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A HOME MADE FARM FORGE

Prepared by

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Assistant Extension Agricultural Engineers

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A HOME MADE FARM FORGE

A farm forge is essential on every farm if any amount of farm machinery repair work is to be done at home. The village blacksmiths who were found in every town a few years ago are gradually disappearing. Some of the work which they did can be handled now at local garages but, in too many cases, these garages are not equipped for, nor the mechanics trained to do, forge work. Even when they are, a farmer often can save money and avoid expensive delays during the busy season if he has a forge and knows how to use it. He also can do such jobs as bending, shaping, sharpening, welding, hardening and tempering which keep his machinery in better working condition.

NECESSARY EQUIPMENT FOR FORGE WORK

Tools

It takes practice to become proficient in forge work just as it does in any of the other skills. Some equipment and a few tools are needed in order to get this practice. A beginner naturally wants to keep the investment in equipment and tools at a minimum until he is sure that he can use what he has to the best advantage. Only a few tools are needed for the more simple and most common forge jobs. These tools and their probable prices are:

Bolt tongs - for holding round stock	\$1.00 to \$1.25
Flat tongs - for holding flat or square work	.75 to \$1.25
3 pound blacksmith's hammer	\$1.25 to \$1.75
2 pound ball-peen hammer	\$1.00 to \$1.25
Hardie to fit anvil - to serve as an edge for cutting hot or cold metal with a hammer,	.50 to .75
TOTAL	\$4.50 to \$6.25

Equipment

An anvil, preferably a 100 pound one, and a forge also are necessary. A new anvil probably will cost from \$15.00 to \$20.00. Sometimes a used one may be obtained and, if so, the price usually is much less. The forge may be purchased or may be home-made. A good quality, commercially made, portable forge, with blower attached will cost in the neighborhood of \$20.00 to \$25.00. The total cost of tools, anvil and forge, if purchased new therefore would be around \$39.50 to \$51.25.

Forges

Commercially made forges often are too light for heavy farm work. Many farmers prefer to make their own forges in order to have sturdier equipment and larger working surfaces. Such forges are in use on many Nebraska farms and considerable ingenuity has been displayed in their construction. They usually are made of concrete although brick may be used equally well. In some cases where old iron rods were available on the farm and where used bricks or sand-gravel could be obtained at reduced prices the cost of the home-made forge was less than the cost of a commercially made one. Construction details and pointers, as well as the materials needed for making a concrete forge are shown on the following pages.

CONSTRUCTION OF HOME MADE FORGES

Foundation

This forge will weigh approximately 2030 pounds when completed and therefore should have a substantial foundation under it. The foundation should be 8 inches deep and should have the same surface size as the over all base dimensions of the forge - 2'-4" x 2'-6". This foundation should be placed on solid dirt - never on filled - and should be reinforced. If reinforcing rods are used they should be $\frac{1}{2}$ inch in size and should be spaced 8 inches on centers and run both ways. Oftentimes enough old iron, suitable for reinforcing, can be found on the farm. Old wagon tires, iron rods or bars may be used if they are not rusty.

Concrete Mix

A mix of 1 part cement, 4 parts clean, well-graded sand-gravel and 5 gallons of water for sack of cement (if the sand-gravel is dry) is recommended for the concrete. If the sand-gravel is damp, 4 gallons of water should be added while if it is wet only 3 gallons will be needed. Strong concrete results from a dry or stiff mix and the amount of water used should be limited to an amount which will give a plastic, workable mix. "Sloppy" mixes always result in weak concrete and should never be used for any type of work.

Aggregate

Good concrete also depends upon the grading of the aggregate and the absence of dirt in this aggregate. Most of the sand-gravel found in Nebraska is fairly well graded but occasionally some of it is too coarse or too fine. A suitable aggregate will have from 40 to 50 percent sand and from 60 to 50 percent gravel. When too little sand is present, more cement is

needed than when the aggregate is well graded. A coarse, harsh mix results which is hard to handle and does not finish smoothly on the surface. If too much sand is present, the resulting concrete is not as good as when the correct proportions of sand and gravel are used.

