Equipment <see figure 7>

fig7x32.gif (486x486)

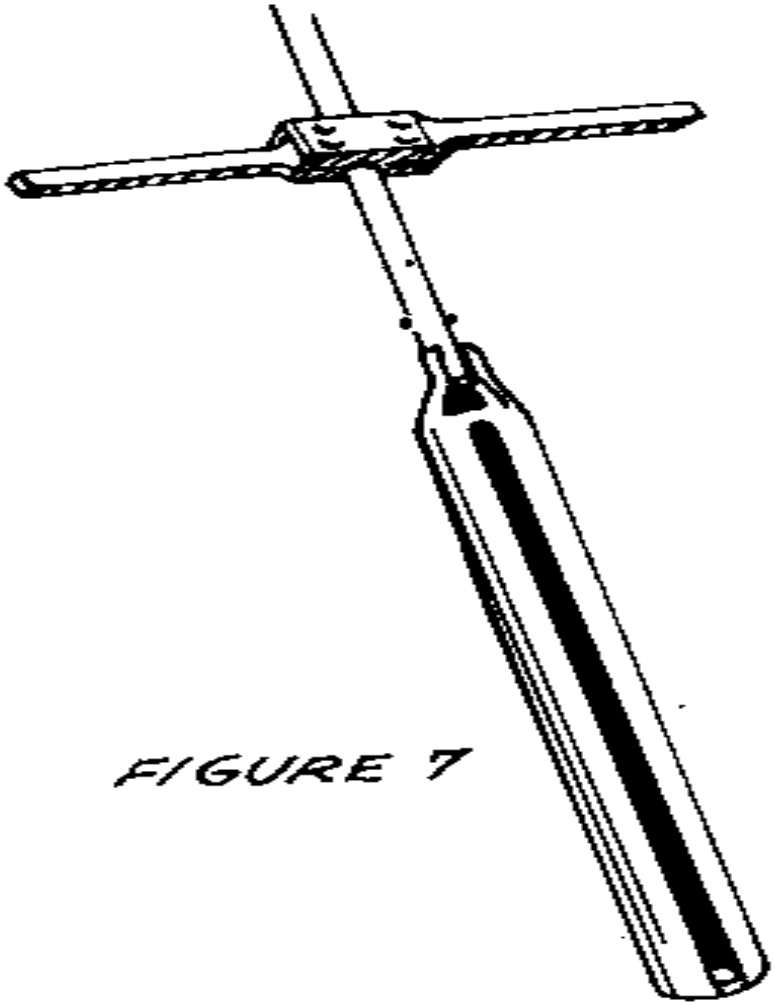

FIGURE 7

The following section gives construction details for the well-drilling equipment used with the ram auger:

- **Auger, Extensions, and Handle**
- **Auger Cleaner**
- **Demountable Reamer**
- **Tripod and Pulley**
- **Bailing Bucket**
- **Bit for Drilling rock**

Auger, Extensions, and Handle

The auger is hacksawed out of standard-weight steel pipe about 10cm (4") in diameter (see Figure 8). Lightweight tubing is not strong enough. The extensions

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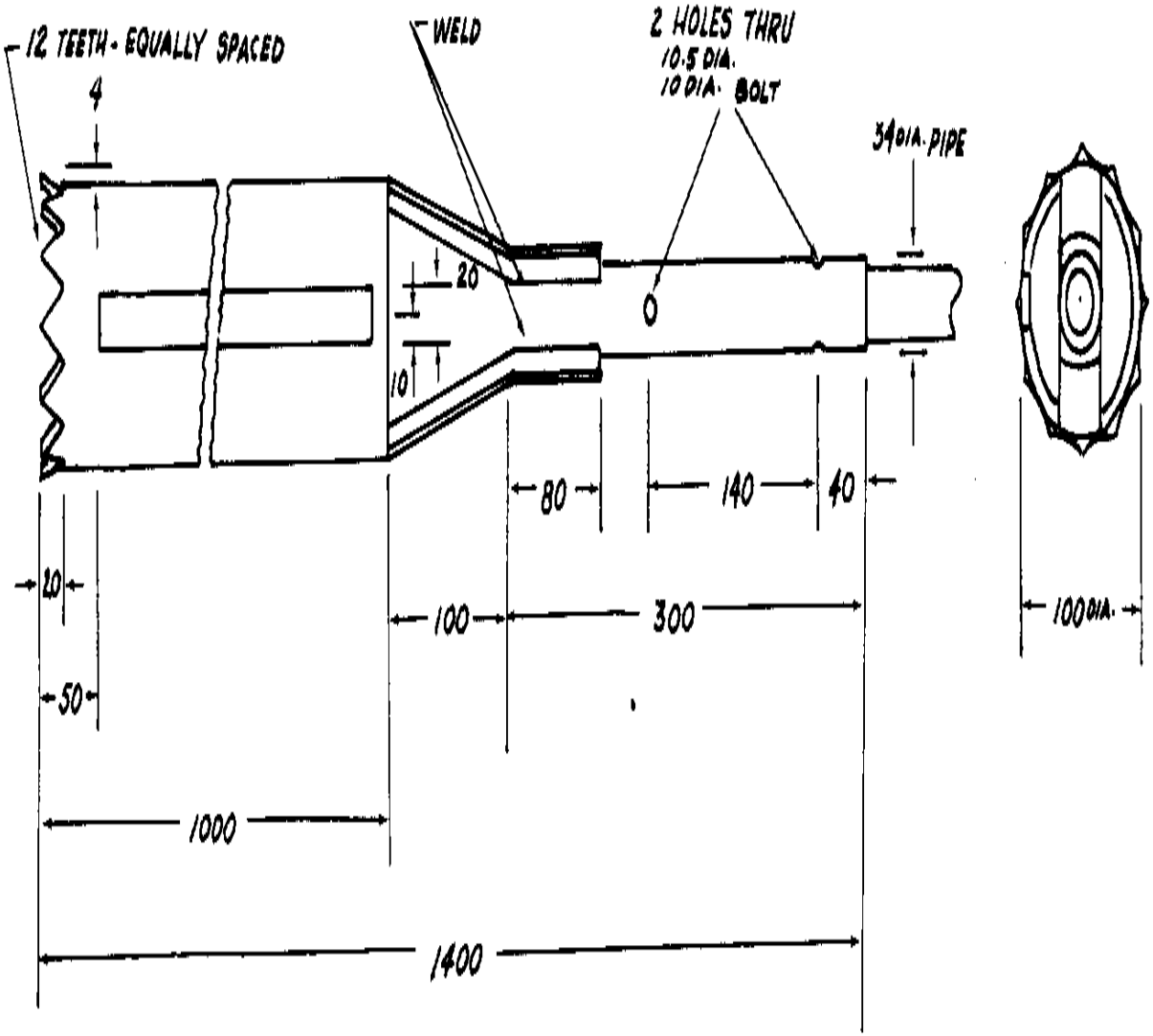

FIGURE 8, CUTTING HEAD, WELL DRILLING AUGER

(see Figure 9) and handle (see Figure 10) make it possible to bore deep holes.

fig9x34.gif (600x600)

