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AN ORCHARD BRUSH BURNER

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Brush burner in operation, burning fig prunings.

There has been much demand from California orchardists and vineyardists for a brush burner that can be built in a substantial manner at a reasonable cost with the tools and equipment found in the average farm shop. Furthermore, a burner is desired that can be built low, that will permit the making of alterations according to individual orchard conditions, and that is light enough to be pulled by two horses. Recognizing the importance of this demand, the Division of Agricultural Engineering at the University Farm, Davis, coöperating with the Division of Pomology, has designed a burner with the above requirements in mind.

TYPE OF BURNER

An angle iron frame carrying a suspension or basket-type fire pan is used (fig. 1). By use of this type of fire pan, the strain placed upon the red-hot sheet iron is direct tension in place of bending.

Therefore, it is possible to do away with the material usually required to reinforce the fire pan. By this plan it is also possible to place the material used in the main frame far enough from the hottest part of the fire that a light type of construction may be used. Angle iron runners are used for transportation. In orchard trials the burner was easily pulled by a team of horses.

Fig. 1.—Sketch of orchard brush burner designed by the Division of Agricultural Engineering.

MATERIALS AND COSTS

The materials used have been carefully standardized so that there is just one size of angle iron necessary ($2\frac{1}{2}$ " by $2\frac{1}{2}$ " by $\frac{1}{4}$ "), one size and length of braces (20 " by $1\frac{1}{2}$ " by $\frac{3}{8}$ "), two sizes of machine bolts ($\frac{1}{2}$ " by 1 " and $\frac{3}{8}$ " by 1 "), one size and length of tie rod ($\frac{1}{2}$ " round) and one gauge or thickness of material for the fire pan.

One burner built at the University Farm, using new material for the frame and the discarded oil tank shown in figure 2 for the pan, cost altogether \$10.40. Another burner built of new material throughout (frontispiece) cost \$27.22. In both cases the angle iron was purchased with the necessary cuts already made. Two men with an average set of tools should be able to build one of these burners in one to two days.

BILL OF MATERIAL

Description of material	Name of part	No. of pieces	Length, size, etc.	Remarks
Angle Iron ($2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{1}{4}$ ")	Skids	2	9'	Bending of ends and drilling of holes are same.
Angle Iron ($2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{1}{4}$ ")	Fire pan supports	2	8'	Both drilled alike.
Angle Iron ($2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{1}{4}$ ")	Vertical members	4	$2\frac{1}{2}$ '	Two right-hand, two left-hand.
Angle Iron ($2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{1}{4}$ ")	Cross beams	2	5'	Both alike.
Strap Iron ($1\frac{1}{2}$ "x $3/8$ ").....	End braces	2	20"	$3/8$ " holes.
Strap Iron ($1\frac{1}{2}$ "x $3/8$ ")	Cross braces.....	2	20"	18 " on center.
Tie Rods ($\frac{1}{2}$ " round).....	Diagonal tie rods	2	$7\frac{3}{4}$ '	U. S. Standard thread for 2" at each end.
Bolts $\frac{1}{2}$ " Standard Machine $3/8$ " Standard Machine	Connecting angles Braces and fire pan	12 30	1" 1"	Use standard machine bolts.
Nuts	Fastening tie rods	4	$\frac{1}{2}$ " U.S.S. thread	Hex nuts will be easier to turn up than square ones.
Washers	Under tie rod nuts	4		
Sheet Iron (Not less than 16 gauge)	Fire pan	1	$\frac{1}{2}$ cylinder 8' long by $4\frac{1}{2}$ ' radius	May be made of old water tanks, boilers, corrugated culverts, etc. Black iron usually cheaper and is just as good. If in small sections pieces may be welded or riveted together.

In some cases it may be possible to buy second-hand material. However, it is usually difficult to obtain angle iron of the correct size and weight for good results. It must be remembered that the dimensions for the angles should not vary too greatly. An angle of smaller dimensions may mean a bent portion on the frame when the burner is in operation. For the fire pan, however, old tanks, boilers, corrugated culverts, or other second-hand sheet iron may often be used to good advantage. For example, note figure 2, which shows how a pan for one burner was cut away from an old cylindrical fuel tank. It is

very important that no material lighter than 16-gauge (approximately $\frac{1}{16}$ " thickness) be used because of the rapid burning and rusting effects.

