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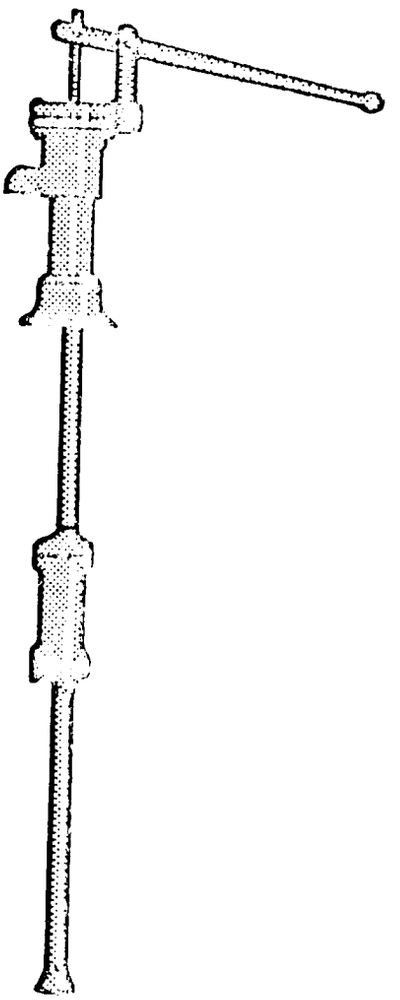
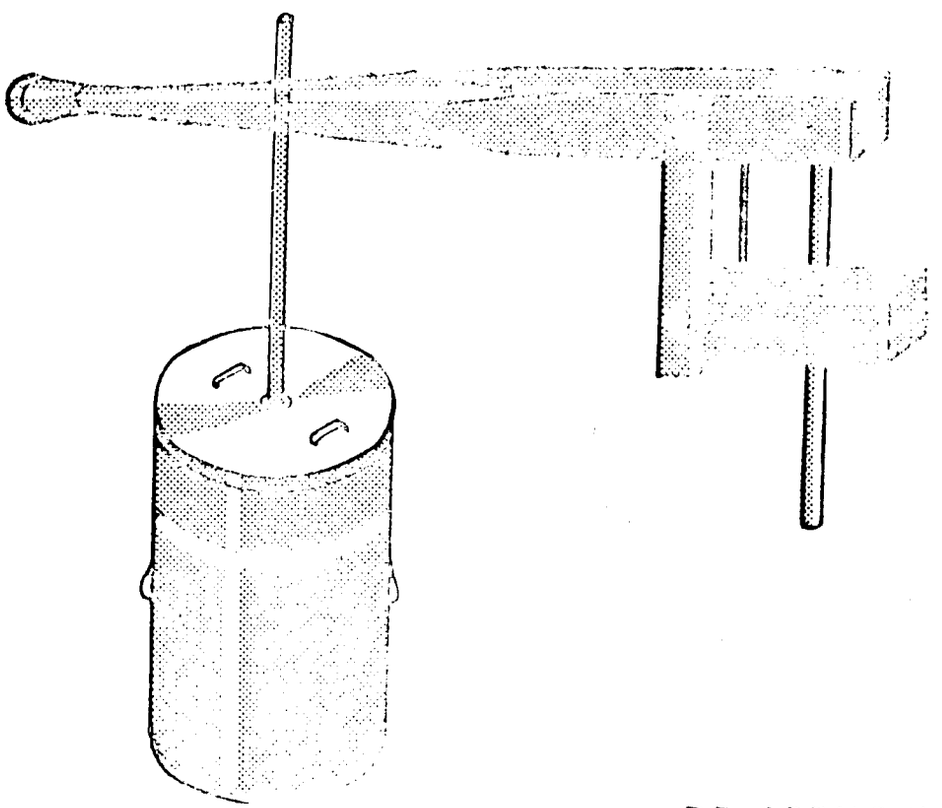
VILLAGE TECHNOLOGY HANDBOOK

HEALTH and SANITATION
AGRICULTURE
FOOD PROCESSING AND PRESERVATION
HOUSING and CONSTRUCTION
HOME IMPROVEMENT
EDUCATION and COMMUNICATION





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

1963

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.

Printed August, 1963
Reprinted October, 1963

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°F equals how many degrees Centigrade?

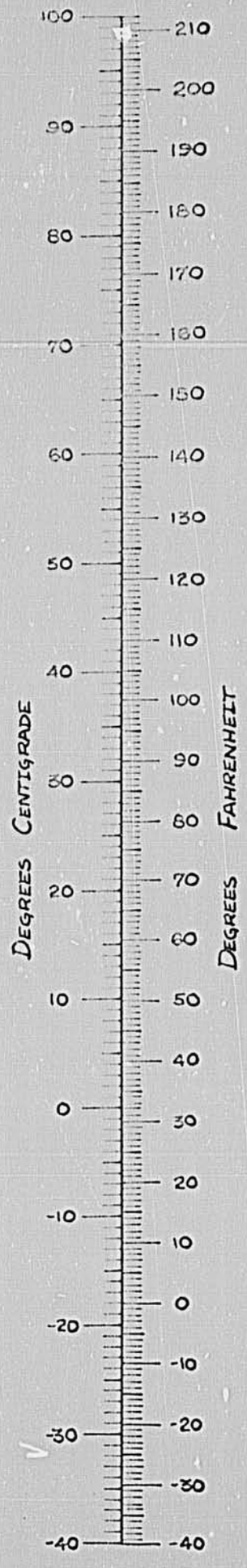
$72^{\circ}F = 5/9\ (^{\circ}F - 32)$

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

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

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

Notice that the chart reads 22 °C, an error of about 0.2 °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.)

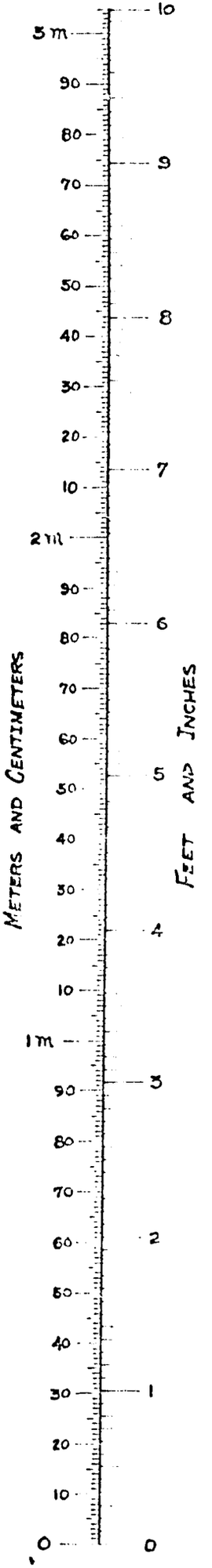
cm.	0	1	2	3	4	5	6	7	8	9
0	inches	0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543
10	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480
20	7.874	8.268	8.661	9.055	9.449	9.843	10.236	10.630	11.024	11.417
30	11.811	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354
40	15.748	16.142	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
30	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.)

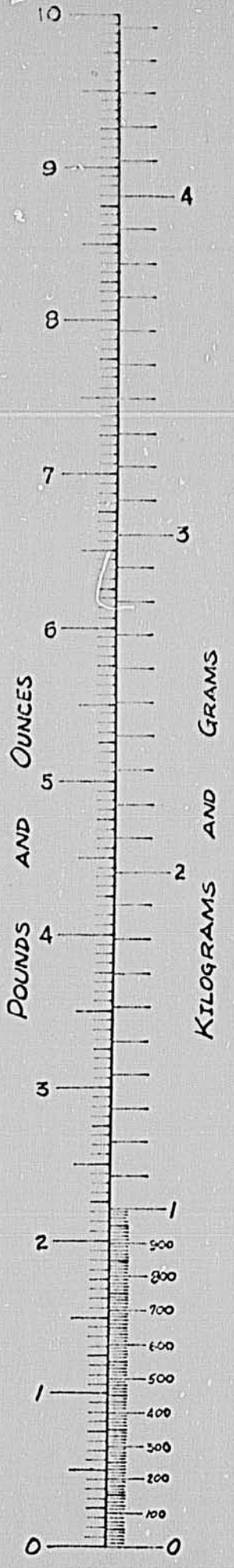
kg.	0	1	2	3	4	5	6	7	8	9
0	lb.	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	52.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.19	90.39	92.59	94.80	97.00	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.



HEALTH AND SANITATION

LATRINE FOR VILLAGE USE

ABSTRACT

This low cost water seal latrine slab is a single concrete casting. It requires very little space, is sanitary, odorless, easy to install and maintain, and can be used to produce nightsoil fertilizer.

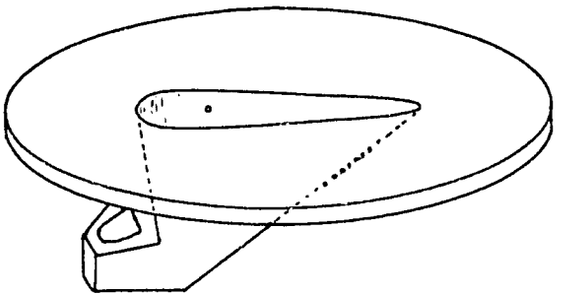


FIG. 1

TOOLS AND MATERIALS

Foot plate form - See Figures 2 and 3
Steel strap iron 2" wide, 9'7" long
3/8" bolt and nut 1" long to hold strap iron form
3/8" bolts 5" long for air vents
Outer form - made of wood detailed on Figure 6.
Inner form - made of wood detailed on Figure 4.
Clay to make water seal form
Cement, sand, stone aggregate up to 1" maximum.

DETAILS

In villages where space is a premium and the soil can absorb the flushing water, this latrine may be worth serious consideration. A 30" diameter hole eight feet deep is covered with a slab. Most soils have sufficient stability to support the slab. Very loose or sandy soils may require some type of lining. Any type of simple superstructure can be fitted over it for privacy. If the nightsoil must be used for fertilizer, this method can be used. After the first six months, a new hole is dug, and the slab moved. The first pit is covered with two feet of dirt. Six months later the nightsoil in the first pit has been converted to essentially non-pathogenic fertilizer and may be used with reasonable safety. Do not use any nightsoil fertilizer that has not been composted at least three months. The slab is moved back to the first hole and the second covered with two feet of dirt.

The latrine can be cleaned with only 1/2 gallon of water. When this is done, there is no odor nor any flies and it stays quite clean. Thus it is easy to use. Villagers must be urged to provide for a sufficient supply of water to be brought and stored at the latrine in a large container (eg. a 4 gallon kerosene tin). A quart container should also be provided. Instructions should be given in the proper method of flushing the latrine. If this is done improperly a large quantity of water will be wasted. Two quarts of water are sufficient to clear the latrine if the water is thrown with a fair amount of force from the narrow end of the latrine.

Installation is so simple that the untrained villager can do it easily. The round one piece construction facilitates moving the slab by rolling it. It is simple to make once the forms and methods are

practiced. The materials cost about $1 for a latrine. One trained villager can make three slabs per day, using three forms. The wooden forms cost about $8 each.

A convex foot-plate form about 38" in diameter is made of wood, metal, or concrete. It must be 1" higher in the center then at the edge. See Figure 2.