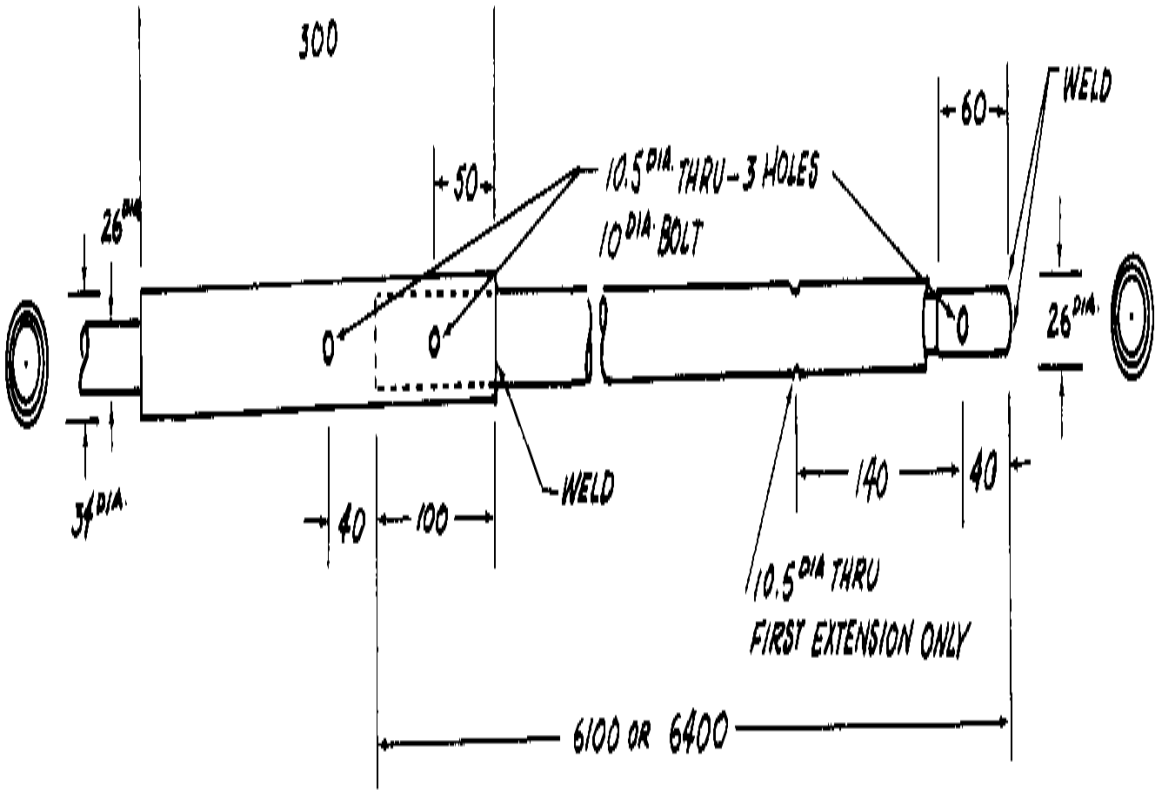

FIGURE 9 EXTENSION, WELL DRILLING AUGER

NOTE: 34 DIA. COUPLING MAY BE OMITTED ON LAST EXTENSION

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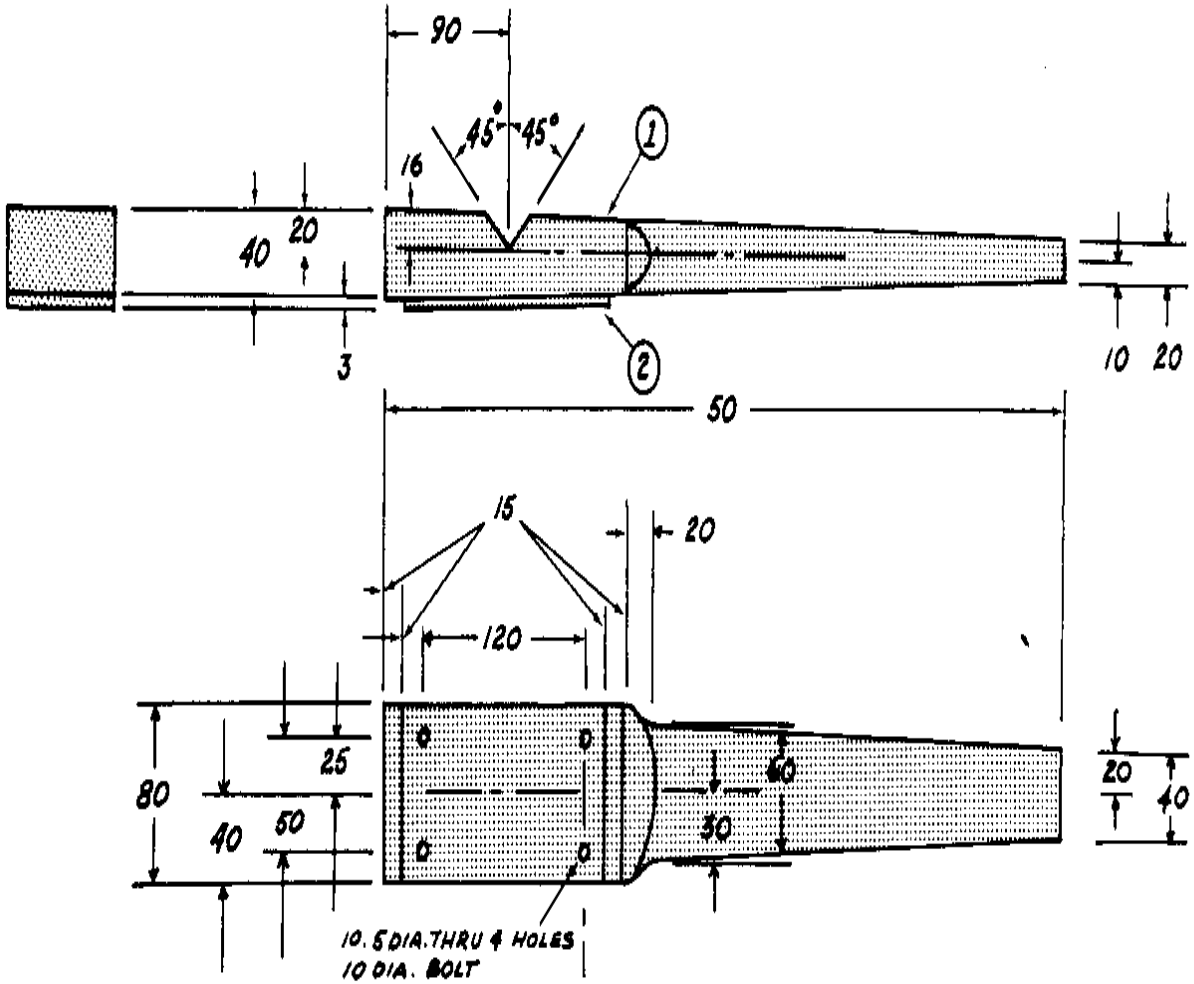

FIGURE 10, HANDLE, WELL DRILLING AUGER

NOTE: 2 REQUIRED PER SET

SCALE: 1/4 SIZE MAT'L: ① HARDWOOD
② MILD STEEL

Tools and Materials

Pipe: 10cm (4") in diameter, 120cm (47 1/4") long, for auger
Pipe: 34mm outside diameter (1" inside diameter); 3 or 4 pieces 30cm (12") long, for auger and extension socket
Pipe: 26mm outside diameter (3/4" inside diameter); 3 or 4 pieces 6.1 or 6.4 meters
(20' or 21') long, for drill extensions
Pipe: 10mm outside diameter (1/2" inside diameter); 3 or 4 pieces 6cm (2 3/8") long
Hardwood: 4cm x 8cm x 50cm (1 1/2" x 3 1/8" x 19 3/4"), for handle
Mild steel: 3mm x 8cm x 15cm (1/8" x 3 1/8" x 6")
4 Bolts: 1cm (3/8") in diameter and 10cm (4") long
4 Nuts

Hand tools and welding equipment

In making the auger, a flared-tooth cutting edge is cut in one end of the 10cm pipe. The other end is cut, bent, and welded to a section of 34mm outside-diameter
(1" inside-diameter) pipe, which forms a socket for the drill line extensions. A slot that runs nearly the length of the auger is used for removing soil from the auger. Bends are made stronger and more easily and accurately when the steel is hot. At first, an auger with two cutting lips similar to a post-hole
auger was used; but it became plugged up and did not cut cleanly. In some soils, however, this type of auger may be more effective.

Auger Cleaner

Soil can be removed rapidly from the auger with this auger cleaner (see Figure 11).

fig11x36.gif (486x486)

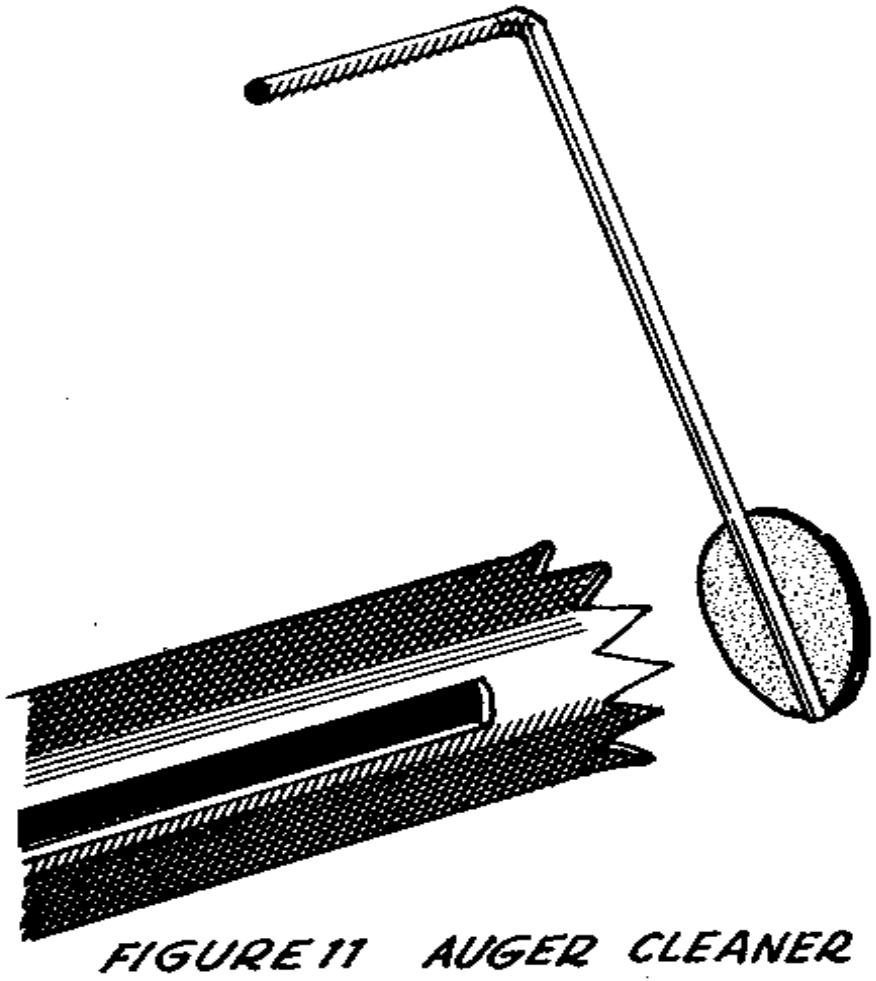

FIGURE 11 AUGER CLEANER

Figure 12 gives construction details.

