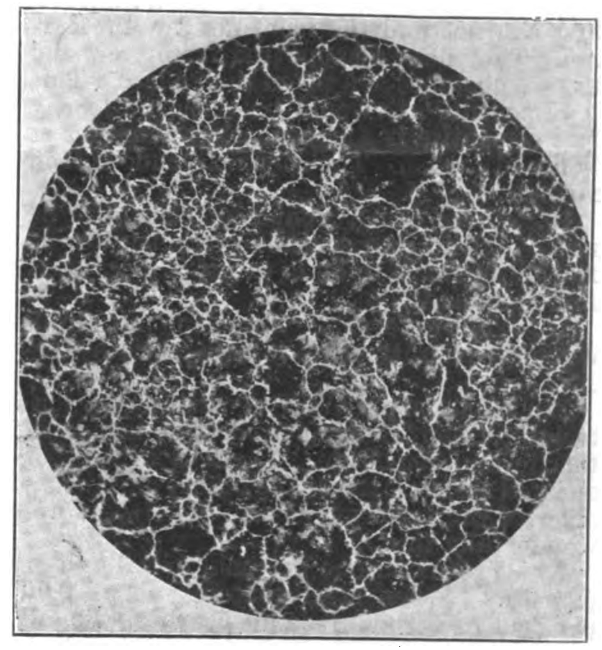


Fig. 2. This photomicrograph shows a high carbon steel magnified 100 times. The white lines represent the cementite honeycomb. The black places represent grains or groups of grains of pearlite.

5. Does carbon affect the strength of steel? It does. And in an astonishing degree. How much it strengthens the steel varies with the quality. But, for ordinary high quality steel, we shall not be far wrong in attributing 1000 pounds per square inch for each and every 0.01 per cent of carbon in the steel. For example, wrought iron without any carbon would have a strength of 40,000 pounds per square inch. That is, a square bar, 1 inch on a side, would be able to sustain 40,000 pounds. If the high grade steel be substituted and the carbon be 0.80 per cent, then such a bar would sustain a weight suspended from it of 120,000 pounds. This is an increase of 80,000 pounds in the load and is due to the carbon added. In a length of bar weighing 100 pounds, the carbon would weigh only 0.80 of 1 pound. This is less than 13 ounces of carbon. Isn't it extraordinary that the addition of this small amount of carbon to the 100 pounds of square rod would enable the rod to take on 80,000 pounds more load? I think it is very remarkable. However, after enough carbon has been added to make the steel a rather high carbon tool steel, the strength begins to fall off. And it continues to fall off as more is added.

6. Does carbon affect the hardness of steel? Yes, it affects the hardness very much. I am not now speaking of the hardness gained by heating and quenching; but of the natural hardness existent in the normal condition of the steel. Every addition of carbon makes the steel harder. Wrought iron is like copper. That is, it is not particularly hard. It is not as soft as lead. On the other hand it is not really hard; as may be seen by filing a horse shoe nail. However, when to wrought iron, or ferrite, we add carbon, its hardness increases. And the more we add, the greater the hardness. White iron is perhaps the hardest form.

7. Is steel uniform everywhere inside? It is not uniform. There is a better word than "uniform"— it is homogeneous. Steel is not

homogeneous. That is, it has structure. There are certain particles of one kind here and certain particles of another kind there.

8. What are meant by grains? Grains of steel are lumps of material that occur in the metal and form all or a large part of it. In short, a piece of steel is not so very much different from a chunk of concrete. In the concrete, the pieces of stone in the form of rounded pebbles or of irregular bits of rock may be regarded as "grains." In steel, however, there may or there may not be any surrounding material. In concrete, there is always surrounding material consisting of a cement mortar (cement and sand). Raisins in raisin bread is another illustration of grains of steel; only, the raisins ought to be pretty thick to make the illustration as good as it should be. They ought to be thicker, perhaps, than in any raisin bread you or I ever ate.

9. What is cementite? Cementite consists of carbon and iron. But it is not a mixture. You can not find the iron, nor yet the carbon. They have disappeared from view and a new substance has taken their place. This is cementite. It would be scientific to say that cementite is a chemical combination of iron and carbon. The chemical name is iron carbide.

10. Where can a sample of cementite be seen? White iron consists of cementite; so that all we have to do is to get a piece of it and examine it.

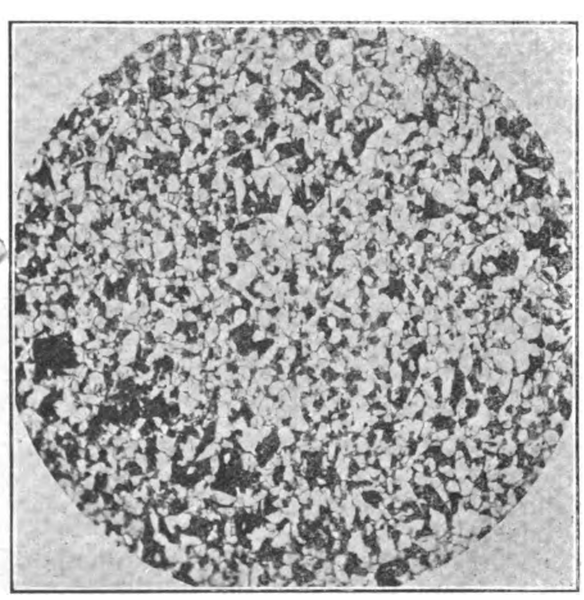
11. What is ferrite? Ferrite is pure iron. Wrought iron, if pure, is substantially ferrite.

12. What is pearlite? Pearlite is a material formed of small and thin layers of ferrite and cementite. There is a layer of one and then a layer of the other; and then a layer of the first, and so on. The layers are wonderfully thin.

13. Where can one get hold of a piece of pearlite? When steel contains about 0.90 per cent of carbon, it is all pearlite. So, all we have to do is to get a piece of such steel, and have it in the normal condition. It will consist of pearlite. However, the size of the layers of ferrite and cementite will be small. They may be long enough and broad enough to form sections of a grain; but this is small.

14. In a piece of normal steel, of what do the grains consist? They consist of pearlite. Every grain is a little lump of pearlite.

15. What surrounds the grains of steel? Just as the bread surrounds the raisins and the cement motar surrounds the pebbles or bits of rock in concrete, so metallic material surrounds the grains. However, when the steel is all pearlite, nothing surrounds the grains. They simply fit into one another. It is similar to what raisin bread would be, if there were no bread and the whole affair were nothing but raisins. You and I never saw anything like that. Again, if concrete contained no cement mortar, that would be a similar thing. Well, there is no raisin bread that is all raisins, nor is there a concrete all pebbles. But there is a steel containing nothing but grains of pearlite. Such steel contains about 0.90 per cent of carbon.



View A; Steel Wire 0.30 Percent Carbon, Heated to 1607 Degrees, F. and Furnace Cooled. (Mag. 100 Diam.)

16. Just what is the metallic material that surrounds the grains of pearlite, if the carbon percentage is less than 0.90? The surrounding material then is simply ferrite—wrought iron.

17. Just what is the metallic material that surrounds the grains of pearlite, if the carbon percentage is greater than 0.90? The surrounding material under these circumstances is cementite.

18. Of what materials is steel made up? Steel, in normal condition, consists of pearlite grains surrounded by ferrite, nothing at all, or cementite.

19. Are there particles of carbon in steel? No, the carbon that was originally put into the steel has disappeared, and there is only cementite (iron carbide) to show for it. You couldn't find a grain or bit of carbon in steel any more than you could find a particle of hydrogen or oxygen in a glass of water. Now, in gray cast iron, particles of carbon do exist in the form of graphite.

