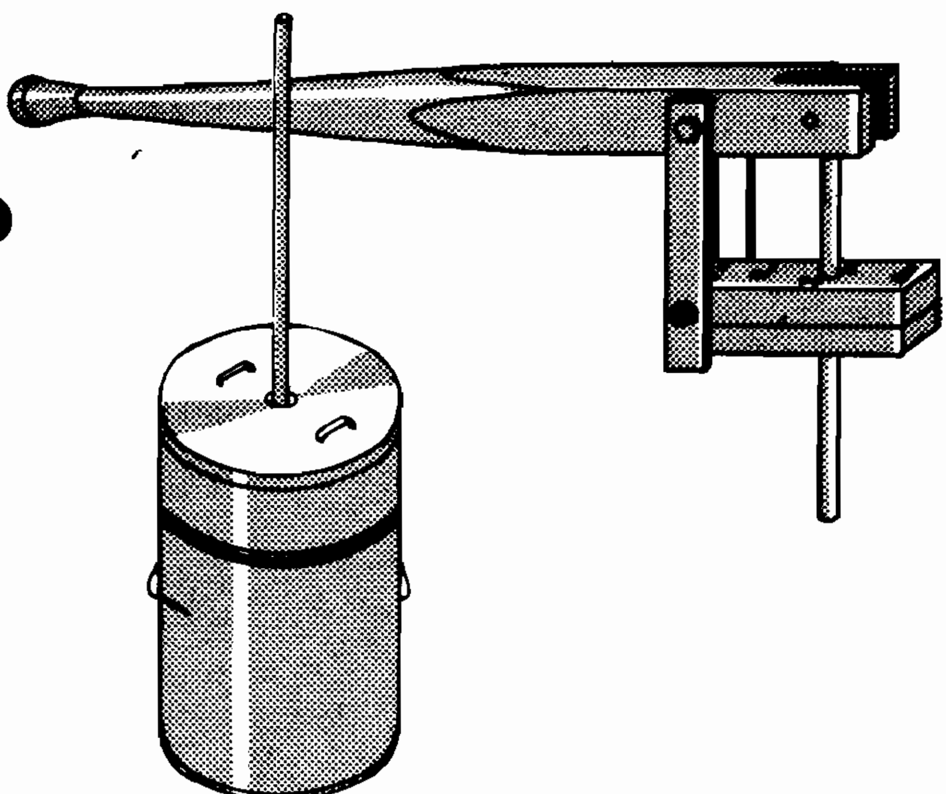
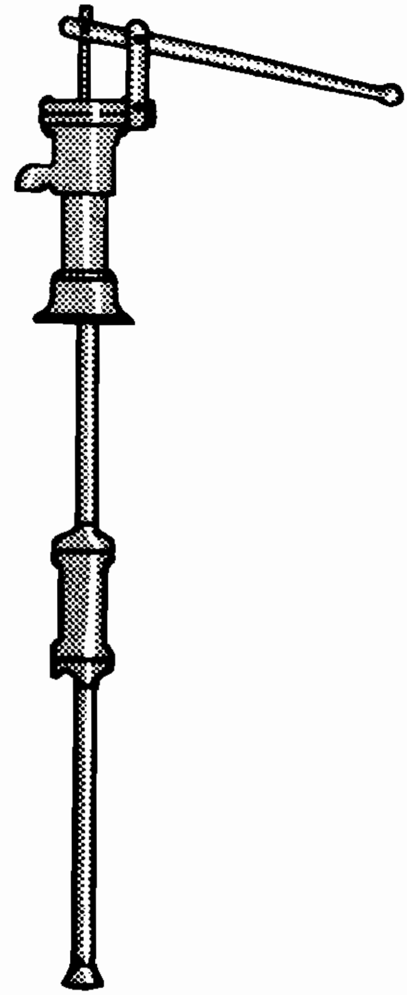
CI-11

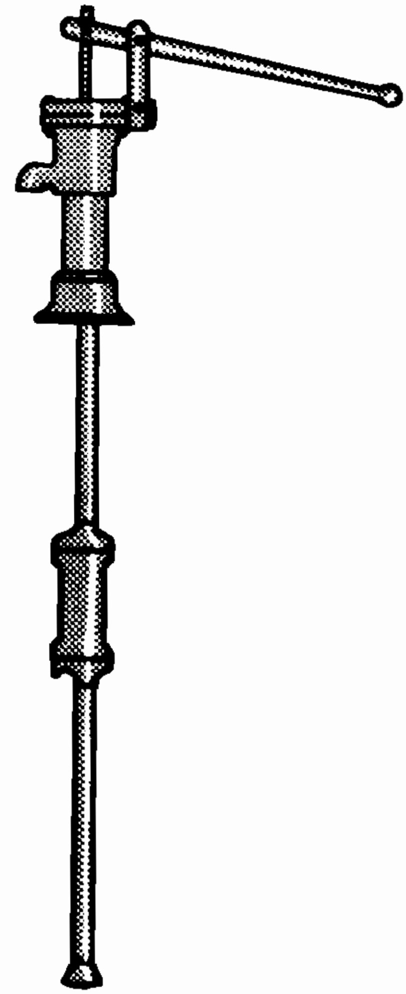
VILLAGE TECHNOLOGY HANDBOOK

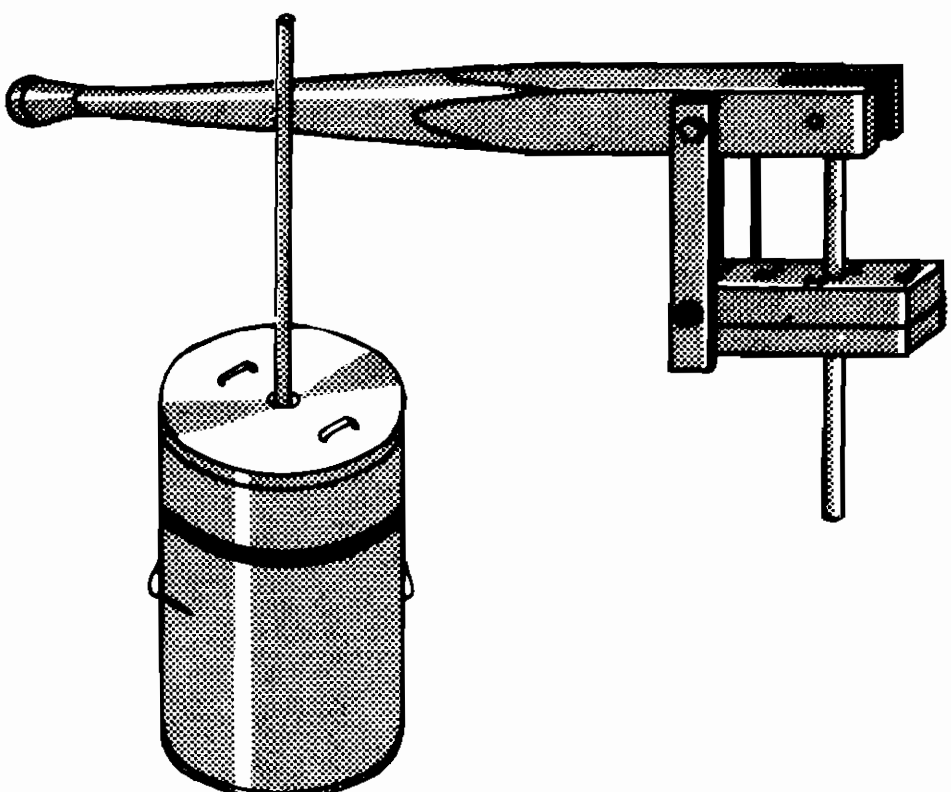




DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION
Washington, D. C. 20523

VILLAGE TECHNOLOGY HANDBOOK





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FOREWORD

This handbook has been prepared to assist village workers of developing countries in making useful tools and in acquiring helpful work techniques. These fifty articles describe and illustrate various tools and techniques primarily in the fields of agriculture, water supply, sanitation and health, housing and construction, and home improvement.

Men and women in villages and on farms may find the information in this book of value in solving some of their problems. English-reading persons assisting in village development program can spread this information among the villagers and farmers and should find this handbook helpful in their programs.

Of course, for maximum effectiveness the material should be selected, adapted and translated for local use.

The articles were provided by the Volunteers for International Technical Assistance, Inc., Schenectady 4, New York, and are based on field-tested experiences. The compilation was made for the United States Agency for International Development under an arrangement with the Office of Technical Services, U.S. Department of Commerce.

The dual-purpose assembly of this publication will permit keeping it intact in a 3-ring notebook or tearing out articles or sections at the perforated lines.

Copies of this handbook may be obtained from the United States Agency for International Development Missions in foreign countries or from the Communications Resources Division, Agency for International Development, Washington, D.C. 20523, U.S.A.

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TABLE OF CONTENTS

INTRODUCTION

TEMPERATURE CONVERSION

ABSTRACT

This chart is useful for quick conversion from Centigrade to Fahrenheit and vice versa. The equations provide slower but more accurate results.

TOOLS AND MATERIALS (None)

DETAILS

Although the chart is fast and handy, you must use the equations below to calculate the exact conversion if your answer must be accurate to within one degree:

Degrees Centigrade = 5/9 x (Degrees Fahrenheit -32)

Degrees Fahrenheit = 1.8 x (Degrees Centigrade +32)

This example may help to clarify the use of the equations; $72^{\circ}F$ equals how many degrees Centigrade?

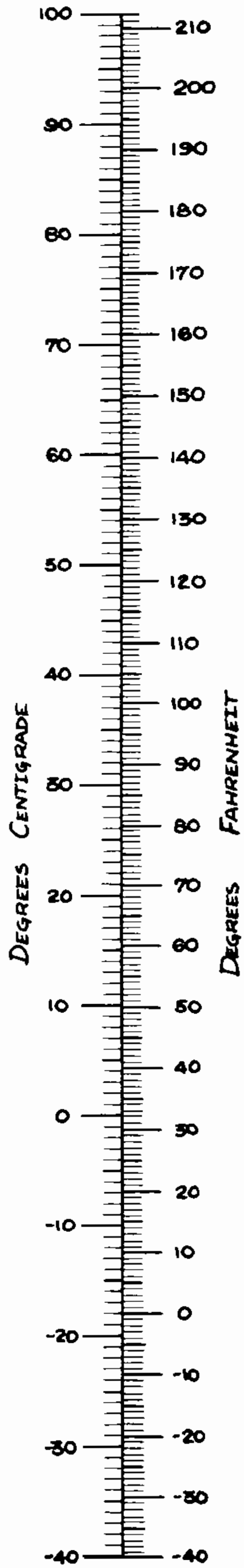
$$72^{\circ}F = 5/9\ (^{\circ}F - 32)$$

$$72^{\circ}F = 5/9\ (72 - 32)$$

$$72^{\circ}F = 5/9\ (40)$$

$$72^{\circ}F = 22.2\ ^{\circ}C$$

Notice that the chart reads 22 $^{\circ}C$, an error of about 0.2 $^{\circ}C$.



LENGTH CONVERSION

ABSTRACT

This foldout chart is useful for quick conversion from meters and centimeters to feet and inches or vice-versa. For distances greater than three meters, or more accurate results, the tables or conversions equations must be used.

TOOLS AND MATERIALS (None)

DETAILS

The chart (page 4) has metric divisions of one centimeter to three meters, and English graduations in inches and feet to ten feet. It is accurate to about plus or minus one centimeter. Folding out the chart makes a handy reference when studying other drawings in the Handbook.

For more accurate results these tables are useful:

INCHES INTO CENTIMETERS
(1 in. = 2.539977 cm.)

inches	0	1	2	3	4	5	6	7	8	9
0	cm.	2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86
10	25.40	27.94	30.48	33.02	35.56	38.10	40.64	43.18	45.72	48.26
20	50.80	53.34	55.88	58.42	60.96	63.50	66.04	68.58	71.12	73.66
30	76.20	78.74	81.28	83.82	86.36	88.90	91.44	93.98	96.52	99.06
40	101.60	104.14	106.68	109.22	111.76	114.30	116.84	119.38	121.92	124.46
50	127.00	129.54	132.08	134.62	137.16	139.70	142.24	144.78	147.32	149.86
60	152.40	154.94	157.48	160.02	162.56	165.10	167.64	170.18	172.72	175.26
70	177.80	180.34	182.88	185.42	187.96	190.50	193.04	195.58	198.12	200.66
80	203.20	205.74	208.28	210.82	213.36	215.90	218.44	220.98	223.52	226.06
90	228.60	231.14	233.68	236.22	238.76	241.30	243.84	246.38	248.92	251.46

CENTIMETERS INTO INCHES
(1 cm. = 0.3937 in.)

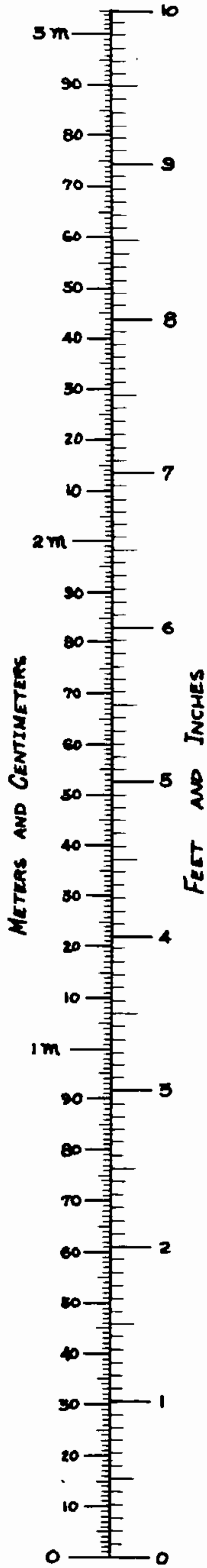
cm.	0	1	2	3	4	5	6	7	8	9
0	inches	0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543
10	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480
20	7.874	8.268	8.661	9.055	9.449	9.843	10.236	10.630	11.024	11.417
30	11.811	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354
40	15.748	16.142	16.535	16.929	17.323	17.717	18.110	18.504	18.898	19.291
50	19.685	20.079	20.472	20.866	21.260	21.654	22.047	22.441	22.835	23.228
60	23.622	24.016	24.409	24.803	25.197	25.591	25.984	26.378	26.772	27.165
70	27.559	27.953	28.346	28.740	29.134	29.528	29.921	30.315	30.709	31.102
80	31.496	31.890	32.283	32.677	33.071	33.465	33.858	34.252	34.646	35.039
90	35.433	35.827	36.220	36.614	37.008	37.402	37.795	38.189	38.583	38.976

An example may help explain how to use this type of table. Suppose you wish to find how many inches are equal to 66 cm. On the cm. to in. table look down the leftmost column to 60 cm., and then right to the column headed 6 cm. This gives the result, 25.984 inches.

EQUATIONS

1 inch = 2.54 cm.
1 foot = 30.48 cm.
       = 0.3048m.
1 yard = 91.44 cm.
       = 0.9144m.
1 mile = 1.6. km.

1 cm. = 0.3937 in.
1 m. = 39.37 in.
      = 3.28 ft.
1 km. = 0.62137 mile



WEIGHT CONVERSION

ABSTRACT

The chart converts pounds and ounces to kilograms and grams or vice versa. For weights greater than ten pounds, or more accurate results, the tables or conversion equations must be used.

TOOLS AND MATERIALS (None)

DETAILS

Notice that there are sixteen divisions for each pound on the chart to represent ounces. There are only 100 divisions in the first kilogram, and each division represents ten grams. The chart is accurate to about plus or minus twenty grams.

The tables have a greater range and accuracy. See the entry on length conversion for an explanation of how to use this type of table.

KILOGRAMS INTO POUNDS
(1 kg. = 2.20463 lb.)

kg.	0	1	2	3	4	5	6	7	8	9
0	lb.	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	52.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.19	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.58	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

POUNDS INTO KILOGRAMS
(1 lb. = 0.45359 kg.)

lb.	0	1	2	3	4	5	6	7	8	9
0	kg.	0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370
90	40.823	41.277	41.730	42.184	42.638	43.091	43.545	43.998	44.452	44.906

EQUATIONS

1 oz. = 28.35 g. 1 g. = 0.03527 oz.