fig12x36.gif (600x600)

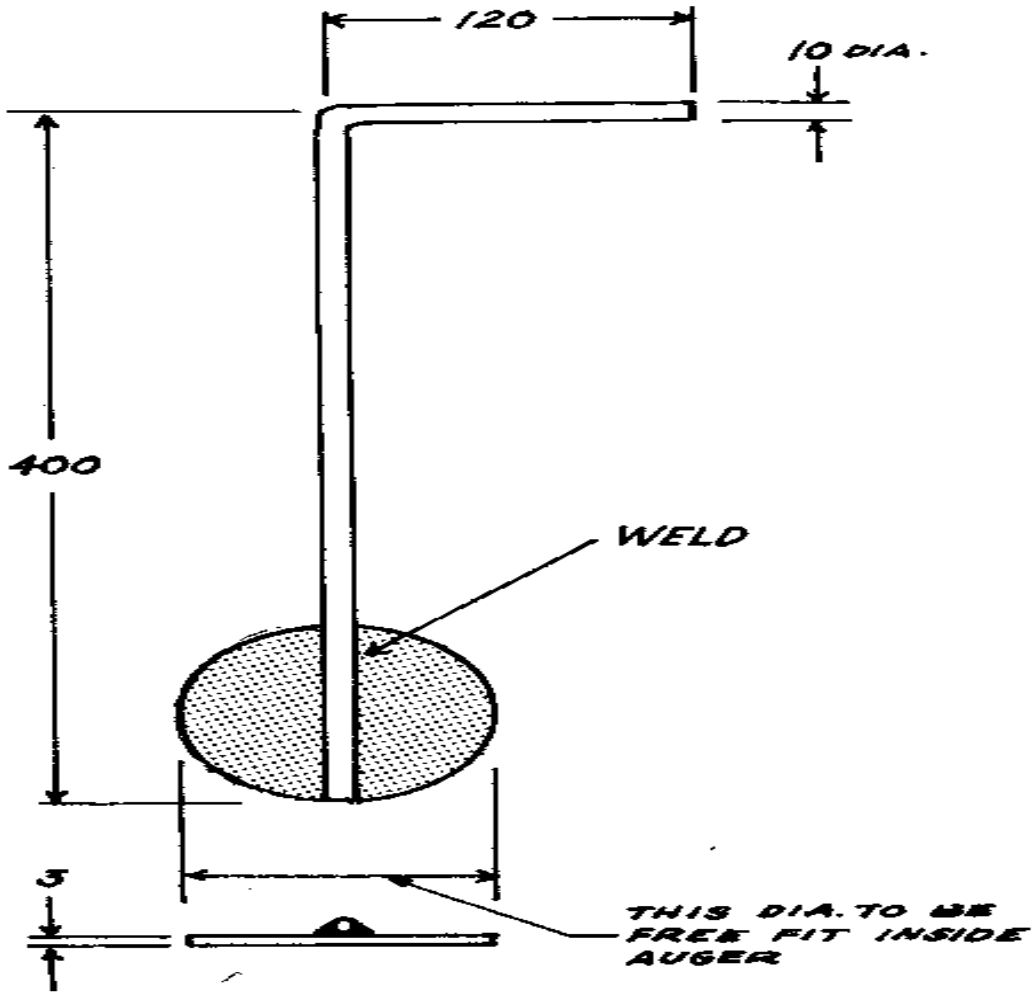

FIGURE 12
SCALE: 1/4 SIZE MAT'L: MILD STEEL

Tools and Materials

Mild steel: 10cm (4") square and 3mm (1/8") thick
Steel rod: 1cm (3/8") in diameter and 52cm (20 1/2") long
Welding equipment
Hacksaw
File

Demountable Reamer

If the diameter of a drilled hole has to be made bigger, the demountable reamer described here can be attached to the auger.

Tools and Materials

Mild steel: 20cm x 5cm x 6mm (6" x 2" x 1/4"), to ream a well diameter of 19cm (7 1/2")
2 Bolts: 8mm (5/16") in diameter and 10cm (4") long
Hacksaw
Drill
File
Hammer
Vise

The reamer is mounted to the top of the auger with two hook bolts (see Figure 13).

fig13x37.gif (600x600)

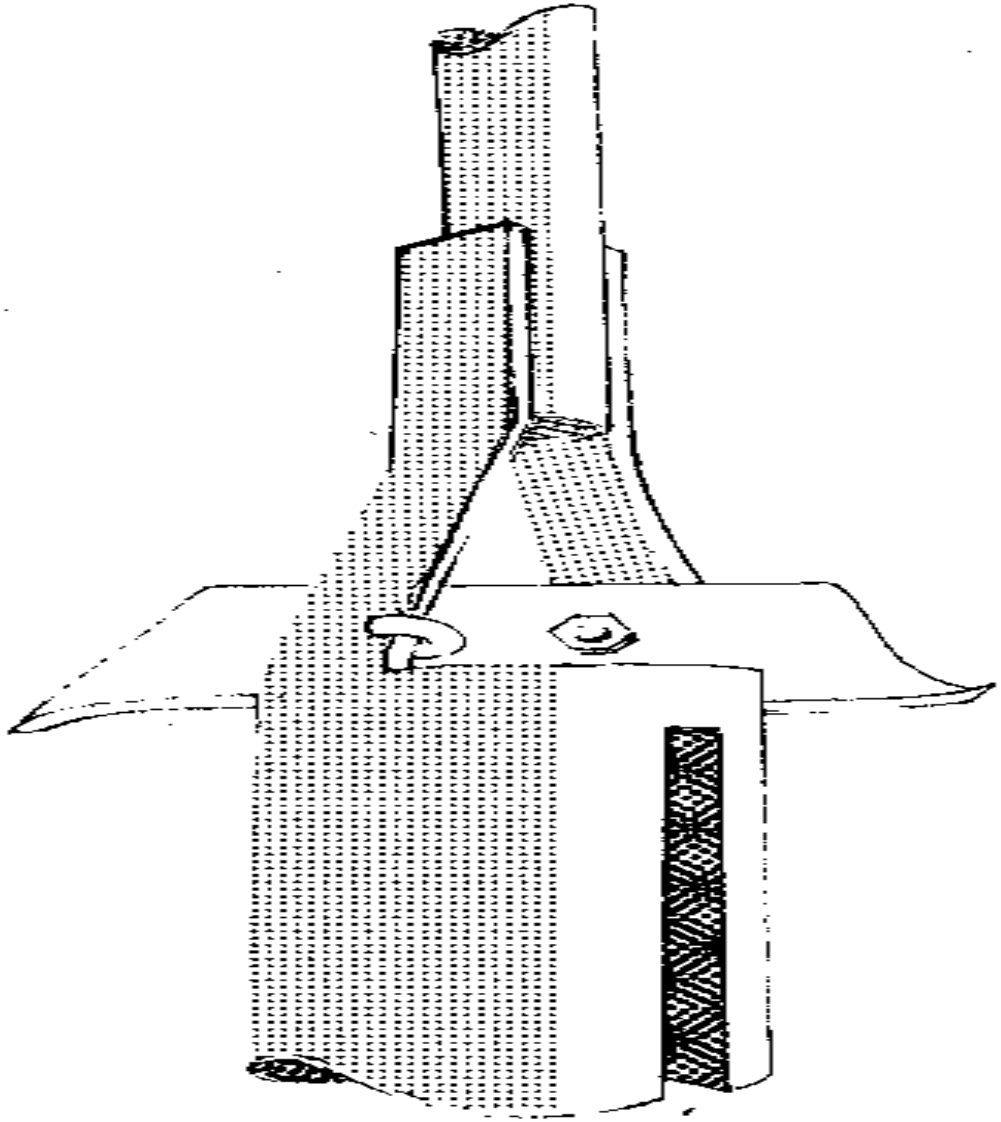

FIGURE 13

It is made from a piece of steel 1cm (1/2") larger than the desired well diameter (see Figure 14).