20. Where is the carbon, even though it can't be found? All the carbon in steel is in the cementite. That is, the carbon is (1) in the layers of cementite which alternate with the layers of ferrite to make up the grains of pearlite; and (2), if the carbon percentage is greater than 0.90, the carbon is also in the surrounding material, which will now consists of cementite. In short, wherever there is cementite, there will be carbon, as it requires carbon to form cementite. But that is all—there is no carbon, visible or invisible, anywhere else than in the cementite.

21. How is cementite pronounced? It is pronounced precisely as if it were spelled sem-en-tite, three syllables. The accent is on the first syllable.

22. How can you tell the amount of cementite in a piece of steel? Multiply the carbon percentage by 15. The result is the cementite percentage. Thus, if the steel contains 1.10 per cent of carbon, we may find the cementite percentage by multiplying by 15. The answer is 16.5 per cent of the total wieght.

23. What part of pearlite is cementite? The answer is that 13.5 per cent of the pearlite consists of cementite.

24. What part of pearlite is ferrite? The answer is, all the rest. That is, since pearlite is made up of just two things, ferrite and cementite, and the cementite is 13.5 per cent, the ferrite must be 86.5 per cent of the pearlite.

25. Which is heavier in a grain of pearlite, a flake of ferrite or a flake of cementite? In No. 24, we have the information that ferrite is 86.5 per cent of pearlite and cementite is 13.5 per cent. This means that the ferrite weighs 6.4 times as much as the cementite. Accordingly, then one flake of ferrite weighs 6.4 times as much as a flake of cementite.

26. Which is thicker, a flake of ferrite or a flake of cementite? The specific gravity of wrought iron is round about the same as the specific gravity of white iron. This means that, bulk for bulk, ferrite and cementite weigh about the same. Accordingly, then, since the ferrite flake is about 6.4 times as heavy as a flake of cementite, the ferrite flake will be, say, 6 times as thick as a flake of cementite.

27. In the usual microphotograph showing the zebra appearance of pearlite, which are the black stripes, the ferrite or the cementite? It is assumed that the ferrite stripes are valleys and the cementite stripes ridges. Then the dark stripes are ferrite and the white stripes are cementite.

28. Which stripes in the zebra appearance are broader, the white or the black? Since the black represents ferrite and the ferrite flakes are 6 times as thick as the cementite flakes, we must conclude that the black stripes are really broader, or else that they would be broader, if the dark effect precisely corresponded to the ferrite in width.

29. In an ordinary microphotograph of normal steel, what are the black patches which are separated one from another by thin white lines, the whole looking something like a map of a state, the patches being the counties? The black patches are grains of pearlite.

30. What are the white lines which separate the grains of pearlite from one another? The answer depends on the percentage of carbon. If the carbon percentage is less than 0.90, then the white net-work is ferrite. If the carbon percentage is greater than 0.90, then the white net-work is cementite.

31. Are the white lines always the same thickness? By no means. Sometimes, they are one thickness; sometimes, another.

32. Which is harder, ferrite or cementite? Well, find the answer yourself. Ferrite is just about the same thing as a horse shoe nail, and cementite about the same thing as white iron.

33. Are there other substances in plain steel in addition to carbon and iron? Yes.

34. Why are these not spoken of? They are much spoken of, under certain circumstances. Plain steel contains them, but these other substances are not wanted. They are in fact impurities.

35. Why are they not removed, or why isn't the plain steel made without them? It would cost too much to get entirely rid of them. It is practically impossible to make steel so that only carbon and iron will be present.

36. What are some of these other substances, these impurities? Some of the impurities are sulphur, phosphorus, manganese.

37. If plain steel contains manganese, why is it not called manganese steel? The reason is this. It was only a few years ago that it was found out that a *considerable* percentage of manganese resulted in a kind of steel very different from the ordinary kind. The name manganese steel has been given to this metal. Note, however, that there must be a considerable percentage—8, 10, 20, or the like—to produce this valuable material.

38. Does heat affect steel? It does affect it, and in a number of ways.

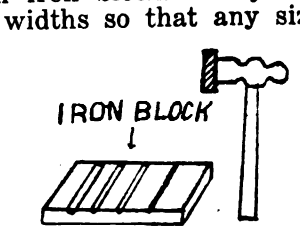
39. Does heat change the size of grains? It does, under certain circumstances. The early heat seems to leave the grain size unchanged.

40. What do you mean by the early heating? Heating up to *red.*

Use Those Old Nails

by
Stuart F. Knepp

MANY old and bent nails litter the shop that could be put to use by the construction of a simple outfit such as is shown by the drawing. Grooves are drilled or filed out of an iron block. They should be of different widths so that any size nail may



be accommodated. A common machine hammer is fitted with a block of iron about the width of the iron block. The nails can then be very easily straightened by laying them in the grooves and applying the hammer. This outfit comes in very handy in other cases also.

A certain young man wrote the following letter to a prominent business firm, ordering a razor:

Dear Sirs—Please find enclosed 50c for one of your razors as advertised and oblige,

JOHN JONES.

P. S.—I forgot to enclose the 50c but no doubt a firm of your high standing will send the razor anyway.

The firm addressed received the letter and replied as follows:

Dear Sir:—Your most valued order received the other day and will say in reply that we are sending the razor as per request, and hope that it will prove satisfactory.

P. S.—We forgot to enclose the razor, but no doubt a man with your cheek will have no need of it.—*The Associated Grower* (Fresno).

The Hoof of the Horse

Character of The Hoof and Certain Troubles to which It is Subject-Information for The Experienced and Inexperienced Horse-shoer

By F. J. SPANGER

THERE is, as we all know, a kind of horny box to which we nail the horse-shoe. It resembles the human finger-nail or toe-nail very much, although I am not going to claim with some that the foot of the horse is really a finger or a toe, and that at one time, in the history of his ancestors, the horse had a five-fingered or five-toed hand or foot. It would be pretty hard to explain, under such conditions, how the other four fingers or toes dwindled to just about nothing. Science seems to show that nothing can be lost—to the children—by the failure of the parents to use all the things Nature gives them.

However, the hoof is a kind of finger-nail or toe-nail, just the same. It grows like our nails, from the base. In fact, the hoof needs cutting at the bottom, when the shoe is attached, just the same as the human nails need cutting.

If a horse runs barefooted, the natural wear and tear may be enough to keep his hoofs pared properly. But that depends on circumstances. If he runs on soft ground, and wear and tear count consequently for very little, his hoofs may become excessively long, and may require the attention of the horse-shoer.

In fact, an unshod horse will grow hoofs at a faster rate than a horse that is kept fully shod. It is curious, too, that the hind hoofs grow more rapidly than front ones. It is said that the hoof grows equally all round the entire affair. Some may think that hoofs of a certain color grow faster than hoofs of another color. But this is denied by a high authority.

The average rate of growth for a horse's *hoof* may be taken as 5/16 inch per month. There will be variations between one horse and another, and also variations of the kind already explained. But on the whole, the 5/16 inch per month may be taken as a general average.

It is said also, that the hoof grows more slowly in the case of stallions than in that of other horses.

A certain horse had hoofs which grew at the rate of 0.12 inch per month. This is much slower than the average, which is 0.31 inch per month. This horse was freed from his shoes and put to grass for a period of three months. His hoofs became very active. In fact, the rate of growth jumped to nearly 0.36 inch per month. This case may be taken as a fine illustration of the rule that the hoof grows faster when the horse runs barefoot.

A lesson to be learned from the foregoing may be stated thus: Whenever the horse-shoer thinks that a customer's horse has hoofs which grow too slowly, and the matter is important enough, he may advise that the horse be sent barefooted to the pasture field. That is one way of promoting the growth of the horny material that forms the hoof.