1 lb. = 0.4536 kg. 1 kg. = 2.205 lb.

WATER SUPPLY

INERTIA HAND PUMP FOR IRRIGATION

ABSTRACT

This efficient lift pump provides 30 gpm (gallons per minute) at 4 meters to 75 gpm at 1 meter. The pump is easily built by a tinsmith, and the three moving parts require almost no maintenance. It has been built in three sizes for different water levels.

TOOLS AND MATERIALS

Soldering equipment
Drill and bits or punch
Hammer
Saws
Tinsnips
Anvil - (Railroad rail or iron pipe)

<u>Material for 1 meter lift pump</u>

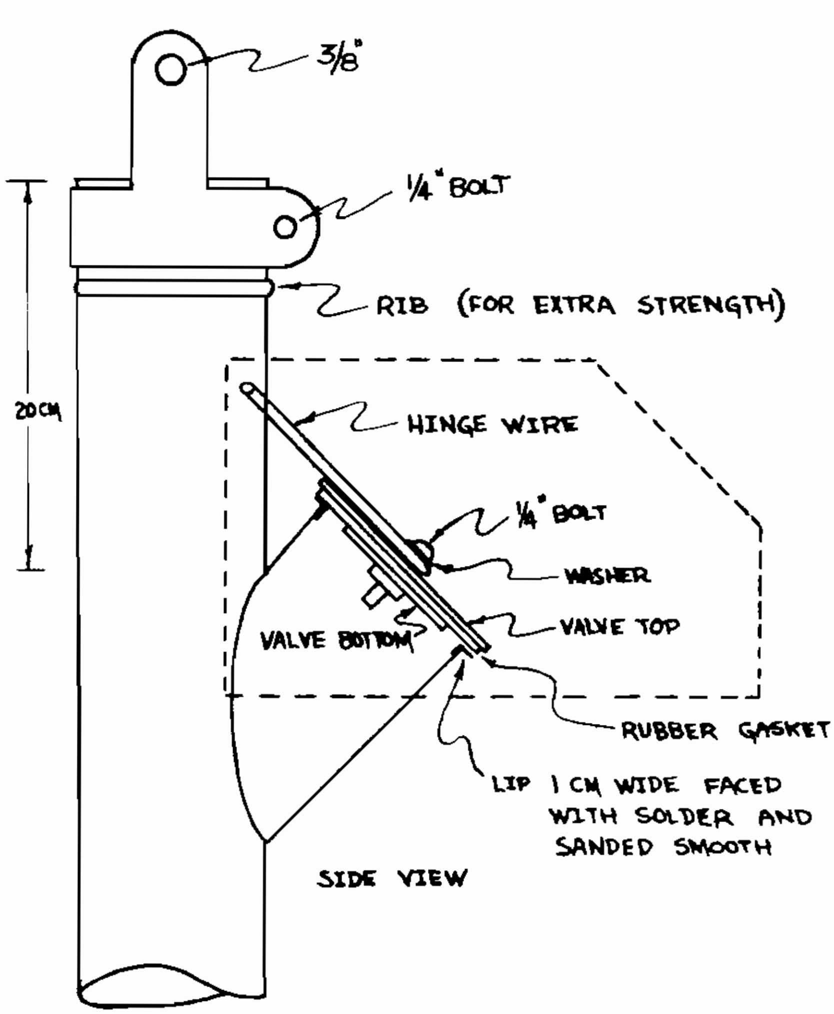
Galvanized iron-	1 piece	61 cm x 32 cm	(shield)
	1 "	21 cm x 22 cm	(shield cover)
	1 "	140 cm x 49 cm	(pipe)
	1 "	15 cm x 15 cm	(top of pipe)
	1 "	49 cm x 30 cm	("Y" pipe)
Barrel metal-	1 piece	15 cm x 54 cm	(bracket)
	1 "	12 cm - diameter	(valve-bottom)
	1 "	18 cm - diameter	(valve-top)
Wire -	1 piece	4 mm - diameter, 32 cm long	(hinge)

DETAILS

The pump is made from galvanized sheet metal of the heaviest weight obtainable which can be easily worked by a tinsmith. The pipe is formed and made air tight by soldering all joints and seams. The valve is made from the metal of discarded barrels and a piece of truck inner tube rubber. The bracket for attaching the handle is also made from barrel metal.

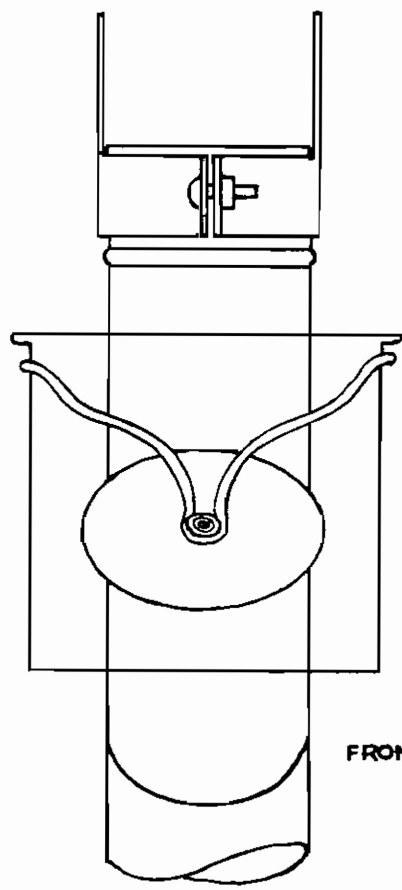
There are two points to be remembered concerning this pump. One is that the distance from the top of the pipe to the top of the hole where the short section of pipe is connected must be 20 cm. The air which stays in the pipe above this junction serves as an air cushion (to prevent "hammering") and regulates the number of strokes pumped per minute. The second point is to remember to operate the pump with short strokes (15 to 20 cm) and at a rate of about 80 strokes per minute. There is a definite speed at which the pump works best and the operator will soon get the "feel" of his particular pump.

In building the two larger size pumps it is sometimes necessary to strengthen the pipe to prevent collapsing which occurs if the pipe is allowed to hit the side of the well. Strengthening may be done by forming "ribs" about every 30 cm below the valve or banding with bands made from barrel metal and attached with 1/4" bolts.

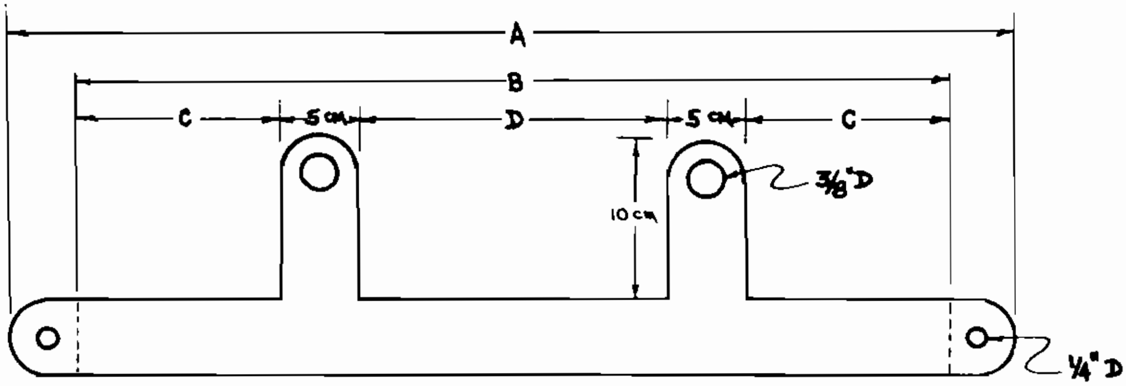


SIDE VIEW

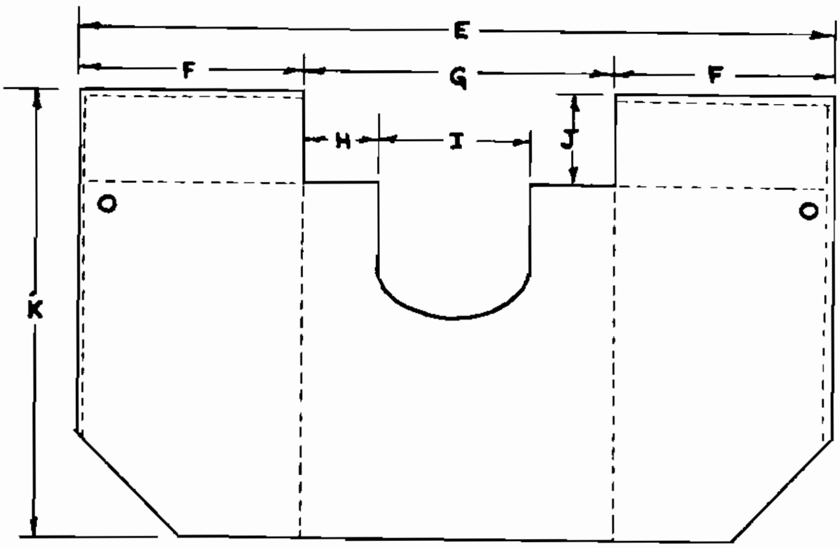
The handle is attached to the pump and post with 3/8" bolts or large nails of similar size.



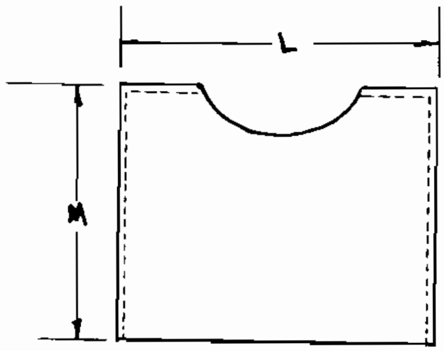
FRONT VIEW



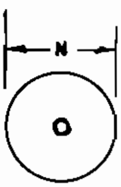
HANDLE BRACKET



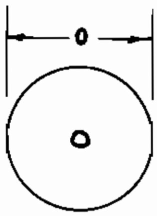
SHIELD



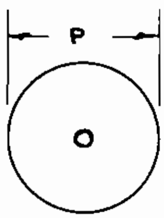
SHIELD COVER



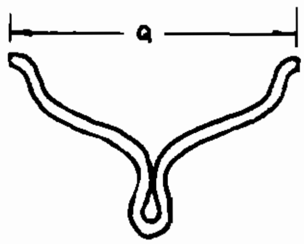
VALVE BOTTOM



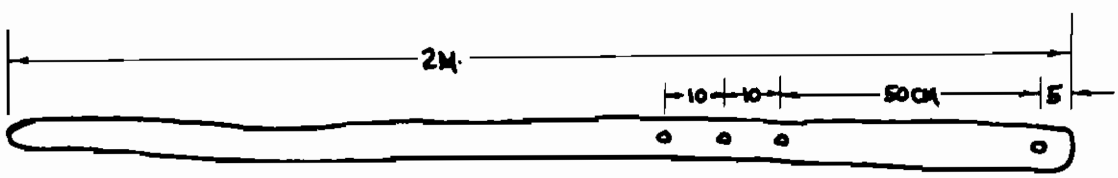
GASKET



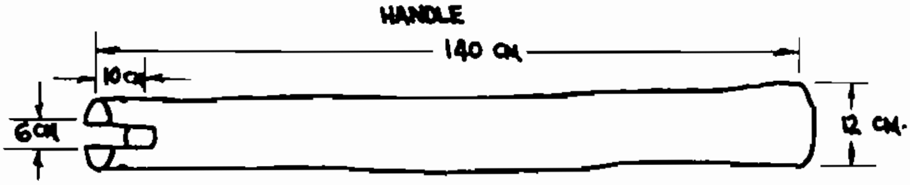
VALVE TOP



HINGE



HANDLE



POST

DIMENSION OF PARTS ACCORDING TO PUMP SIZE

Part	Material	8 cm pipe	10 cm pipe	15 cm pipe
Handle Bracket	Barrel Metal			
A		34 cm	40 cm	54 cm
B		24	30	44
C		3½	5	8½
D		7	10	17
Shield	Galvanized tin			
E		43	49	61
F		14	16	20
G		14	16	20
H		3	3	2½
I		8	10	15
J		4	4	4
K		30	30	32
Shield Cover	Galvanized tin			
L		15	17	21
M		20	20	22
N	Barrel Metal	6	8	12
O	Inner tube rubber	11	13	18
P	Barrel Metal	11	13	18
Q	Wire (4 mm)	16	18	22
Handle	Wood pole			
Post	Wood post			

EVALUATION

Approximately three hundred pumps are now in use in Afghanistan where this design originated. The hand pump described here has proven to be a very efficient pump for lifting water short distances. The following table shows the pumping capacity for each size pump.

Diameter of pipe	Length of pipe	Height of lift	Gallons per minute at 6000' elevation
8 cm	450 cm	2 to 4 meters	30 gallons
10 cm	270 cm	1 to 2 meters	40 gallons
15 cm	140 cm	1 meter	75 gallons

Material From - Dale Fritz, The Asia Foundation

HANDLE MECHANISM FOR HAND PUMPS

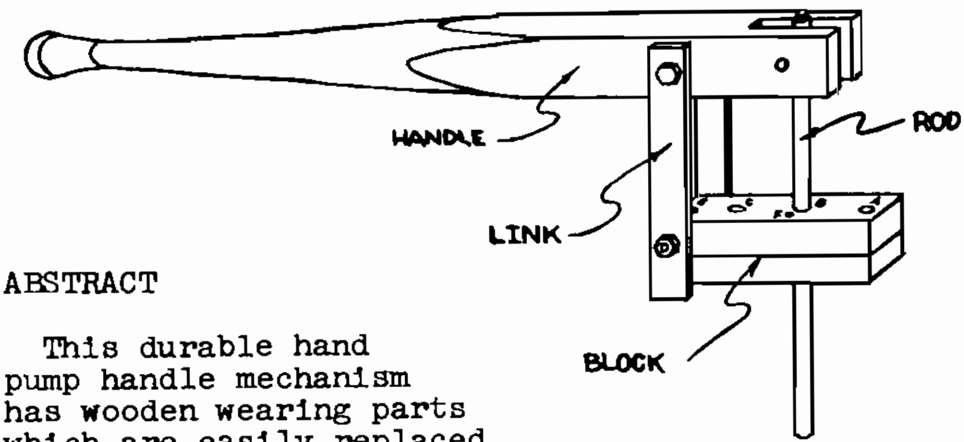


FIG 1

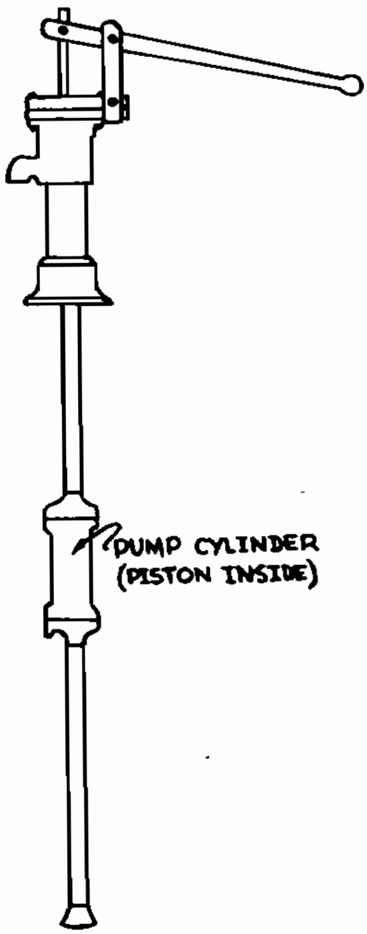


FIG. 2

ABSTRACT

This durable hand pump handle mechanism has wooden wearing parts which are easily replaced by the village carpenter. It is designed to replace the handle mechanism of your pump.