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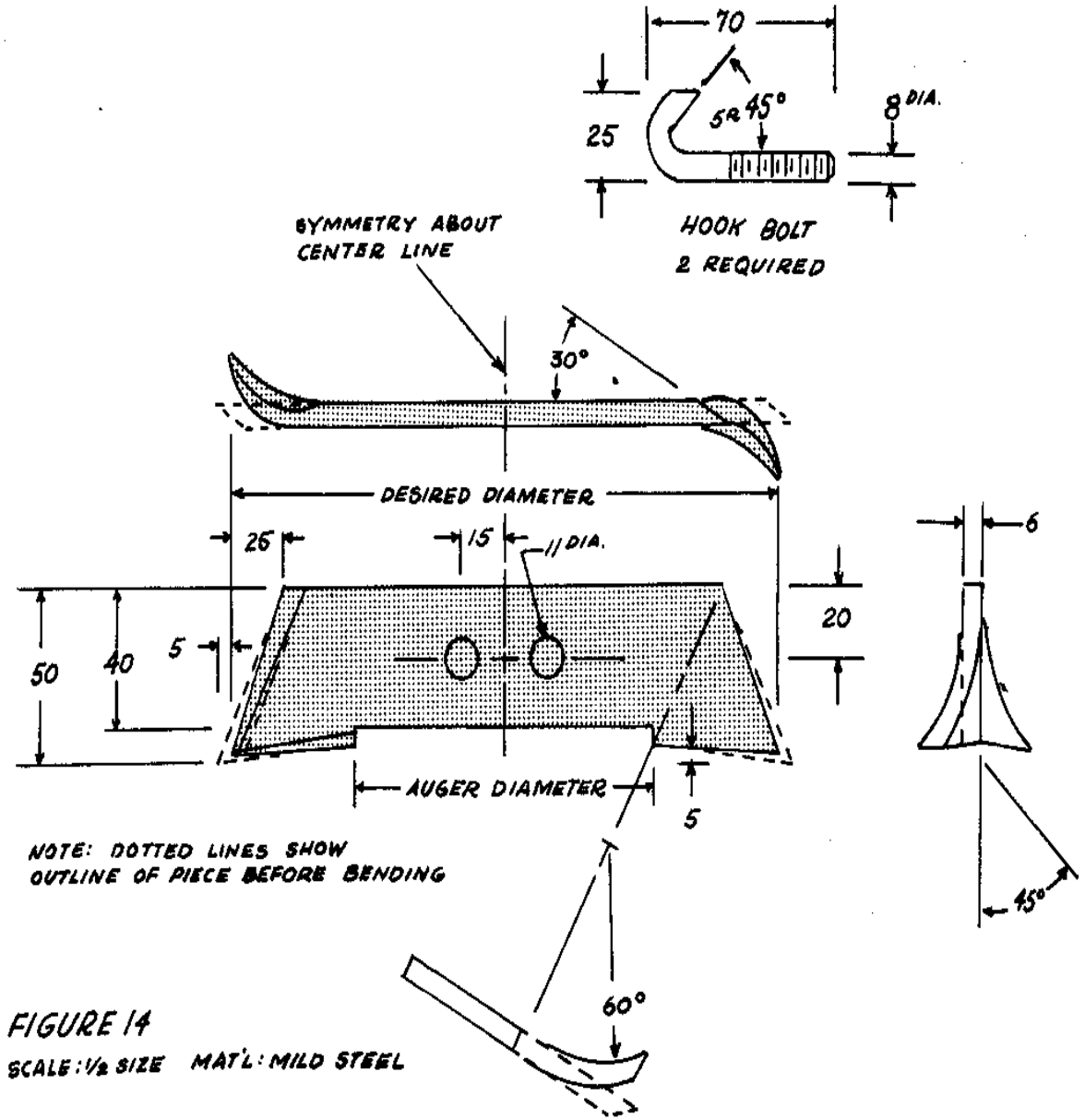

FIGURE 14

SCALE: 1/2 SIZE MAT'L: MILD STEEL

After the reamer is attached to the top of the auger, the bottom of the auger is plugged with some mud or a piece of wood to hold the cuttings inside the auger.

In reaming, the auger is rotated with only slight downward pressure. It should be emptied before it is too full so that not too many cuttings will fall to the bottom of the well when the auger is pulled up.

Because the depth of a well is more important than the diameter in determining the flow and because doubling the diameter means removing four times the amount of earth, larger diameters should be considered only under special circumstances. (See "Well Casing and Platforms," page 12.)

Tripod and Pulley

The tripod (see Figures 15 and 16), which is made of poles and assembled with

fig15390.gif (393x393)

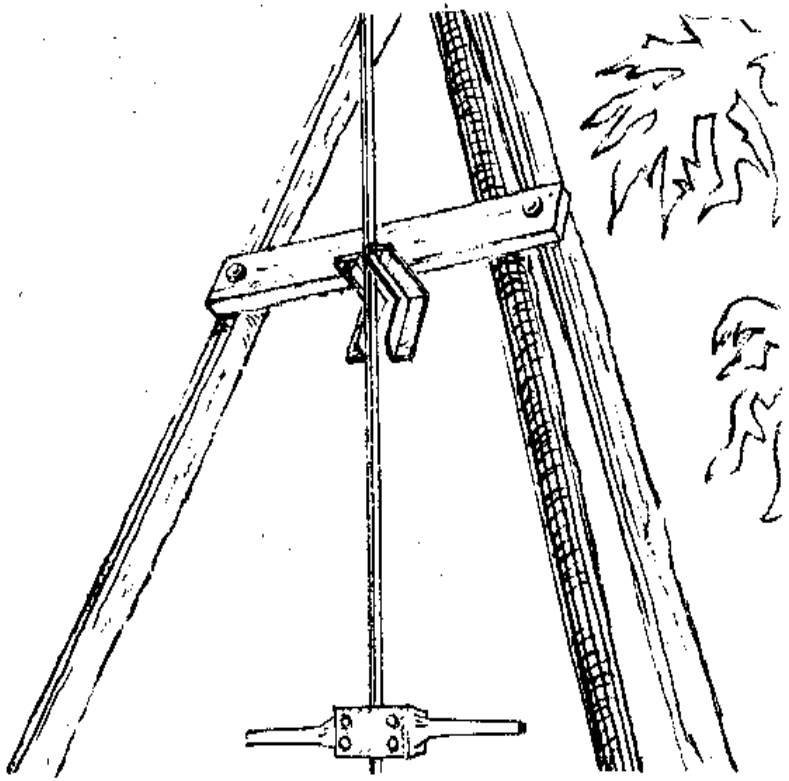

FIGURE 15

when it extends far above ground; (2) to provide a mounting for the pulley (see Figures 17 and 19)

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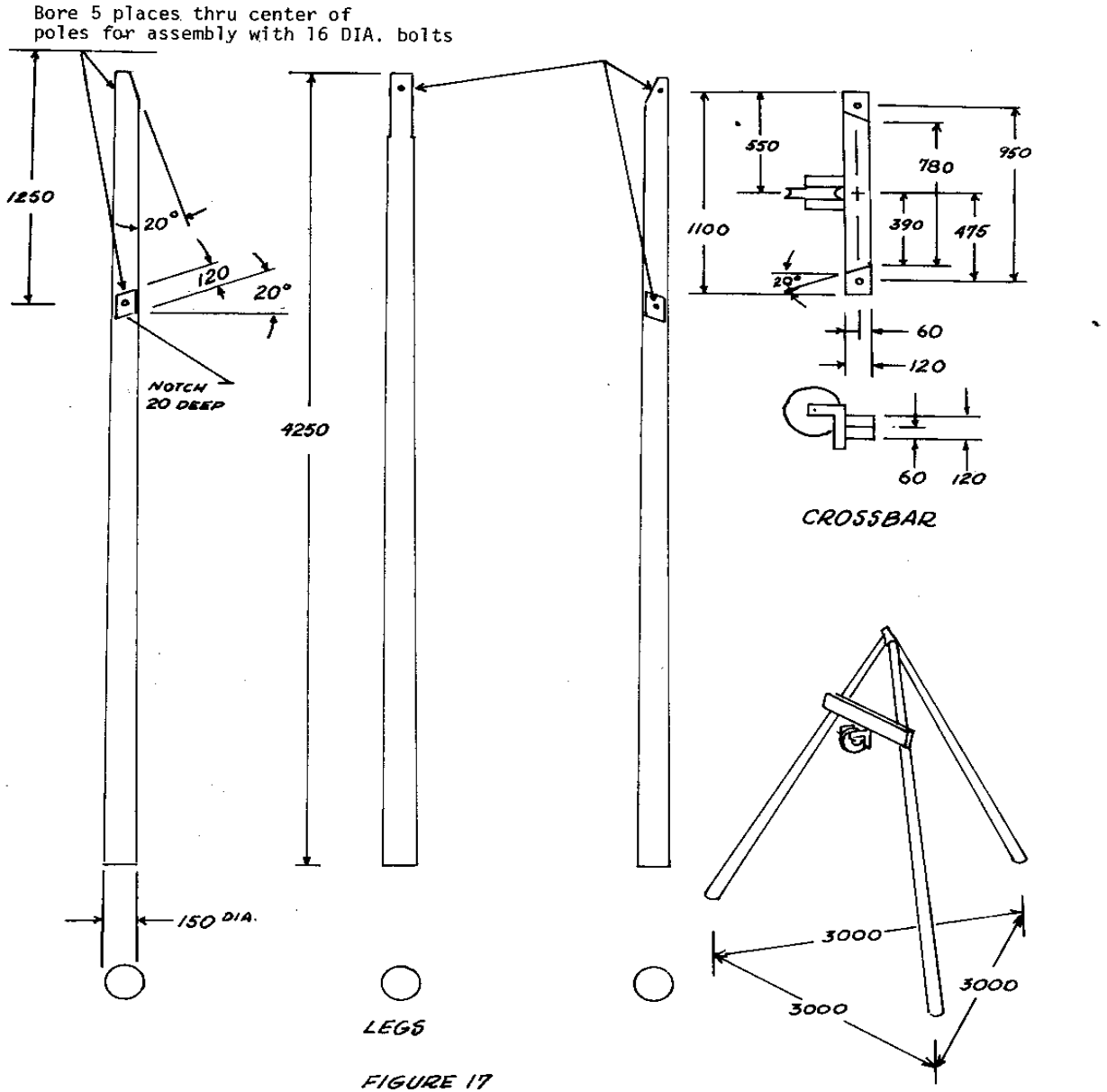