It is important that the sand-gravel be free of dirt or vegetable matter. The presence of these materials prevents a good bond between the cement paste and the sand-gravel particles. Most of the sand-gravel taken from the Platte river or pumped from pits is clean, while oftentimes that taken from banks is dirty. A simple test to use in determining whether or not the sand-gravel is suitable for use is as follows:

1. Place 2 inches of the sand-gravel in question in a one quart fruit jar.
2. Add water until the jar is approximately $\frac{3}{4}$ full and then screw on the lid being sure to use a jar rubber.
3. Shake vigorously for about one minute with the last shake or two leaving the surface of the sand-gravel level.
4. Let the jar stand for about one hour without moving. This will allow such dirt, as the water may have washed off of the sand-gravel, to settle out in a thin layer on top of it.
5. If the resulting layer of dirt is $\frac{1}{8}$ of an inch or more thick, the sand-gravel from which the test sample was taken is too dirty and should not be used unless it is washed thoroughly. Such washing usually is difficult or expensive. In most cases it would be better to obtain aggregate from some other source.

Forms

All concrete construction requires the use of forms to hold the plastic mass in the desired shape until it has hardened. Since concrete weighs approximately 140 pounds per cubic foot and, until it starts to harden, exerts considerable bursting pressure, the forms must be rigidly built. Flimsy forms nearly always result in failures because once they start to shift it is almost impossible to repair them without damaging the concrete.

The following bill of material is for the forms shown on Page 4. The actual cutting lengths of the pieces are shown, since oftentimes old material is available on the farm or short lengths may be obtained from a materials dealer at a reduced cost.

12 pcs. - 2" x 4" x 2'-6"
2 pcs. - 2" x 4" x 2'-4"
6 pcs. - 2" x 4" x 1'-4"
2 pcs. - 2" x 2" x 2'-6"
9 pcs. - 8" shiplap - 3'-0" long
6 pcs. - 8" shiplap - 2'-6" long
9 pcs. - 8" shiplap - 2'-4" long
5 pcs. - 8" shiplap - 12" long
Nails:
2 lbs. 8d. common
 $\frac{1}{2}$ lb. 10d. common