TOOLS AND MATERIALS

Saw
Drill
Bits
1/2" tap
3/8" tap
Chisel
Drawknife, spokeshave, or lathe
43" x 2 1/2" x 2 1/2" Hardwood
16" of 3/4" diameter mild steel rod
2 pieces 10 1/2" x 1 1/2" x 1/4" strap iron

BOLT HARDWARE						
# Bolts reqd.	Dia. inches	length inches	# nuts reqd.	# Lock-washers	# Plain washers	Purpose - fastens:
1	3/8	1 1/2	0	0	0	3" bolt to rod
1	3/8	3	0	0	2	Rod to Handle
2	1/2	3 1/2	2	4	4	Link to Handle Link to Block
2	1/2	?	2	2	2	Block to your pump
1	1/2	?	1	1	0	Rod to piston

DETAILS

If you have been having difficulty with maintenance on the handle mechanism of hand pumps, this design will help. The mechanism of Figure 1 is bolted to the top flange of your pump. The mounting holes A and C in the block are spaced to fit your pump. Figure 2 shows a pump with this handle mechanism already attached which is being manufactured by F. Humain and Bros., 28 Strand Road, Calcutta, India. The price for the pump is about Rs. 36, f.o.b. Calcutta, which is roughly $7.50. The major parts of the handle mechanism are described in the following paragraphs.

Handle - Make the handle of tough hardwood, shaped on a lathe or by hand shaving. The slot should be cut wide enough to accommodate the rod with two plain washers on either side. See Figure 3.

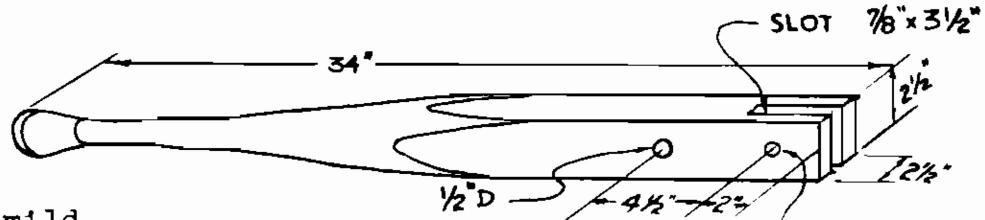


FIG 3
HANDLE

Rod - Made of mild steel as shown in Figure 4. A 3/8" diameter machine bolt 1 1/2" long screws into the end of the rod to lock the rod hinge pin in place. The rod hinge pin consists of a 3/8" diameter machine bolt. The piston can be bolted directly to the end of the rod using a 1/2" bolt. If the pump cylinder is too far down, a threaded 1/2" rod should be used instead of a bolt.

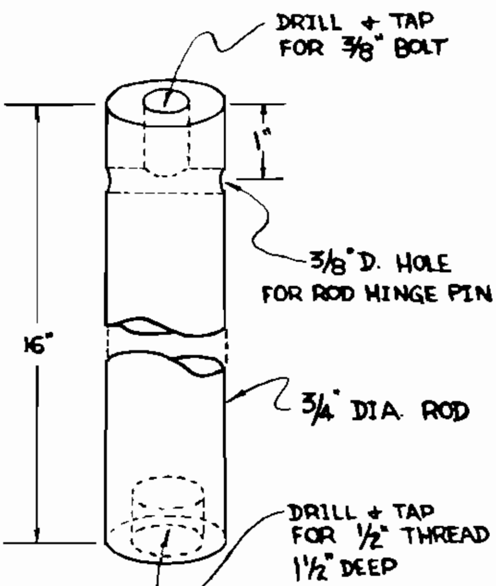


FIG 4
ROD

Link - These consist of two pieces of flat steel strap iron. Clamp the pieces together for drilling in order to make the hole spacing equal. See Figure 5.

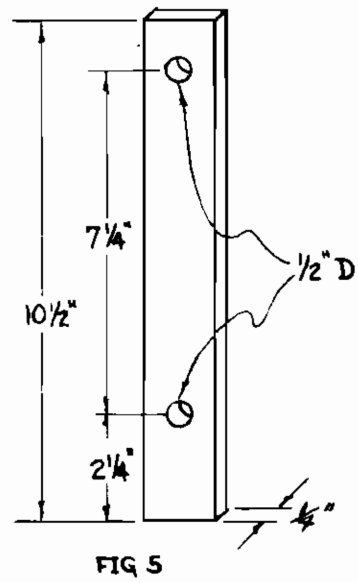


FIG 5
LINK

Block - The block forms the base of the lever mechanism, serves as a lubricated guide hole for the rod, and provides a means for fastening the mechanism to the pump barrel. If the block is accurately made of seasoned tough hardwood without knots, the mechanism will function well for many years. Carefully square the block to 9" x 2 1/2" x 2 1/2". Next holes A, B, C, and D are drilled perpendicular to the block as shown in Figure 6. The spacing of the mounting holes A and C from hole B is determined by the spacing of the bolt holes in the barrel flange of your pump. Next saw the block in half in a plane 1 3/8" down from the top side. Enlarge hole B at the top of the lower section with a chisel to form an oil well around the rod. A 1/4" hole, F, is drilled at an angle from the oil well to the surface of the block. A second oil duct hole E is drilled in the upper section of the block to meet hole D. Use lockwashers under the head and nut of the link bolts to lock the bolts and links together. Use plain washers between the links and the wooden parts.

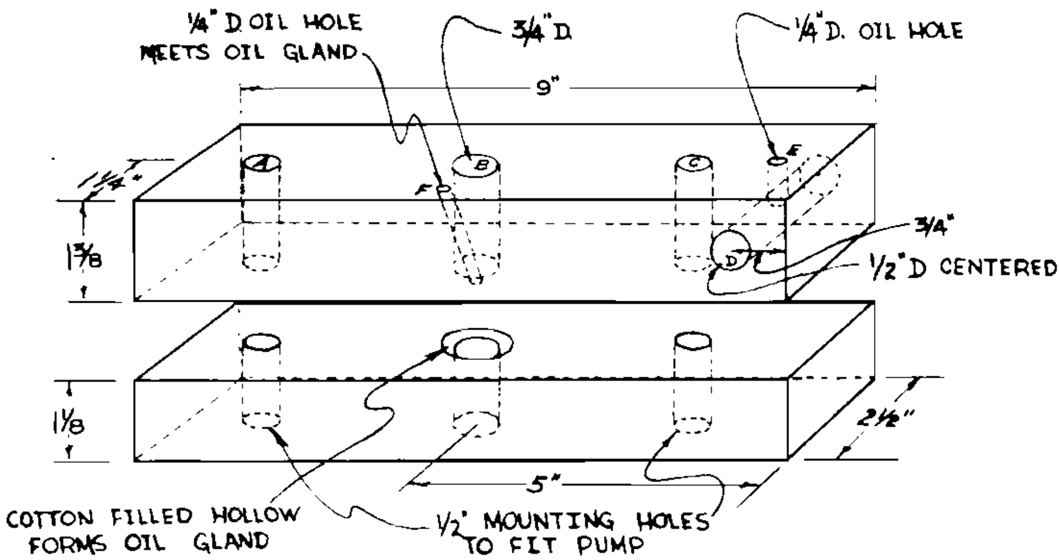


FIG 6
BLOCK

EVALUATION

Dr. Abbott of the AFSC Barpali project, Orissa, India, has had 45 such pumps in operation for more than three years. Repairs have been simple and infrequent.

Material From - Dr. Edwin Abbott, M.D. (AFSC)

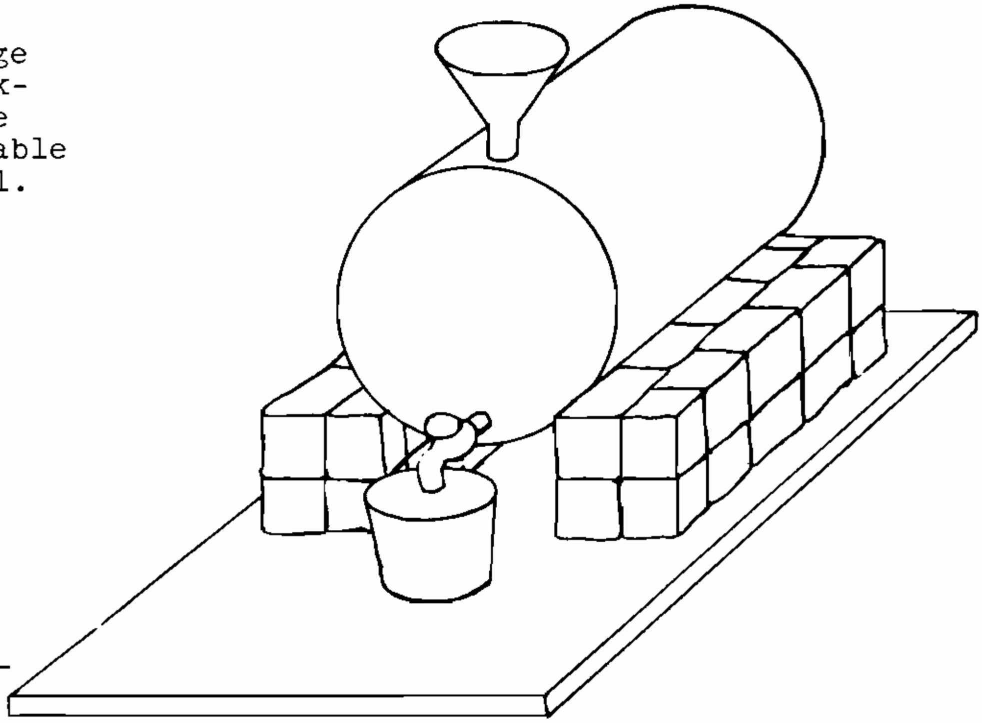
REFERENCE

A Pump Designed for Village Use by Dr. Edwin Abbott, M.D., available through VITA, 1206 State Street, Schenectady 4, New York

BOILER FOR POTABLE WATER

ABSTRACT

To provide safe storage and preparation of drinking water in areas where pure water is not available and boiling is practical.



TOOLS AND MATERIALS

1 - 55 Gallon drum
1 - 3/4" Pipe Nipple 2" long. Quantity of bricks for two 1 layers of bricks to support drum.
1 - Bag of cement plus sand for mortar and base of fireplace.
1 - large funnel and filter medium for filling.
1 - Metal plate to control draft in front of firebox.
1 - 3/4" Valve, preferably all metal such as a gate valve to withstand heat.

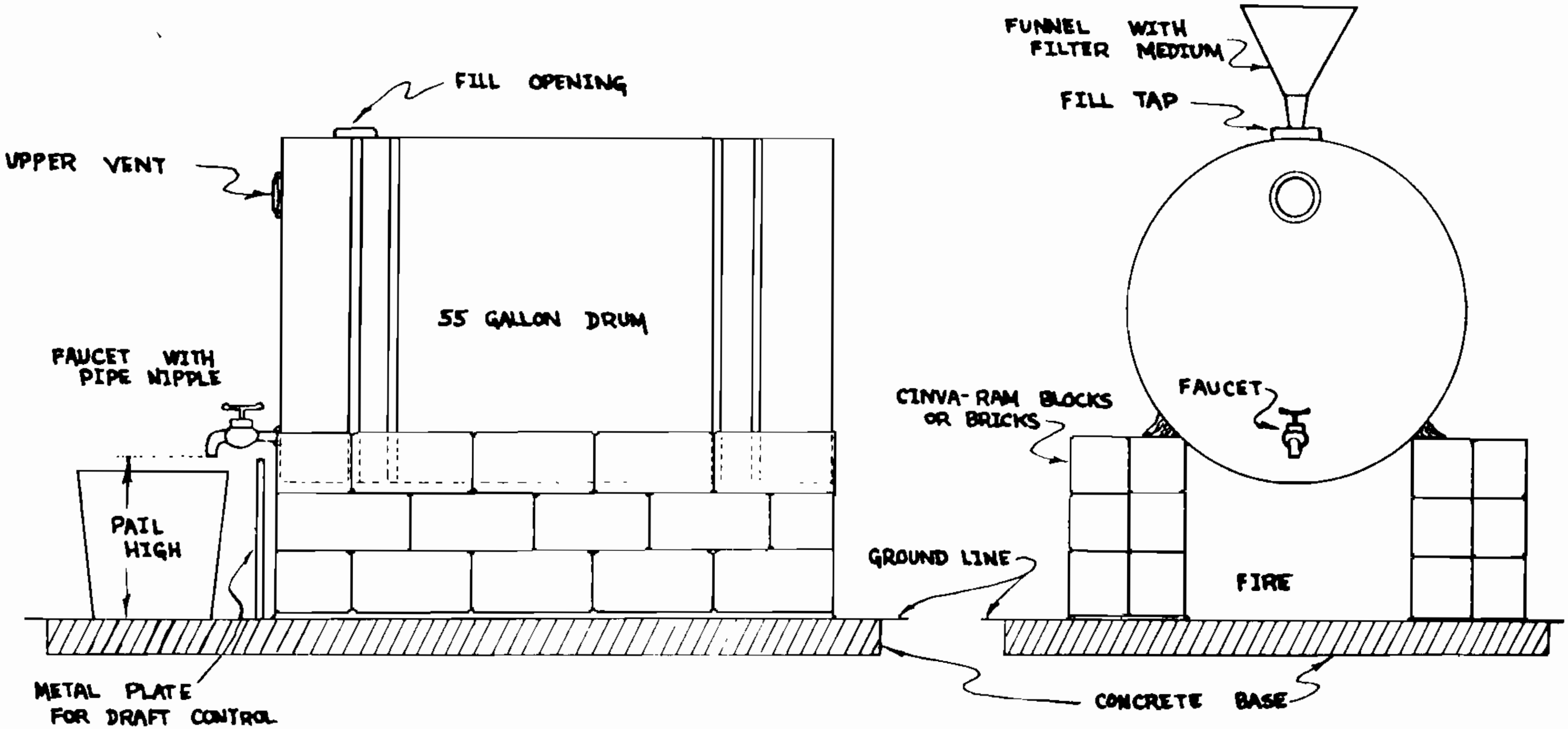
DETAILS

This drum for boiling of drinking water is intended for use in your residence to provide a convenient method for preparation and storage of sterile water. The fireplace is simple, oriented so that the prevailing wind or draft goes from front to back of the drum between the bricks. A chimney can be provided but is not necessary.

EVALUATION

The unit has been tested in many Friend's workcamps in Mexico and elsewhere. A 55 gallon drum would normally last a 20 person camp group for an entire week, and certainly would provide adequate safe water supply for two or three individuals for a much longer time. Water must boil at least 15 minutes with steam escaping around the completely loosened filler plug. Be sure that the water in the pipe nipple and valve reach boiling temperatures by purging about two liters of water out through the valve while the drum is at a full boil.

Material From - Chris Ahrens, CARE-PEACE CORPS


FUNNEL WITH FILTER MEDIUM
FILL OPENING
FILL TAP
UPPER VENT
55 GALLON DRUM
FAUCET WITH PIPE NIPPLE
PAIL HIGH
CINVA-RAM BLOCKS OR BRICKS
FAUCET
GROUND LINE
FIRE
METAL PLATE FOR DRAFT CONTROL
CONCRETE BASE

CHLORINATION FOR POLLUTED WATER

ABSTRACT

Chlorination, when properly applied, is a simple way to insure and protect the purity of water. These guidelines include tables to give a rough indication of the amounts of chlorine bearing chemicals needed.

TOOLS AND MATERIALS

Chlorine in some form
Container to mix chlorine

DETAILS

The surest way to treat water for drinking is to boil it--see "Boiler for Potable Water." However, under controlled conditions chlorination is a safe method, and often more convenient and practical than boiling. Water properly treated has residual free chlorine which resists recontamination. The chlorine in water is not harmful, since water with a harmful amount of chlorine in it is extremely distasteful. Proper treatment of water with chlorine requires some knowledge of the process and its effects.

When chlorine is added to water, it attacks and combines with any suspended organic matter as well as some minerals such as iron. There is always a certain amount of dead organic matter in water, and almost always live bacteria, virus, and perhaps other types of life. Enough chlorine must be added to oxidize all of the organic matter, dead or alive, and to leave some excess uncombined or "free" chlorine.