FIGURE 17

place for leaning long pieces of casing, pipe for pumps, or auger extensions while
they are being put into or taken out of the well.

When a pin or bolt is put through the holes in the two ends of the "L"-shaped pulley bracket (see Figures 15 and 18) that extend horizontally beyond the front

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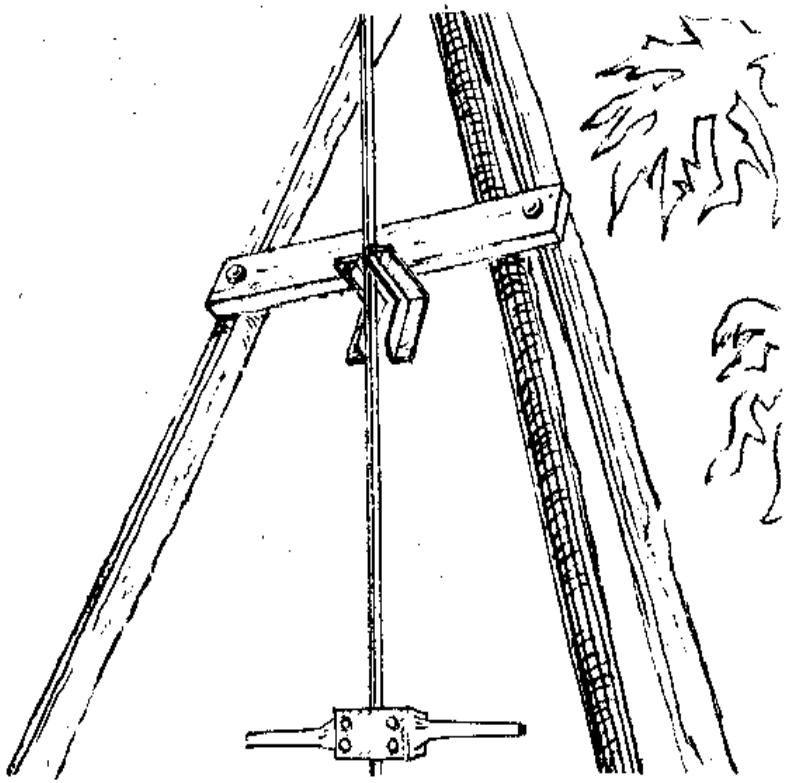
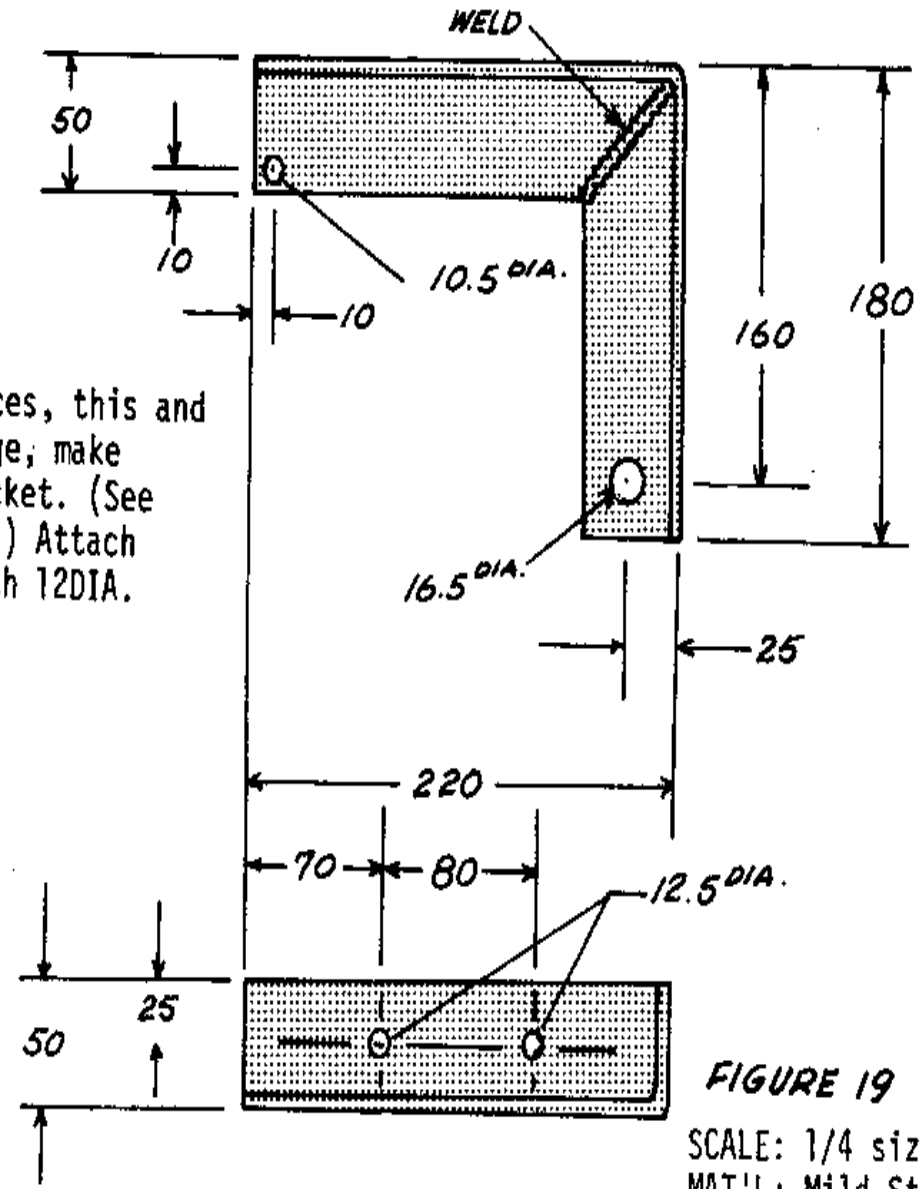


FIGURE 15

formed.

To keep the extensions from falling when they are leaned against the tripod, two 30cm (12") long wooden pegs are driven into drilled holes near the top of the tripod's two front legs (see Figure 19).

fig19x41.gif (600x600)



NOTE: Two pieces, this and its mirror image, make one pulley bracket. (See tripod drawing.) Attach to crossbar with 12DIA. Bolts.

FIGURE 19

SCALE: 1/4 size
MAT'L: Mild Steel

Tools and Materials

3 Poles: 15cm (3") in diameter and 4.25 meters (14') long
Wood for cross bar: 1.1 meter (43 1/2") x 12cm (4 3/4") square
For pulley wheel:
Wood: 25cm (10") in diameter and 5cm (2") thick
Pipe: 1.25cm (1/2") inside diameter, 5cm (2") long
Axle bolt: to fit close inside 1.25cm (1/2") pipe
Angle iron: 80cm (31 1/2") long, 50cm (19 3/4") webs, 5mm (3/16") thick
4 Bolts: 12mm (1/2") in diameter, 14cm (5 1/2") long; nuts and washers
Bolt: 16mm (5/8") in diameter and 40cm (15 3/4") long; nuts and washer
2 Bolts: 16mm (5/8") in diameter and 25cm (9 7/8") long; nuts and washers
Bore 5 places through center of poles for assembly with 16mm bolts

Bailing Bucket

The bailing bucket can be used to remove soil from the well shaft when cuttings are too loose to be removed with the auger.