However, it is sometimes—perhaps generally—possible to bring about a better growth without taking the shoes off. That is to say, if the horse is allowed free movement on ground that is moderately soft, this is understood to favor growth, even though the shoes remain. Another thing that helps is so to shoe the horse that his foot may expand better. At least, this is claimed as something that promotes growth. It is understandable, because when expansion is promoted that means a movement out and in which certainly must help along the circulation of the blood. And the circulation of the blood is the thing upon which growth actually depends. In fact, pretty much anything that facilitates circulation may be expected to promote the growth of the hoof. Note, however, that it is not general circulation through the body, but circulation in the foot. The hoof grows from its base. This means that it is fed from that point. So, then, circulation in that region is what is wanted.

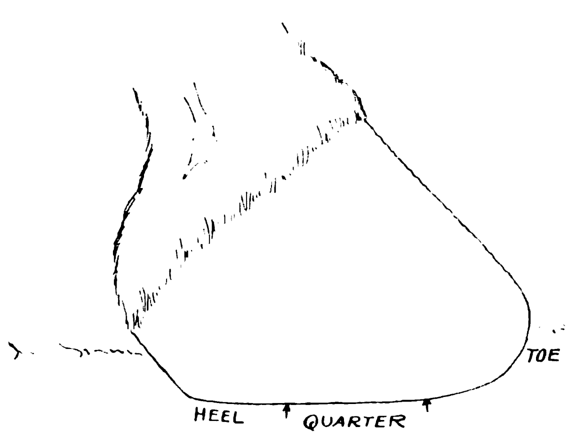
It appears that, if the hoof is regularly pared, the growth will be promoted. At any rate, this is claimed on good authority.

Also, it seems that a nourishing diet promotes the growth of the hoof. This is understandable. A nourishing diet is one that supplies the body with what it needs. So, if a horse is well and properly fed, it is quite probable that pretty much everything—hoofs included—will be assisted in growth.

On the other hand, the growth of the hoof may be retarded by the conditions which surround the life of the horse. If he has but little exercise, or work, or if he is ill fed, or if he is in poor health, a slowing up of the hoof growth may be expected. Thus: "Growth is retarded by want of movement, ill health, low condition, exercise on hot sand or on stones, drought, excessive length of hoof, unequal distribution of weight in the two limbs, and by continued standing on one foot."

Wear and tear naturally depend upon circumstances. It is said to depend, in part, upon the pace; and that a full gallop or a fast trot tends to affect rather the heels, while a slow trot or a walk seems to affect the toe in preference. "That is to say, that at a fast pace the foot is brought flat to the ground, or even with the heel first, but at a walk the toe strikes the ground first."

Draft horses are said generally to wear the outer quarter more than the inner one.



THE HORSE'S HOOF
Showing location of Toe, Quarter and Heel.

The rate of growth can be tested by the horse-shoer in one or more ways. If the horse is brought to him regularly, he may note how much has to be cut off from the bearing surface of the hoof. The bearing surface is the surface next the shoe.

The hoof differs from horse to horse in respect to the thickness of the horny material forming it. But before dealing with this matter of thickness in any detail, it will be well to be sure we understand just how the thickness is to be measured.

It is obvious that the outer surface of the hoof is, for the most part, out of the vertical. In front, the wall of the hoof may be very much off from the vertical. The slant may be steep, but it is not perpendicular to the ground. Now, if we pare the bottom of the hoof for the purpose of attaching a shoe, the bearing surface at the toe will have a breadth which may be rather easily noted. The breadth, in any given case will probably vary a good deal as one follows the bearing surface round from one heel to the other. And it will probably be quite broad at the toe.

Is this breadth the thickness of the wall of the hoof? In general, no. Only at places where the hoof wall is perpendicular to the ground is the breadth of the bearing surface the same as the thickness of the wall.

The thickness must be measured perpendicularly to the wall. Thus, if I imagine myself to bore a hole through the wall, I may in this way get a proper idea. If I bore the hole so as to have it *perpendicular to the outer surface of the wall,* then the depth of the hole will be the thickness. It is important to understand this. The true thickness is generally less, and sometimes much less, than the apparent thickness when we view the bearing surface. At the toe, the apparent thickness when the shoe is off is generally very much greater than the true thickness. This is especially the case where the horse has "oblique" hoofs. The wall may appear to the horse-shoer to be quite thick, when in reality it is not thick at all. He is looking at the pared surface which comes next the shoe. And this will be at a sharp angle with the front of the hoof. Consequently, he is not looking at the proper thing at all.

Let me illustrate the matter: Take the case of a 1 inch board. The 1 inch is the thickness when measured perpendicularly to the broad, flat sides of the board. Now saw the board through so that the cut will, when seen on the edge of the board, be on the bias. Now look at the surface of the cut. It is broader than the true thickness. And if the slant of the bias cut is quite sharp, the apparent thickness will be very much greater than the true. So will a horse's hoof. With a horse with "oblique" hoofs, the bearing surface at the toe will be ever so much greater in width than the true thickness of the horny wall.

In short, the flatter the outer surface of the hoof is when it rests on the ground, the greater will be the difference between the apparent and the true thickness.

This is important, because a wrong idea of this matter may cause the horse-shoer to make mistakes in shoeing. He may look at the pared bearing surface and think that there is much more material than there really is. What he should do is to take into account the slant of the outer round surface. Generally, this surface meets the ground at a flatter angle at the toe than at any other point. At some places, the outer surface will be quite steep—perhaps, almost or quite at right angles with the ground. At such points, the apparent thickness and the true thickness will be nearly the same.

If the slant is flat enough to make an angle of 45 degrees with the ground, then the apparent thickness will be 41 per cent greater than the true one. Or, to put it in the reverse manner, the true thickness will be something less than a third smaller. That is, the true thickness will be only a little more than two-thirds of what the horse-shoer sees when he is about to put on the shoe.

The true horny matter contains no blood vessels and no nerves. A nail can not cause bleeding nor pain as long as it has penetrated no further than the horny material. This needs to be qualified somewhat. If bleeding or pain results when the nail has touched nothing else than horn, then this result is to be attributed to pressure or the like. Thus if disease is present in the foot, a nail might, conceivably, exert pressure through a thin layer of horn, and in this way cause pain or bleeding. But no pain or bleeding can come from the true horny material itself, because it contains no blood vessels or nerves.

The thickness—true thickness is what is meant—varies in different parts of the same hoof. It is thicker at the toe than at the heels. In general, it gets thinner and thinner from toe to heel. In the case of one and the same horse, the thinning off from toe to heel may be more marked in a fore foot than in a hind foot. And the thinning from toe to heel will vary from horse to horse, especially if the horses differ much in breed.

Steepness makes a difference in thickness. I am not speaking of apparent thickness, but of the true thickness. If the wall is quite steep with the ground, the thickness will be less than if the wall is flatter. This is a general rule, and doubtless has exceptions.

The reader may be interested in a few measurements of the true thickness of the wall of the horny hoof. I will give the toe thickness which will always be greater than the quarter thickness. For the reader to get the idea squarely before him, it is necessary to have a pretty clear idea of what is meant by the *quarter.*

Suppose we consider a horseshoe. The region at the front is the *toe.* But, how far does the toe extend back? Imagine that the middle point of the whole horseshoe be marked. Then divide each half into three equal parts. The *heel* is the rear third. Naturally, there are two heels to one shoe. One is the *outside heel* and the other the *inside heel.* "Inside" and "outside" take into account the fact that there are two feet abreast of each other. Thus, there are two hind feet. There will be a heel on one hind shoe that is opposite and nearest to a heel on the other hind shoe. These two heels are inside heels. Then there is a heel of one hind shoe that is farthest distant from a heel of the other hind shoe. These are the outside heels.