Some organisms are more resistant to chlorine than others. Two particularly resistant varieties are amebic cysts (which cause amebic dysentary) and the cercariae of schistosomes (which cause schistosomiasis). These, among others, require much higher levels of residual free chlorine and longer contact periods than usual to be safe. Often special techniques are used to combat these and other specific diseases. It always takes time for chlorine to work. Be sure that water is thoroughly mixed with an adequate dose of the dissolved chemical, and that it stands for at least 30 minutes before consumption.

Since both combined and uncombined chlorine has an unpalatable taste, it is best (and safest) to choose the clearest water available. A settling tank, and simple filtration can help reduce the amount of suspended matter, especially particles large enough to see. Filtration that can be depended upon to remove all of the amebic cysts, schistosomes, and other pathogens normally requires professionals to set up and operate. NEVER depend on home-made filters alone to provide potable water. However, a home-made slow sand filter is an excellent way to prepare water for chlorination.

Thus, depending on your water, different amounts of chlorine are needed for adequate protection. Measuring the amount of free chlorine after the 30 minute holding period is the best way to control the process. A simple chemical test using a special organic indicator (orthotolidine) can be used. When this is not available, the chart (Figure 1) can be used as a rough guide.

Water Condition	Initial Chlorine Dose in Parts Per Million(ppm)	
	No hard-to-kill organisms suspected.	Hard-to-kill organisms present or suspected.
Very Clear, few minerals.	5 ppm	Get expert advice; in an emergency boil and cool water first, then use 5 ppm to help prevent recontamination. If boiling is impossible, use 10 ppm.
A coin in the bottom of an 8 oz. glass of the water looks hazy.	10 ppm	Get expert advice; in an emergency boil and cool first. If boiling is impossible use 15 ppm.

FIGURE 1

In the chart, parts per million or "ppm" means the ratio of:

$$\frac{\text{Weight of active material (chlorine)}}{\text{Weight of water}}$$

In water supply terminology, ppm means exactly the same thing as milligrams per liter or "mg/l".

The second chart, Figure 2, gives the amount of chemical to add to 1000 gallons of water to get a solution of 1 ppm. Multiply the amount of chemical shown in Figure 2 by the number of ppm recommended in Figure 1 to get the amount of chemical you should add to 1000 gallons of water. Usually it is convenient to make up a solution of 500 ppm strength which can then be further diluted to give the chlorine concentration needed. The 500 ppm solution must be stored in a sealed container in a cool dark place, and should be used as quickly as possible since it does lose strength. Modern chlorination plants use bottled chlorine gas, but this can only be used with expensive machinery by trained experts.

Compound	% by weight of active material	Quantity to add to 100 gallons of water to get a 1 ppm solution
High Test (Calcium hypochlorite) $Ca(OCl)_2$	70%	1/5 ounce
Chlorinated lime	25%	1/2 ounce
Sodium hypochlorite NaOCl	14%	1 ounce
Sodium hypochlorite	10%	1.3 ounces
Bleach - a solution of chlorine in water	usually 5.25%	2.6 ounces

FIGURE 2

EVALUATION

The amount of chlorine specified will normally make reasonably safe water. Try to have your water treatment system inspected by an expert, and the water itself tested periodically.

Principal References - J. S. Salvato, Environmental Saniatation, Wiley, 1958
TM 5-700, Field Water Supply

EARTH BORER

ABSTRACT

This simple, lightweight inexpensive earth borer developed in India can be used for digging postholes, latrine holes, and in fact any hole with a diameter from 8" to 23" or even larger. It works well only in certain types of soil.

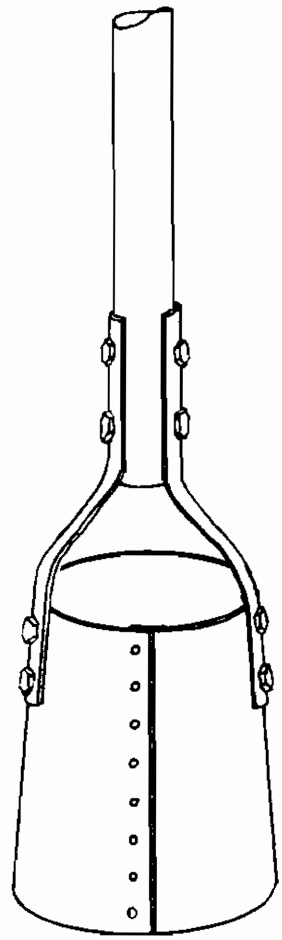


FIG 1

TOOLS AND MATERIALS

Earth Borer - a similar earth borer, the Ulti-Balti, is manufactured by the Agricultural Development Society, P.O. Naini, Allahabad, U.P., India - only the cutting head is supplied for about Rs. 17, nP. 25, or about $6.00. It weighs 3 1/2 Seers, or 7.2 pounds, f.o.b. factory.
Bamboo pole - 15' to 18' long, smooth and straight, 1 1/2" diameter maximum.
Barrel metal 23" x 9" for blade, but tough steel 1/16" thick is better.
Strap iron - 2 pieces 1/4" x 1" x 11"
Machine bolts - 2, 3/8" x 2" with nuts and lockwashers for attaching handle to straps.
Machine bolts - 4, 3/8" diameter x 3/4" long with nuts and lockwashers for attaching straps to blade.
Iron rivets - 8, 1/4" diameter x 3/8" long to fasten ends of blade together.
Drill - with 1/4" and 3/8" bits
Hammer and anvil
Wrench
Heavy tinsnips
File

DETAILS

(1) Mark the outline of Fig. 2 on the metal, and cut the blade to shape. Mark the locations for bolt holes for attaching the straps.

(2) Drill the 3/8" diameter holes for the strap bolts.

(3) Bend the blade into an open cone, 6" diameter at the top and 7" diameter at the bottom, with a 1" overlap and rivet or braze.

(4) Mark the location for the holes in the end of the straps from the holes already drilled in the blade, to be sure they will line up.

(5) Drill the holes in the straps to attach to the blade.

(6) Bend the straps to shape and bolt on to the outside of the blade.

(7) Drill the holes for attaching the handle with the bamboo in place to insure that these holes line up and that the mounted handle will be straight.

(8) Mount the handle, and file off any rough spots or sharp corners.

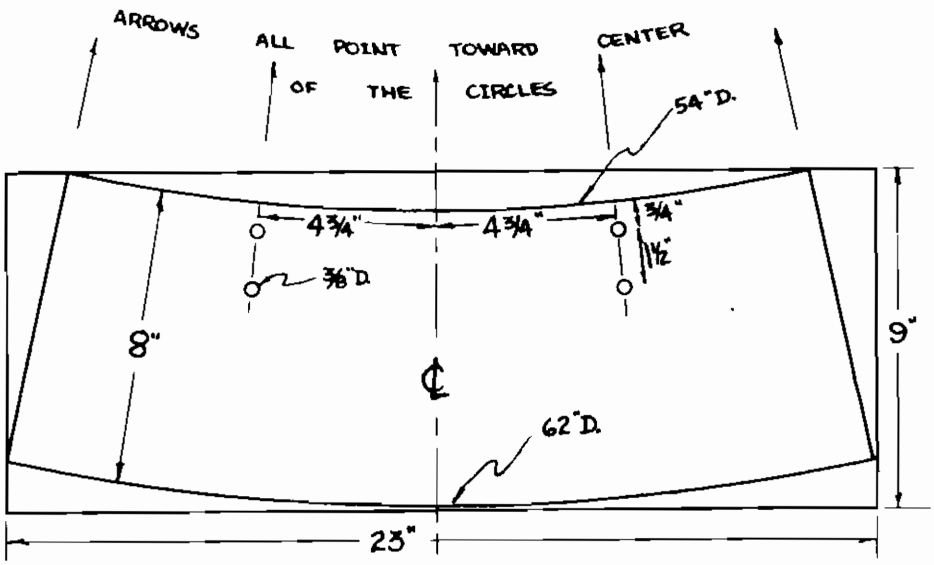


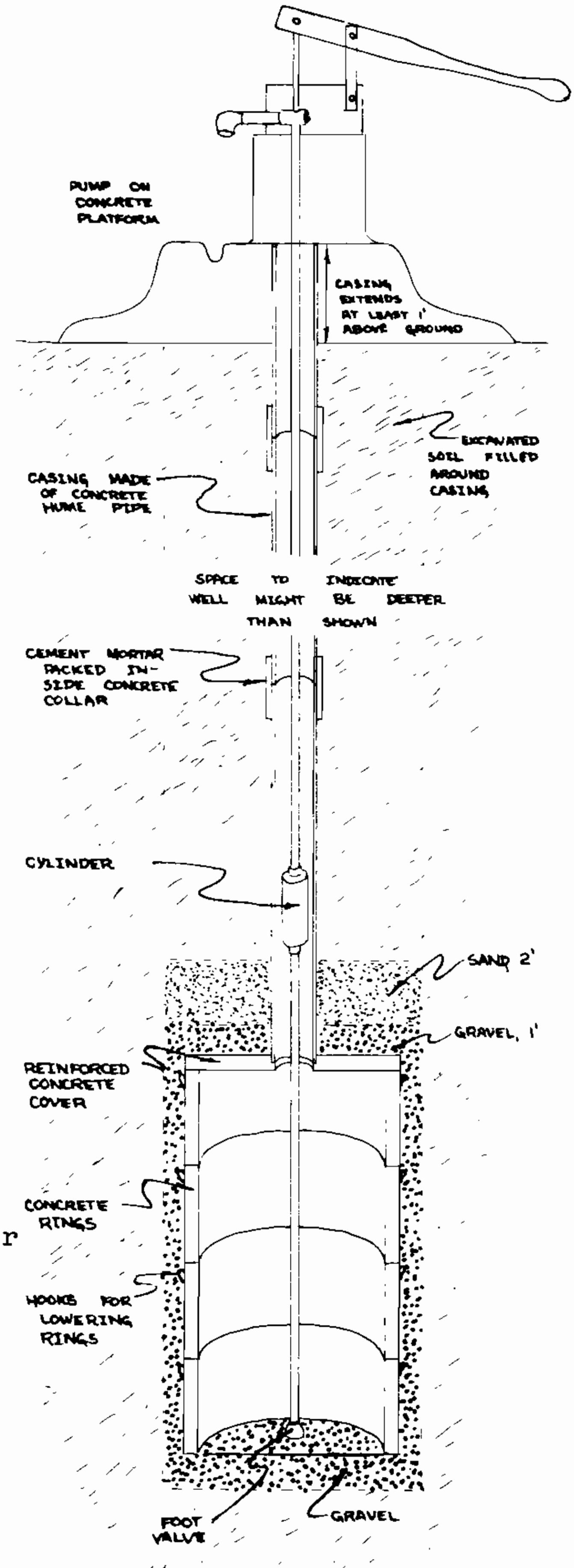
FIG. 2

To work it, the site is cleared of weeds and a shallow hole of the proper diameter is dug. Then the borer is brought down into the pit with force, and this up and down motion repeated till the borer fills with soil. Dirt inside the cutter is held tightly since the unit tapers together toward the top. Once it is full, it is removed and emptied and the operation repeated. For larger diameter holes, move the blade around on different strokes to cover the whole area. This device is not recommended for holes greater than 15' deep. Fitting with a steel pipe handle can increase its usefulness to about 25'.

EVALUATION

Has found extensive use in India and other places where a simple, inexpensive earthborer for small fairly shallow holes are needed.

Material From - Mason Vaugh and the Agricultural Development Society Catalog.



ABSTRACT

This well has an underground concrete tank with a casing pipe instead of brick walls. Advantages are pure water, no hazard to children, ease of construction, small area required and low cost.

TOOLS AND MATERIALS

Four reinforced concrete rings with iron hooks for lowering, 3' diameter.
One reinforced concrete cover with seating hole for casing pipe.
Washed gravel to surround tank; 70 cubic feet.
Sand for top of well; 24 cubic feet
Concrete hume pipe, 6" diameter from top of tank cover to at least 1' above ground.
Concrete collars - as many as joints required in hume pipe.
Cement - 10 pounds for mortar for hume pipe joints.
Deep well pump and pipe
Concrete base for pump
Tripod, pulleys, rope for lowering rings.
Special tool for positioning casing when refilling, see text.
Digging tools, ladders, rope.

DETAILS

A village well must, in many places, act as a reservoir. This is because at certain hours of the day the demand is heavy, whereas during the night and the heat of the day there is no call on the supply. Thus it is calculated to make the well large enough to allow the water slowly percolating in to accumulate during the off use hours, in order to have an adequate supply when the demand on it is heavy. For this reason wells are usually made six or seven feet in diameter. Wells cannot store rainy season water for the dry season, and there is seldom sense in making a well larger in diameter than seven feet. The depth of a well is much more important than the diameter in determining the amount of water that can be drawn when the water level is low. A deep, narrow well will often provide more water than a wide shallow one. Remember that tubewells are much easier to construct than a dug well, and should be used if your region allows their construction and an adequate amount of water can be drawn from a tubewell during the busy hours.

The masonry lining of a deep dug well is very expensive. An open well, having organic matter falling into it from the surface and a continuous source of possible contamination from the various buckets lowered into it is very often contaminated. The tremendous quantity of soil removed from a deep well of reasonable diameter must be disposed of somewhere.

A villager in Barpali, India, working with the AFSC unit there suggested this radical new idea; to make a masonry tank at the bottom of the well, roof it over, and draw the water from it with a pump. The resulting sealed well has many advantages:

1. Provides pure water, safe for drinking.
2. Presents no hazard of children falling in.
3. Drawing water is easy, even for small children.
4. The well occupies little space, a small courtyard can accommodate it.
5. The cost of installation is greatly reduced.
6. The labor involved is much reduced.
7. There is no problem of getting rid of excavated soil, since most of it is replaced.
8. The casing enables the pump and pipe to be easily removed for servicing.
9. The gravel and sand surrounding the tank provide an efficient filter to prevent silting, allows a large surface area for percolating water to fill the tank, and increases the effective stored volume in the tank.

On the other hand, there are two minor disadvantages--only one person can pump at one time, and the pump might go out of order. In addition, there is a certain amount of technical skill required to make the parts used in the well and to install them properly.

A well is dug four feet in diameter and about thirty feet deep. The digging should be done in the dry season, after the water table has dropped to its lowest level. There should be a full 10 feet reaccumulation of water within 24 hours after the well has been bailed or pumped dry. Greater depth is, of course, desirable.

Six inches of clean, washed gravel or small rock is spread over the bottom of the well; the four rings and cover are lowered into the well and positioned there. Lowering of the rings to form the tank requires setting up a tripod of strong poles and block and tackle since the rings weigh about 400 pounds each. The rings and cover form a tank six feet high and three feet in diameter with a round opening in the top which forms a seat for the casing pipe and allows the suction pipe to penetrate to about six inches from the gravel bottom.

The first section of concrete hume pipe is positioned in the seat and grouted in place. It is braced vertical by a wooden plug with four hinged arms to brace against the sides of the wall. More gravel is packed around the concrete rings and over the top of the cover till the gravel layer above the tank is at least six inches deep. This is then covered with two feet of sand. Soil removed from the well is then shoveled back until filled within six inches of the top of the first section of casing. The next section of casing is then grouted in placed, using a concrete collar made for this purpose. The well is filled and more sections of casing added until the casing extends at least one foot above the surrounding soil level.

The amount of soil which will not pack back into the well can make a shallow hill around the casing to encourage spilled water to drain away from the pump. A concrete cover is placed on the casing and a pump installed.

If concrete or other casing pipe cannot be obtained, a chimney made of burned bricks and sand-cement mortar will suffice. The pipe is somewhat more expensive, but much easier to install.

In India, the concrete rings are being made for about Rs. 10 each, the cover for 15, the pump platform for 10, and the casing at Rs. 2 per foot. Thus for a 25 foot well, the materials cost Rs. 115. The pump, pipe, cylinder, fittings etc. to complete the well cost about an equal amount. Thus the whole installation, without figuring the labor, costs Rs. 230, or about $50.00. In India, the AFSC group is charging Rs. 40 for installation of such a well, which would cover labor. The Service Committee actually uses this money to buy a set of tools which are given to the villager after he has received training in well and pump maintenance.