Tools and Materials

Pipe: about 8.5cm (3 3/8") in diameter, 1 to 2cm (1/2" to 3/4") smaller in diameter than the auger, 180cm (71") long
Steel rod: 10mm (3/8") in diameter and 25cm (10") long; for bail (handle)
Steel plate: 10cm (4") square, 4mm (5/32") thick
Steel bar: 10cm x 1cm x 5mm (4" x 3/8" x 3/16")
Machine screw: 3mm (1/8") diameter by 16mm (5/8") long; nut and washer
Truck innertube: 4mm (5/32") thick, 10mm (3/8") square
Welding equipment

Drill
Hacksaw
Hammer
Vise
File
Rope

Both standard weight pipe and thin-walled tubing were tried for the bailing bucket. The former, being heavier, was harder to use, but did a better job and stood up better under use. Both the steel bottom of the bucket and the rubber valve should be heavy because they receive hard usage. The metal bottom is reinforced with a crosspiece welded in place (see Figures 20 and 21).

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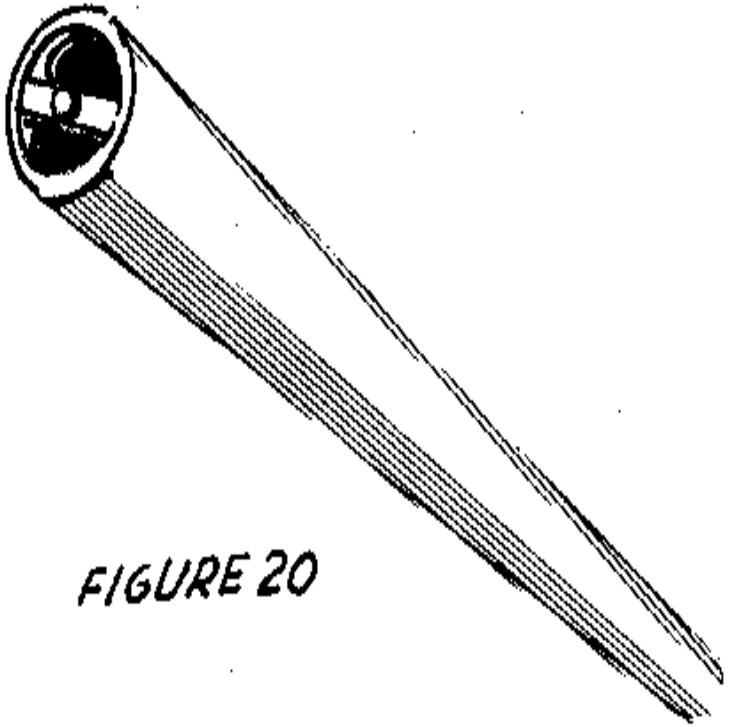

FIGURE 20

When water is reached and the cuttings are no longer firm enough to be brought up in the auger, the bailing bucket must be used to clean out the well as work progresses.

For using the bailing bucket the pulley is mounted in the pulley bracket with a 16mm (5/8") bolt as axle. A rope attached to the bailing bucket is then run over the pulley and the bucket is lowered into the well. The pulley bracket is so designed that the rope coming off the pulley lines up vertically with the well, so

that there is no need to shift the tripod.

**The bucket is lowered into the well, preferably by two people and allowed to drop
the last meter or meter and one-half (3 to 5 feet) so that it will hit the bottom
with some speed. The impact will force some of the loose soil at the bottom of the well up into the bucket. The bucket is then repeatedly raised and dropped 1 to 2 meters (3 to 6 feet) to pick up more soil. Experience will show how long this should be continued to pick up as much soil as possible before raising and emptying the bucket. Two or more people can raise the bucket, which should be dumped far enough from the well to avoid messing up the working area.**

If the cuttings are too thin to be brought up with the auger but too thick to enter the bucket, pour a little water down the well to dilute them.

Bit for Drilling Rock

**The bit described here has been used to drill through layers of sedimentary stone
up to 11 meters (36') thick.**

Tools and Materials

**Mild steel bar: about 7cm (2 3/4") in diameter and about 1.5 meters (5') long, weighing about 80kg (175 pounds)
Stellite (a very hard type of tool steel) insert for cutting edge
Anvil and hammers, for shaping
Steel rod: 2.5cm x 2cm x 50cm (1" x 3/4" x 19 3/4") for bail**

Welding equipment

**The drill bit for cutting through stone and hard formations is made from the 80kg
(175-pound) steel bar (see Figures 22 and 23). The 90-degree cutting edge is hard-surfaced**

fig22440.gif (393x393)

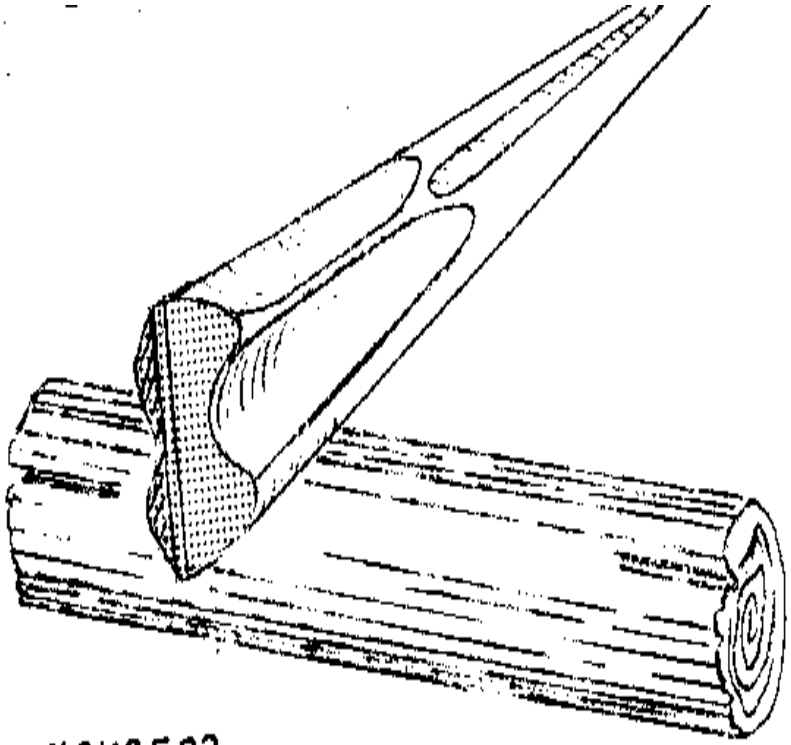

FIGURE 22
HEAVY BIT FOR DRILLING ROCK

handle) for attaching a rope or cable is welded to the top. The bail should be large enough to make

"fishing" easy if the rope breaks. A 2.5cm (1") rope was used at first, but this was subject to much wear when working in mud and water. A 1cm (3/8") steel cable was substituted for the rope, but it was not used enough to be able to show whether the cable or the rope is better. One advantage of rope is that it gives a snap at the end of the fall which rotates the bit and keeps it from sticking. A swivel can be mounted between the bit and the rope or cable to let the bit rotate.

If a bar this size is difficult to find or too expensive, it may be possible, depending on the circumstances, to make one by welding a short steel cutting end onto a piece of pipe, which is made heavy enough by being filled with concrete.

In using the drilling bit, put the pulley in place as with the bailing bucket, attach the bit to its rope or cable, and lower it into the well. Since the bit is heavy, wrap the rope once or twice around the back leg of the tripod so that the bit cannot "get away" from the workers with the chance of someone being hurt or the equipment getting damaged. The easiest way to raise and drop the bit is to run the rope through the pulley and then straight back to a tree or post where it can be attached at shoulder height or slightly lower. Workers line up along the rope and raise the bit by pressing down on the rope; they drop it by allowing the

rope to return quickly to its original position (see Figure 24). This requires five

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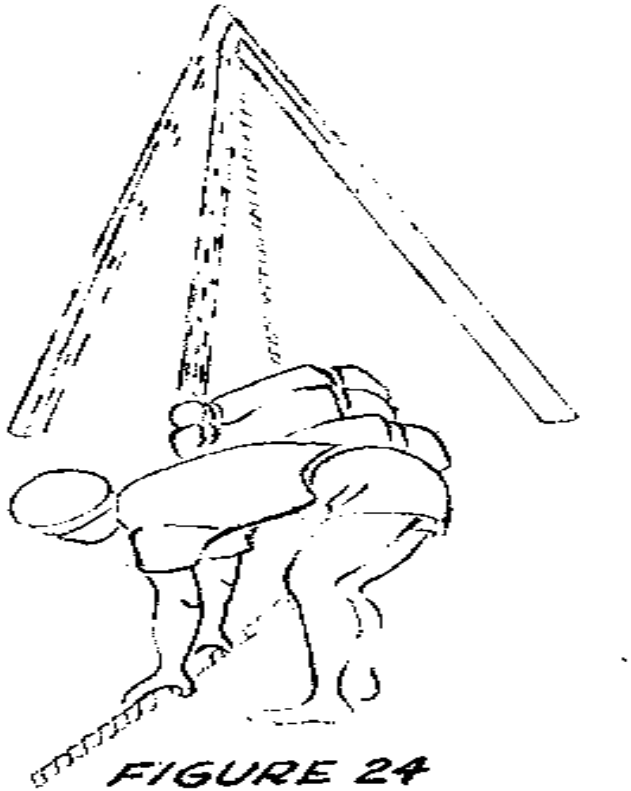

FIGURE 24

to seven workers, occasionally more. Frequent rests are necessary, usually after every 50 to 100 strokes. Because the work is harder near the ends of the rope than in the middle, the positions of the workers should be rotated to distribute the work evenly.