So, then, every horseshoe has an inner and an outer heel. The rear third of one-half of the horseshoe is one heel and the rear third of the other half is the remaining heel of that shoe.

The midde third of each half of a horseshoe is a *quarter.* There are two quarters, one being the *inner quarter* and the other the *outer quarter.* There is a remaining third to each half of the shoe. Both together form the *toe.*

Now just as we have divided up the shoe, so we may divide up the hoof and name the parts in exact accordance with the parts of the shoe.

Now, in the case of a pure Arabian, and of other horses, careful measurements were long ago made for the purpose of ascertaining the thickness of the toe and of the two quarters. The measurements of the quarters were made at the junction of quarter and heel.

The toe thickness for the fore foot of the Arabian horse was found to be 0.36 inch. This is something less than 3/8 inch. The outer quarter measured 0.28 inch and the inner quarter 0.20. So much for the fore foot. For the hind foot, the toe was found to be 0.34 inch and the outer and inner quarters 0.28 and 0.24 inch.

Notice, in the case of this Arabian horse, how the toe is thicker than either the outer or the inner quarter.

The hoof thicknesses of a well-bred horse of medium size were also taken, with the following results. The toe of the fore foot was found to be 0.52 inch and the outer and inner quarters 0.32 and 0.28 inch. So much for the fore foot. For the hind foot, the toe was disclosed as having a thickness of 0.44 inch, while the quarters were observed to have thicknesses of 0.32 and 0.30 inch.

Take another case. This is a big coarse-bred horse. The fore foot toe was found to have a thickness of 0.64 inch, and the outer and inner quarters of 0.44 and 0.40 inch. The hind foot toe showed a thickness of 0.52 inch and the two quarters a thickness of 0.40 and 0.36 inch.

The reader has now before him accurate measurements for three distinctly different types of horse. In all cases, the toe of the fore foot was found to be thicker than the toe of the hind foot.

All the measurements given are in the region where nails are usually put. This fact should make the figures of more value than would otherwise be the case.

The *foot* of the horse is counted from the fetlock down. In front, the foot should form a straight line although there are three distinct parts that are hinged together. That is to say, there is the hoof and inside it the hoof bone. These constitute the lowermost one of the three.

Lessons for the Young Blacksmith

How A Youngster Learned To Overcome Some Difficulties

By JAMES F. HOBART

"I want another 'C-Clamp' and they are all in use" said Mort Buxton, journeyman blacksmith in young Walter Langley's shop: "Never yet saw a shop which had enough clamps!" and Mr. Buxton hunted up a sixteen-inch monkey wrench, applied the wrench to the work as if it had been a clamp, then he screwed the wrench jaws together as far as he could with his thumb and finger on the wrench-screw.

The wrench staid in place all right, but it didn't pull the parts together with any force and Mr. Buxton took up a pair of adjustable (slip) jaw pliers, opened the jaws to their greatest extent, applied them to the wrench-screw and tightened the jaws so they held almost as well as a regular clamp. The pliers slipped once or twice when the wrench-screw began to turn hard and Mr. Buxton shook his head and looked at some bright places where the pliers had torn the knerling from the thumb-boss of the wrench-screw.

"Pliers do the business but they are wicked on a wrench" said Mr. Buxton, then

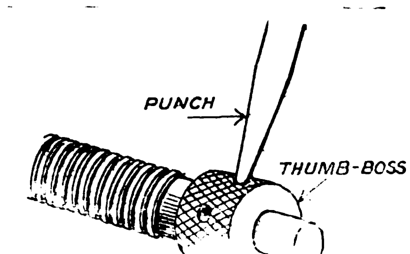


Fig. I
HE DRILLED THE WRENCH THUMB-SCREW

he finished the clamp work the wrench was to do, removed the wrench, screwed the jaws together and tightened the thumb-screw again with the pliers, then he took the wrench to the post drill and drilled two one-eighth-inch holes through the thumb-boss as shown by Fig. 1. Then he countersunk, or rather reamed, the outer end of each hole with a taper reamer and enlarged the ends of the holes so that a punch would fit therein. A nail-set was used in the hole and with it, the wrench-screw was turned and the jaws forced together with clamp tightness, holding fast any work between the wrench jaws.

Patching A Burned Weld

"Consarn it!" exclaimed Mr. Buxton as he looked over a three-inch-square piece of steel which he had, with Walter's help, just united with a lap-weld: "There's a half-inch corner burned off that weld, which won't do at all as the whole thing must be finished and polished." Mort picked up a "hot chisel" and drove it into the burned corner of the weld, holding the chisel flat with the weld as he did so, opening a gap as shown by the second sketch in Fig. 2.

Mr. Buxton then picked out a piece of steel as nearly like the three-inch piece as possible and made a "dutchman" as shown by the small sketch. He cut a few "file-teeth" on either side of the wedge to make it stay in place when driven home. He selected steel as nearly like that in the large bar as possible in order that when the surface had been polished, the wedge would not show in outline as it might do if made of iron or of steel containing a larger carbon content than that in the large bar.

The metal was heated when the hot-chisel was driven into the defective weld and the "dutchman" was cold as water would make it when it was slipped into the chisel-cut and driven into the metal as deeply as it would go. Then, another welding heat was taken, the last few minutes in the fire being with the wedge corner next to the greatest heat. But Mort took care that the projecting portion of the wedge was not burned off before the adjacent metal reached a welding heat.

A few blows with hammer and a sledge, the latter in Walter's hands, drove the wedge into the steel and flatted it out so it was indistinguishable. Then Mort picked up a flatter and Walter hammered it until the steel was brought to size, all its corners square and full and the four sides as smooth as a flatter and a good workman could make them—and that is pretty smooth, too.

"Say, Mort," asked Walter; "Why didn't you save all this heavy heating and sledge work and just fill out that corner with the oxy-acetylene torch?"

"Might have done it" replied Mr. Buxton. "But Walt. I figure it like this—if we had filled the corner with metal melted in with the torch, it would have been very hard or utterly impossible to match the new metal with the old and the filled-in corner might have been as prominent after completion, as a new cloth patch on an old pair of pants. Furthermore, we should have been forced to chip, file or grind smooth the surface left by the torch, and still further, the job should have been pre-heated almost to redness before doing the actual filling-in of the crack, so it cost less in this case, to weld in a "dutchman" than to build up the defective corner by welding-in with the torch."

"But why would preheating be necessary," asked Walter—"there is no danger of contraction doing damage to a weld of that shape, so why should preheating be necessary?"

"It's like this, Walt. The job could be done perfectly without preheating, but it would be necessary to heat a considerable portion of the three-inch steel during the welding operation. In fact, it is necessary

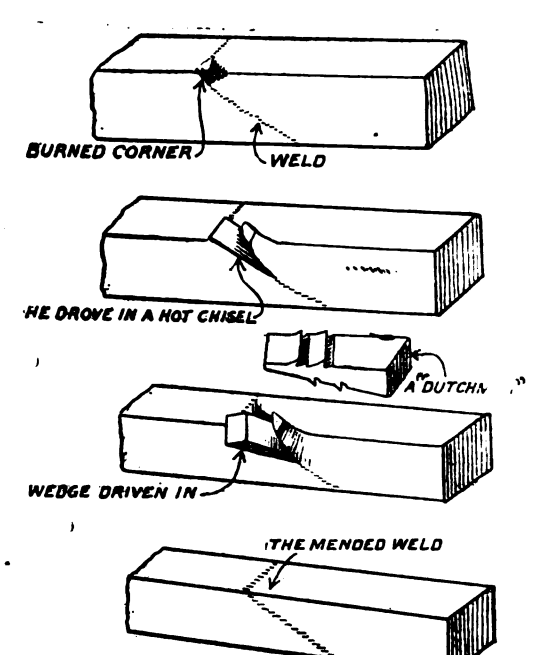


Fig. 2 - FILLING-IN A WELD-BURN

because it is impossible to make the weld without losing a whole lot of heat into the heavy piece of steel and all the heat thus lost, must be supplied from the acetylene gas, with costly oxygen gas to burn the acetylene. If preheating gets done, even though it is not necessary to protect against contraction strains, it would be far cheaper to preheat with coal than with acetylene. Take it all around, the fire-weld for this job is cheaper —and quicker—than the oxy-acetylene weld. See?"