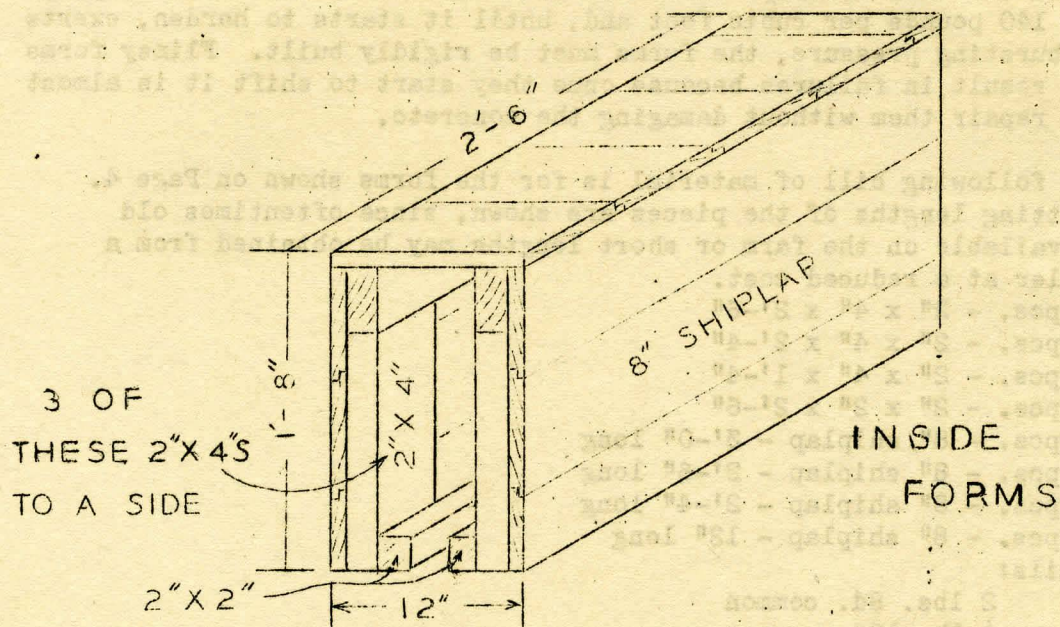
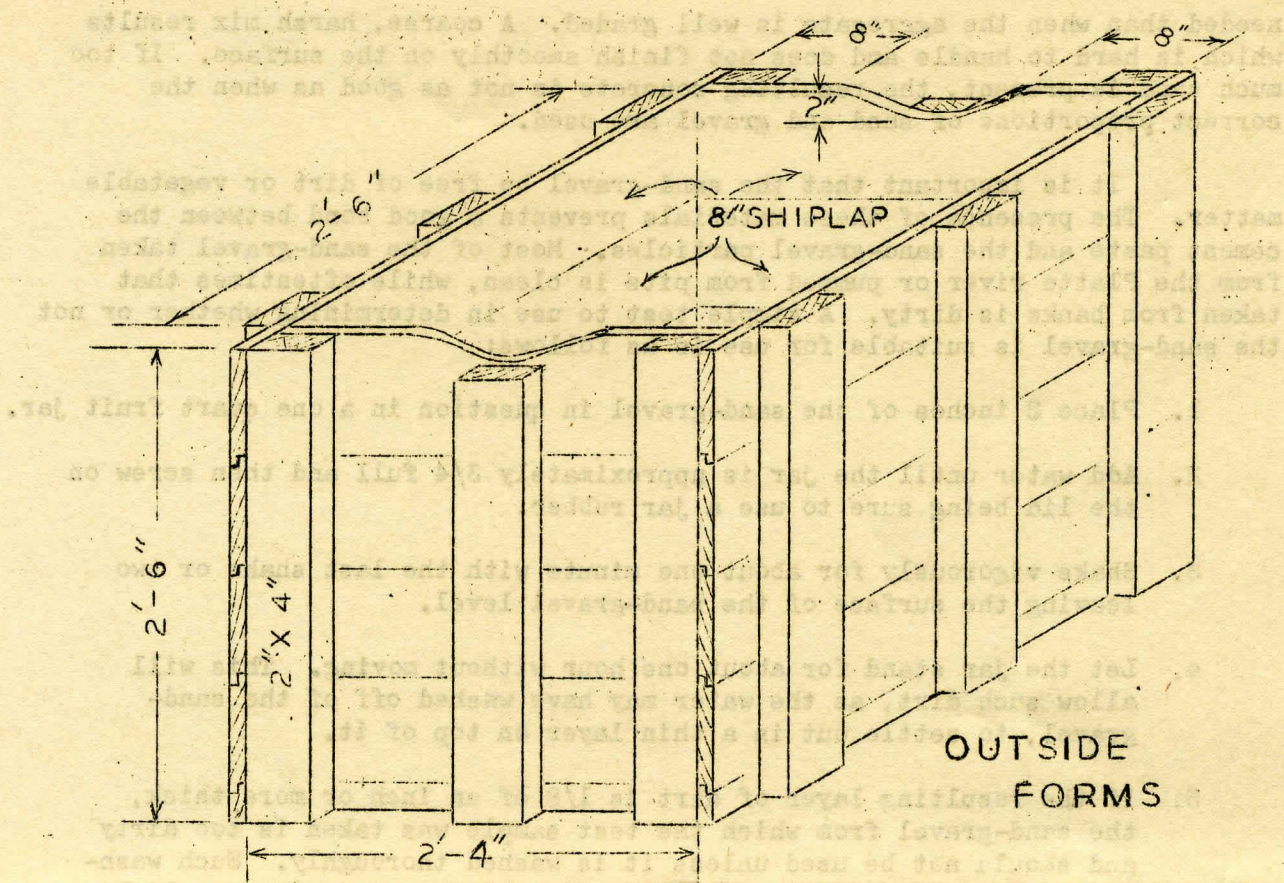


FIG. I

Forms for the forge should be made of 1 inch material and should be braced carefully to prevent bulging when the concrete is placed in them. Details showing one method of constructing such forms are shown in Figure 1. It may be necessary to place a wedging block between the 2" x 2"s on the bottom of the inside forms to keep them from buckling. Only one such block will be needed, and it should be located at the mid-point of these 2" x 2"s, if the ends of the inside forms are held in place by nailing the shiplap on the ends of the outside forms to the 2" x 4" uprights of the inside forms. Such nailing should be done after the two sets of forms are assembled. These nails may be removed easier after the forge is completed if they are not driven in completely.

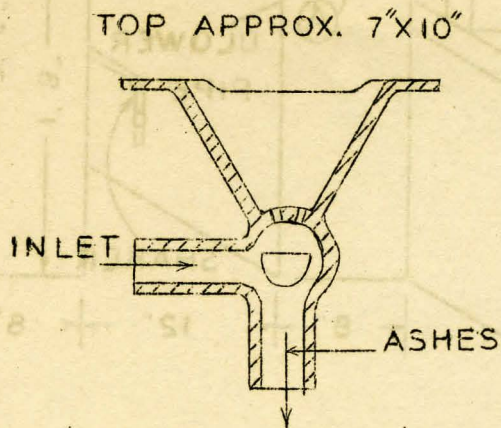
All of the holes for bolts and the blower pipe should be bored in the forms before they are assembled.

A coating of old crank case motor oil on the inside of the outside forms and the outside of the inside forms will make the removal of the forms easier. If the lumber is to be used later for rough work, this oil will not be objectionable.