A small amount of water should be kept in the hole for lubrication and to mix with the pulverized stone to form a paste that can be removed with a bailing bucket. Too much water will slow down the drilling.

The speed of drilling, of course, depends on the type of stone encountered. In the soft water-bearing stone of the Ban Me Thuot area it was possible to drill several meters (about 10 feet) per day. However, when hard stone such as basalt is encountered, progress is measured in centimeters (inches). The decision must then be made whether to continue trying to penetrate the rock or to start over in a new location. Experience in the past has indicated that one should not be too hasty in abandoning a location, since on several occasions what were apparently thin layers of hard rock were penetrated and drilling then continued at a good rate.

Occasionally the bit may become stuck in the well and it will be necessary to use a lever arrangement consisting of a long pole attached to the rope to free it (see Figure 25).

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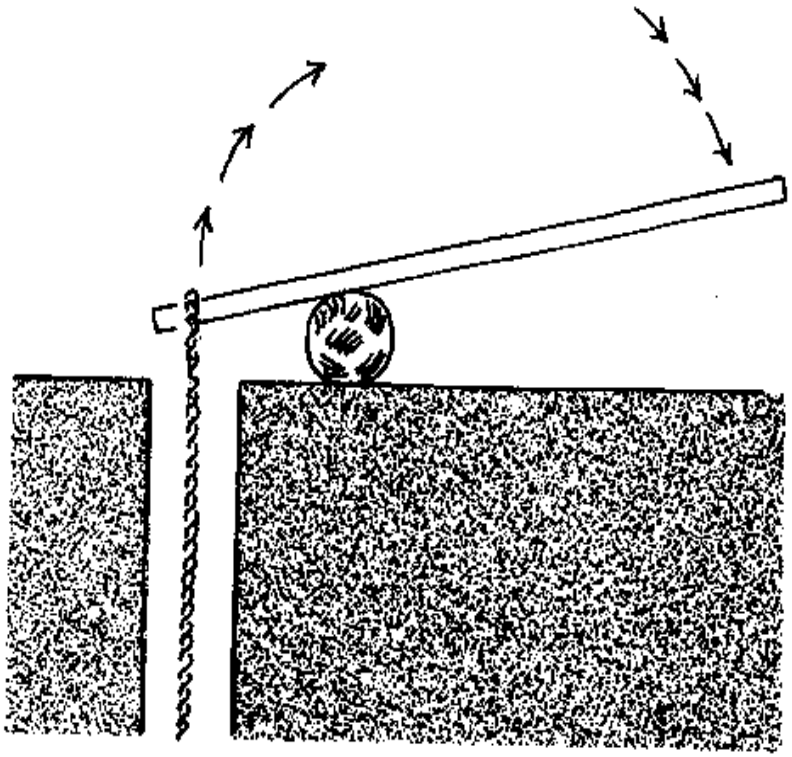

FIGURE 25

Alternatively, a windlass may be used, consisting of a horizontal pole used to wrap the rope around a vertical pole pivoted on the ground and held in place by several workers (see Figure 26). If these fail, it may be necessary to

fig26x47.gif (437x437)

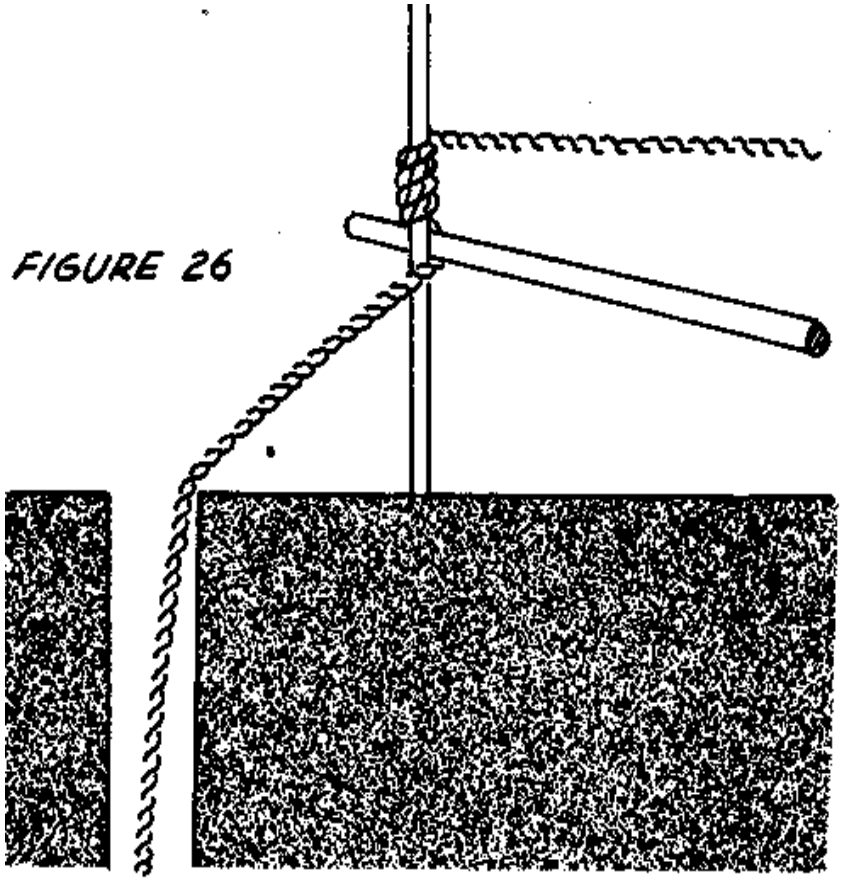

FIGURE 26

rent or borrow a chain hoist. A worn rope or cable may break when trying to retrieve a stuck bit. If this happens, fit a hook to one of the auger extensions,
attach enough extensions together to reach the desired depth, and after hooking the bit, pull with the chain hoist. A rope or cable may also be used for this purpose, but are considerably more difficult to hook onto the bit.

Drilling Mechanically

The following method can be used for raising and dropping the bit

mechanically:

o Jack up the rear wheel of a car and replace the wheel with a small drum (or use the rim as a pulley).
o Take the rope that is attached to the bit, come from the tripod on the pulley, and wrap the rope loosely around the drum.
o Pull the unattached end of the rope taut and set the drum in motion. The rope will move with the drum and raise the bit.
o Let the end of the rope go slack quickly to drop the bit.
It will probably be necessary to polish and/or grease the drum.

Dry Bucket Well Drilling

The dry bucket method is a simple and quick method of drilling wells in dry soil that is free of rocks. It can be used for 5cm to 7.5cm (2" to 3") diameter wells in which steel pipe is to be installed. For wells that are wider in diameter, it is a quick method of removing dry soil before completing the bore with a wet bucket, tubewell sand bailer, or tubewell sand auger.

A 19.5-meter (64') hole can be dug in less than three hours with this method, which works best in sandy soil, according to the author of this entry, who has drilled 30 wells with it.

Tools and Materials

Dry bucket
Rope: 16mm (5/8") or 19mm (3/4") in diameter and 6 to 9 meters (20' to 30')

longer than the deepest well to be drilled
3 Poles: 20cm (4") in diameter at large end and 3.6 to 4.5 meters (12' to 15') long
Chain, short piece
Pulley
Bolt: 12.5mm (1/2") in diameter and 30 to 35cm (12" to 14") long (long enough to reach through the upper ends of the three poles)

A dry bucket is simply a length of pipe with a bail or handle welded to one end and a slit cut in the other.