TOOLS NECESSARY

The principal tools required for making one of these burners are a forge, a drill press, a center punch, a $\frac{3}{8}$ " point hot punch, a cold chisel (preferably with handle), and a $\frac{1}{2}$ " U. S. standard die. A sledge, a machine hammer, a steel square, a bit brace, and two adjustable wrenches are also necessary.

Fig. 2. Using an old oil tank for fire pan. In this case the required material was cut away by the aid of an oxy-acetylene torch. Usually the material is cut with a cold chisel.

If oxy-acetylene equipment is available, it can be used with advantage, especially for cutting the air-draft holes in the fire box. It is also convenient for cutting the angles in case they are bought in stock lengths. Moreover, it can be used for bending the curved ends of the skids. With an oxy-acetylene outfit, it is not necessary to have the forge fire, the cold chisel, or the hot punch mentioned above.

BUILDING THE FRAME

The bill of materials (page 3) and figures 3 and 4 furnish the information necessary for cutting the stock for the frame and preparing it for assembly. As a general rule, time and money can be saved by buying the angle iron already cut to the proper lengths. It will help greatly in the assembling to get the cuts as square as possible. In case the angle iron is bought in stock lengths, a hack saw is a good tool for cutting it. A cold chisel can be used with greater speed but is not so accurate.

In making the bend for the curved end of the skid or runner, heat the angle iron to a white heat at a point approximately one foot from the end. Hold the angle iron over a solid body such as an anvil (fig. 5) and bend by striking the overhanging portion with a sledge. As the

Fig. 3.—Side view.

angle is bent down, it should be turned sidewise from time to time and the kink which tends to form along the inner flange straightened (fig. 5a). Be certain that the bent part of the skid lies in the same vertical plane as the main part. By holding the long blade of a

Fig. 4.—End view.

steel square along the bottom of the skid the amount of the bend can be easily read on the short blade. Bend until the vertical rise at the end of the skid is five inches. It is important to get the skids curved as nearly alike as possible.

After completing the bending of the skids, the holes for the diagonal tie rods should be punched. These are $\frac{5}{8}$ " and should be punched through the corners of the vertical angles at a point $3\frac{1}{2}$ "

Fig. 5.—Bending the curved ends of the runners.

Fig. 5a—Hammering out the kinks formed during the bending of the runner.

from the bottom ends. Use a white heat for the angle iron when punching these holes. The horn of an anvil makes a good support for the inside of the angle when punching. Do not try to punch the holes all the way through from one side. Go two-thirds of the way through, then turn the angle over and finish from the other side. This will

keep the edges of the hole from burring out. Keep driving the punch in from one side and then the other until the hole is the correct size.

Next, locate the position of the remaining holes by center punch marks. Note here that all holes for bolts connecting angles are $\frac{1}{2}$ "; all those connecting braces or fire pan to angles are $\frac{3}{8}$ ". A little extra care in laying out these center punch marks will be worth while when it comes to assembling the frame. The $\frac{3}{8}$ " holes at the ends of the curved skids are the only ones on the whole frame that should not be drilled before assembling.

Fig. 6.—Assembly in progress. Frame complete except for one fire pan supporting angle. Draft holes cut and fire pan ready to go on to the frame.

Each side as a unit, including one top rail, one skid, and two of the vertical angle irons, should be temporarily bolted together. Attach the upper ends of each of two of the $1\frac{1}{2}$ " by $\frac{3}{8}$ " by 20" end braces to the vertical angle irons. With the frame straightened by means of a square, swing the end braces down to the inside of the angle on the bent ends of the skids and center punch for the holes. The skids may then be removed and taken to the drill press for drilling the $\frac{3}{8}$ " end brace holes.