Walter "saw," and went about his business thinking of how much he still had to learn of "inside blacksmithing!" "Crackee!" he mused "—I used to think blacksmithing was mostly hammering hot iron with main strength and a forging-hammer, but there's a whole lot more to the business and all of it don't show unless a fellow everlastingly digs for it, and the difference between a good smith and a bad one is in the amount of "inside" work he has gotten next to! My old Dad was surely right when he used to tell me: "Yes, the young man *thinks* the old man is a fool, but the old man KNOWS the young man is one!"

A "Flier" in Journal Babbitting

Work got slack in Walter's shop, after a time, but he didn't sit down on a horseshoe keg to wait for jobs to come to the shop. He just filled the gasoline tank of his "flivver" and went after jobs—and he found a lot of them too. Among the farmers he found many cases where rebabbitting was necessary to journals of all sorts, sizes and shapes. Walter accepted all jobs of this kind which could be taken to the shop, then he rigged up a babbitt melting furnace, using a stout iron pot to hold the soft metal, and placing the melting pot over a little furnace all of its own.

At first, Walter suspended the babbitt-melting pot over the forge fire by means of a rod and turnbuckle, attached to an overhead timber. When a job of babbitting was to be done, Walter would swing the pot to the forge fire. After the job was finished, the pot would be swung off to one side and held there securely by means of a small chain, fitted with a hook and attached to a post near by. When the melting pot was swung aside from the forge fire, the hook was placed around the rod and the pot was held aloof from the forge and entirely out of the way until wanted for use again.

But Walter soon found that this arrangement did not pay. In fact, it speedily became a great nuisance and the melting pot was banished for good from the forge fire and fitted with a little furnace all of its own. It was found that drops of melted soft metal were continually finding their way into the forge fire, being spattered there when removing hot metal from the pot with a ladle, or flying into the forge fire when cold babbitt metal was dropped into the pot to replenish the supply.

Walter found that as surely as babbitt metal—or the lead it contained, got into the forge fire, that welding was impossible. The parts to be welded would be coated with a very thin film of lead oxide and then it was "good-bye" as far as welding was concerned until after every vestige of lead had been removed from the forge fire and from the coal scattered upon the forge. So, an independent little furnace was rigged for the babbiit melting pot, which affair was left thereon permanently.

Walter soon found that it was almost impossible to obtain babbitt metal of uniform hardness. Let him purchase "Best Babbitt" from the hardware store and it might be exactly what was required by the work in hand, or the alloy might prove too soft for small, light bearings and while O. K. for large bearings, it might be N. G. for babbitting mowing machine journals. Mort and Walter put their heads together and worked out a scheme whereby they could test out samples of babbitt pretty well and then govern themselves accordingly in purchasing same in quantity. When they found some which showed up well, they bought all of that kind they could obtain.

Testing "Babbitt" Metal

First, they cut off bits of the babbitt with a pocket knife same as you would sharpen a pencil. The hardness or softness of the alloy was judged by the manner in which it cut. They bent some of the thin cuttings between thumb and finger and noted if the cuttings bent or broke, or how much a chip would bend before it broke. This gave a good clue to the hardness and toughness of the lining metal.

Next, Mort grasped a bar of babbitt firmly with the fingers, or with a pair of tongs in such a manner that a corner of the bar laid over a corner of the anvil. With a medium weight forging hammer, Mort "drew-out" a corner of the babbitt, reducing it in thickness and making it spread out under the blows. He watched closely the effect of the blows and estimated carefully the amount of hammering which caused the alloy to crack. If it could be hammered thin, the metal was too soft for small bearings. On the other hand if it quickly cracked and crumbled, it is probably too hard and brittle for any use whatever. But, should the alloy draw down slightly and then crack slightly along the edges of the hammered portion, it is evident that the sample under test is both hard and tough and should make good bearing linings for light, fast running journals.

Babbitt which flattens out under the hammer freely, may not be inferior alloy, it may have been made soft purposely for use in very large, heavy bearings, and while perfectly fitted therefor, is not suitable for the thin, light bearings of small machinery.

A whole bar of babbitt is not necessary for making the above tests, a small fragment chiselled or hack-sawed from a bar, will answer well, and the hammer test may be made on portions of babbitt removed from bearings which had worn well, and babbitt may be selected for re-lining those bearings, which shows about the same hardness and tenacity as the fragments removed from the lining.

Walter and Mort found they could tell a whole lot about babbitt by the manner in which it came out of the bearings when removed therefrom. Usually, they would use a narrow (cape) cold chisel and chip a channel right along the bottom of bearing—or cap—from one end to the other, then knock out remains of the old lining as best they could. If it came out like a bit of leather, it was probably too soft and not of suitable quality.

When chips fly from the cape chisel as the channel is cut, and the anchor plugs break off in every hole, then Walter knew he was handling good babbitt metal and governed himself accordingly when putting the old babbitt back into the melting pot. When he found some too hard, and some which was too soft, he tempered both by a judicious mixture in the melting pot and brought all the lining metal in that manner, up to a standard of hardness which he found best fitted for the service required from the bearings to be lined.

Walter quickly found out another thing in regard to bearing babbitt metal. The old-time instruction, is to heat the metal until it will just char a newly whittled white pine stick when inserted in the melted metal. But Walter found this rule to be a "has-been" which could not be used under some circumstances. In many sections of the country, white pine is scarcer than proverbial hen's teeth, and other kinds of wood may work very differently from dry white pine. Walter found that he should heat lining metal hotter for small thin bearings and not so hot for large thick ones, and just hot enough for any bearing that the metal will flow into place.

Expensive Horse-Shoeing

A HORSE-SHOER once offered to shoe a horse all round for one cent for the first nail, twice that for the second, and twice that for the third, and so on until he finished the job, using the usual number of nails, which is thirty-two. The offer was hastily accepted. Whether or not he got his pay, his bill amounted to $21,474,836.48.—*Our Dumb Animals.*

Suspicious

"I'm afraid I must have made a mistake and given that waiter a larger tip than I intended to."

"What makes you think so?"

"He said 'Thank you.'"

Helpful Small Boy—I beg your pardon, sir, but your car was stolen about ten minutes ago.

Car Owner—Well why didn't you raise an alarm and stop the thieves?

Boy—I never thought of that, sir; but it's all right—I took the number of the car.—*The Lightning Line.*

CINCINNATI SELECTED AS 1923 CONVENTION CITY FOR C. B. N. A.

AT a meeting of the Executive Committee of the Carriage Builders' National Association, held last month, it was decided to hold the next annual convention of the association in Cincinnati, Ohio.

At this meeting it was also decided that the feature of Manufacturers' Exhibits would be omitted from future conventions.

E. E. HUGHES
New President of C. B. N. A.

The photograph of the association's new president, Mr. E. E. Hughes, of Lynchburg, Va., which appears herewith, was received too late for publication in our December issue.