The dry bucket is held about 10cm (several inches) above the ground, centered above the hole location and then dropped (see Figure 1). This drives a small

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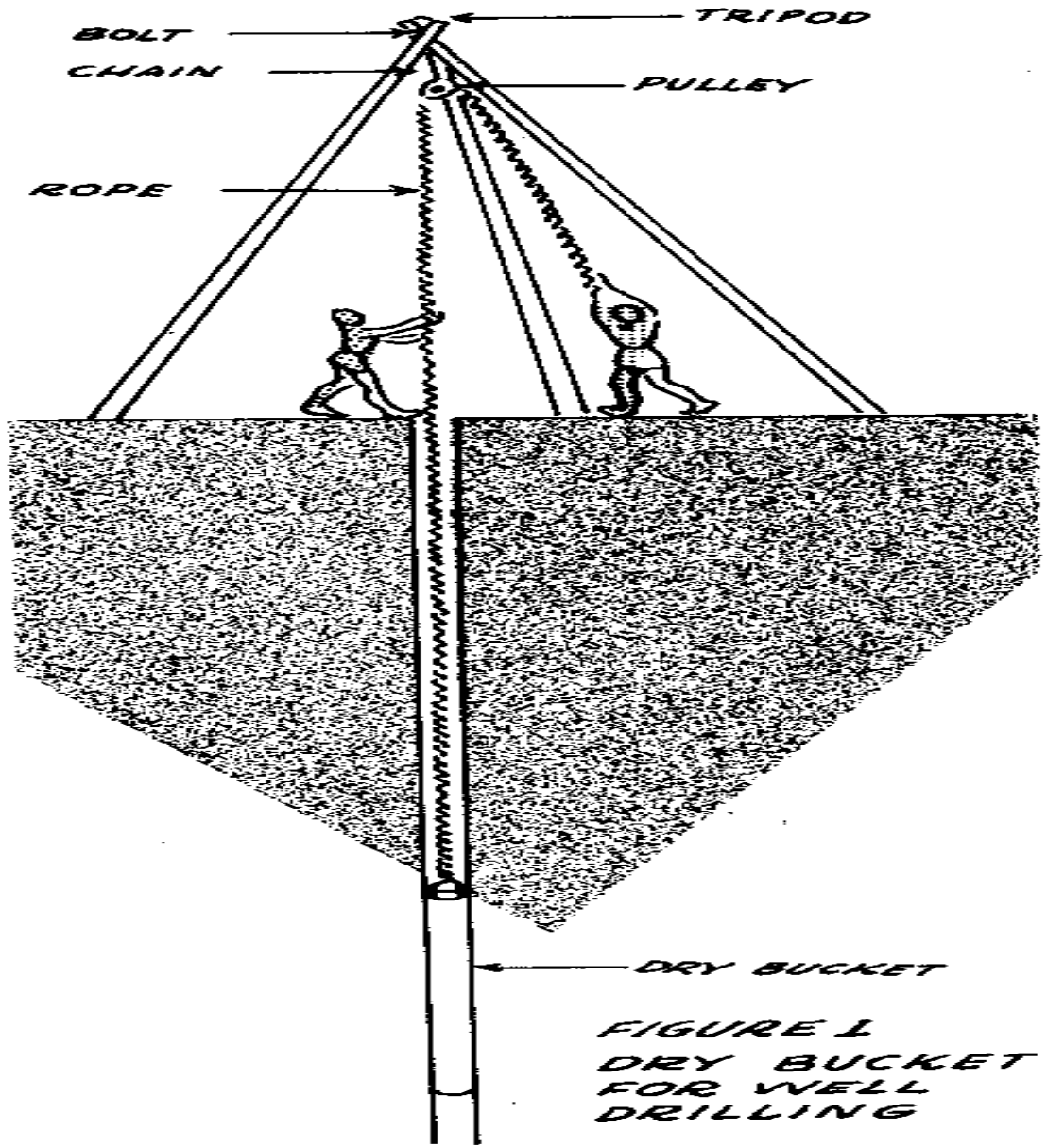

FIGURE 1
DRY BUCKET
FOR WELL
DRILLING

amount of soil up into the bucket. After this is repeated two or three times, the
bucket is removed, held to one side and tapped with a hammer or a piece of iron

to dislodge the soil. The process is repeated until damp soil is reached and the bucket will no longer remove soil.

To make the dry bucket, you will need the following tools and materials:

Hacksaw
File
Iron rod: 10mm (3/8") or 12.5mm (1/2") in diameter and 30cm (1') long
Iron pipe: slightly larger in diameter than the largest part of casing to be put in
the well (usually the coupling) and 152cm (5') long

Bend the iron rod into a U-shape small enough to slide inside the pipe. Weld it in
place as in Figure 2.

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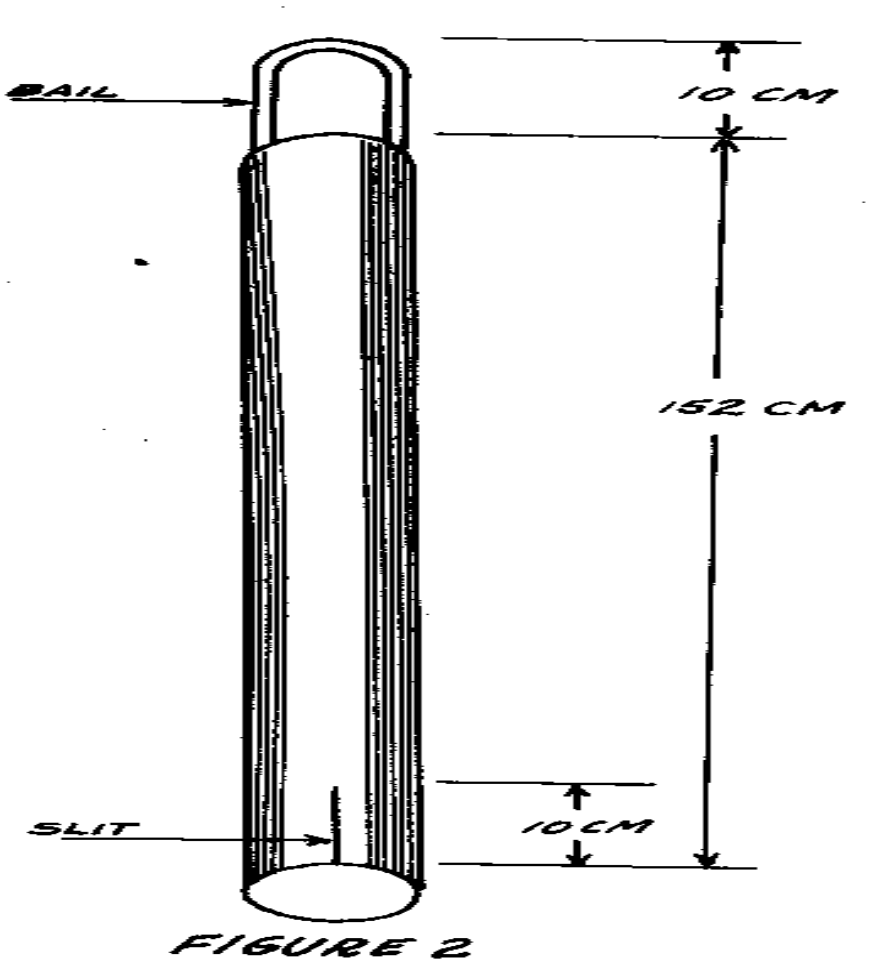

FIGURE 2

File a gentle taper on the inside of the opposite end to make a cutting edge (see Figure 3).

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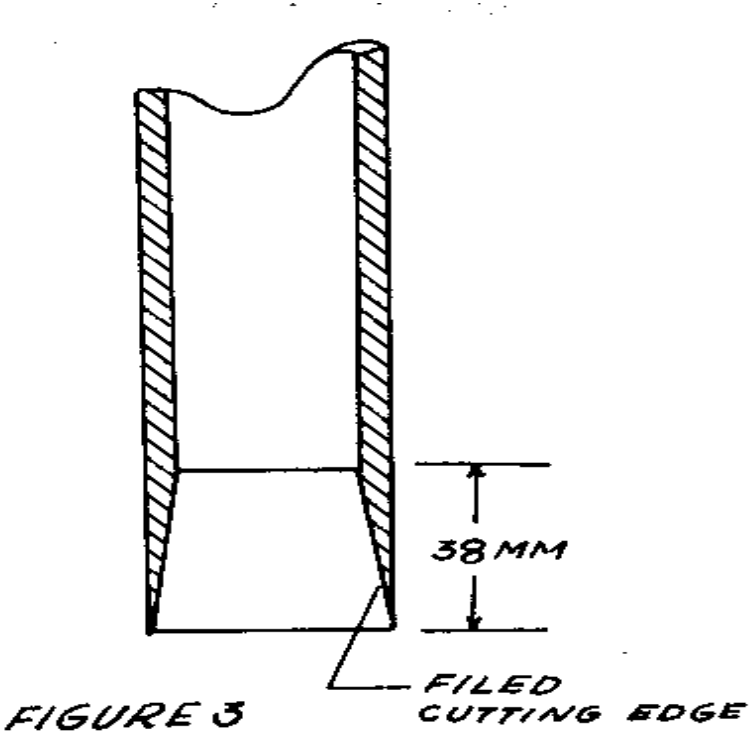

FIGURE 3

Cut a slit in one side of the sharpened end of the pipe (see Figure 2).

Source:

John Brelsford, VITA Volunteer, New Holland, Pennsylvania

Driven Wells

A pointed strainer called a well point, properly used, can quickly and cheaply drive a sanitary well, usually less than 7.6 meters (25') deep. In soils where the