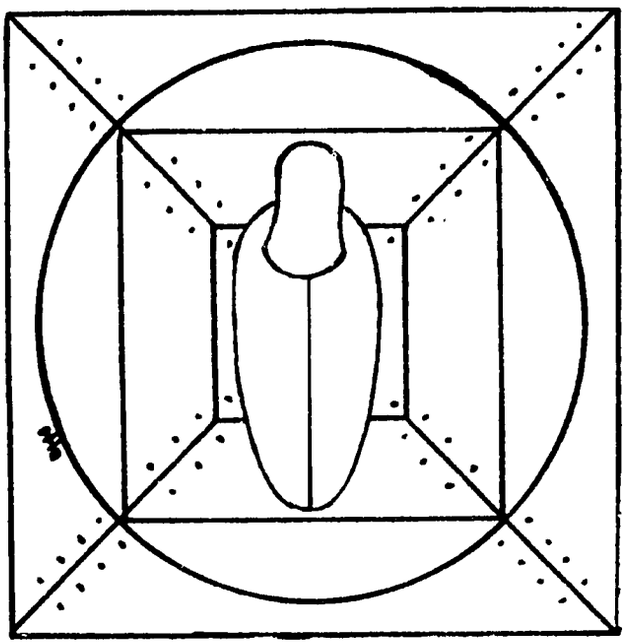


Figure 2
Wood and clay inner form in place on the base seen from above. Steel rim also in position.

Figure 3 shows the steel ring and inner form in place on the base. The ring is formed of two inch wide strap iron and fastened with a bolt for easy removal from the concrete slab. The collapsible wooden inner form is detailed in Figure 4.

The inner form has three pieces. Figure 4A shows the outline of the two side pieces of the form. These must be cut from wood 2 1/4" thick. The 18 1/8" sides and 3 3/4" sides stay nearly in contact. A wedge shaped piece of wood shown in Figure 4D holds corner G of the sides one inch apart. The wedge fits along the 9" side. The spring holds the form closed tight against the separation bars while the wedge is inserted and the inner form placed on the base. The dimensions shown for the inner form should only be used as a guide since some inconsistencies have been observed.

Two inches of well mixed concrete (cement 1, sand 2, stone chips 3) is placed in the ring and tamped well to compact it. Next the wooden outer form is set up around the inner liner. See Figures 5 and 6. There should be a clearance of not less than 1/2" between the inner liner and the wooden outer forms. A cement sand mixture (cement 1, sand 2) of plastic consistency is placed in this inner space and compacted. A 3/8" bolt through the outer wood form and into the inner form provides an antisyphon vent and helps to hold the inner form in place. See Figures 8, 10, and 11.

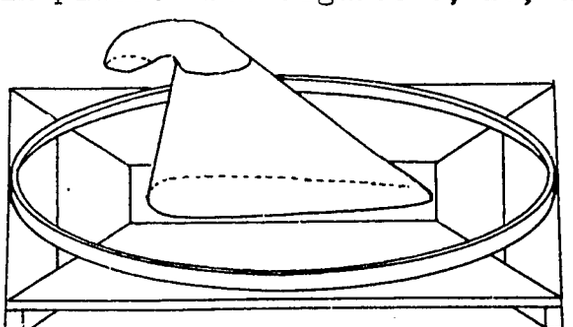
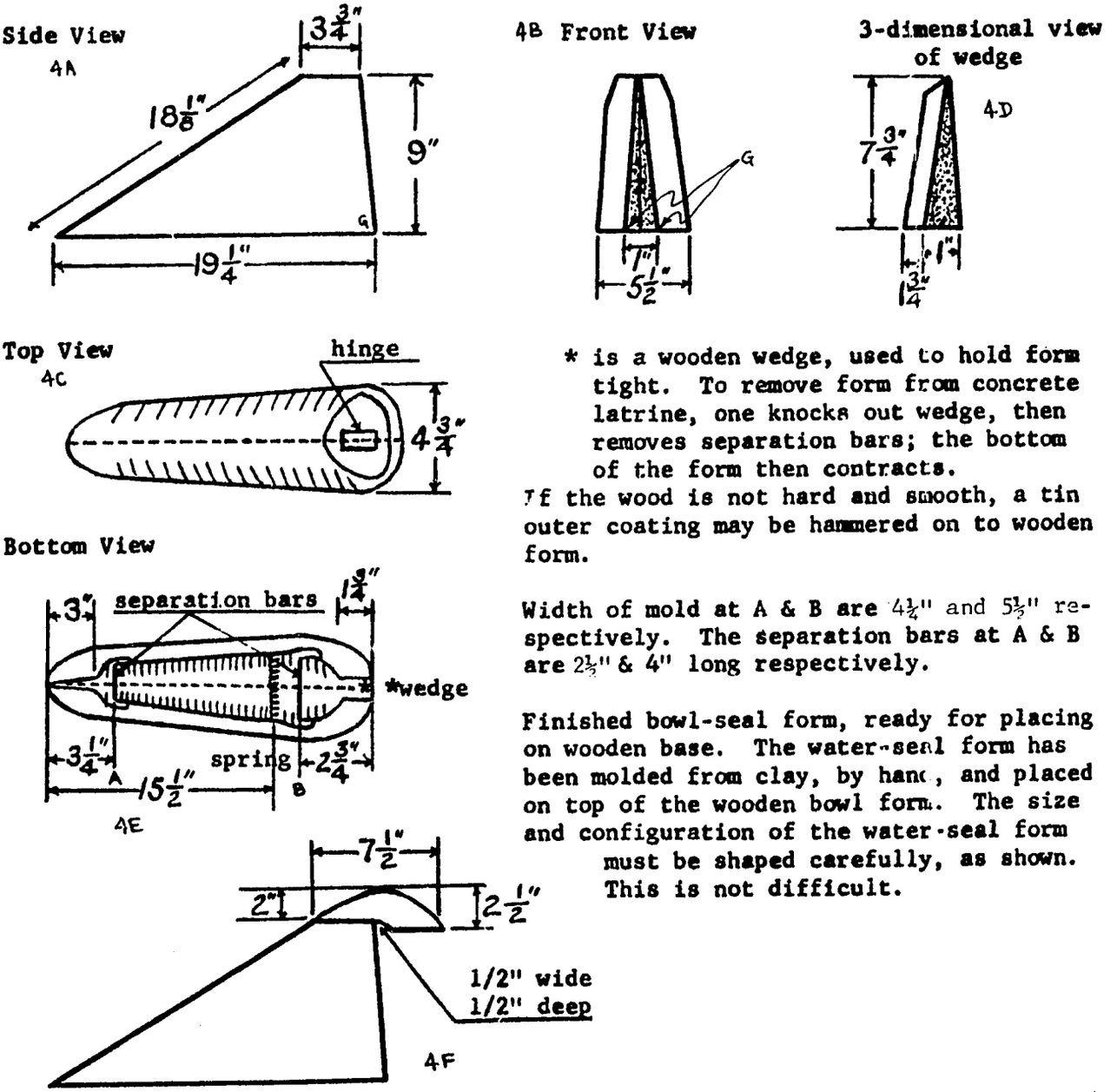


Figure 3
Inner form and steel rim in place on base.

After 48 hours the casting may be placed on blocks. The clay siphon and wooden inner form removed, and a finish of cement plaster added to cover any imperfections. When this is set a final coat of pure cement is put on. If there is any defect in the seal it may easily be repaired by putting a little cement slurry (cement and water in creamy consistency) over the defect and adding at once cement plaster to fill the defect.

EVALUATION

The American Friends Service Committee Barpali project has developed this unit and have many in use. They are teaching a 10 day course in latrine construction to villagers and selling forms at cost to the villagers completing the course. More than 25 persons have completed this course.



* is a wooden wedge, used to hold form tight. To remove form from concrete latrine, one knocks out wedge, then removes separation bars; the bottom of the form then contracts.

If the wood is not hard and smooth, a tin outer coating may be hammered on to wooden form.

Width of mold at A & B are 4¼" and 5½" respectively. The separation bars at A & B are 2½" & 4" long respectively.

Finished bowl-seal form, ready for placing on wooden base. The water-seal form has been molded from clay, by hand, and placed on top of the wooden bowl form. The size and configuration of the water-seal form must be shaped carefully, as shown. This is not difficult.

FIGURE 4

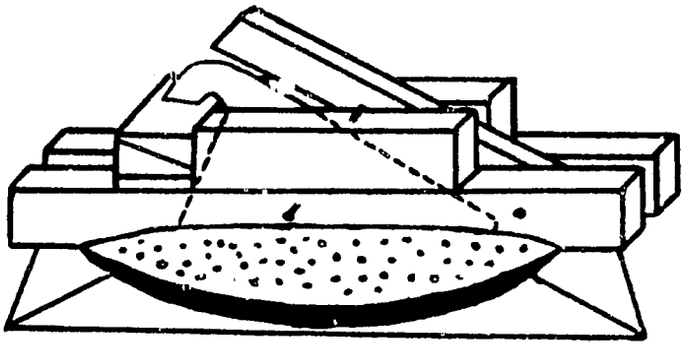


Figure 5
Concrete slab has been poured; part of the exterior sectional mold has been placed in its position.

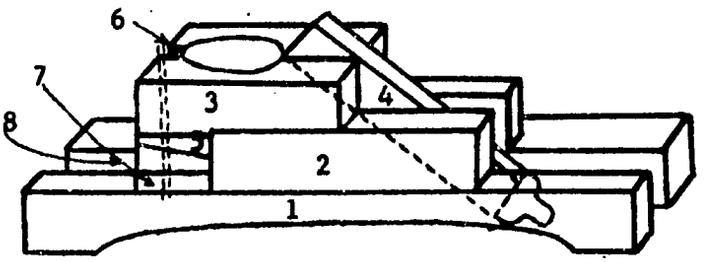


Figure 6
Rough exterior knock-apart mold made to fit around the clay core with a clearance of 1/2" to 3/4".

Wooden constituents of above mold.

1. 4" x 4" x 36" - 2 pieces
2. 3" x 4" x 16" - 2 pieces
3. 3" x 4" x 16" - 2 pieces
4. 3" x 3" x 21" - 1 piece
5. 2" x 5" x 13" - 1 piece
6. 4" x 4" x 1" - 1 piece
7. 5" x 13" x 1" - 1 piece
8. 3" x 4" x 4" - 1 piece

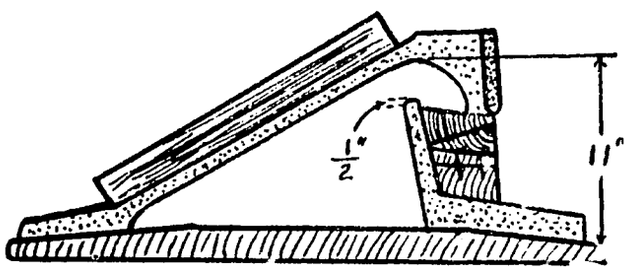


Figure 7
Sectional view after pouring the cement in bowl and trap. Note the concave shape of the base plate.