It's a Grand and Glorious Feeling

Salesman (at automobile show)—"Are you interested in a new motor car?"

Pedestrian Visitor—"Naw, I'm just seeing how it feels to dodge 'em without getting hit."

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Horses Must Still Be Shod

NOTWITHSTANDING the changes brought about by the advent of the automobile, horses are still being used and it is possible that the future may see an increase in the number. With all the advance of invention. A fraction of the total will run barefoot in the pasture fields and a fraction will be used unshod on soft roads. But the work horses, the driving horses and the saddle horses will in general have to be protected by shoes.

Consequently, we must go on with horseshoeing. Nobody seems to have invented any reasonable substitute and there appears to be no prospect of a future means of protecting the hoof in a different way. Horseshoes and horseshoeing accordingly remain with us.

And so those who read this journal may expect to find practical information on methods of modifying blank shoes, of making special shoes from the bar, of trimming the hoof, of caring for it by way of prevention and cure, and of doing generally those things that a horseshoer ought to do.

Attention is called to a series of articles on the foot and on shoeing which begins in the present issue. Our readers may expect all kinds of useful information as the series goes on and opportunity is afforded for setting forth approved methods of carrying on the business of horseshoeing.

Many of our readers are, naturally, expert horseshoers. But nobody knows it all. And we suggest that all read the articles as they appear. Everyone—even the most experienced—will probably find, time and again, something that he did not know before, provided he reads with the purpose of finding out everything he can. The beginner will find the articles plain and correct. Naturally, there will be some things he will not understand to the fullest extent at first.

On the whole, we recommend all our readers that are interested in shoeing and caring for the feet of horses and mules to read the articles with attention. There will be in them something for everybody—experienced and inexperienced, old and young.

The first article, printed elsewhere in the present issue, begins the consideration of the hoof of the horse, both with respect to its character and with respect to certain troubles to which it is subject. The horseshoer should understand both matters, because each affects the shoeing. It is proposed to go on and consider other parts of the foot, always connecting things up with the business of the man who shoes horses. In addition, it is proposed to consider matters connected with the blacksmithing part of shoeing.

Be A Pioneer

A WRITER in a business paper recently asserted that "The Pioneer never receives much assistance. He has to have enough faith in his scheme to put it through on his own initiative." We quite agree with this statement. It is especially worth consideration too, by the present day blacksmith, or to be more definite, by the present day blacksmith who is undecided as to the future of his business.

We have received many interesting letters from our blacksmith friends commenting on the lack of business in their ordinary line of work, and also in many cases stating, that they have gone in for automobile and motor truck business. Indications are, however, that a great many are "on the fence" as regards future practice. It would seem that the advent of the automobile and motor truck had brought about a situation that appears to some a very difficult problem. A problem because, it leaves them undecided and more or less uncertain of the future of their business. There has been created what might be termed a "giant Boogy"— and this "Boogy" has scared a good many folks. It is our belief that the blacksmith of today has just as bright a future as ever appeared to those who have preceded him.

There is no denying the fact that the blacksmith who has been alive to the changing conditions, who has had "faith enough," in both his ability and his business, is today enjoying prosperity along with the rest of the wide-awake and progressive men in kindred lines of effort. It cannot be said that the blacksmith is altogether a "back-number." If he is willing to exercise the pioneer spirit, to go ahead on his own judgment of what is best for his business, and has the faith to make his work count, he is in line for harvesting of profits that are now in many cases being gathered by numberless young fellows who possess only a small fraction of the skill and mechanical ability that forms the big asset of the real smith.

Make the resolution now. If your business is going down hill, and the automobile trade is going to other shops, resolve that you will turn over a new leaf next year and reach out and gather in all of the work that should be yours. Be a pioneer. The business can be had, but you'll have to go after it.

International Livestock Exposition

The International Live Stock Exposition, —the greatest all-around live stock show in the world,—opens at the Stock Yards in Chicago, December 2, and continues one week. More than ten thousand animals,—horses cattle, sheep and swine, will be on display. The livestock exhibits and judging will hold attention during the day, but each evening, the International Horse Show will, as usual, fill the seats around the arena to overflowing. No show in America draws such tremendous crowds to its evening performances as the International, and the only regret is that there is not sufficient seating capacity to accommodate the 20,000 people who apply.

A new feature will be introduced this year. Commercial vehicle classes have been announced and have attracted more than eighty entries from business firms, of their teams in regular work on city streets. Dairy companies, bakeries, laundries, etc., have entered their best outfits in the commercial vehicle and single horse and wagon classes; the Western News Company, Chicago Daily News, Chicago Tribune, and such big cartage firms as the Arthur Dixon Transfer, Willett Transfer, Olson Cartage and Broderick Teaming Company, will be represented, either in the wagon or heavy draft classes. It is a practical demonstration of the advertising possibilities in good horse equipment, and, according to the Horse Association of America, evidences a reviving interest in the use of horses in commercial hauls under 20 miles. The American Railway Express Company, which now uses 15,254 horses in the United States, will also be represented.

BIG INCREASE IN HORSE SALES OVER LAST YEAR

THE crop and market report of the U. S. Department of Agriculture for September, shows 89.4 percent increase in horse receipts for September this year as compared to the same month last year. Horses received in 46 public stockyards in September totalled 41,327, an increase of 19,509 over September last year. This indicates a movement toward normal business conditions and a general increase in the use of horses commercially.

The total thus far for 1922 sustains both points. The first nine months total is ahead of last year's by 52,934 horses, or a general increase through the year of 23.3 percent. The reason given by the Horse Association of America for increased demand, is that business firm are beginning to discriminate in the kind of equipment used for long and short hauls, putting horse vehicles back on all short haul and route delivery work. The Horse Association does not anticipate that the horse will return to former numbers on city streets, but that the proportion will be generally greater, and will continue to keep step with the return of better business.

Buying in the southern horse and mule markets has picked up considerably, reflecting the better tone of the cotton market. It has been noted in the past that within two weeks of a change in cotton prices, a change in the same direction takes place in the mule markets. The stockyards at Atlanta, Ga., Ft. Worth and San Antonio, Texas, at Memphis, Tenn., and at Montgomery, Ala., all show a healthy increase in horse and mule business over last year's record.

MORE HORSES—LESS SHOES

NOTWITHSTANDING the fact that there are now more horses in the country than for some time past, evidently a good many of them are destined to go without shoes. According to Census Bureau figures, the number of horseshoe manufacturing establishments has declined from twenty to twelve, during 1919-1821, and the number of persons engaged in the plants from 919 to 306, while the value of the products turned out fell from over three million dollars to less than two million.

Babbitting Connecting Rods

The Entire Job Fully Described and Illustrated

By DAVID BAXTER

THE devices employed in this work are few and the process is quite simple, although these things vary somewhat in different shops. However, the theory is practically the same, whatever be the method or devices.

The mechanic may use home made contrivances or he may purchase a factory-made babbitting outfit. Or combine the two and pattern the former after the latter. This is probably the best suited to all shop conditions, since the mechanic must consider the different shapes and sizes of the various styles of connecting rods, especially if he is doing a general repair business and not specializing on one particular car, for the devices employed on one connecting rod job will not always fit another of a different make. But it is well to have a babbitting device for each of the several kinds of automobiles which are the most numerous in his locality. It will at least save a great deal of time, which is a prime factor nowadays.