Attention is called to the shape of the ends of the outside forms. This 2 inch depression in the center is needed to permit the correct shaping of the concrete on the working surface of the forge.

Tuyere Iron and Blower Pipe

The tuyere iron or fire box is the heart of the forge and it will pay to buy a good one. A cross section of one good type of tuyere iron is shown in Figure 2. This tuyere iron and the sleeve for the blower pipe, shown at "A" Figure 3, should be fastened in place before the concrete is placed in the forms.



SECTION OF A
GOOD TUYERE

FIG. 2

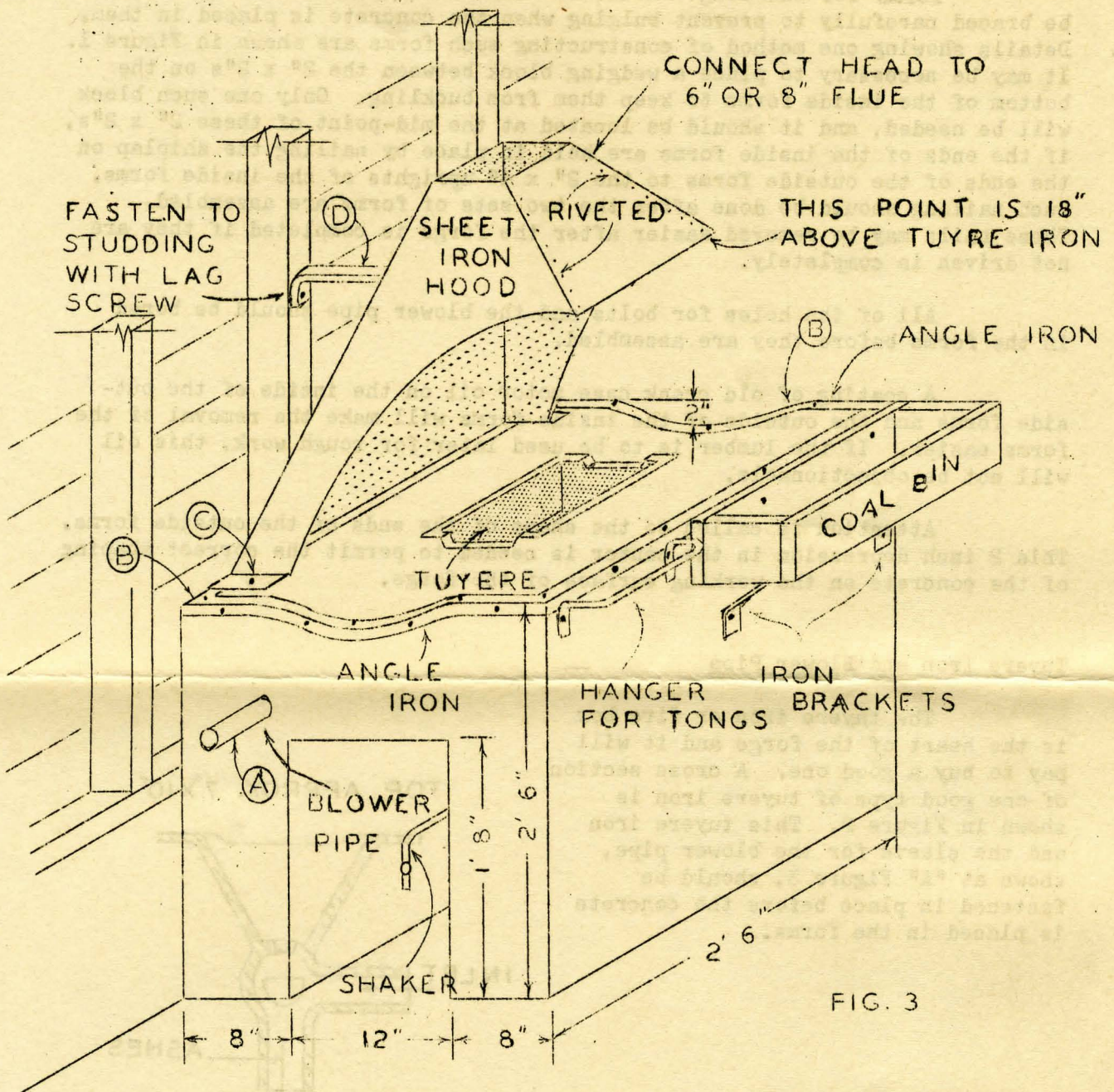


FIG. 3

Tool Rack and Coal Bin

A hanger for tools and a bin for coal may be fastened to the side of the forge, as shown in Figure 3, if desired. Bolts for supporting the hanger and the bin would have to be inbedded in the concrete if this arrangement were used. Holes for the bolts should be bored in the forms and the bolts inserted their correct distance before the concrete is placed. Since the thread end of the bolt will be on the outside, no difficulty should be experienced in the removal of the forms. Care should be taken at the time of

removal, however, to prevent any movement of the bolts. Since this arrangement of supporting the hanger and bin complicates construction somewhat, tools are often hung on a hanger or a rack fastened to the wall and coal stored in a bin built independently of the forge itself.