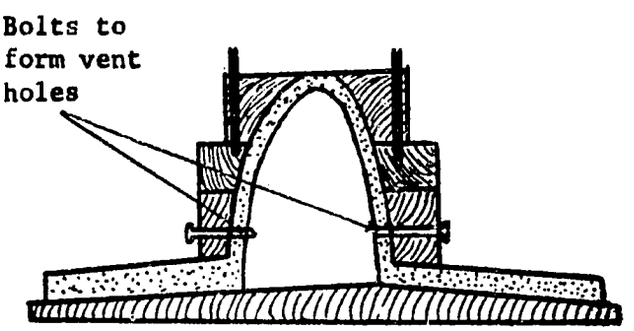


Figure 8
Transverse section of the casting with forms in place.

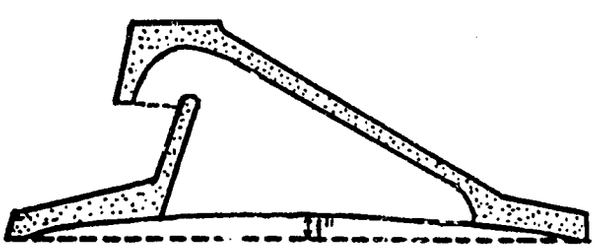


Figure 9
Section of the casting after removal of the forms.

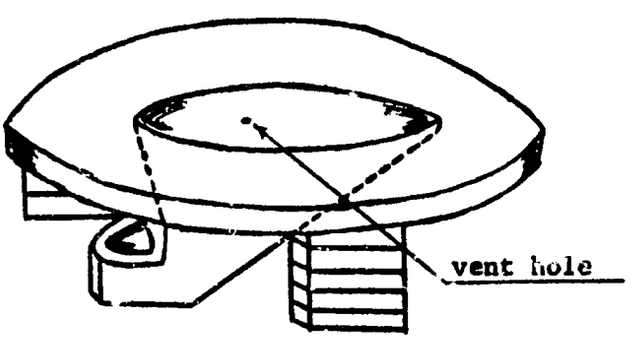


Figure 10
Completed casting set up on bricks where the wooden inner form is removed and clay siphon lining dug out. The final finish of cement plaster and neat cement polish is applied.

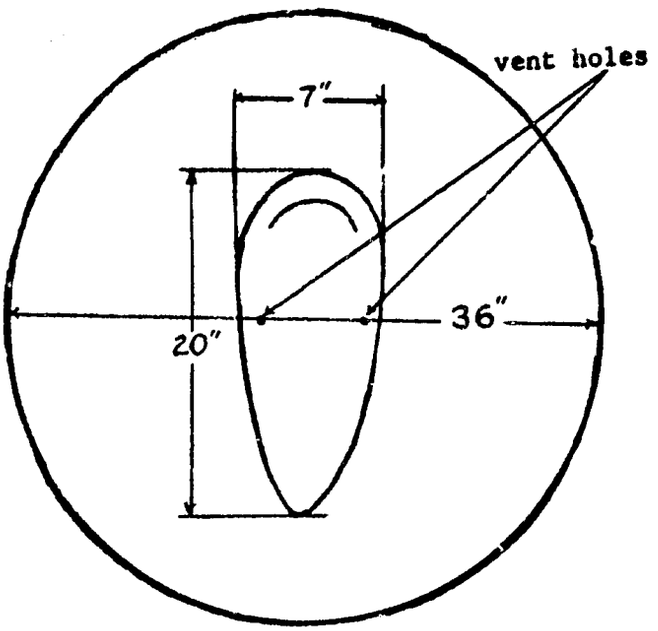


Figure 11
The completed casting from
above showing the dimensions.

Material From - "Latrines for Village Use" Report
on Work in the Field of Sanitary
Engineering, by Edwin Abbott, M.D.

THAILAND WATER-SEAL PRIVY

ABSTRACT

This concrete water-seal slab is most useful for widescale privy programs. It is used to cover an ordinary pit privy.

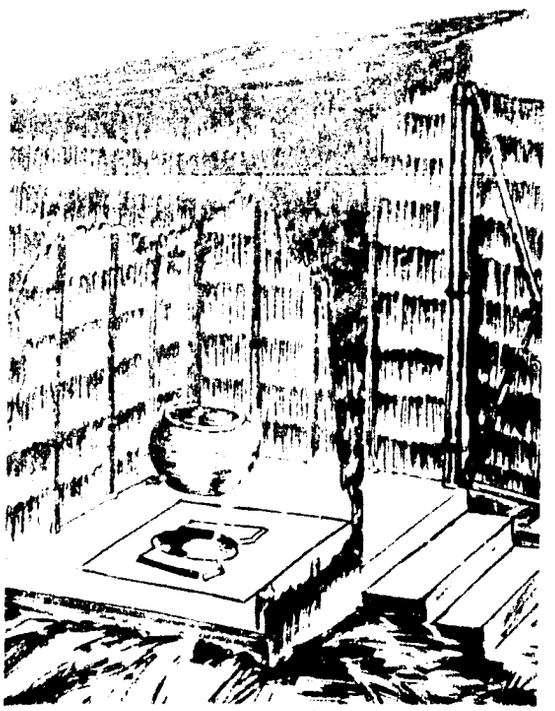


FIGURE 1 SKETCH OF FENISHED PRIVY

TOOLS AND MATERIALS

Master molds - Can be purchased from Village Health and Sanitation Project, Ministry of Public Health, Department of Health, Bangkok, Thailand. This aluminum master mold weighs 24 pounds and costs $7.50 plus shipping charges. Master molds can be made using the entry "Master Molds for the Thailand Water-Seal Privy".
Concrete making materials
Wood for platform forms
Reinforcing rod and wire
Clay
Crankcase oil
Beeswax and kerosene (optional)
3/4" x 3/4" x 5" steel bars

DETAILS

The basic method used for making these water-seal slabs is to cast the slab, bowl, and water-seal trap using three forms:

(1) A wooden form for shaping the slab.
(2) A concrete bowl core for shaping the inside of the bowl.
(3) A concrete core for shaping the inside of the water-seal trap.

Since the three parts of the slab are all cast at one time, the finished privy slab is quite strong. The water-seal trap is curved back under the bowl as shown in Figure 2a.

This makes flushing more difficult, but prevents erosion of the back of the pit on loose soil. The same general method could be used to make a forward flushing trap, Figure 2b.

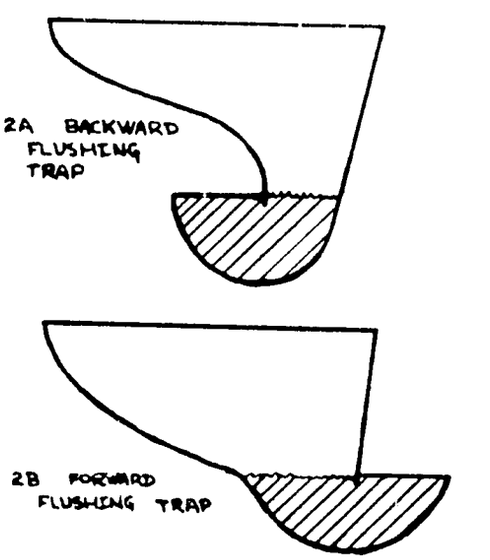


FIGURE 2 WATER SEAL TRAPS

The forms used when making a slab must stay in place till the concrete has gained enough strength to allow their removal. This is usually 24 hours. For this reason, many sets of forms are necessary if a reasonable number of slabs are to be cast every day. Here is where the master molds are needed. One is used to cast the bowl core, and two are needed to cast the trap core.

Casting the Bowl Core

1. Oil the inside of the master bowl mold and insert a 3/4" x 3/4" x 5" steel bar into the bottom.

2. Add a fairly loose mixture of cement and water, called neat cement, to a depth of about 6". Then fill to brim with a 1:1 cement sand mixture. The 1:1 should be firm, not runny, and should be laid into the loose neat cement without stirring to insure a smooth finish on the bowl core.

3. After the bowl core has become firm enough, scoop a depression into the surface to install the two steel hooks made from the reinforcing rod. They should be about 9" apart, and should not protrude above the surface of the concrete.
See Figure 3.

4. Allow the concrete to set at least 24 hours before removing the bowl core from the master mold. The bowl core can be used to make another master mold and vice versa.

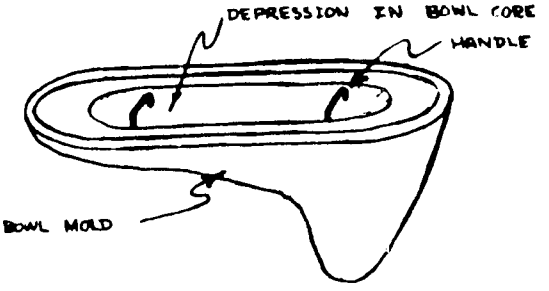


FIGURE 3 BOWL CORE HANDLES

Casting the Trap Core

Make the trap core using the pair of master molds, which consist of the trap master mold and the insert mold.

1. Add about 1" of 1:1 cement sand mix to the oiled trap master mold and put in some wire for reinforcing. Then fill it with 1:1 almost to the brim. See Figure 4.

2. Put the oiled insert mold into place and scrape off excess. See Figure 5.

3. After 45 minutes remove the insert and add a square sheet metal pipe 3/4" high made by wrapping sheet metal around a 3/4" x 3/4" steel bar.

4. Remove the finished trap core by gently tapping the master mold with a wooden block.

FIGURE 4 REINFORCING THE TRAP CORE

FIGURE 5 PLACING THE INSERT MOLD

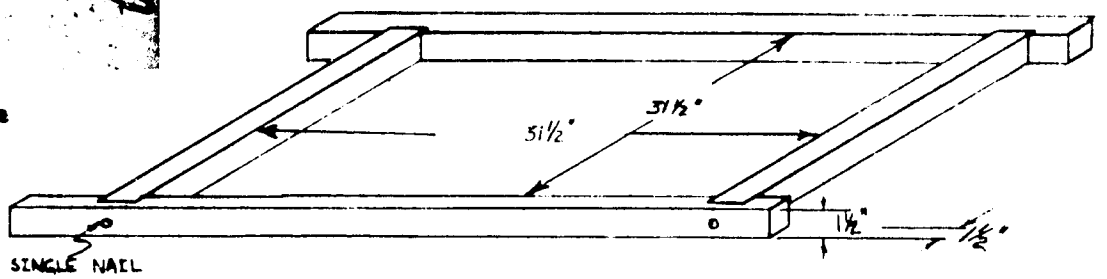


FIGURE 6 FRAME

Construction of the Wooden Slab Form

1. Make a frame of 1 1/2" x 1 1/2" wood with an inside diameter of 80 cm x 80 cm. A notch and single nail on each corner works well. See Figure 6.
2. Make a wooden platform 90 cm x 90 cm out of 1" thick planks. Gouge 1/2" deep footrests if these are desired. See the outline in Figure 7.