EVALUATION

Over 45 wells of this type have been installed in India by the AFSC team there, and all have performed perfectly for several years except one that was not dug deep enough.

Material From - "A Safe Economical Well," AFSC,
Barpali Village Service

ABSTRACT

Where soil conditions permit, the tubewell described here will provide pure water, is much easier to install, and costs considerably less than large diameter wells.

TOOLS AND MATERIALS

Asbestos cement, tile, concrete, or even galvanized iron will do.
Casing pipe (from pump to water-bearing layer to below minimum water table).
Sand
Gravel
Cement
Device for lowering and placing casing.
Drilling rig - see "Tubewell Boring"
Foot valve, cylinder, pipe, hand-pump.

DETAILS

In areas where a simple earth borer or earth auger works (ie. alluvial plains with few rocks in the soil), and where there is a permeable (sandy) water-bearing layer, 50 feet or less from the surface, the tubewell will probably work well.

It is a sealed well which will provide pure water and offers no hazard to small children. It is intended for the individual family or small group of families since it may not have the capacity for a large group. Since there is only a small hole to dig and a small amount of purchased material involved, the tubewell is quite inexpensive to install.

Because of the small diameter of these wells, their storage capacity is limited. Therefore, their yield will depend largely upon the rate with which water from the surrounding soil flows into the well. From a

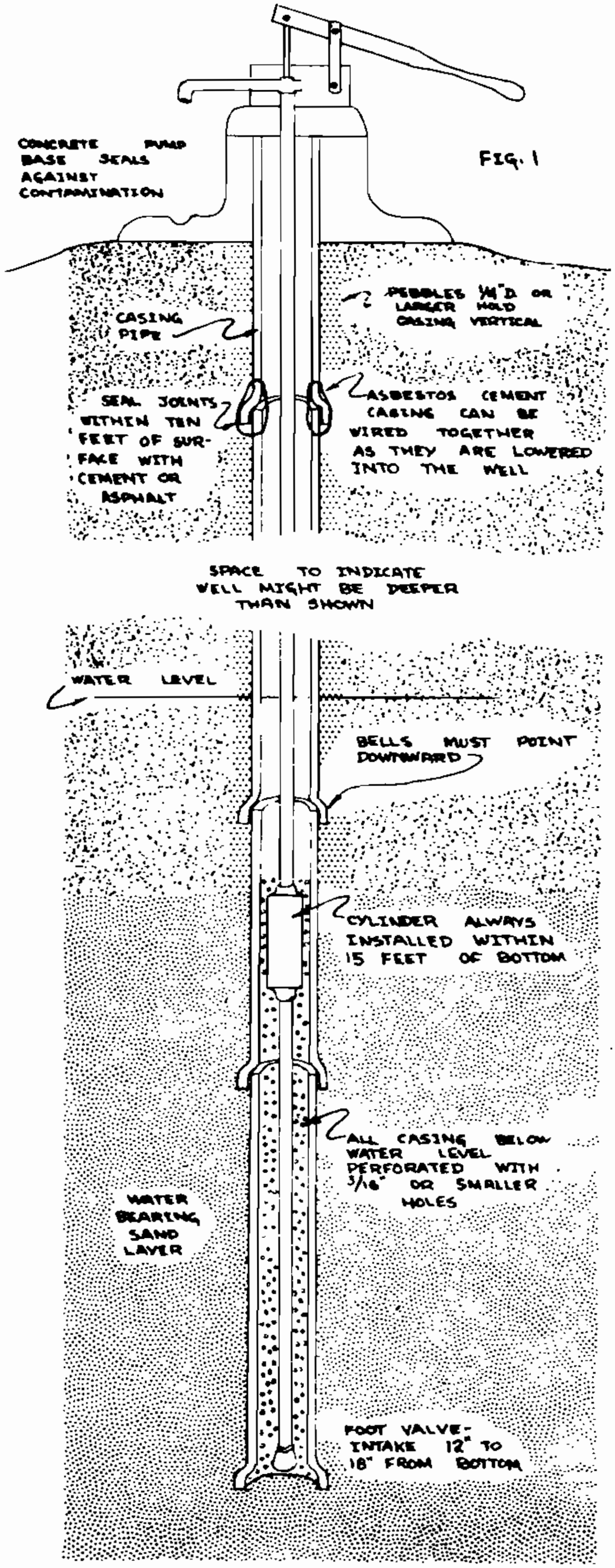


FIG. 1

saturated sand layer the flow is rapid. Inflowing water quickly replaces the water being drawn from the well. A well tapping such a layer seldom goes dry. However, even when water-bearing sand cannot be reached, the requirements of the household may be such that a well with even a limited storage capacity can be utilized.

The hole is dug as deep as possible into the water-bearing strata as described in "Tubewell Boring." The diggings are placed near the hole to make a mound, which later will serve to drain spilled water away from the well. This is important since backwash is one of the few sources of contamination for this type of well. The entire casing pipe below water level should be perforated with many small holes. These should be no larger than 3/16" in diameter at the maximum. Holes larger than this will allow coarse sand to be washed inside. This will plug up the well. Fine particles of sand, however, are expected to enter. These should be small enough to be pumped immediately out through the pump. This keeps the well clear. It may be that the first water from the new well will bring with it large quantities of fine sand. When this happens, the first strokes should be strong and steady and continued until the water comes clear.

Perforated casing is lowered, bell end downward, into the hole using the device shown in Figure 2. When properly positioned, the trip cord is pulled and the next section prepared and lowered. Since holes are easily drilled in Asbestos cement pipe, they can be wired together at the joint and lowered into the well. Be sure the bells point downward, since this will prevent surface water or backwash from entering the well without the purifying filtration effect of the soil as well as sand and dirt from filling the well. Install the casing vertical and fill the remaining space with pebbles. This will hold the casing plumb. The casing should rise 1' to 2' above ground level and be surrounded with a concrete pedestal to hold the pump and drain spilled water away from the hole. The casing joints that are within 10 feet of the surface should be sealed with concrete or bituminous material.

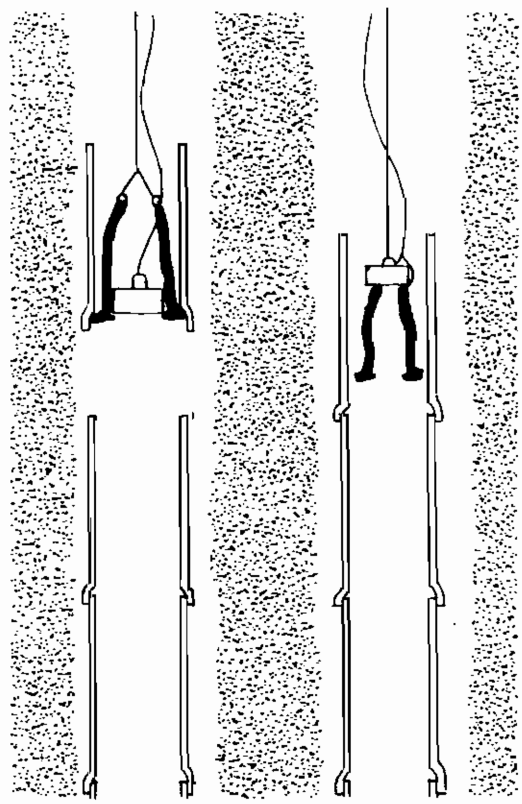


Figure 2

EVALUATION

Many of these wells were installed by the American Friends Service Committee, Barpali team, and all have been producing water for several years.

Material From - "Explanatory Notes on Tubewells" by Wendell Mott, AFSC, Barpali project.

TUBEWELL BORING

ABSTRACT

This simple hand drilling rig bores 6" to 8" diameter holes up to 50' deep for installation of tubewells.

TOOLS AND MATERIALS

Earth auger
Coupling to attach to 1" drill line
(see other entries on earth augers)

Standard weight galvanized steel pipe
Four - 10' sections of 1" diameter
(2 pieces have threads on one end only; others need no threads.)
Two - 3 1/2' sections of 1" diameter
(1 piece has threads on one end only; the other needs no thread.)
(Above sections for drill line.)

Two - 2' sections of 1" diameter
(both threaded one end only)
(Sections for turning handle.)

Four - 1' sections of 1 1/4" diameter
(Sections for Joint A.)

One - 9" section of 1 1/4" diameter
(threaded one end only)
One - 14" section of 1 1/2" diameter
(threaded one end only)
One - 1 1/4" to 1" reducer coupling
One - 1 1/2" to 1" reducer coupling
(Sections and couplings for Joint B.)

One - 1" T coupling (turning handle)

Eight - 3/8" diameter hex head steel machine bolts 1 3/4" long with nuts.

Two - 3/8" diameter hex head steel machine bolts 2" long with nuts.

Nine - 3/8" steel hex nuts

One - 1/8" diameter countersink head iron rivet 1/2" long
One - 1/16" sheet steel 3/8" x 1"
(To make toggle bolt.)

Drills - 1/8", 13/32", 13/16"

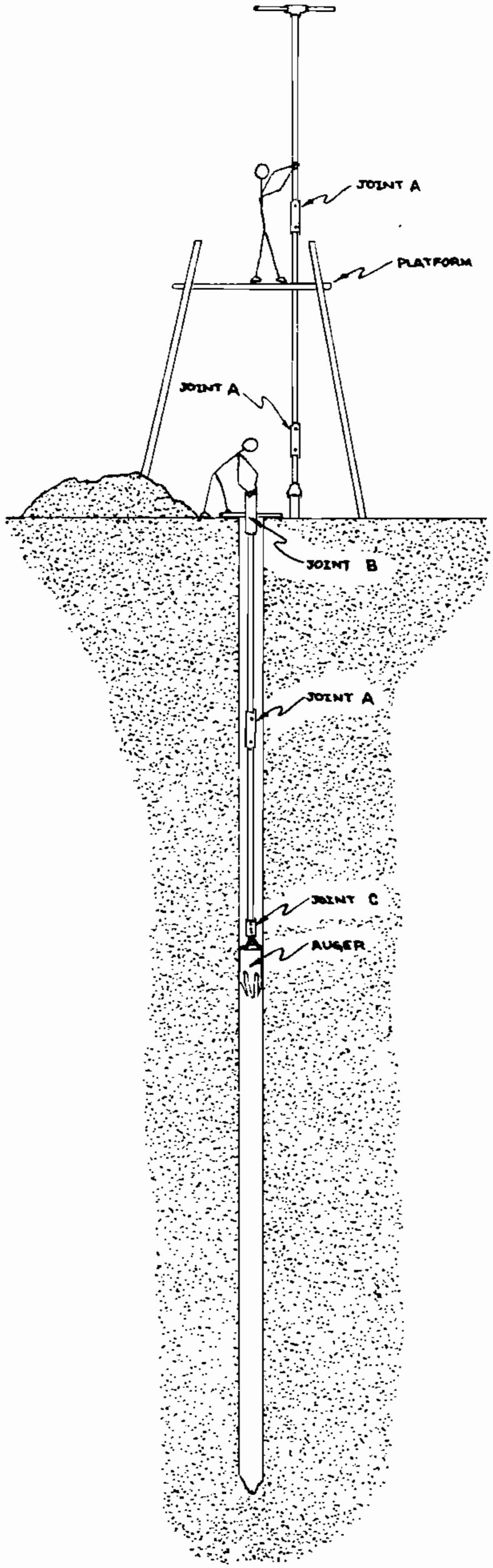


FIG 1

Countersink
Thread cutting dies or buy pipe already threaded.
Small tools - wrenches, hammer, hacksaw, files, etc.
Wood, nails, rope, ladder, etc. for platform.

DETAILS

This method will work in places where the water level is within 40 to 50 feet from the surface, and where there are no rock formations to obstruct drilling. These conditions are most often found in the alluvial plains of river valleys. See the entry on tubewells for directions to assemble the well. This description covers the tools and the method for drilling the hole.

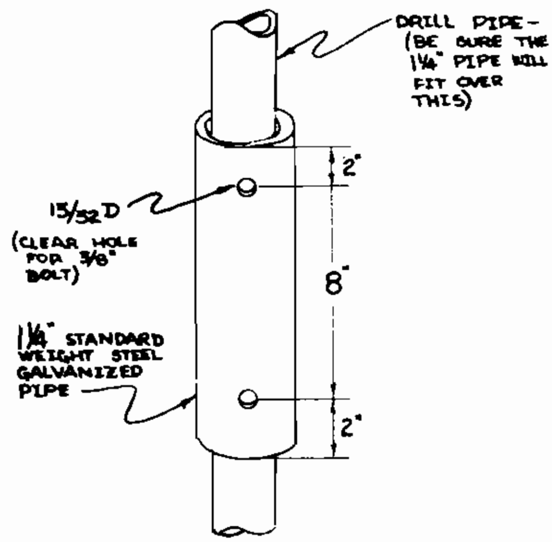


FIG 2
JOINT A

Basically the method consists of rotating an ordinary earth auger. As the auger penetrates the earth, it fills with soil. When full it is pulled out of the hole and emptied. As the hole gets deeper, more sections of drilling line are added to extend the shaft. Joint A in Figures 1 and 2 describe a simple method for attaching new sections.

By building an elevated platform 10 to 12 feet from the ground, a 25 foot long section of drill line can be balanced upright. Longer lengths are too difficult to handle. Therefore, when the hole gets deeper than 25 feet, the drill line must be taken apart each time the auger is removed for emptying. Joint B facilitates the operation. See Figure 1 and 3.

Joint C is proposed to allow rapid emptying of the auger. Some soils respond well to drilling with an auger that has two sides open. These are very easy to empty, and would not require Joint C. Find out what kinds of augers are successfully used in your area, and do a bit of experimenting to find the one best suited to your soil. See the entries on augers.

Joint A has been found to be faster to use and more durable than pipe threaded connectors. The pipe threads become damaged and dirty and are difficult to start. Heavy, expensive pipe wrenches get accidentally dropped into the well and are hard to get out. By using a sleeve pipe fastened with two 3/8" bolts, these troubles can be avoided. A small ten-cent bicycle wrench or the inexpensive bolts will not obstruct drilling if dropped in. Be sure the 1 1/4" pipe will fit over your 1" pipe drill line before purchase. See Figure 2.

Four 10 foot sections and two 3 1/2 foot sections of pipe are the most convenient lengths for drilling a 50 foot well. Drill a 13/32" diameter hole through each end of all sections of drill line except those attaching to Joint B and the turning handle which must be threaded joints. The holes should be 2" from the end.

When the well is deeper than 25 feet several features facilitate the emptying of the auger as shown in Figure 3 and 4. First the full auger is pulled up until Joint B appears at the surface. See Figure 4A. Then a 3/4" diameter rod is put through the hole. This allows the whole drill line to rest on it making it impossible for the part still in the well to fall in. Next remove the toggle bolt, lift out the top section of line and balance it beside the hole. See Figure 4B. Pull up the auger, empty it, and replace the section in the hole where it will be held by the 3/4" rod. See Figure 4C. Next replace the upper section of drill line. The 3/8" bolt acts as a stop which allows the holes to be easily lined up for reinsertion of the toggle bolt. Finally withdraw the 3/4" rod and lower the auger for the next drilling. Mark the location for drilling the 13/32" diameter hole in the 1 1/4" pipe through the toggle bolt hole in the 1 1/2" pipe. If the hole is located with the 1 1/4" pipe resting on the stop bolt, the holes are bound to line up.

Sometimes a special tool is needed to penetrate a water-bearing sand layer, because the wet sand caves in as soon as the auger is removed. If this happens a perforated casing is lowered into the well, and drilling is accomplished with an auger that fits inside the casing. A percussion type with a flap, or a rotary type with solid walls and a flap are good possibilities. See the entries describing these devices. The casing will settle deeper into the sand as sand is dug from beneath it. Other sections of casing must be added as drilling proceeds. Try to penetrate the water bearing sand layer as far as possible (at least 10 feet). Ten feet of perforated casing embedded in such a sandy layer will provide a very good flow of water.