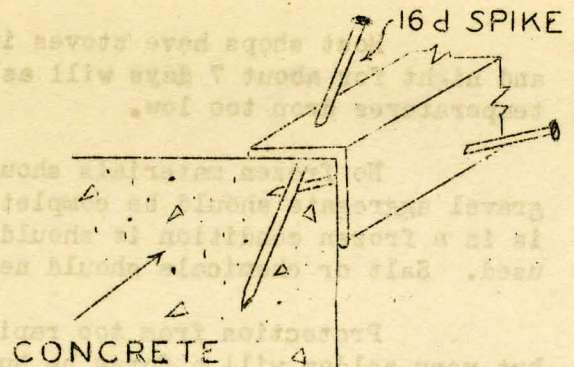
Edge Protection

The angle iron for the protection of the edges of the forge, as shown at "B", Figure 3, should be bent and drilled as shown in Figure 3 ready for fitting into place before the concrete is mixed. Twenty-eight 16d spikes will be enough to hold the angle iron to the forge securely. Attention is called to the spikes in the side of the angle iron as well as those in the top. It will be necessary to bore holes in the forms so these may be inserted before the forms are removed. Old wagon tires may be substituted for angle iron if the latter is not available.

Placing the Concrete

The concrete for the forge should be mixed in the same proportions as that for the foundation slab. It must be spaded and tamped thoroughly when placed in the forms. Attention is called to the depression which runs lengthways of the top surface of the forge. This depression is important and may be made without difficulty if the end forms have been built correctly. A 1" x 4" placed on edge across the end forms and pulled from the rear of the forge to the front will leave the surface the correct shape. Some method of keeping the excess concrete from falling into the tuyere iron, as the 1" x 4" is pulled over it, must be provided.

The angle iron should then be placed in position and the spikes pushed through the holes and into the concrete as shown in Figure 4. As soon as this operation is finished and before the concrete has had a chance to "set", which is about 45 minutes after it has been mixed, bolts should be inserted for the hood. These bolts are shown at "C", Figure 3, and care should be taken to get them located correctly. No great strain will fall on these so 3/8" x 4" bolts will be large enough. The thread ends should extend above the forge surface approximately 3/4 of an inch to allow room for the tab on the hood, a washer and a nut.



A smooth working surface on the top of the forge may be obtained by the use of a steel trowel. Troweling should not be done too soon after the concrete is placed in the forms or a "dusty" surface may result. Troweling should be delayed until the concrete is quite stiff, has a dull appearance and there is no indication of water standing on its surface. In case the surface should be a little too stiff to trowel easily it may be dampened slightly by the use of a whitewash brush which has been dipped in water. Excessive troweling should also be avoided in order to prevent dustiness.

The forms should be left in place for approximately 48 hours after the forge is completed. This allows the concrete to cure thoroughly throughout its entire mass. The forge should not be used for 14 days after the forms have been removed to prevent damage from the heat of the fire.

Weather Protection for Concrete

Protection from weather extremes is essential in the production of good concrete. The conditions under which the concrete is cured as well as the mix used, influence the strength of the finished product. It must not be allowed to freeze or to dry too rapidly.

Ordinarily, it is not advisable to do concrete work during the coldest winter months but too often it is the only time when other farm work permits it. A temperature of around 50 degrees allows concrete to develop full strength while curing. Should the temperature drop below this point the concrete cures more slowly and the use of the article is delayed. Damage from freezing will not occur, of course, until the temperature falls below 32 degrees but it is unwise to allow concrete to cure at temperatures in the upper 30's or lower 40's if it can be avoided. Some protection can be provided by covering the work with straw but manure should never be used.

Most shops have stoves in them. A fire kept going in a stove day and night for about 7 days will assure curing without damage unless the temperatures drop too low.

No frozen materials should be used in making concrete. The sand-gravel aggregate should be completely free from particles of ice. If it is in a frozen condition it should be thawed out by heating before it is used. Salt or chemicals should never be added to prevent freezing.