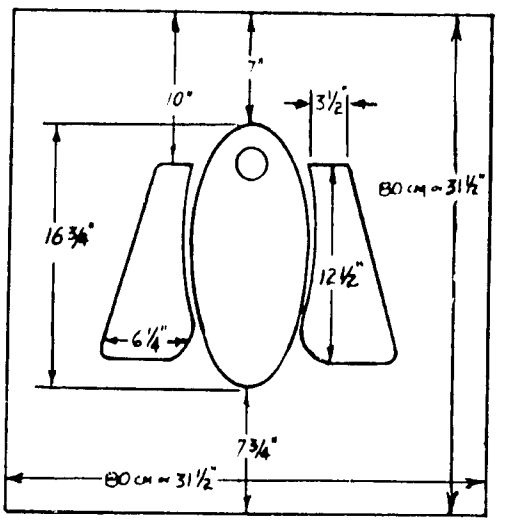


FIGURE 7 PRIVY SLAB OUTLINE

Casting the Slab

With these three forms finished you are ready to cast the first water-seal slab.

1. Use a paintbrush to coat the bowl core and the trap core with a layer of wax about 1/8" thick. Prepare the wax by dissolving 1 kilogram of melted beeswax in 1/2 liter of kerosene. The wax coating will last 5 or 6 castings adding 1¢ to the cost of each slab. Wax makes removing the cores much easier, but isn't absolutely necessary.

2. Place the bowl core on the wooden slab form and fill all cracks with clay. See Figure 8.

3. Oil the bowl, platform and frame.

4. Apply a 1/4" thick coat of pasty cement and water mixture to the bowl core and platform. (Many Thai people prefer to spend 25¢ more for an attractive polished slab. To do this, instead of using a mixture of cement and

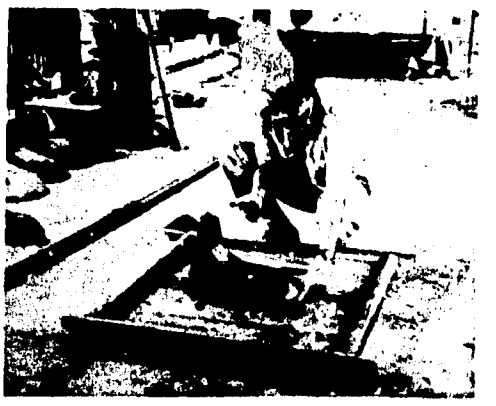


FIGURE 8 SEALING CRACKS WITH CLAY

water, use a mix of 5 cement : 5 color : 1 granite chips. After the forms are removed, polish with a carborundum stone and plenty of water.)

5. Cover the bowl core with a mixture of 1 cement : 2 sand, to total thickness of 1/2". Notice the smooth lip made on the cement 3/8" from the top of the bowl core in Figure 9. This lip is your water seal. Use fairly dry cement and allow it to set for 15 minutes before cutting this lip.

6. Place the trap core on the bowl core and seal the crack with clay. Also add a little clay on each side of the form (near the thumb in Figure 9) to prevent cement from getting to the front lip.

7. Cover with 1 : 2 cement sand mixture to a thickness of 1/2". Do not exceed the 1/2" thickness below the trap core or you will not be able to remove this core.

8. Fill the slab form with a mixture of 1 cement : 2 sand : 3 clean gravel or crushed rock almost to the top. In preparing the concrete, first mix cement and sand, then add gravel and water. Use water conservatively. The looser the mixture, the weaker the concrete will be.

9. Press in 4 pieces of 1/4" steel rod reinforcing. See Figure 10.

10. Fill to top of frame and smooth. Allow at least 24 hours for setting.

11. Remove the frame by tapping lightly with hammer.

12. Turn the slab form over on a wooden stand and use simple levers to remove the bowl core. You must remove the bowl core before the trap core. See Figure 11.

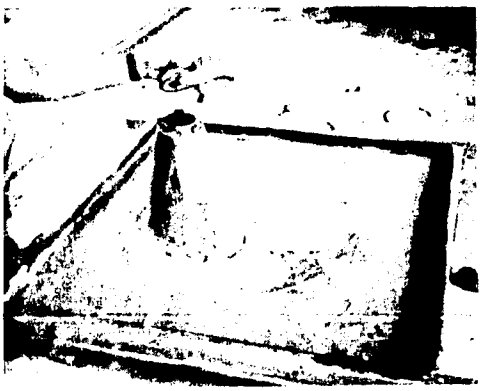


FIGURE 9 MOUNTING THE TRAP CORE

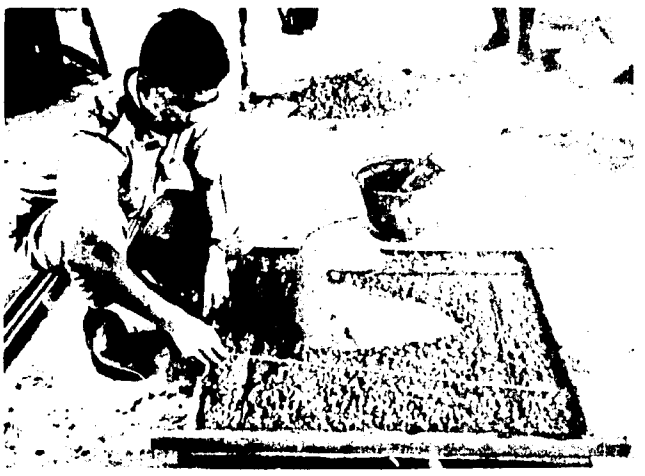


FIGURE 10 PLACING REINFORCING ROD

FIGURE 11 REMOVING THE BOWL CORE

13. Tap the trap core gently and slip it out. Add a little water and check to see if your seal is 3/8".

14. Keep the slab damp and covered for a minimum of 3 days and preferably a week to gain strength.

EVALUATION

This method represents the collected experience of a long established privy program in Thailand. The general method should be applicable to other water-seal slab designs.

Material From - Thailand's Water-Seal Privy Program, by Barry Karlin, MPH Sanitation Advisor, USOM/Lprat. Thailand.

MASTER MOLDS FOR THE THAILAND WATER-SEAL PRIVY

ABSTRACT

This paper describes how to make the three master molds, from which any number of cores can be cast. These cores are used for casting the water seal privy slabs.

TOOLS AND MATERIALS

Concrete making materials
3/4" square steel rod
Sheet metal (tin can metal is satisfactory)
Clay
Crankcase oil (used oil is satisfactory)
Paintbrush

DETAILS

It may be necessary to make master molds rather than to purchase them. Study the entry "Thailand Water-Seal Privy" before starting to make these master molds.

Making the Master Bowl Mold

1. Cut out profiles of the bowl outline from Figure 1, which is full size.

2. Shape a mound of clay using the cardboard profiles as a guide.

3. Form a little square pipe, 3/4" long, of sheet metal on the 3/4" square steel rod. Make several of these as they will be used later when casting the cores. Fill the square pipe with clay and press it into the top of the clay mound a little bit. This will be used later to "key" the cores together. See Figure 2.

4. Paint the clay mound with crankcase oil.

5. Cover the clay mound with a stiff mixture of cement and water to a thickness of 1/2". If the clay mound was properly prepared, the inside finish of the bowl mold will need no further smoothing.

6. After this cement has set 30 minutes, build up the thickness to 1 1/2" with 1 : 1 cement sand mix. Let this set 24 hours and carefully lift the finished master bowl mold from the clay mound. The finished bowl mold is shown in Figure 3.

FIGURE 2 CLAY MOUND

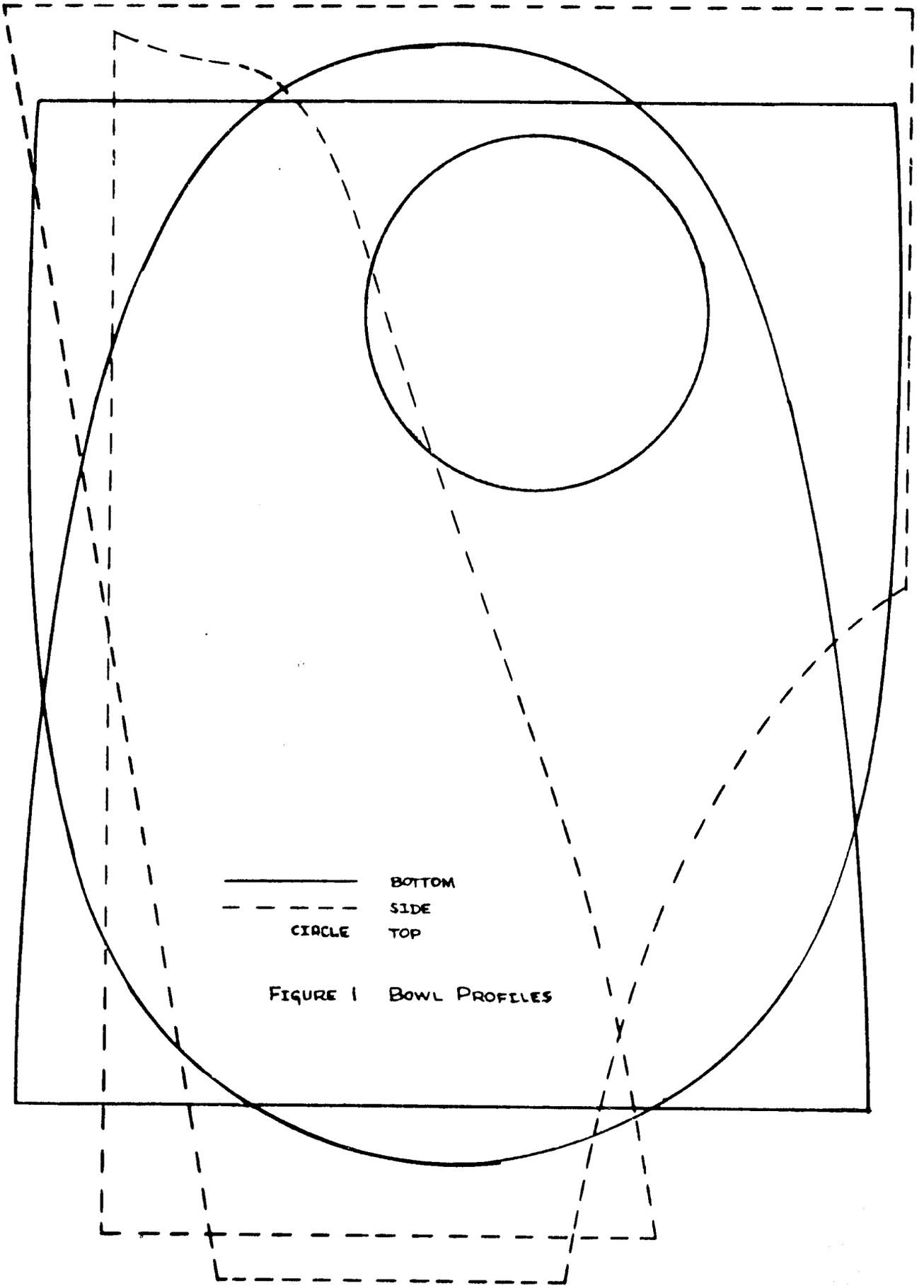


FIGURE 1 BOWL PROFILES

The next step is to make the pair of master molds used to cast the trap core, which consist of the master trap mold and the insert.