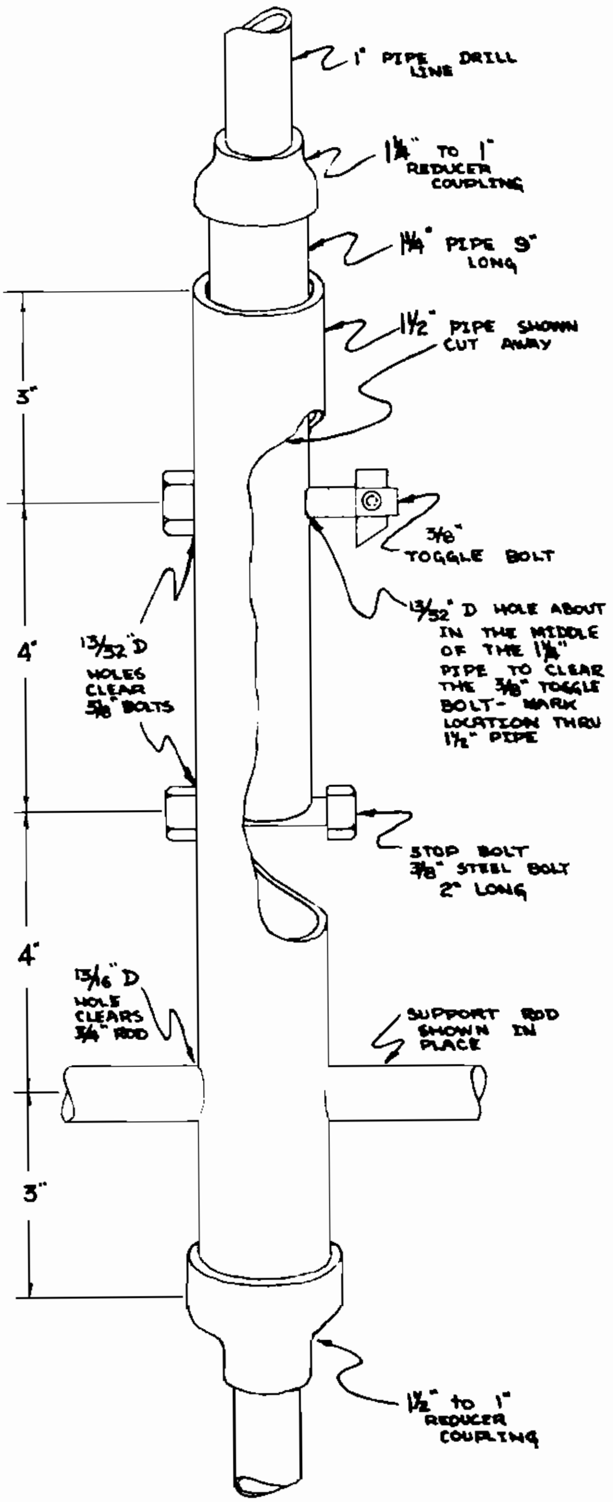


FIG 3
JOINT B

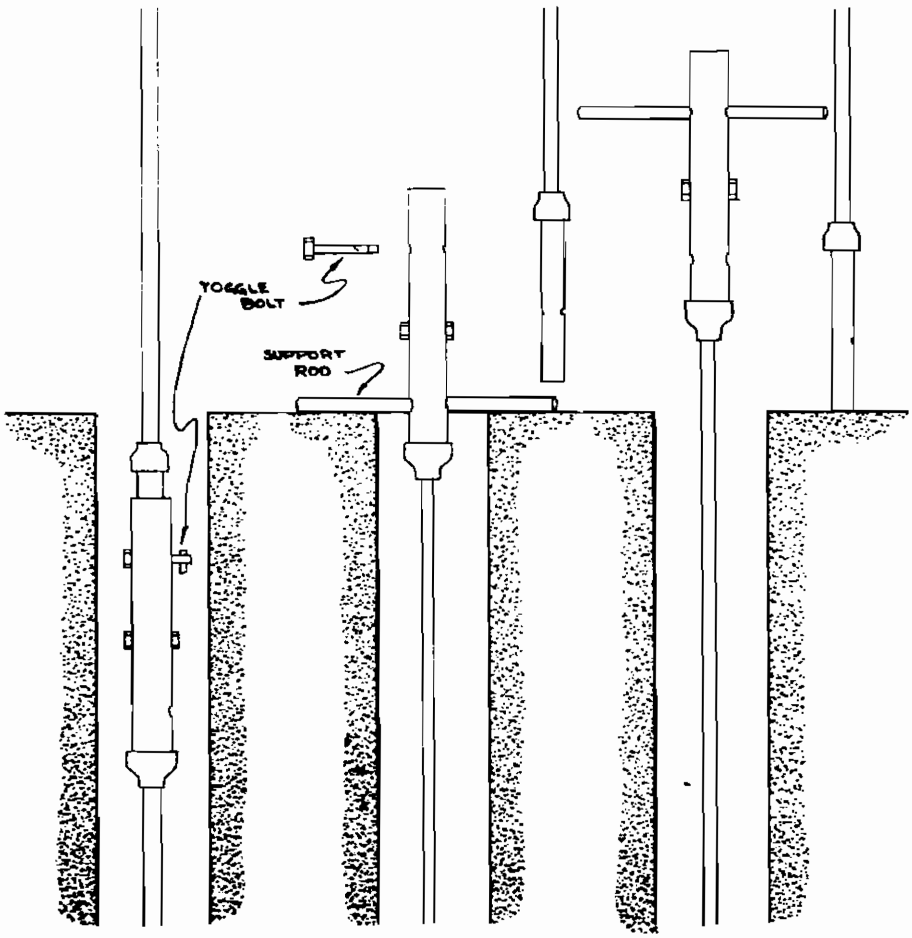


FIG 4
JOINT B IN OPERATION

EVALUATION

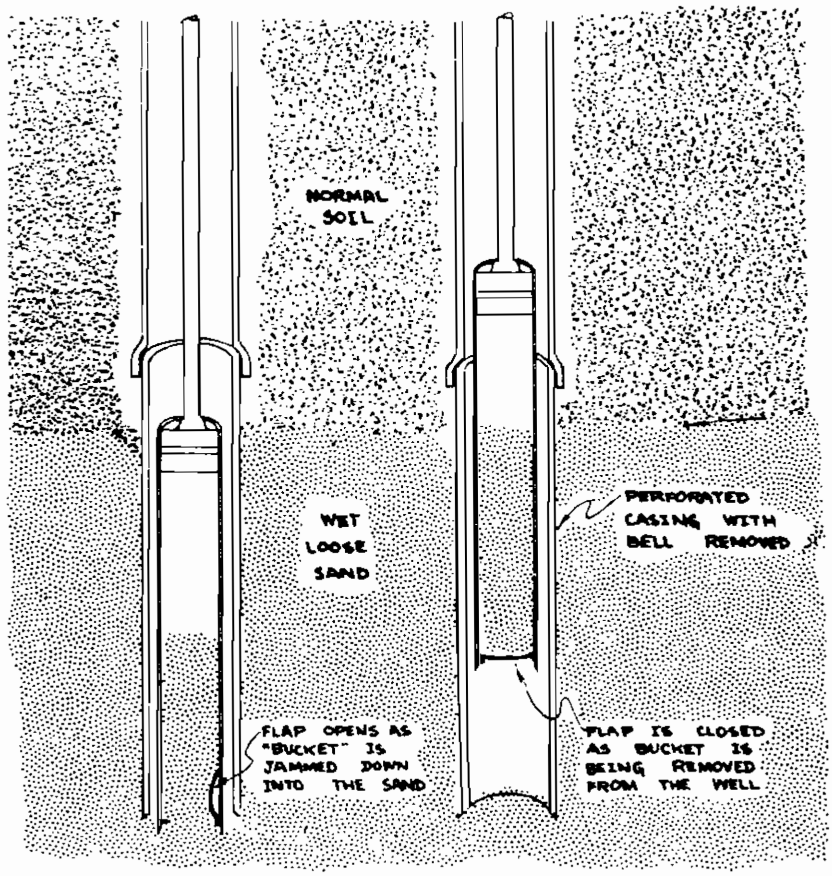
A crew of five men can dig a fifty foot well in two days. Many wells have been dug with this equipment by the American Friends Service Committee Barpali team in India.

Material From - "Explanatory Notes on Tubewells"
by Wendell Mott, AFSC, Rasulia
Friends Rural Center.

TUBEWELL SAND BAILER

ABSTRACT

When loose wet sand is encountered when boring a tubewell and the walls begin to cave, this device allows digging from inside the perforated casing.



TOOLS AND MATERIALS

5" diameter steel tube 3' long
5" square of truck innertube or leather.
Coupling from 5" to 1" pipe
small tools

DETAILS

By repeatedly jamming this "bucket" into the well, sand will be removed from in front of the perforated casing allowing it to settle deeper into the sand layer. The casing prevents the walls from caving in. The first section of casing has the bell removed; at least one other section rests on top of it to help force it down as digging proceeds. Try to penetrate the water bearing sand layer as far as possible (at least 10 feet). Ten feet of perforated casing embedded in such a sandy layer will provide a very good flow of water.

Be sure to try your sand "bucket" in wet sand before attempting to use it at the bottom of your well.

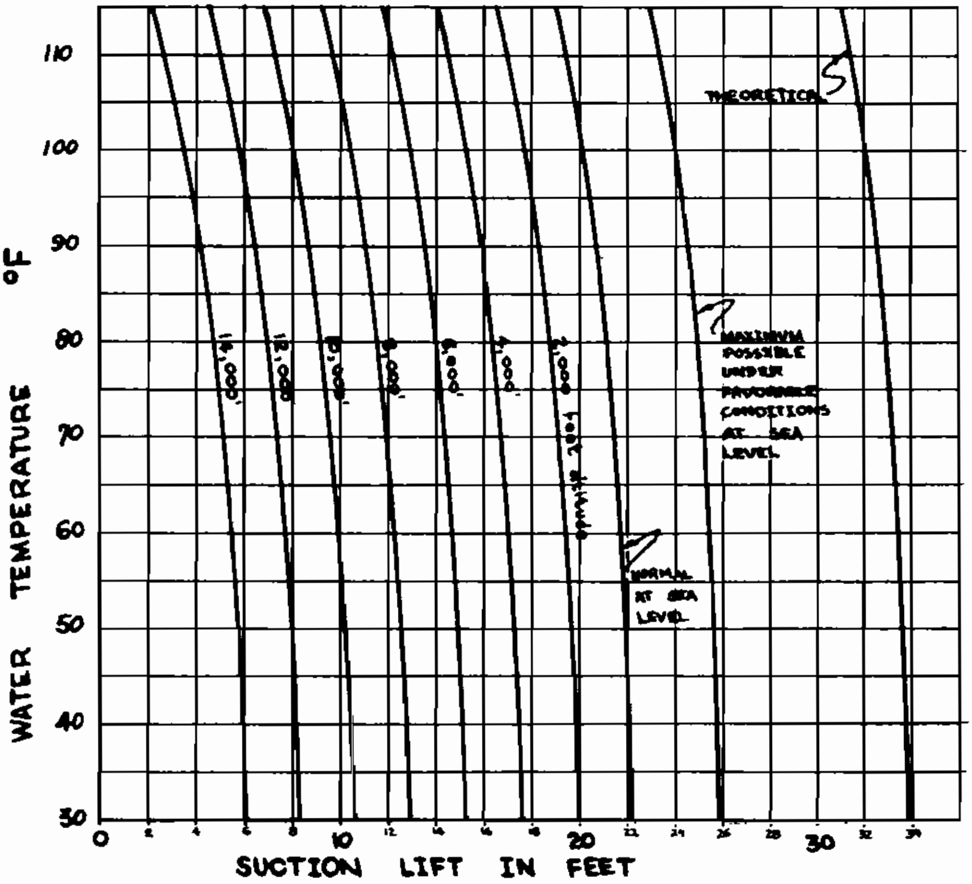
EVALUATION

Used by the American Friends Service Committee Barpali Team in making many tubewells in India.

Material From - "Explanatory Notes on Tubewells"
by Wendell Mott, AFSC, Rasulia
Friends Rural Center.

ABSTRACT

The height that a pump can lift water depends on the altitude and to a lesser extent on water temperature as shown in the graph.



TOOLS AND MATERIALS

Measuring tape
Thermometer

DETAILS

If you know the altitude and temperature of your water, this chart will tell you the maximum allowable distance from the pump cylinder to the lowest water level expected. Suppose your elevation is 10,000 feet and the water temperature 65° F. The chart shows that the normal lift would be just ten feet. The maximum possible under favorable conditions would be 14 feet, but would require slow pumping and probably result in considerable difficulty with "loosing the prime."

If the chart shows lift pumps are marginal or won't work, then a force pump should be used. This involves putting the cylinder down in the well, close enough to the lowest expected water level to be certain of proper functioning.

EVALUATION

Check these predictions by measuring the lift in nearby wells, or by experimentation.

Material adapted From - Mechanical Engineer's Handbook by Theodore Baumeister, copyright 1958, 6th edition, McGraw-Hill Book Company. (used by permission)

WELL DRILLING AUGER, EXTENSIONS, AND HANDLE

ABSTRACT

This auger is fashioned from standard weight steel pipe, and is intended for use in hand drilling small diameter wells. The handle and extenions allow boring deep holes.

TOOLS AND MATERIALS

10 cm. diameter pipe (4"), 120 cm. long, for auger
3.4 cm. diameter pipe (1") 3 or 4 pieces, 30 cm. long for auger and extension socket
2.6 cm. diameter pipe (3/4") 3 or 4 pieces 6.1 or 6.4 meters long for drill extensions
1.8 cm. diameter pipe (1/2") 3 or 4 pieces 6 cm. long
2 pieces 4 x 8 x 50 cm. hardwood for handle
2 pieces mild steel 0.3 x 8 x 15 cm.
4 bolts with nuts 1 cm. diameter x 10 cm. long
Hand tools and welding equipment

Figure 1

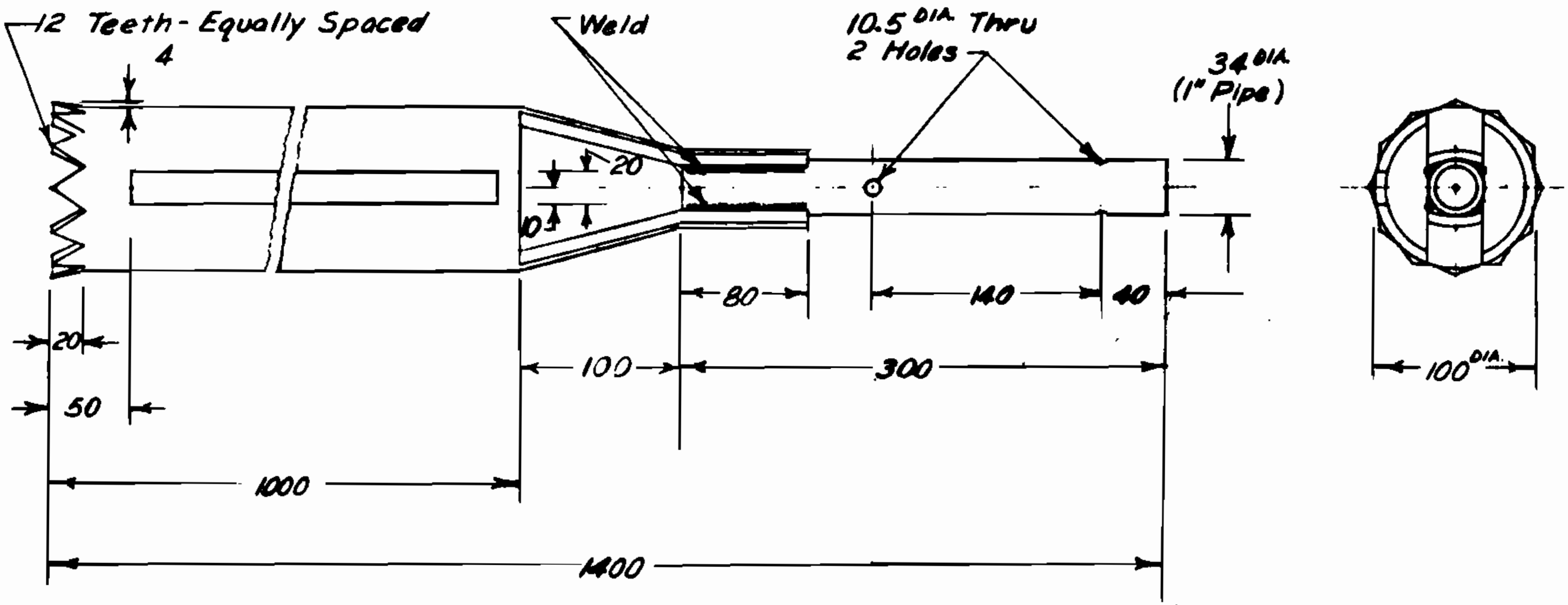
DETAILS

The auger is hacksawed out of standard weight pipe approximately 10 cm. in diameter. Lightweight tubing does not stand up in use. The flared toothed cutting edge is cut on one end. The other is cut, bent and welded to a section of 1" pipe. This pipe forms a socket for the drill line extensions. A slot running nearly the length of the auger is used when cleaning out the earth. Bends are stronger and made easier and more accurately with the metal hot. Figure 2 shows the dimensions of the auger. Figure 3 shows the extensions, while Figure 4 the handle.