Protection from too rapid drying of the concrete is also essential but very seldom will a forge be built where it will be exposed to direct sunshine or drying winds. Should the work be done during the hottest part of the summer, the exposed surface of the concrete should be wetted thoroughly at least twice daily during the first week. This may be done by sprinkling but more effective wetting may be accomplished by laying wet gunny sacks over the surface.

Brick Forge

If brick were used instead of concrete, the top 3 or 4 inches of the forge should be a reinforced concrete slab. A brick surface on a forge is not very durable and it is difficult to build so that it will have the center of depression.

PATTERN FOR CUTTING HOOD

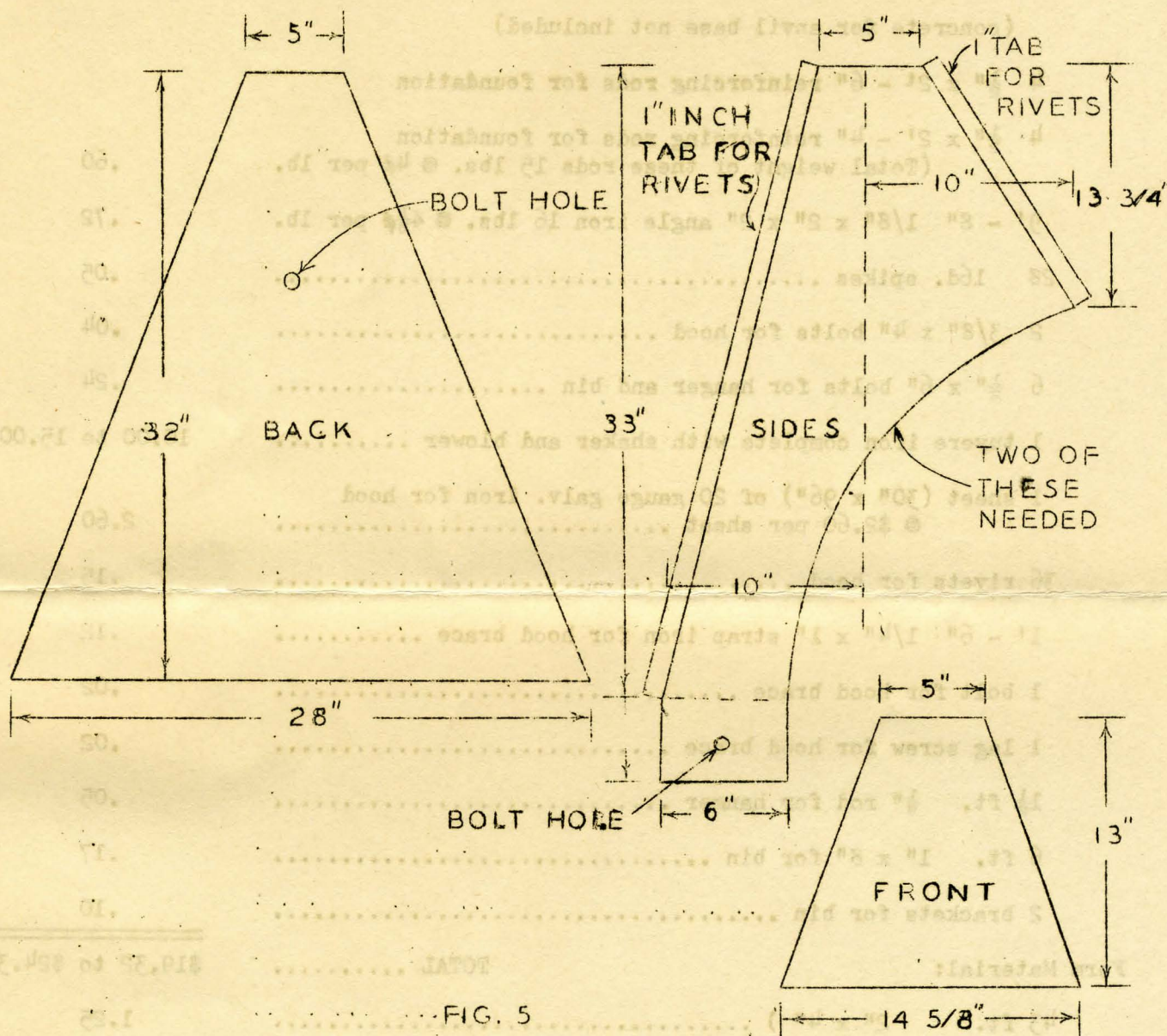


FIG. 5

Hood Construction

The hood may be made of 20 gauge galvanized iron or from black sheet iron. A cutting pattern for the back, sides and front is shown in Figure 5. Attention is called to the 1 inch tabs for riveting left along the edges of the side pieces. An iron brace should be attached to the back of the hood, as shown at "D", Figure 3, so it may be fastened to the wall of the building. A 6 or 8 inch flue may be connected to the top of the hood but it should be well insulated where it passes through the roof to prevent fires. The flue should extend approximately 2 feet above the ridge of the building to assure a good draft.