Making the Master Trap Mold

1. Make cardboard profiles of the trap from Figure 4, which is full size. Shape the outside of tne trap from clay, and let it harden overnight.

2. Shape the under side with trowel and hand using the master insert profile from Figure 4 and Figure 5 as a guide. Mark the location for a 3/4" square metal pipe by holding the clay trap over the clay mound used to shape the bowl mold, and letting the square sheet metal cube mark the trap.

3. Insert the sheet metal pipe into the clay trap and scoop out the clay from inside. See Figure 5. Check the clay trap on the bowl mound again to be sure it lines up properly.

4. Oil the clay trap.

5. Put a heel shaped piece of clay under the clay trap and trim the sides. This will prevent the cement from running under the mold. See Figure 6.

6. Cover with cement and water to 3/4", add steel reinforcing wire, and cover with 3/4" more of 1 : 1 cement sand mixture.

7. Flatten the top and insert wire handles. Let set at least 24 hours. This completes the master trap mold.

Making the Trap Mold Insert

1. Turn the master trap mold over carefully, and remove the heel shaped clay plug.

2. Oil all inner surfaces and fill to the brim with 1 : 1.

FIGURE 3 BOWL MOLD

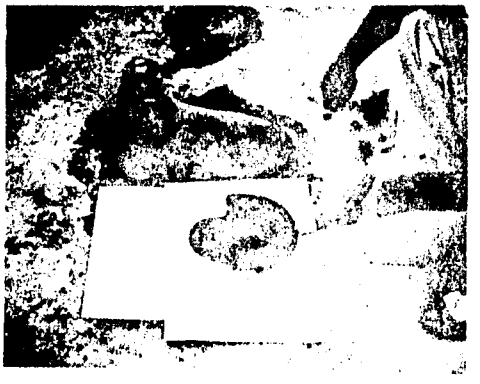
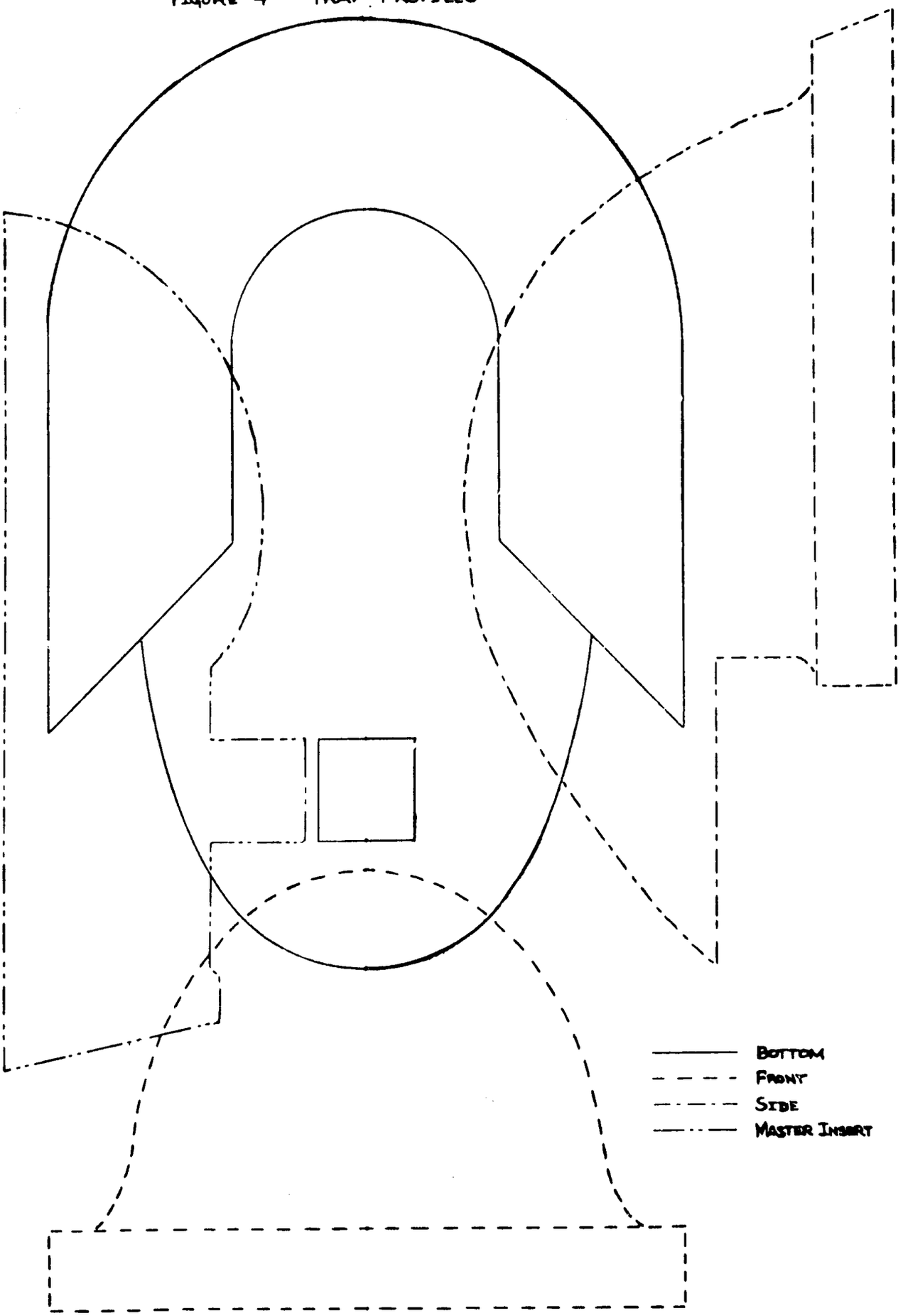


FIGURE 5 CLAY TRAP

FIGURE 6 PREPARING CLAY TRAP FOR CASTING MOLD

FIGURE 4 - TRAP PROFILES



3. Insert a small wire handle and allow the concrete to set for at least 24 hours before separating the finished molds.

Figure 7 shows the completed master trap mold and insert.

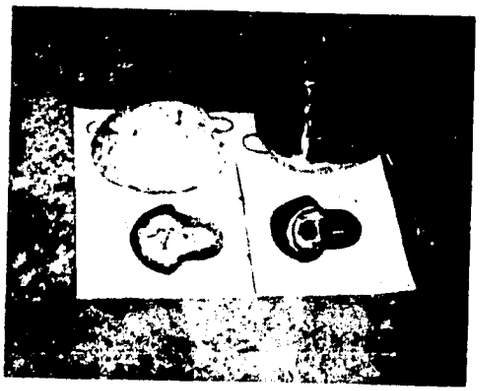


FIG. 7 TRAP MOLD AND INSERT

EVALUATION

This method represents the collected experience of a long established privy program in Thailand. The general method should be applicable to other water-seal slab designs.

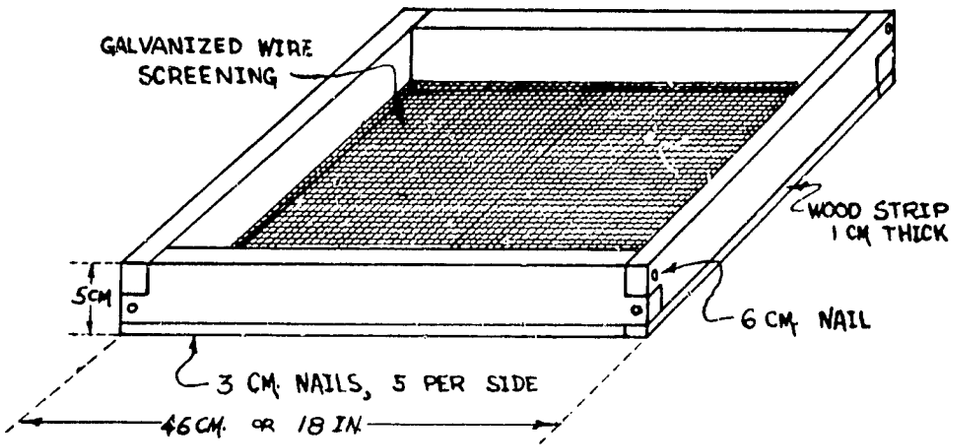
Material From - Thailand's Water-Seal Privy Program, by Barry Karlin, MPH Sanitation advisor, USOM/Lprat. Thailand.

AGRICULTURE

SEED CLEANING SIEVES

ABSTRACT

The set of sieves described here will clean your crop seeds effectively, which is an important step for improved crop production.



TOOLS AND MATERIALS

12 - boards
$2\frac{1}{2}$ x 5 x 46 cm.
1" x 2" x 18"
12 - wood strips
1 x $2\frac{1}{2}$ x $43\frac{1}{2}$ cm.
$\frac{1}{4}$" x 1" x 17"
1 - 46 cm (18 in.) square of $\frac{1}{4}$" galvanized screen.
1 - same but 3/16" screen
1 - same but 1/8" screen
Hammer, saw, nails.

DETAILS

The exact size of these sieves is not important, but 1/8", 3/16" and 1/4" mesh make convenient sizes for cleaning wheat, barley, corn and seeds of similar size. The sieves are also useful for grading certain seeds. Grading consists of removing the small, weak seeds which will produce small weak plants or will not grow at all. Less seed can be planted per acre, if it is properly cleaned and graded, and still produce a good crop.

EVALUATION

This old method finds use in many countries; the simple design described here was found useful in Afghanistan.

Material From - Dale Fritz, The Asia Foundation

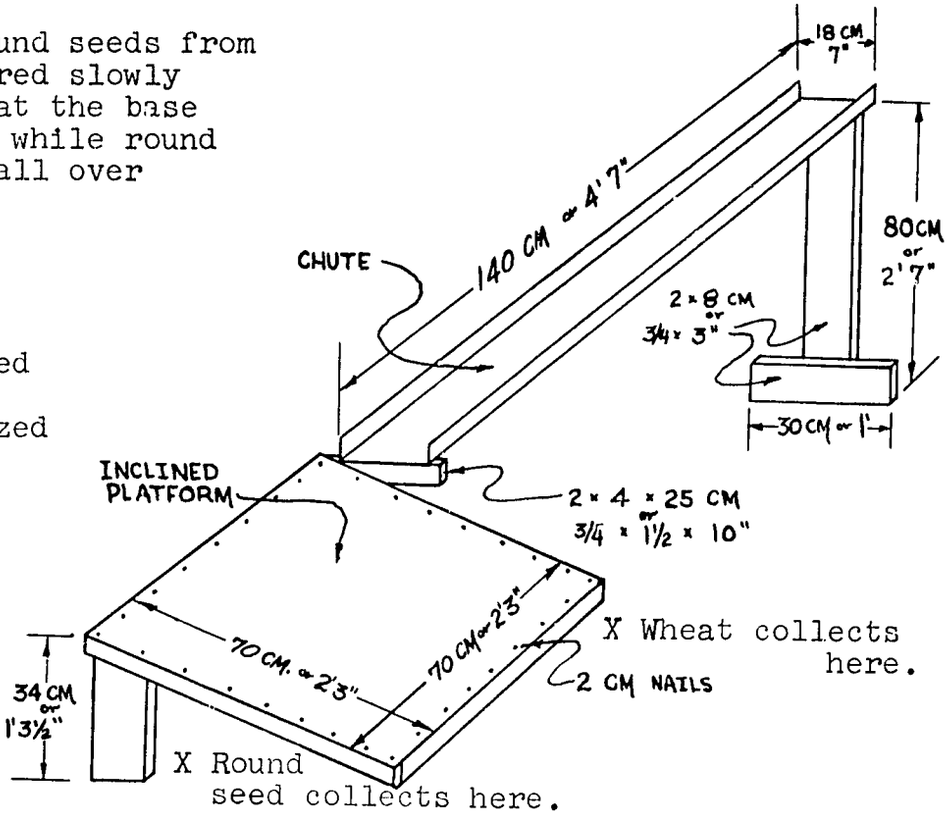
GRAIN CLEANER

ABSTRACT

This device removes round seeds from wheat. Sieved grain poured slowly down the chute collects at the base of the inclined platform while round seeds, rolling faster, fall over the far side.