With the skids bent and all the holes drilled or punched, everything is ready for putting the frame together (fig. 6). It is a good plan to slip the bolts into place and turn the nuts up by hand until all the parts are in position. This will give greater flexibility in fitting the more stubborn joints. It is important, however, that all the frame bolts be carefully tightened when once they are in place. Adjust the

tie rods until the diagonal distances between the vertical angle irons are equal. Bring them up at least tight enough that they will not sag.

BUILDING THE FIRE PAN

There are three important points which should be considered in laying out and cutting the draft holes:

1. They must be narrow enough to prevent the loss of burning coals.
2. They must be low enough on the sides of the fire pan to allow the ashes to sift through.
3. They must be numerous enough to supply plenty of air to the fire.

Fig. 7.—Cutting the draft openings, showing tools used for cutting, sledge, cold eye chisel, and the wood block.

The side draft holes indicated by “x” in figure 6, also by the dotted lines in figure 1, were added during the latter part of the pruning season when the brush was full of sap and an extra large amount of air was needed. It is well not to cut these until the burner has been tried, for the use to which the burner may be put often alters the draft requirements. For the same reason it is usually better to start with the drafts smaller than necessary and, after trial, increase them to the required size.

If the cutting is to be done with a sledge and cold chisel (fig. 7) a block of wood (preferably hard wood) should be placed on end against the portion of the sheet iron being cut. Chalk the outlines of the desired openings and follow carefully the lines so made. After the air holes are cut they should be smoothed up with the aid of a hammer and sledge (fig. 7a).

It is easier to hold the wood block against the sheet iron if the air holes are cut before the fire pan is fastened to the frame. However, this is not the case when oxy-acetylene is used. In the latter case, it is perhaps better to cut the draft holes after the pan has been bolted into place.

To drill the holes for the bolts connecting the sheet iron to the top angle irons of the frame, lay the sheet iron in place and by means of clamps over the edges of the angles or blocking from beneath, bring the sheet iron up to the top edge as shown in figure 1. Remove the four upper frame bolts and center punch the sheet iron through these

Fig. 7a.—Straightening edges of draft openings.

four holes. Drill these holes $\frac{1}{2}$ " and fasten the sheet iron into place. An ordinary bit brace can be used for operating the drill when drilling through the sheet iron, if the end of the drill is given clearance from the iron at all times by driving into the center of the hole occasionally with a center punch. Once the $\frac{1}{2}$ " main frame bolts are in place it is a very easy matter to drill for the $\frac{3}{8}$ " bolts at the one foot intervals along the top rail.

MAKING THE HITCH

This burner is so designed that it may be pulled from either end. By this plan it is possible to get out of a tight place very easily without trying to turn the burner around and perhaps damaging a tree. Two fifth chains and a clevis make a very satisfactory combination for connecting the doubletree to the burner. Both ends of one chain should be fastened to the vertical posts between the cross-

beam and the skids as shown in figure 1 and also in figure 8. Do not hitch to the end of the skids as this would raise the hitch connection too high and thereby increase the load for the team. Furthermore, there would be danger of bending the ends of the angle iron skids when making turns. The other fifth chain should be hitched from the center of the first chain to the doubletree clevis or ring. Keep this chain as short as possible and still not have too much heat for the team.

Fig. 8.—Preparing to fire up. Old packing boxes, excelsior, or newspapers may be used to good advantage. Note how hitching chains are attached.

PRESERVING THE FIRE PAN

To prolong the life of the fire pan it is important that each year after use it be given a coat of waste tractor crankcase oil, or something of that nature, to keep the material from rusting out so rapidly. A thin coat of asphaltum is also very good for this purpose. A recent survey of the burners in use showed that more of them had been discarded because of the pan rusting out than for all other reasons combined. The design used in this burner makes it comparatively easy to put in a new fire pan. With ordinary care this burner will last many years.

FOR VINEYARD WORK

One of the regular orchard burners has been tried in vineyard work. The indications are that it will prove as satisfactory for vineyards as for orchards. No investigations have yet been made, however, of the most economical width of frame or of the proper size and placing of the draft holes for vineyard work.

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