The Babbitting Jig

The device is what is termed a "babbitting jig" and is easily constructed in any machine shop. A metal spool is turned out on a lathe in about the shape indicated in the photos which accompany this discussion. This spool is easily made from a piece of shafting. Between flanges it is turned to fit exactly the particular connecting rod bearing in which it is to be used. The body of the spool should be machined to the size of the bearing it is to form. That is, it should be the size of the crank pin the bearing is to fit; the corners next the flanges should be squared or rounded according to the desired shape of the babbitt bearing. The whole thing should be polished smooth before it leaves the lathe.

Spacing Slots

After machining the center part of the spool, the next thing is to cut spacing slots. A hack saw is used to cut a narrow slot in one side of both flanges. These slots should be directly in line from end to end of the spool. They should also be cut at exact right angles with the center of the spool diameter. The metal is sawed out the full depth of the flanges; or until the hack saw blade rests squarely along the body of the spool. Then a spot on each spool flange directly opposite the slots is located, or in other words, an imaginary line would cut the spool in halves on the end.

Slots are then sawed in each flange exactly like the first two slots, being particular about the alignment in regard to the first slots, and to the body of the spool. These slots are for the purpose of dividing the spool in halves so that both bearings can be babbitted at one time.

That is, the cap and the rod bearings can be babbitted at one and the same time. This is achieved by slipping two pieces of tin in the slots, as is shown in one of the pictures. Not only does this arrangement permit casting both bearings at one time but it also spaces them so that each bearing is the proper thickness. That is, the molten babbitt when poured will run the right thickness around the spool.

After the spacer slots are located and cut, a pouring groove is next made in both sides of one flange. This pouring groove is clearly shown in the picture where the mechanic is indicating the inserting of both pieces of tin in the sawed slots. It consists of a filed groove about half way between the tins. The pouring groove for the other half of the bearing is located on the other edge of the same flange. Molten babbitt is poured through these grooves into the bearings.

This spool and the strips of tin form what is called the "babbitting jig." It is placed between the cap and connecting rod bearings while holes are located in the pieces of tin through which the bearing bolts may be inserted when the babbitting is to be done. After the holes are cut in the tins they are again placed in the spool slots and fitted in place on the connecting rod. Then the cap is bolted on and the bearings are ready for casting.

The next essential part of this semi-home-made process is a quantity of moist earth for banking around the jig while the metal is being poured. This earth is much more satisfactory than fire clay or babbitting putty. Ordinary garden soil is very well but if the mechanic has access to a foundry it is better to obtain a bucketful of molding sand; this will last for years if care is taken to preserve it. The sand or earth is moistened enough so that it will cling in a ball when squeezed with the hand, but is not moistened sufficiently to make it muddy. It should be moist enough to hang together well and still crumble easily.

The details of this process, employing the devices described above, are as follows: First, the worn babbitt is removed from the connecting rod and its cap. This is often done with a hammer and chisel but is very easily accomplished with a blow torch or a welding torch flame. The babbitt is melted out more readily than it can be cut out; and the mechanic does not have to bother about drilling out the babbitt anchor holes. A ladle should be held below each bearing to catch the melting babbitt and prevent it from being wasted.

Besides being handier a flame also serves to clean and dry the rod metal after the babbitt is removed and this is an essential part of the babbitting process. The bearings must be dry, as the molten babbitt will be blown back out if it is poured into a wet bearing. It is also a good idea to have the connecting rod warm before pouring the babbitt, especially in winter.

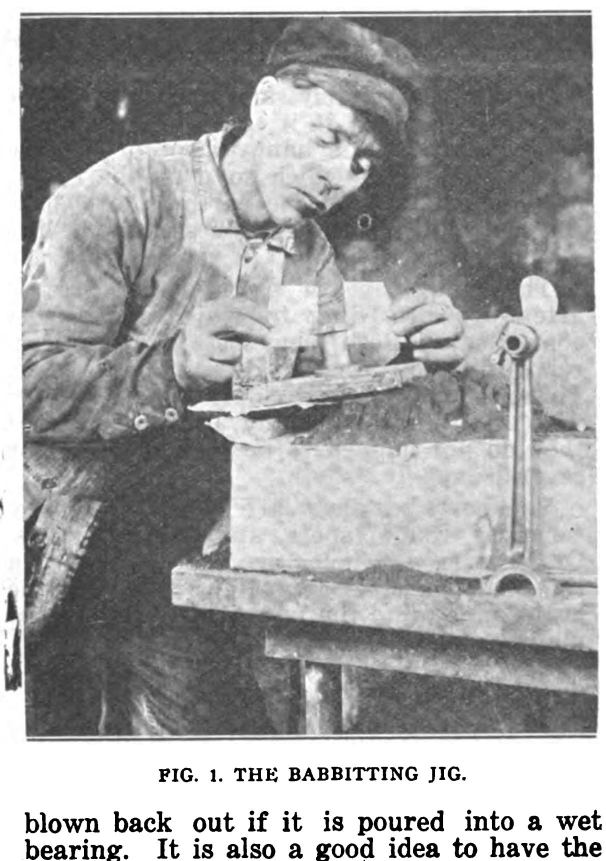

FIG. 1. THE BABBITTING JIG.

After removing the old worn babbitt and drying the bearings, the jig is fitted and the cap bolted on. Then the whole arrangement is bedded level upon the box of moist earth. The earth is then banked up around the jig as shown in Fig. 3. This banking is for the purpose of preventing the fluid babbitt from leaking. When banking up the dirt the mechanic is careful to keep any of it from rolling into the pouring grooves; it is pressed back from these with the thumb and forefinger. The banking should be firmly pressed around the jig as there is considerable pressure when the metal is poured.

Melting the Babbitt

The next thing to do is to melt the babbitt. This is usually carelessly or at least indifferently done in many shops. But the results obtained by being careful and systematic are well worth the effort. However, very few shops are equipped with modern appliances so we must substitute "home remedies." In the first place the babbitt should not be over-melted, or too hot when poured. Nor, on the other hand, should it be poured sluggish or too cold. If it is overheated its nature is changed or its quality altered; it is burned or oxidized; excessive dross forms on the surface of the molten metal. If it is not hot enough, the molten babbitt will not run well but will leave seams or mis-run places in the bearing; often holes or open portions. Then too, sluggish babbitt traps impurities beneath the surface, which would rise if more fluid metal were used.

FIG. 2. ILLUSTRATING THE USE OF THE MOLDING SAND.

There are several tests by which the pouring temperature may be estimated quite accurately in absence of heat measuring devices. One is to plunge a splinter of soft white pine into the melted babbitt. If it ignites, the metal is too hot and should be allowed to cool perceptibly before pouring. If the pine chars badly although it does not blaze, the metal is still too hot. Sawdust may be used in place of the splinter by sprinkling a pinch of it upon the molten surface, or the metal may be tested by bits of newspaper in the same way.

Melt Over Slow Fire

The babbitt should be melted over a slow fire because the danger of over-heating is then minimized. Borings, filings, and scrap metal should be melted first and then the new or ingot metal added to the molten bath. This does not take so long because the borings touch the ladle in all parts. Therefore they melt quicker, and when the ingots are placed in the molten pool they are heated on all sides at once, which makes them melt more quickly. After the ladle is filled with melted babbitt the heat tests are applied.

A bit of resin dropped into a ladle of molten babbitt is said to improve its running qualities and make a more solid bearing. Some mechanics advocate the placing of this resin before the ladle is heated. But it would seem that nothing like this is needed if the babbitt is of good quality in the first place and is melted carefully.

Probably the simplest way to tell whether the babbitt is hot enough to pour well is by rocking the ladle and watching the surface of the molten bath. But this can be truly learned by experienced observation only. If the surface ripples somewhat like water it is too hot yet. When it rolls more slowly it is about right for pouring.