TOOLS AND MATERIAL

1 - 70 x 70 cm. galvanized iron
1 - 24 x 140 cm. galvanized iron
4 - 2 x 4 x 68 cm. wood
1 - 2 x 4 x 25 cm. wood
1 - 2 x 8 x 80 cm. wood
1 - 2 x 8 x 30 cm. wood
1 - 2 x 8 x 34 cm. wood
Hammer, saw, nails.



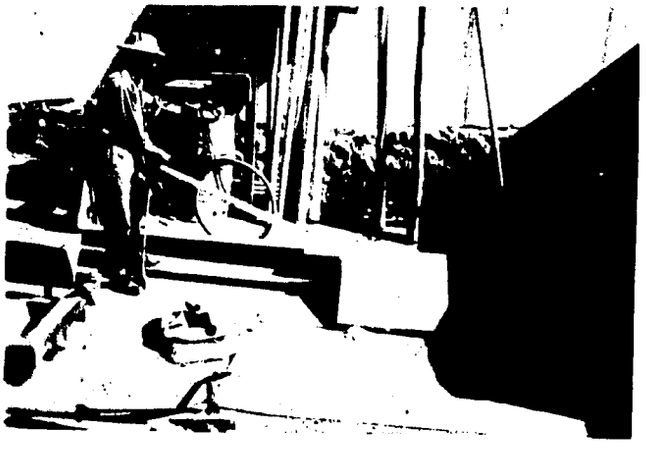
DETAILS

To operate the grain cleaner drop the seed very slowly into the upper end of the chute. The seed will roll down the chute but the round seed, because it is round, will roll much faster than the wheat seed. The speed of the round seed will cause it to roll compleately across the inclined platform while the wheat seed will collect on the ground near the end of the chute. The seed should first be cleaned with sieves to remove as much dirt and foreign material as possible.

EVALUATION

This device has found use in Afghanistan.

Material From - Dale Fritz,
The Asia Foundation



BUCKET SPRAYER

ABSTRACT

This simple sprayer works on the same principle as the inertia pump, and is designed so that local artisans can make it. Two people operate it; one sprays while the other pumps.

TOOLS AND MATERIALS

Galvanized iron 30 cm x 30 cm plus 10 cm x 20 cm
Barrel metal 10 cm x 20 cm
1/4" hose (high pressure) 4 m.
1/4" pipe (truck brake line may be used) 50 cm
Wood for handle 2 cm x 15 cm x 30 cm.
3/4" galvanized iron pipe (thin-wall) 120 cm long
4 mm wire-20 cm
Truck inner tube material 10 cm x 20 cm
1 mm galvanized wire 30 cm
4 - 3/16" bolts 1 cm long
2 - 3/16" bolts 3 1/2 cm long

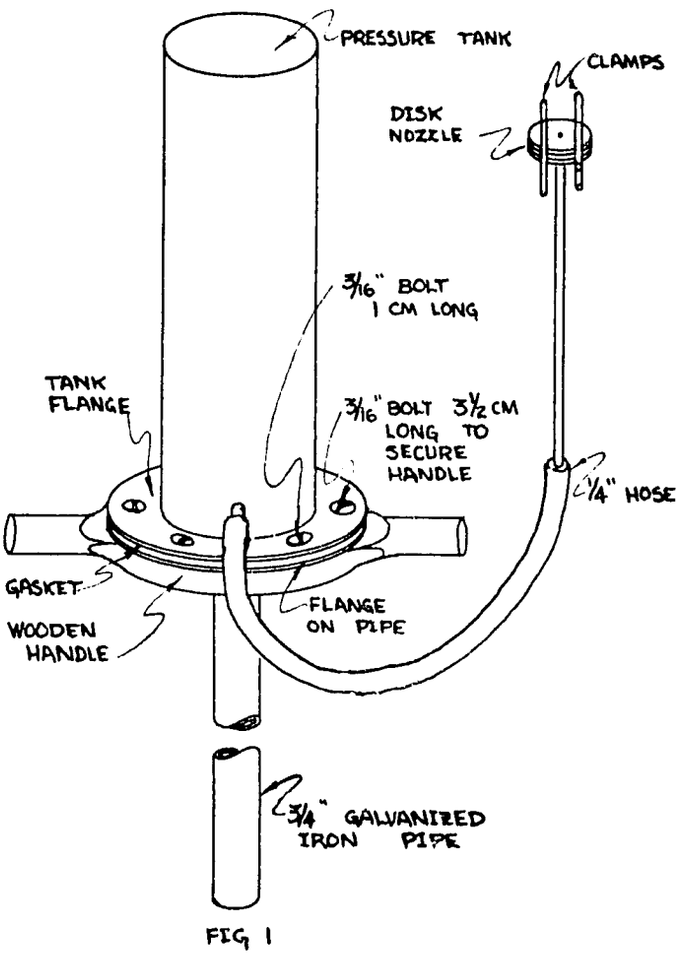


FIG. 1

DETAILS

The bucket sprayer described here has been designed primarily to meet the need for a sprayer which can be built in an area where production facilities are limited. This sprayer can be made by the local artisans. It is intended only for water solutions of insecticides or fungicides.

The sprayer pump is of the inertia type which consists of a 3/4" iron pipe with the top plugged and a simple valve located 8 cm. from the top. The valve is a piece of truck inner tube rubber wrapped around the pipe and held in place by wire. One corner of the rubber is over a hole in the pipe. Some careful adjustment is necessary when placing the rubber to make sure it works properly and does not leak.

The pressure tank encloses the valve assembly and, as the liquid is pumped into the tank, builds up pressure sufficient to operate the simple disk type spray nozzle. The tank is built so that it can be removed in order to service the valve.

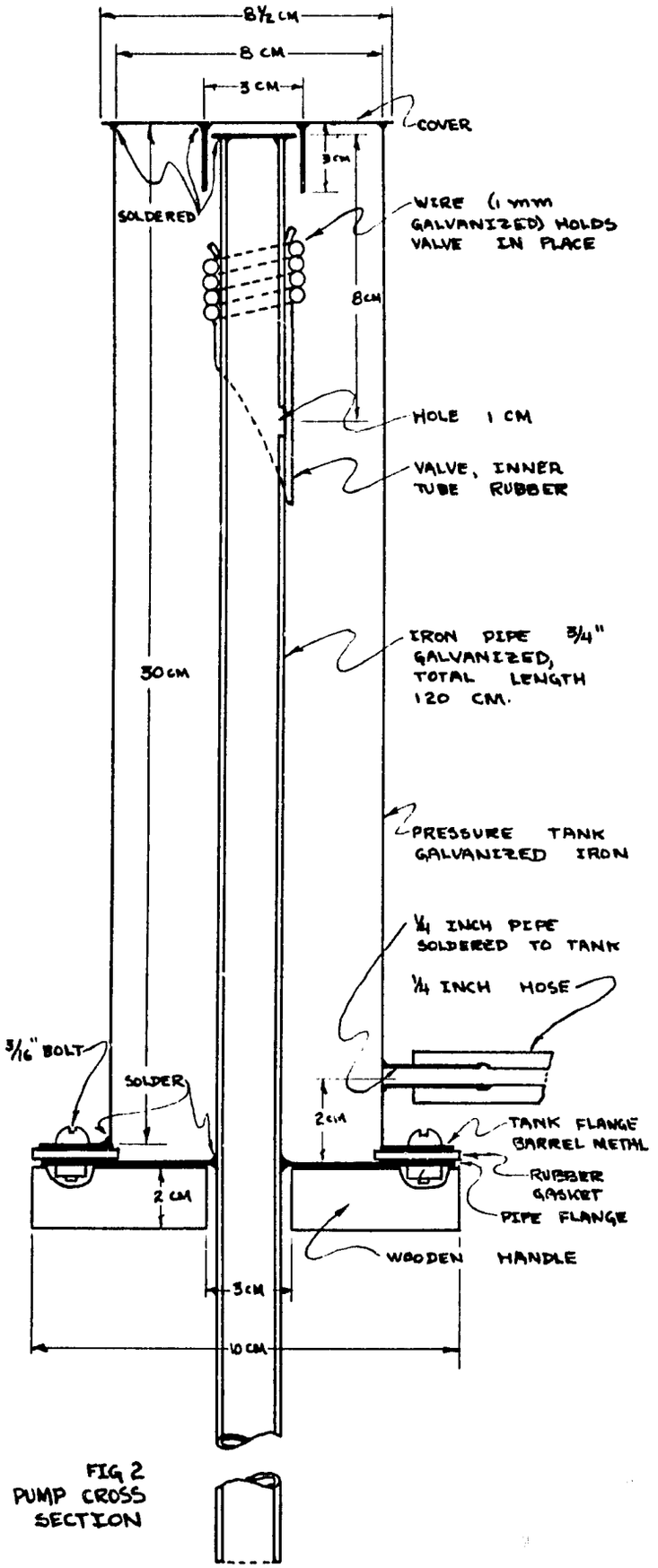


FIG 2
PUMP CROSS SECTION

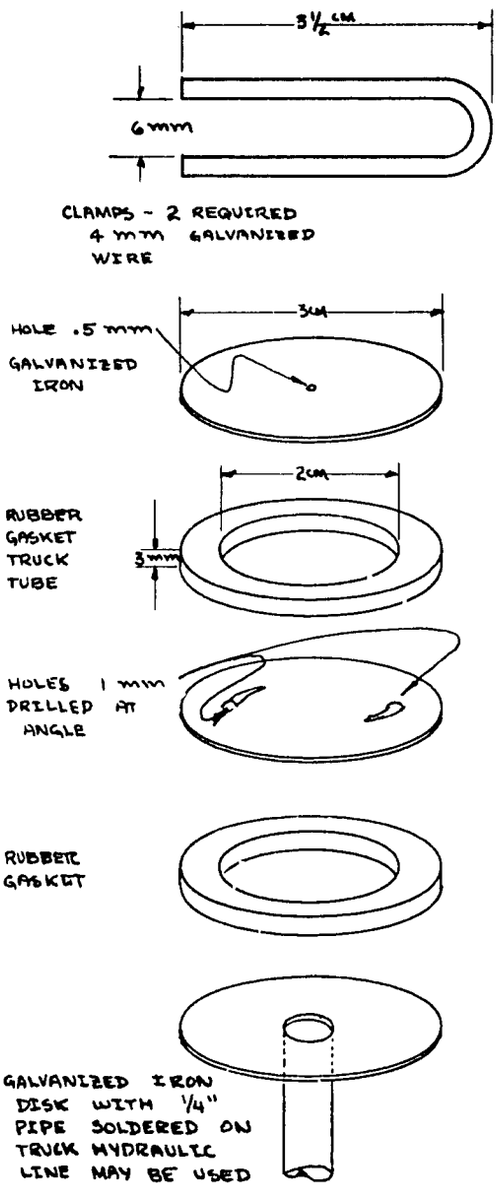


FIG. 3
DISK NOZZLE

The length of the hose can be determined by the maker of the sprayer but should be about 4 meters to allow the man doing the spraying to cover quite a large area before having to move the bucket. Also, the length of the small pipe and the angle of the spray nozzle will be determined by the kind of crops being sprayed.