The following materials will be needed for the construction of this forge and the foundation under it. Approximate prices also are given.

4 sacks cement @ 85¢ per sack	\$ 3.40
1040 pounds sand-gravel @ 10¢ per 100 lbs.	1.04
(concrete for anvil base not included)	
4 $\frac{1}{2}$ " x 2' - 6" reinforcing rods for foundation	
4 $\frac{1}{2}$ " x 2' - 4" reinforcing rods for foundation (Total weight of these rods 15 lbs. @ 4¢ per lb.	.60
9' - 8" $\frac{1}{8}$ " x 2" x 2" angle iron 16 lbs. @ $4\frac{1}{2}$ ¢ per lb.	.72
28 16d. spikes .....	.05
2 $\frac{3}{8}$ " x 4" bolts for hood .....	.04
6 $\frac{1}{2}$ " x 6" bolts for hanger and bin .....	.24
1 tuyere iron complete with shaker and blower	10.00 to 15.00
1 sheet (30" x 96") of 20 gauge galv. iron for hood @ \$2.60 per sheet	2.60
36 rivets for hood .....	.15
1' - 6" $\frac{1}{4}$ " x 1" strap iron for hood brace .....	.12
1 bolt for hood brace .....	.02
1 lag screw for hood brace .....	.02
1 $\frac{1}{2}$ ft. $\frac{1}{2}$ " rod for hanger .....	.05
6 ft. 1" x 8" for bin .....	.17
2 brackets for bin .....	.10
Form Material: TOTAL	\$19.32 to \$24.32
43 ft. 2" x 4")	1.25
) @ \$43.00 per M. bd. ft.	
5 ft. 2" x 2" ) .....	.10
77 ft. 8" shiplap) @ \$43.00 per M. bd. ft.	2.25
Nails:	
2 lbs. 8d. common	
$\frac{1}{2}$ lb. 10d. common .....	.15
TOTAL	\$3.75

ANVIL LOCATION

The forge may be used to the best advantage only when the anvil is located correctly. Excessive cooling of the material and many extra steps for the worker will be eliminated if the anvil is located approximately as shown in Figure 6. This arrangement presupposes the user is right-handed. For left-handed workers the entire layout should be reversed.