When the metal is ready to pour the surface impurities or dross should be carefully skimmed. This is handily accomplished with a flat spoon-like tool, made by hammering a couple of inches off a half-inch round bar of iron flat and thin. The dross is lifted off and deposited in a special receptacle if it is the shop practice to save the stuff. At any rate the mechanic should be careful not to spill any of it in the fire if the melting is being done on a blacksmith forge, as it will spoil the fire for welding.

FIG. 3. THE BABBITTING ARRANGEMENT READY FOR POURING THE METAL.

The babbitt should be poured as soon as it is in the right condition. And, it is not amiss to state here that the babbitt should be melted and poured soon after the jig arrangement is ready, since the moist earth banking tends to cause moisture to gather on the spool and tin shims. At least the device should not stand long before it is poured. The molten metal is poured quickly and deftly into one pouring groove and then the other without delay. This prevents gas or condensation from forming the second half of the bearing. The grooves may be filled entirely full as they are easily cut off after the metal cools.

When the metal has set thoroughly the moist earth is scraped aside and the connecting rod taken out. The dirt is all replaced in the box to keep for future operations. It will keep indefinitely and has only to be moistened a little if it becomes dry before using again. It is handy also for making ingot molds into which to pour the excess of melted babbitt. The earth is leveled in the box and has troughs pressed in it into which the extra babbitt is poured.

The strips of tin are removed first or afterward according to which is the most convenient. Both new bearings are then ready for polishing or dressing otherwise. The spool and the tin dividers are then coated with oil to prevent rusting, in the event that they do not happen to be needed again for several days.

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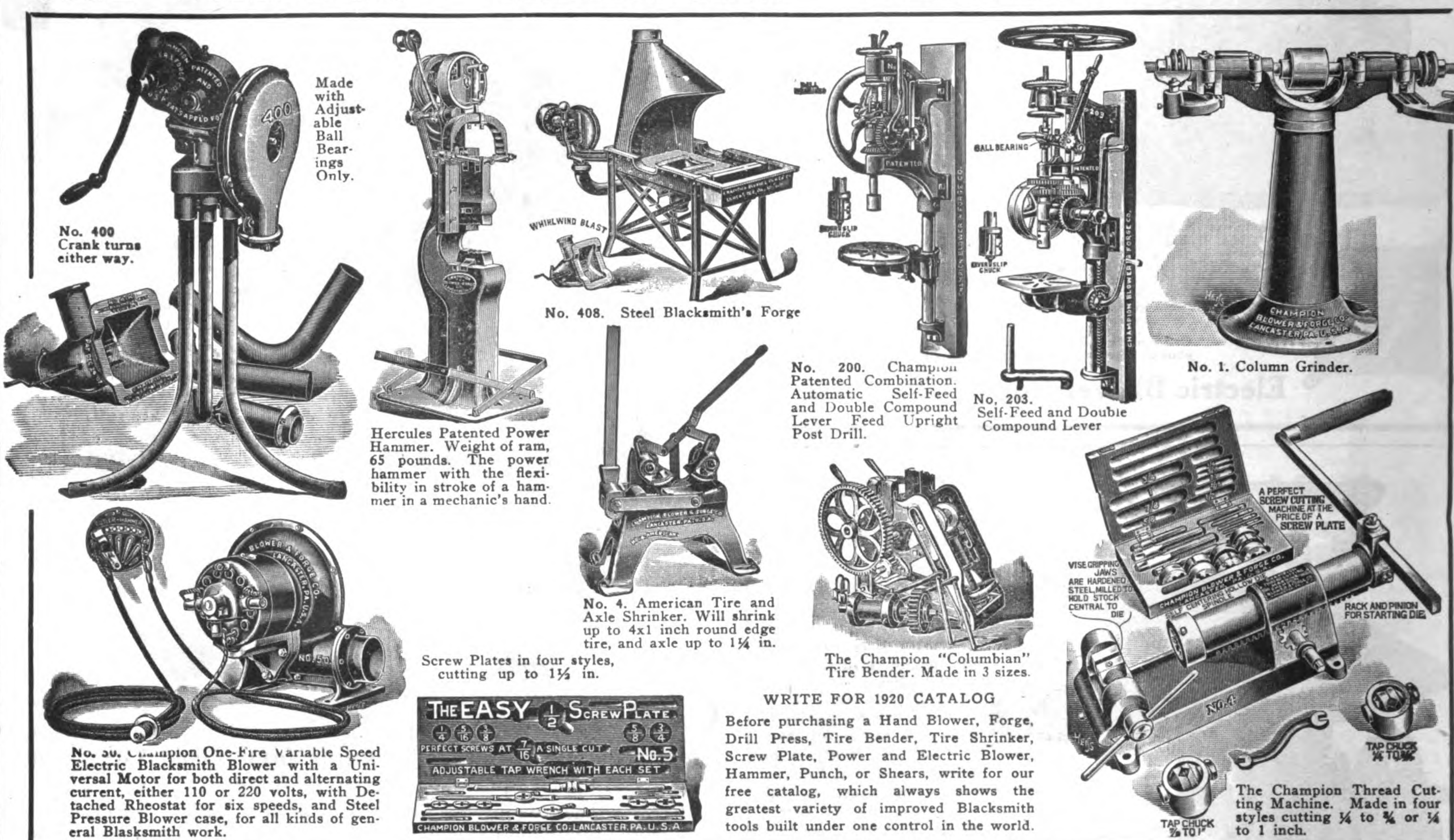

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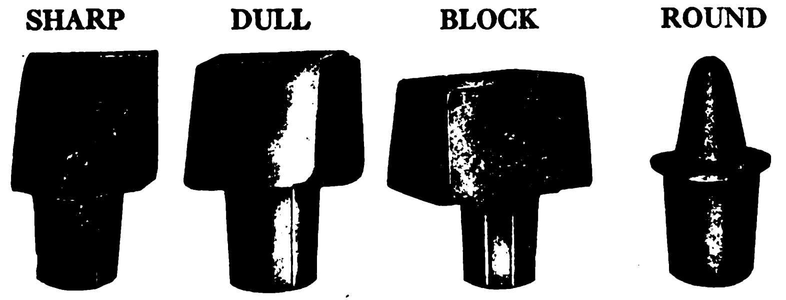

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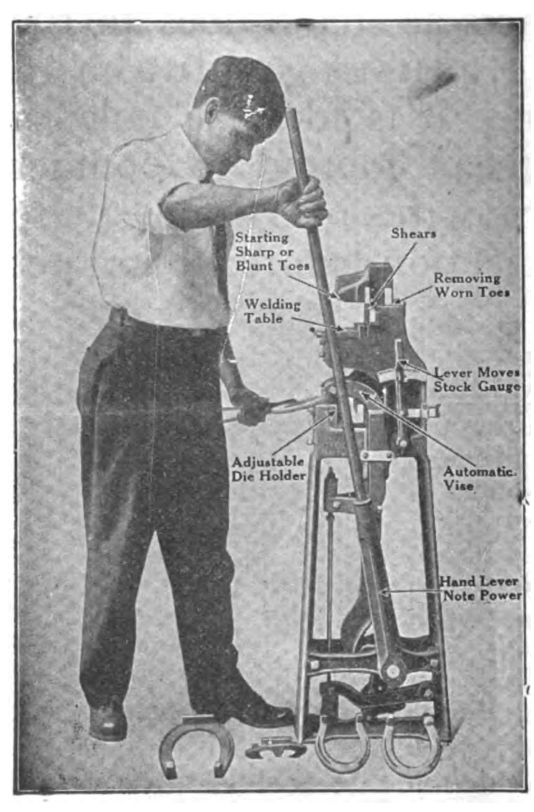

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