At times it will be necessary to "prime" the sprayer pump. This is caused by two things. Either the valve rubber is too tight and the air cannot be forced through the valve, or the rubber is stuck to the pipe. To prime the pump turn it up-side-down and fill the pipe with water. Holding the thumb over the pipe, turn the pump over and lower it into the bucket of liquid and start pumping in the usual manner. If priming does not start the pump it will then be necessary to remove the pressure tank to inspect and repair the valve.

Only very clean water should be used to make the mixture for spraying and it should be strained through a cloth after mixing to remove any particles which might cause the nozzle to plug. If a very fine brass screen is available, it should be put in the nozzle to keep the dirt from plugging the holes.

EVALUATION

Have been useful in Afghanistan.

Material From - Dale B. Fritz, The Asia Foundation

BAMBOO POULTRY HOUSE

ABSTRACT

This bamboo poultry house has a thatch roof and slat walls tc provide good ventilation. The elevated slat floor keeps chick ens clean and healthy while the egg catch and feed troughs simplify maintenance.

TOOLS AND MATERIALS

Bamboo
Nails
Thatching materials
Small tools

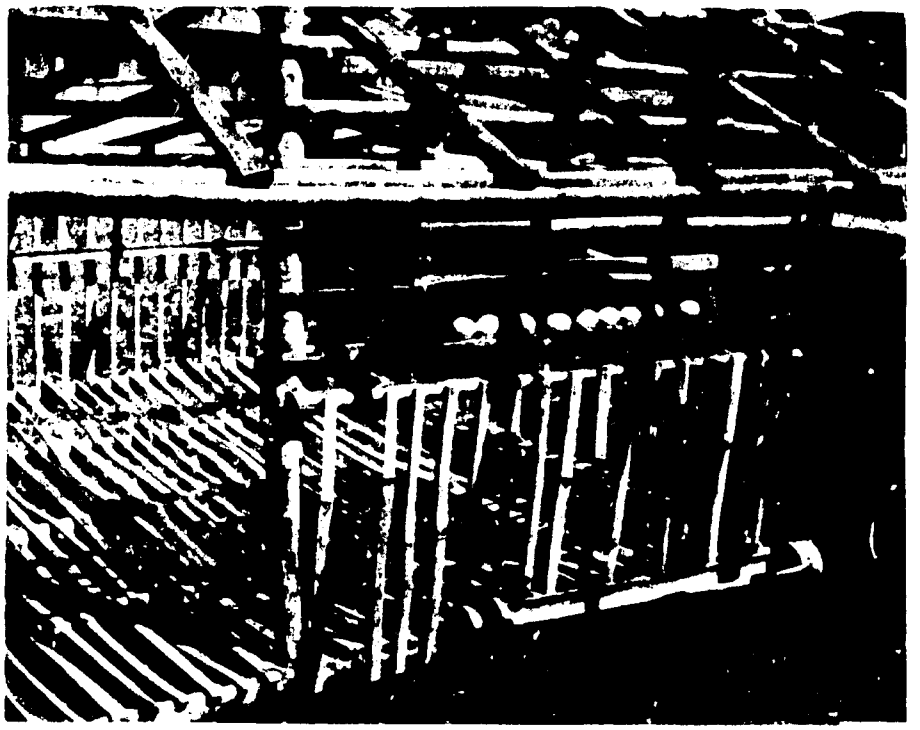


FIG. 1 SHOWS EGG CATCH AND FEED TROUGH

DETAILS

The house is built on a frame of small poles, with floor poles raised about 3 feet from the ground. The floor poles are covered with large bamboo stalks, split into strips 1 1/2" wide, spaced 1 1/2" apart. Floors so constructed have several advantages: better ventilation, no problem of wet moldy litter during rainy season or dry dustry litter during dry season; droppings fall between split reeds to ground away from chickens. This eliminated parasites and diseases normally passed from hen to hen through droppings remaining warm and moist in litter. However, it has been suggested that wide spacing of floor and wall slats might invite marauders such as weasels and snakes.

Walls are constructed from vertical strips of bamboo 1 1/2" wide, spaced 2 1/2" to 3" apart. This also allows ample ventilation, needed to furnish oxygen to the chickens and to allow evaporation of excess moisture produced in the droppings. In the tropics the problem is to keep chickens cool, not warm. Using a closed or tight-walled poultry house with a solid floor would keep them too warm and result in lowered production and increased respiratory problems.

The roof must protect the chickens from the weather. In Liberia thatch roofing keeps the birds cool, but it must be replaced more often than most other materials. Since it is cheap and readily available to the small farmer or rural family, it is most likely to be used. Aluminum, which reflects the heat of the sun, and asbestos, an efficient insulator, are desirable roofing materials in the tropics. Zinc, which is commonly used to roof houses in Liberia, is undesirable for chicken houses because it is an efficient conductor of heat.

Whatever the roofing material, the roof must have an overhang of or 3' on all sides to prevent rain from blowing inside the house. It may be desirable to slope the overhang toward the ground.

Feeders and waterers are made from 4 to 5" diameter bamboo of the desired length. A node or joint must be left intact in each end of the bamboo section to keep the feed or water in. A section 3 to 4" wide around half the circumference of the bamboo, except for 3" sections on the ends, is removed to make a kind of trough. All nodes between the ends are removed. These feeders must be fastened at the base, to keep them from rolling.

The feeders are fastened to the outside of the walls about 6" above floor level. The hens place their heads through the bamboo strips to feed or drink, thus conserving floor space for additional chickens.

In laying houses nests are also constructed of split bamboo for unobstructed ventilation. Conventional lumber nests are hotter and may result in hens laying eggs on the floor instead of in the nests. This means more dirty eggs, more broken eggs, and more likelihood of the hens eating the broken eggs. The only way to cure a hen of eating eggs once the habit is formed, is to kill her. In addition, as the hens enter the nests they sit on eggs laid previously by other hens, keeping them warm. The quality of eggs deteriorates very fast under these conditions.

FIG. 2 NESTS IN BAMBOO POULTRY HOUSE

The demonstration nests are 15" long, 12" wide, and 14" high. The strips used on the floor of the nest are about 1/2" wide, spaced 1/2" apart, and must be very smooth. The floor slopes 1/2" from front to back, so that when the eggs are laid they will roll to the back of the nest. An opening 2" high at the back of the nest allows the eggs to roll out of the nest into an egg catch. This type of nest results

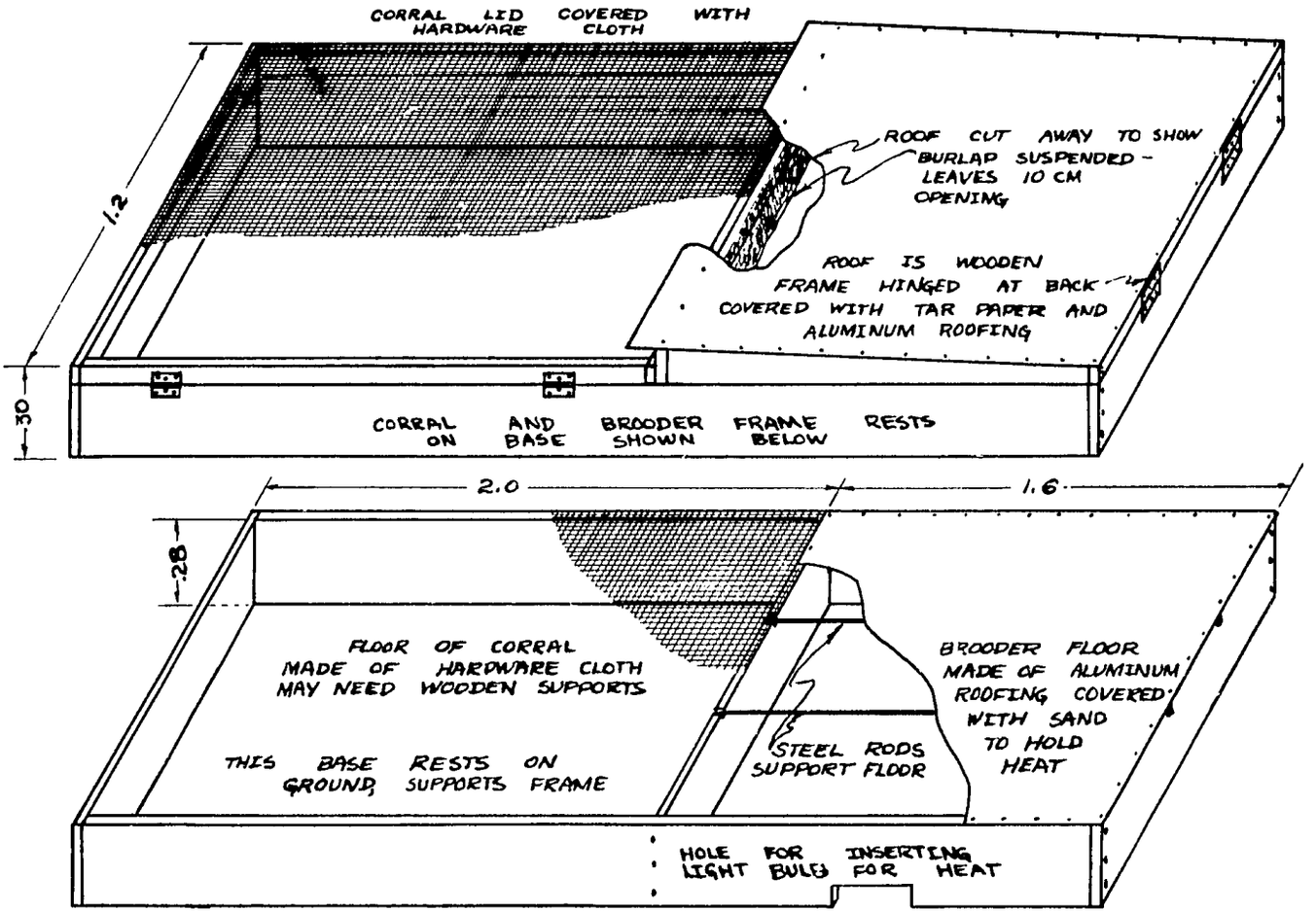
in less egg breakage, cleaner eggs, better quality eggs, because they begin to cool as soon as they roll out of the nest. In addition, the eggs are outside the nest where egg eating hens cannot reach them. Placing the egg catch so it protrudes outside the wall of the house allows the eggs to be gathered from outside. Placing the nests 3' above the floor conserves floor space and permits more laying hens to be placed in the laying house. One nest is put in for every five hens.