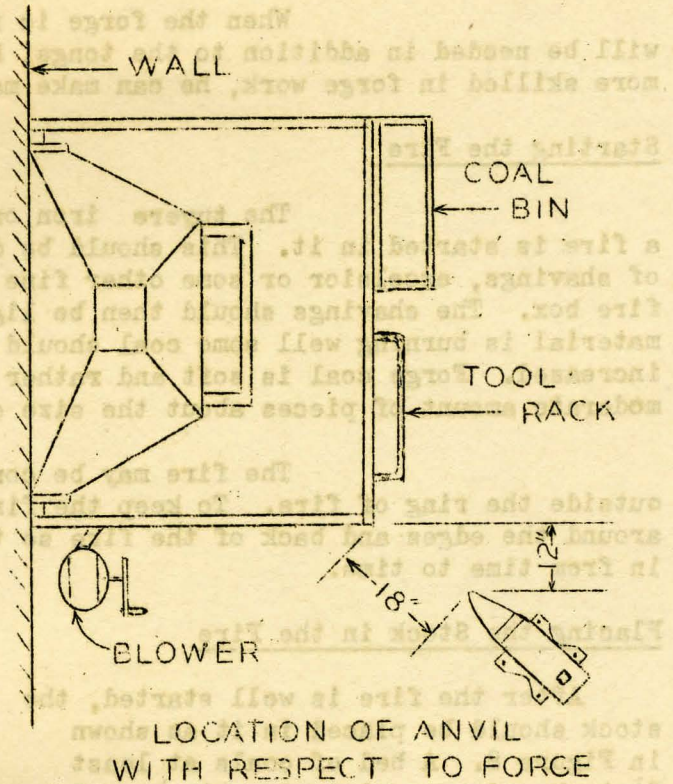


FIG. 6

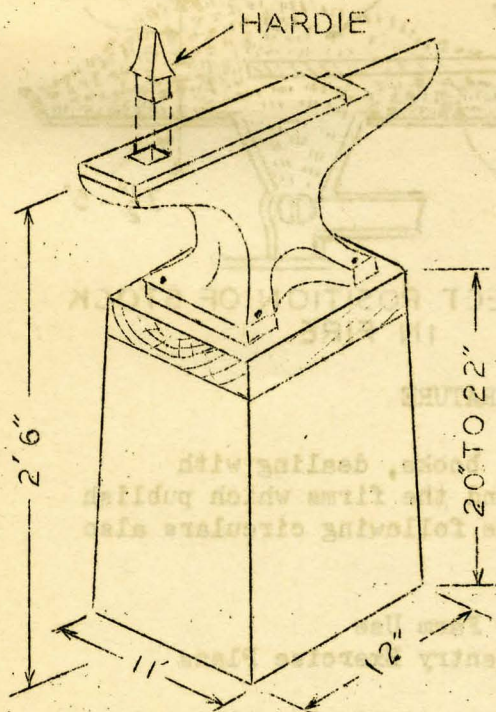


FIG. 7

The anvil should be mounted on a firm base. One type of base is shown in Figure 7. Attention is called to the block of hard wood on top of the concrete. This wood acts as a cushion and is held in place by the bolts which fasten the anvil to the concrete base. The securing of the anvil to the base is important and should never be omitted.

The height of the base is shown for workers of average height: 5'-10" to 6'-0". If the worker is taller or shorter, the base should be so made that he may work at the anvil with ease.

Approximately $1\frac{1}{2}$ cubic feet of concrete will be required to make a base of the dimensions shown. The same mix should be used for this concrete as for the forge itself.

If a large enough piece of an old tree trunk is available it might be used as a base for the anvil. Hardwood rather than softwood is desirable. The anvil may be fastened to a base of this sort with long lag screws.

Additional Equipment Needed

When the forge is ready for use, a small shovel and broom will be needed in addition to the tongs, hammers and anvil. As the user becomes more skilled in forge work, he can make many other tools which he will want.

Starting the Fire

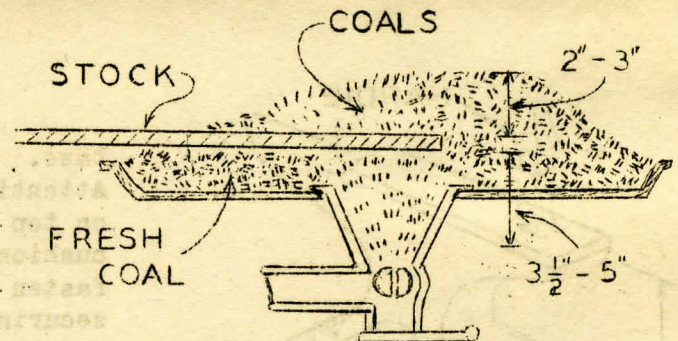
The tuyere iron or fire box should be cleaned out before a fire is started in it. This should be done each time it is used. A handful of shavings, excelsior or some other fine material should then be placed in the fire box. The shavings should then be lighted and the blower started. When this material is burning well some coal should be added and the speed of the blower increased. Forge coal is soft and rather fine but should always contain a moderate amount of pieces about the size of a walnut.

The fire may be controlled by dampening the coal just outside the ring of fire. To keep the fire clean, new coal should be placed around the edges and back of the fire so that small amounts of it may be worked in from time to time.

Placing the Stock in the Fire

After the fire is well started, the stock should be placed in it as shown in Figure 8. A bed of coals at least $3\frac{1}{2}$ inches deep, and preferably 4 or 5 inches, is necessary to assure thorough and rapid heating. The stock should also be covered with 2 to 3 inches of coals.

Care must be taken to place the stock as indicated. The end of it must not be pushed too far down in the tuyere iron. If the end gets too near the bottom of the bed of coals it is apt to be "burned" making it unfit for use.



CORRECT POSITION OF STOCK
IN FIRE

AVAILABLE FORGE LITERATURE

There are a number of good text books, dealing with forge work, on the market. The names of these books and the firms which publish them may be obtained from your Agricultural Agent. The following circulars also contain helpful information:

Ext. Circ. 743 - Simple Forge Hints for Farm Use

Ext. Circ. 744 - List of Forge and Carpentry Exercise Plans

Copies of these circulars may be obtained from your County Agricultural Agent or from Agricultural Extension Service, College of Agriculture, Lincoln, Nebraska.