EVALUATION

Equipment designed has been used successfully in Viet Nam. At least three sets have had fairly extensive use. The original auger had two cutting lips similar to a post hole auger. This was discarded in favor of the design described here since the soil in Viet Nam plugged up the auger instead of cutting cleanly. In some soils an auger with cutting lips might work more effectively.

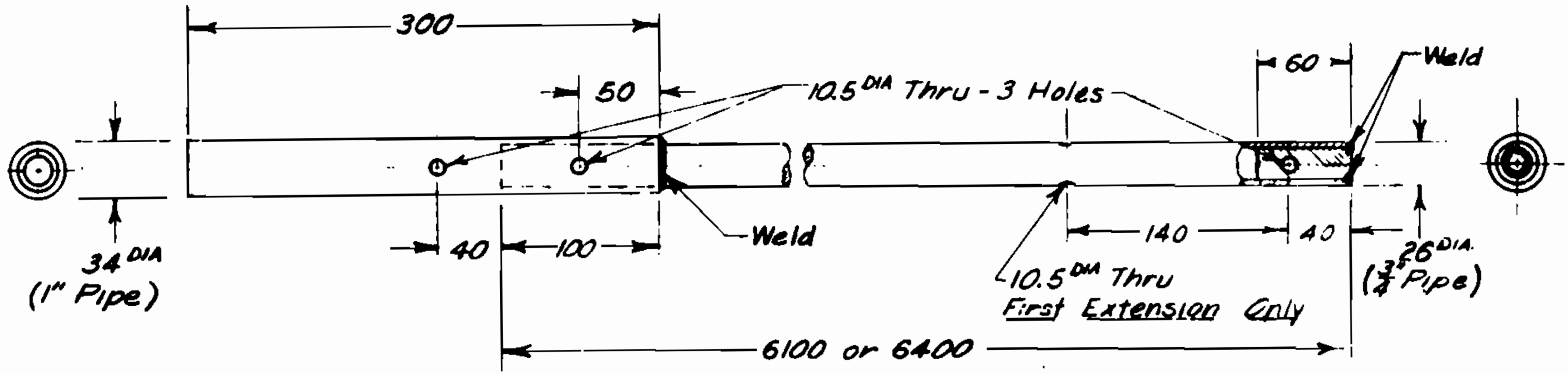
Material From - Richard G. Koegel, International Voluntary Services, Ban Me Thuot, Viet Nam, April 1959.



Cutting Head, Well Drilling Auger

Scale: 1/4 Size **Mat'l.: Mild Steel**

Fig. 2

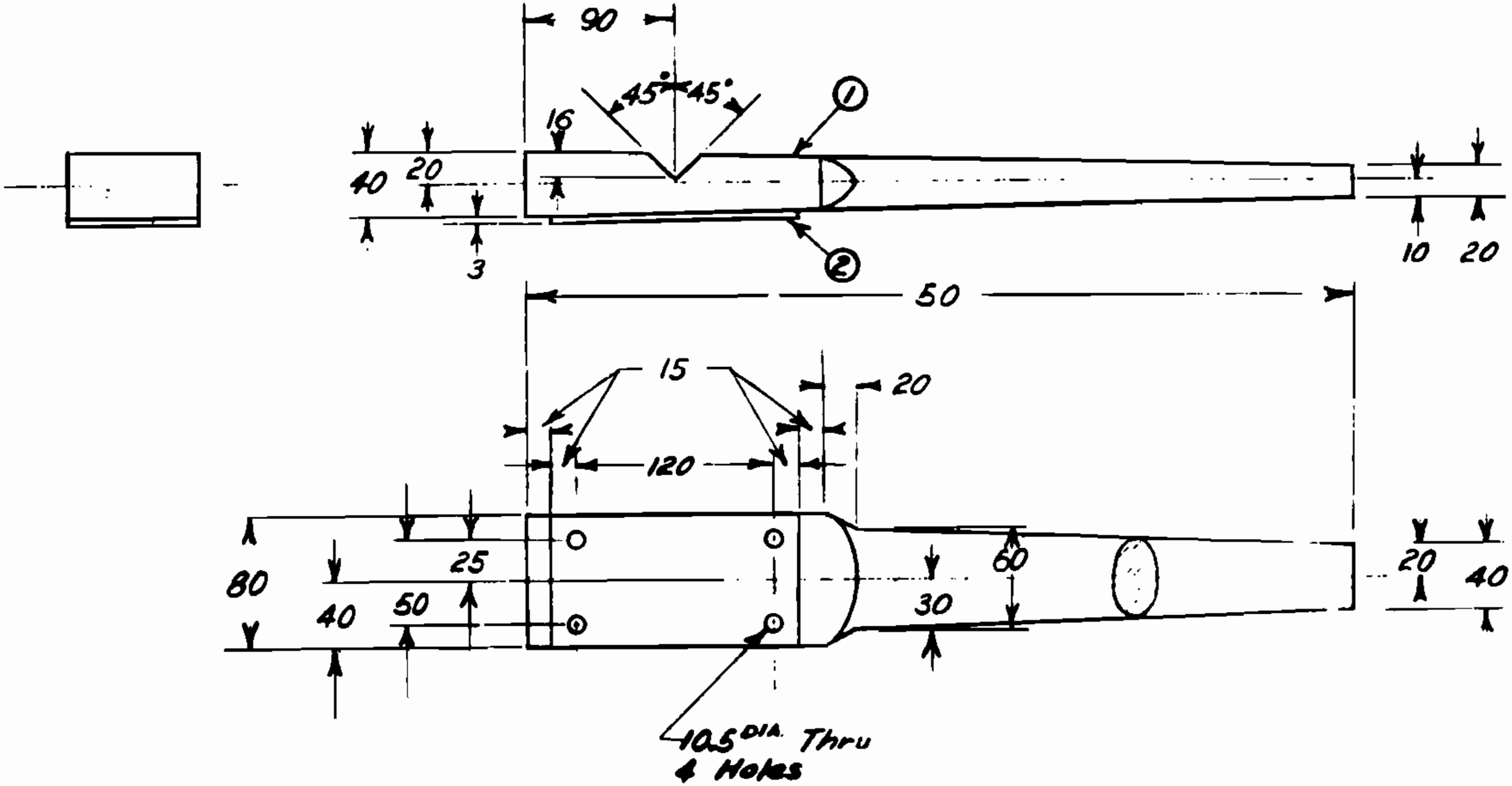


Note: 34 DIA. Coupling May Be Omitted On Last Extension

Extension, Well Drilling Auger

Scale: $\frac{1}{4}$ Size Mat'l: Mild Steel

Fig. 3



Note: 2 Req'd per set

Handle, Well Drilling Auger

Scale: ¼ Size

Mat'l.: ① Hardwood
② Mild Steel

Fig. 4

AUGER CLEANER

Figure 1

ABSTRACT

This simple cleaning tool allows rapid removal of soil from the well drilling auger.

TOOLS AND MATERIALS

10 cm. square of mild steel
  3 mm. thick
52 cm. of steel rod, 1 cm.
  diameter
Welding equipment
Hacksaw
File

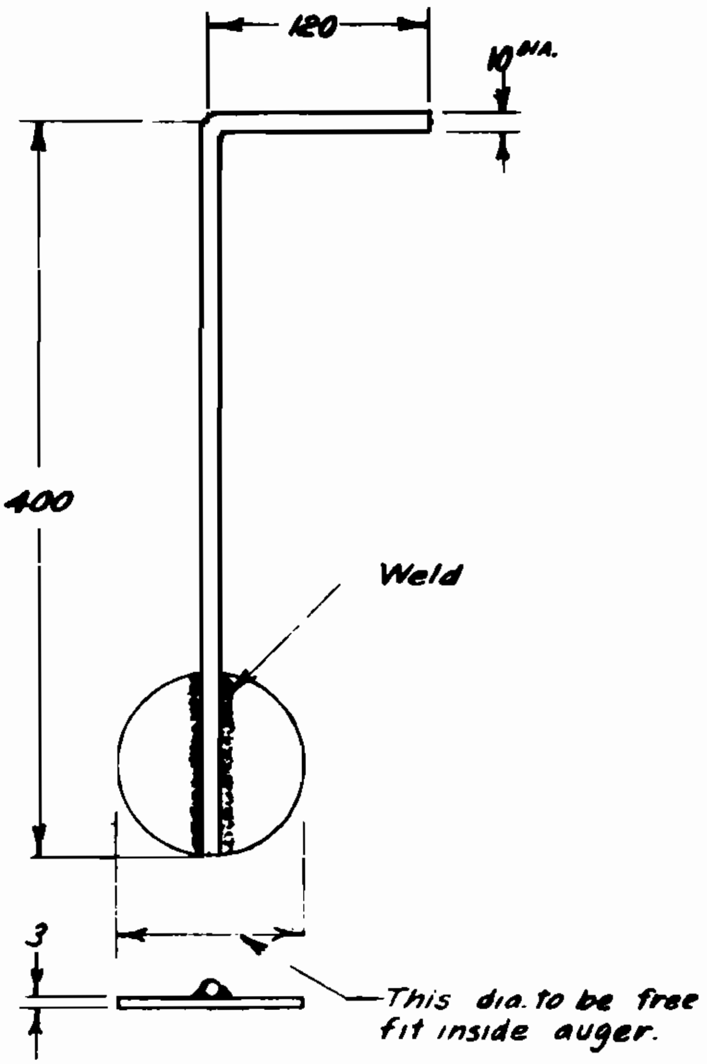
DETAILS

See Figures 1 and 2, and the entry "Well Drilling" for details of how to use this device.

EVALUATION

Equipment designed has been used successfully in Viet Nam. At least three sets have had fairly extensive use.

Material From - Richard G. Koegel
International Voluntary Services
Ban Me Thuot, Viet Nam, April 1959.



Auger Cleaner

Scale: 1/4 Size Mat'l.: Mild Steel

Fig. 2

DEMOUNTABLE REAMER

ABSTRACT

This reamer attaches to the Well Drilling Auger if it is desired for any reason to enlarge the diameter of the hole drilled.

Figure 1

TOOLS AND MATERIALS

20 cm. x 5 cm. x 6 mm. mild steel (provided the desired well diameter is 19 cm.)
Two 8 mm. diameter bolts, 10 cm. long
Hacksaw
Drill
File
Hammer
Vise

DETAILS

This reamer is mounted with two hook bolts to the top of the auger. It is made from a piece of steel 1 cm. larger than the desired well diameter. See Figure 2.

If it is desired to ream out the hole to a larger diameter, the reaming cutter is attached to the top of the auger with the two hook bolts and the bottom of the auger is plugged with a piece of wood or some mud, so that the cuttings will be caught inside the auger. For reaming, the auger is rotated with only slight down pressure. It should be emptied before it is too full in order to avoid too many cuttings falling to the bottom of the well when the auger is pulled up.

EVALUATION

The depth of a well is much more important in determining the flow than the diameter, and doubling the diameter means removing four times the amount of earth. Therefore, only under special circumstances should larger diameter wells be considered.

Material From - Richard G. Koegel
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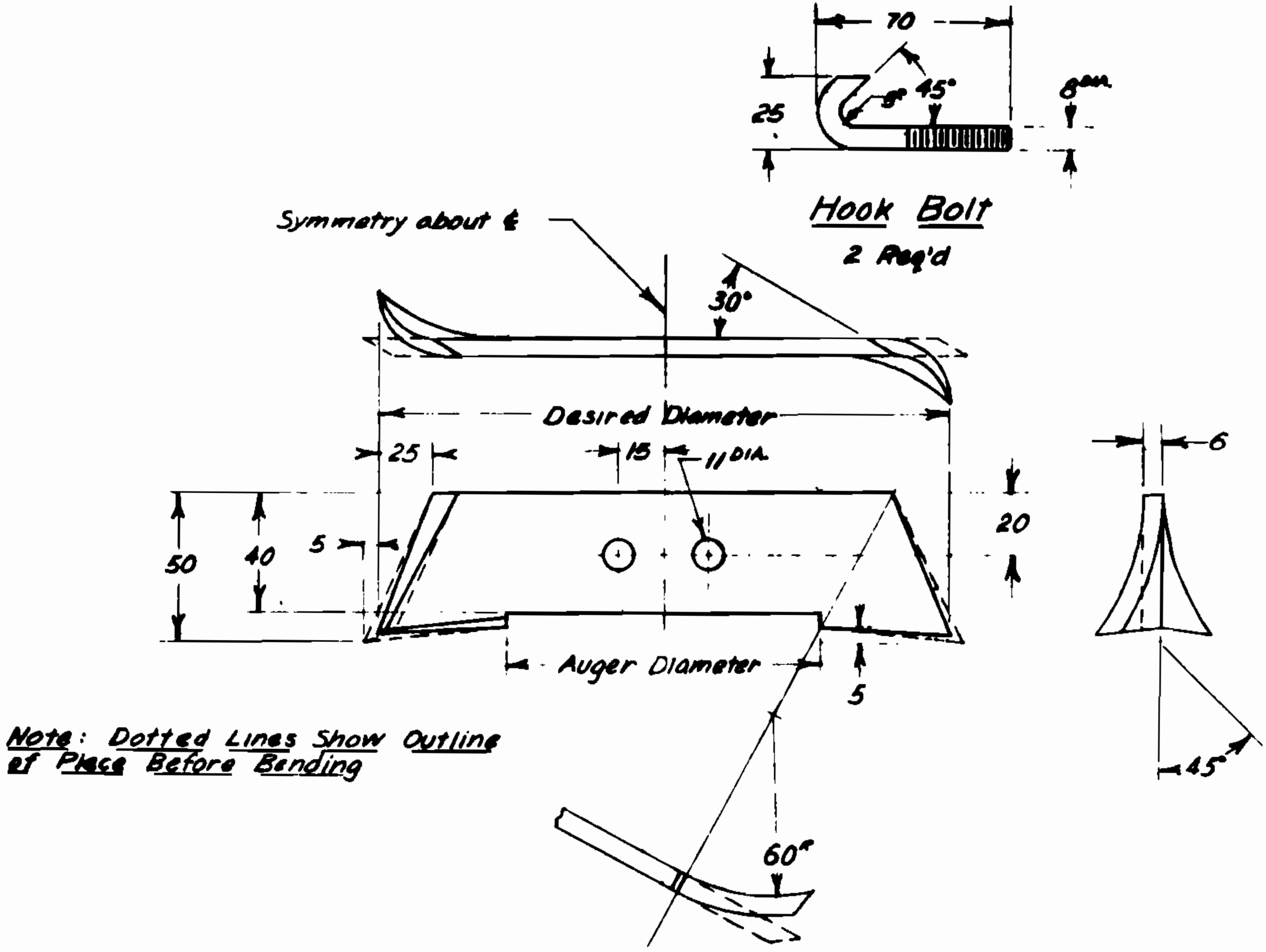


Reamer, Well Drilling Auger

Scale: ½ Size Mat'l.: Mild Steel

Fig. 2

WELL DRILLING

ABSTRACT

This paper gives the details on how to use the hand well drilling equipment described in related entries.

Figure 1

TOOLS AND MATERIALS

Wood 3 cm. x 3 cm. x 140 cm.
Wood 3 cm. x 30 cm. x 45 cm.
(for tool tray)

1 cm. diameter steel rod
30 cm. long
Drill
Hammer
Anvil
Cotter pin
(for safety rod)

Wood 4 cm. x 45 cm. x 30 cm.
Steel 10 cm. x 10 cm. x 4 mm.
(for Auger support)

DETAILS

Drilling the Well -

Location of the well -- Two main considerations are necessary for the location of village wells: (1) The location(s) should be such that the average walking distance for the village population is as short as possible. (2) Since it seems inevitable under village usage that a large quantity of water becomes spilled around the well, it is important that a site be selected where the waste water can easily be drained away so as to avoid creating a mudhole.

In the Ban Me Thuot area the final choice of location was in all cases left up to the villagers. The question of "water witching" or the determination of the location or depth of underground water by means of a forked stick or other means was frequently brought up by the villagers, but was never resorted to. In this particular area, water was found in varying quantities at all locations where drilling was undertaken.

Starting to Drill -- The tripod is set up over the approximate location and the legs set into shallow holes with dirt packed around them to prevent their moving. To insure that the well is started exactly vertically, a plumb bob (a piece of string with a stone tied to it is good enough) is then hung from the auger guide on the cross-bar to locate the exact starting point. It is probably easiest to dip a little starting hole before setting up the auger.

Drilling -- Drilling is accomplished by ramming the auger down to penetrate the earth and then rotating it by means of the wooden handle to free it in the hole before lifting it to repeat the process. This is a little awkward until the auger is down a foot or two and should be done carefully until the auger starts to be guided by the hole itself. Usually two or three men work together with the auger. One system which worked out quite well was to use three men, two working while the third rested, and then alternate.

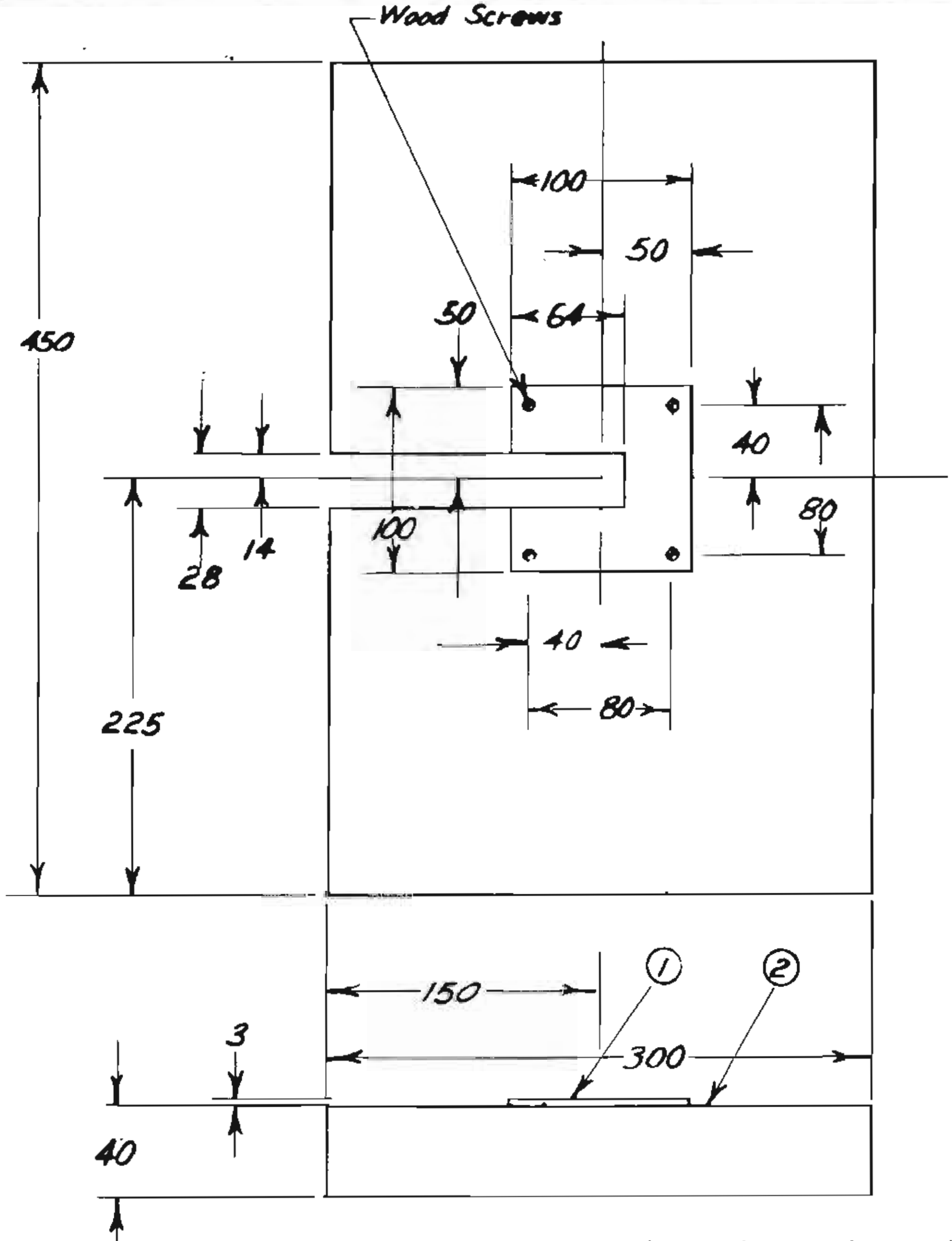
As the auger goes deeper it will be necessary from time to time to adjust the handle to the most convenient height. Any wrenches or other small tools used should be tied by means of a long piece of cord to the tripod so that if they are accidentally dropped in the well, they can easily be removed. Since the soil of the Ban Me Thuot area would stick to the auger, it was neceassary to keep a small amount of water in the hole at all times for lubrication.

Emptying the auger -- Each time the auger is rammed down and rotated, it should be noted how much penetration has been obtained. Starting with an empty auger the penetration is greatest on the first stroke and becomes successively less on each following one as the earth packs more and more tightly inside the auger. When progress becomes too slow it is time to raise the auger to the surface and empty it. Depending on the material being penetrated, the auger may be completely full or have a foot or less of material in it when it is emptied. A little experience will give one a "feel" for the most efficient time to bring up the auger for emptying. Since the material in the auger is hardest packed at the bottom, it is usually easiest to empty the auger by inserting the auger cleaner through the slot in the side of the auger partway down and pushing the material out through the top of the auger in several passes. When the auger is brought out of the hole for emptying, it is usually leaned up against the tripod, since this is faster and easier than trying to lay it down.

Coupling and uncoupling extensions -- The extensions (see "Well Drilling, Auger, Extensions and Handle") are coupled by merely slipping the small end of one into the large end of the other and pinning them together with a 10 mm. bolt. It has been found sufficient and time-saving to just tighten the nut finger-tight instead of with a wrench.

Each time the auger is brought up for emptying, the extensions must be taken apart. For this reason the extensions have been made as long as possible to minimize the number of joints. Thus at a depth of 60 feet, there are only two joints to be uncoupled in bringing up the auger.

For the sake of safety and speed a definite procedure should be followed in coupling and uncoupling. When bringing up the auger it should be raised until a joint is just above the ground and the auger support (Figure 1 and Figure 2) should be slipped into place straddling the extension so that the bottom of the coupling can rest on the small metal plate. The next step is to put the safety rod (Figure 3) through the lower hole in the coupling and secure it with either a cotter pin or a piece of wire. The purpose of the safety rod is to keep the auger from falling into the well if it should ever be knocked off the auger support or be dropped



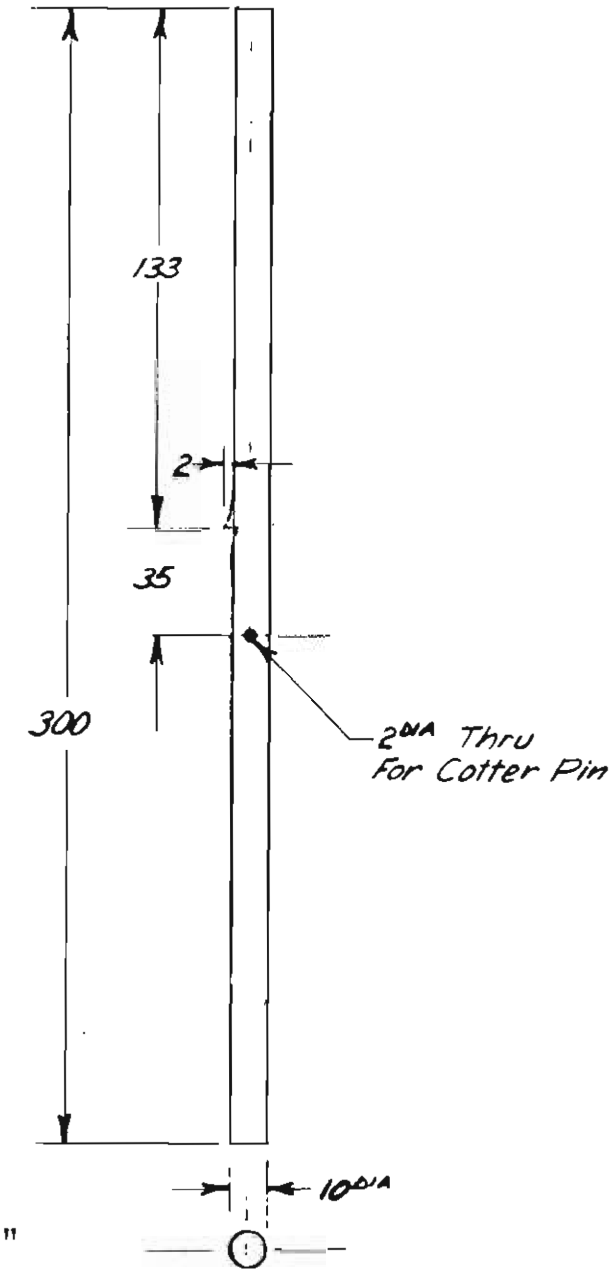
"Dimensions shown in millimeters."

Auger Support

Scale: 1/4 Size   Mat'l.: ① Mild Steel

② Hardwood

Fig. 2



Safety Rod

Scale: 1/2 Size   Mat'l.: Mild Steel

Fig. 3

while it is being raised. Once the safety rod is in place, the coupling bolt may be removed and the upper extension is slipped out of the lower. The upper end of the extension can then be leaned against the tripod and the lower end rested in the tool tray (Figure 4 and Figure 5) which has been set at an appropriate place. The reason for resting the extensions in the tool tray is to eliminate the dirt which adheres to the lower ends and later gums up the couplings so that the extensions cannot easily be taken apart or put together. It was found helpful to drive two 30 cm. long wooden pegs into drilled holes near the top of the two front legs of the tripod for the auger extensions to rest between (See Figure 5 in Well Drilling Tripod and Pulley). This eliminated the possibility of their falling down when they were leaned against the tripod.

Figure 4

For coupling the extensions after emptying the auger, the procedure is the exact reverse of uncoupling.

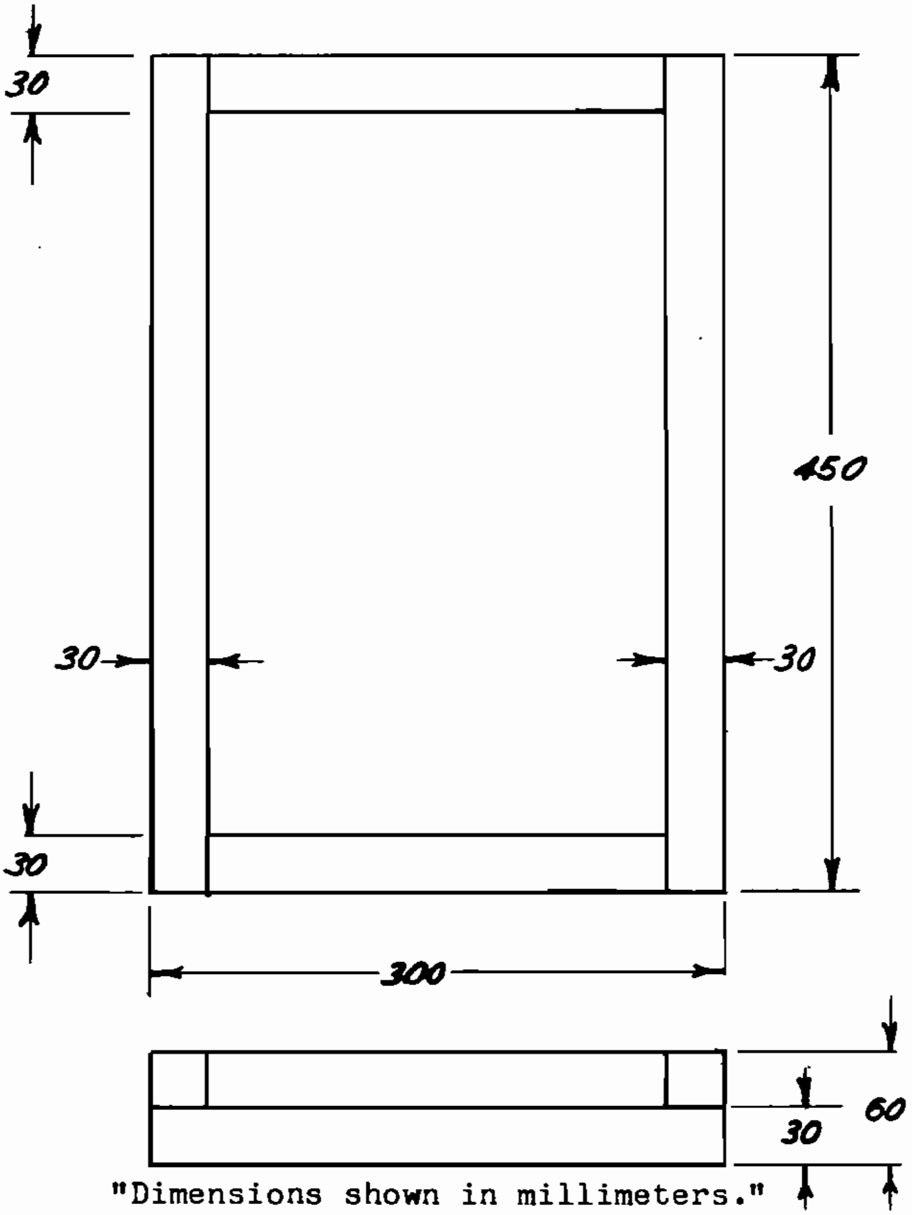
Depth of Well -- As was pointed out earlier, the rate at which water can be taken from a well is roughly proportional to the depth of the well below the static water level. However, in village wells where water can only be raised slowly by hand pump or bucket, this is not usually of major importance. The important point is that in areas where the water table varies from one time of year to the next the well must be deep enough to give sufficient water at all times.

Information on the water table variation may be obtained from already existing wells, or it may be necessary to drill a well before any information can be obtained. In the latter case the well must be deep enough to allow for a drop in the water table.

EVALUATION

Performance of the Equipment -- One of the best performances was turned in by a crew of three inexperienced mountain tribespeople who drilled 20 meters (65 feet) in 1 1/2 days. This, however, was above average. The deepest well so far ran slightly over 25 meters (80 feet) and was completed, including the installation of the pump, in 6 days. It appears that this equipment could be used without modification to drill deeper wells than this if necessary. In the last well to be drilled it was necessary to drill through about 11 meters (35 feet) of sedimentary stone. The complete set of equipment including auger, extensions and handle, reamer cleaner, tripod, pulley, rock bit and cable was obtained for labor plus $35.19 in 1957.

Material From - Richard G. Koegel, International Voluntary Services



"Dimensions shown in millimeters."

Tool Tray

Scale: 1/4 Size Mat'l: Wood

Fig. 5