EVALUATION

The poultry house costs nothing but labor to build and is certain to produce healthier, more productive chickens. It has been used successfully in the Philippines and Liberia.

Material From - USAID, Monrovia, Liberia, described in OTS Information Kit, Vol. I, No. 5, May 1961.

CHICKEN BROODER



ABSTRACT

This brooder is sufficient size for 200 chicks, and is hinged for easy access to corral and brooder. Dimensions are shown in meters.

TOOLS AND MATERIALS

Hardware cloth 1.2 x 2 m., 2 pieces this size needed.
Aluminum roofing - 1.2 m. x 1.6 m., 1.2 m. x 1.7 m.
Wood, approximately 30 cm x 2 cm x 20 m..
Steel rod 1 cm diameter x 3.2 m.
4 hinges about 8 cm long
Woodscrews for hinges
2 buckets clean dry sand
Nails, tacks, staples
Small tools

DETAILS

This chick brooder is heated by a regular electric light bulb, placed under the brooder floor. Sand placed on the floor of the brooder holds and distributes the heat, and helps keep the area clean and dry. Depending on the temperature rise required, the wattage of the light bulb will have to be chosen by experimentation. The metal floor and roof prevent predators such as rats from entering the brooder. If electric power is not available, an excavation can be made for a lantern. Be sure the lantern has adequate ventilation.

EVALUATION

This type of brooder has been used successfully in Ecuador and other places by the indigenous people to raise broilers for a cash crop.

Material From - Article by George Kreps in Rural Missions, Issue #122, published by Agricultural Missions, Inc.

FOOD PROCESSING AND PRESERVATION

HAND-POWERED GRAIN MILL

ABSTRACT

This hand-powered grinder will grind corn, wheat or other grain coarse or fine. It is simple in design and easily built by a carpenter, being made almost entirely of plain one inch lumber.

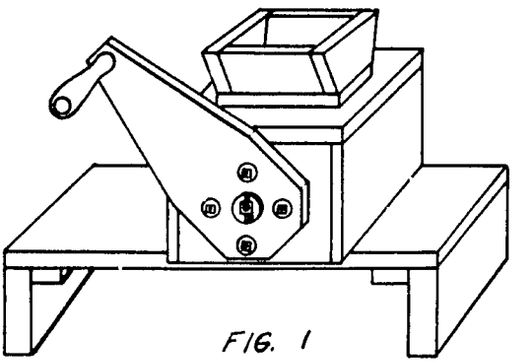


FIG. 1

TOOLS AND MATERIALS

Tools -
Hammer
Hand cross cut saw
Auger brace and 1/4, 1/2 and 7/8 inch auger bits.
Round file
Coping saw or key hole saw
Breast drill and 1/8" twist drill
One flat file
One three corner file
1/2" x 13" die and die handle
5/16" die
Wood chisel
Half round wood file
Tin shears
Screw driver

Materials -
12 feet of 1" x 6" seasoned sheathing lumber
2 feet 1" x 10" sheathing lumber
2 feet 2" x 8" framing lumber
3 feet 2" x 4" framing lumber
1 piece 1/2" x 14" cold rolled steel
12 - 1 1/2" x 8" flat head wood screws
3 - 1/2" steel washers
4 - 1" x 4" carriage bolts
1 - 1/2" wing nut
1 - 3/8" x 5" carriage bolt
2 cast iron burrs. (The cast iron burrs are available from Booher Equipment Company, 3627 Devon Drive S. E., Warren, Ohio, for about $.50 plus postage.

DETAILS

Through the following discussion 1" lumber refers to the standard board thickness for surfaced sheathing lumber in the United States. It actually measures only about three quarters of an inch in thickness. All dimensions are in inches. Lumber used should be flat and well seasoned. The numbers in the next section refer to part numbers shown in Figure 2 and subsequent detailed part sketches.

1. Grinder Body - make of 1" x 6" pine or hard wood lumber. Circular hole can be cut with coping saw or jig saw but for a better and quicker way to cut see Notes 1 and 2, Figures 3 and 4.

2. Rotor - See Note 2. Take care tc bore the 1/2" holes thru each part where required accurately and at right angles to the surface of the part. If

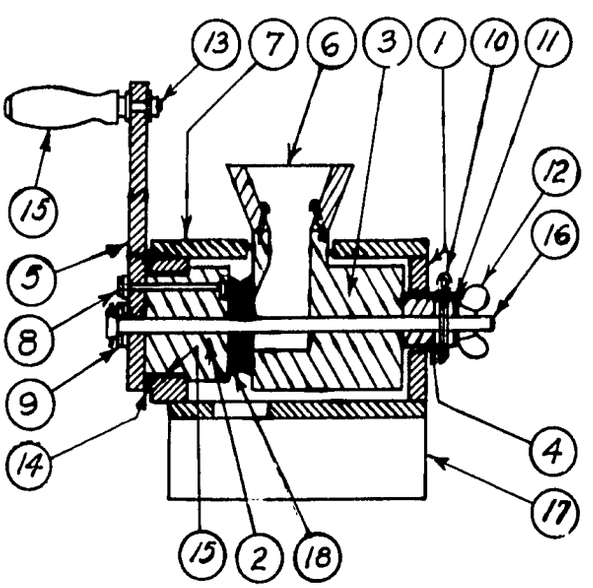
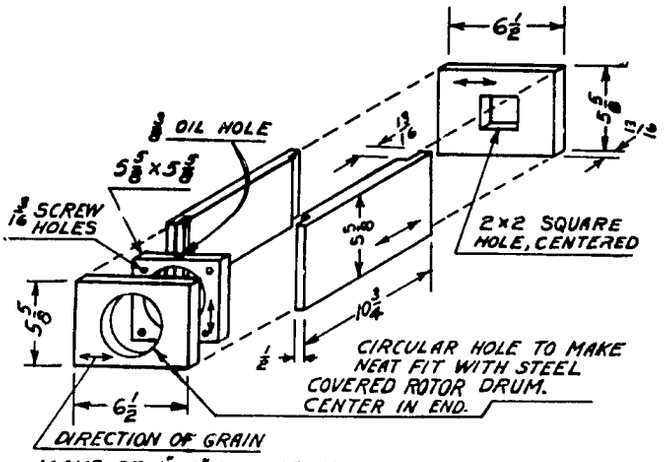


FIG. 2. ASSEMBLY DWG.

when placed on the assembly post, it does not lay flat to the assembly post surface marked "A" in Figure 3 or against an adjacent part because the hole is not bored straight, remove it from the assembly post and use a round file in the hole carefully until it will lay flat. Use a few spots of glue between parts. Be careful in nailing so nails will not interfere with boring the 1/4" holes later. Keep the nails within 1" of the center post. 1 1/2" finishing nails are about right.



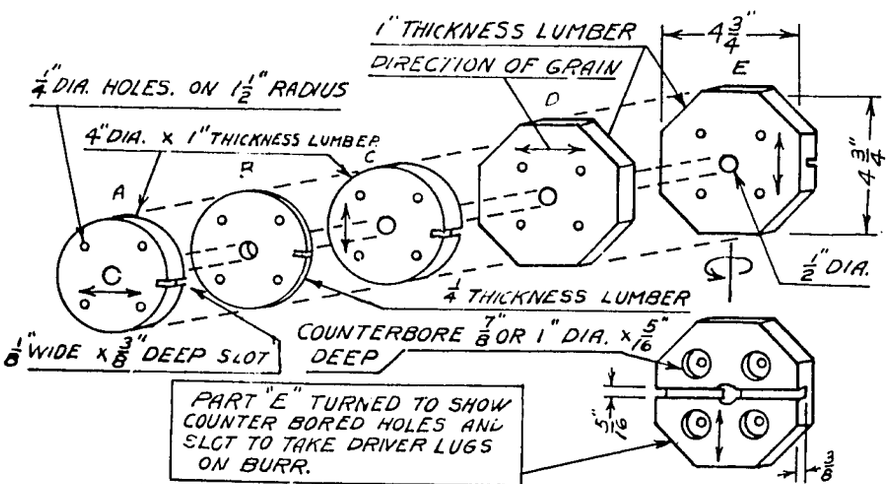
(1) GRINDER BODY. EXPLODED VIEW.

It is a help in getting the metal band snugly on the rotor drum to form the 3/8" lip on one end first, then bend the band around some round object that is about 3" in diameter. Next put it on the rotor drum with the one lip engaged in the slot. Use strong twine or flexible wire to pull band snugly around drum and mark position of the second lip. Remove from rotor, form the second lip and cut off excess. The band may need to be formed a little with the fingers. It should now fit snugly.

3. Stationary Burr Holder - In boring 1/2" holes and assembling follow the instructions given under (2). Assemble the parts using a few spots of glue and nails. 1 1/2" finishing nails are about right.

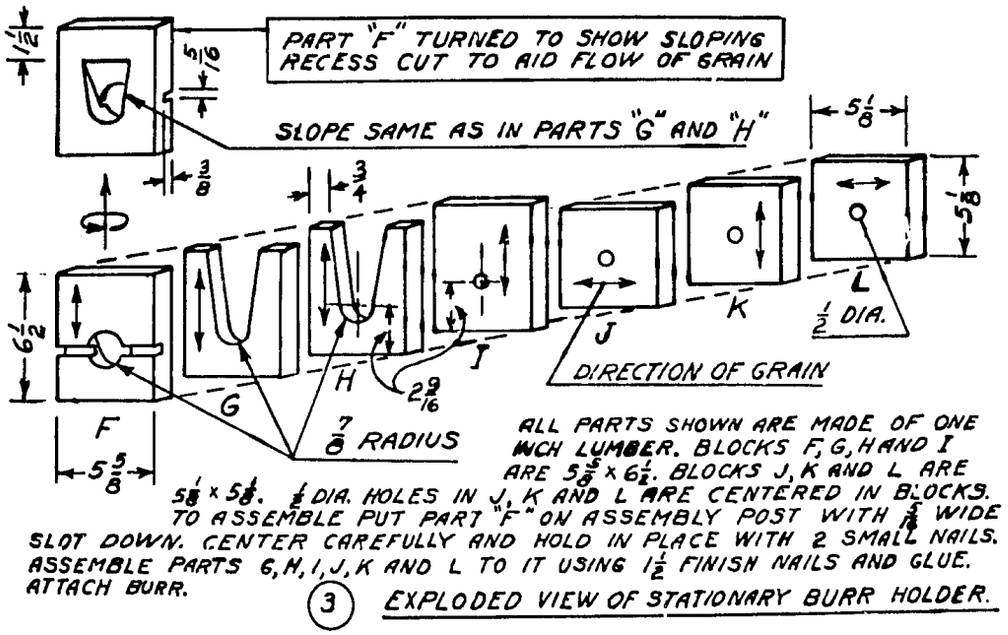
4. Follow instructions under (2) Rotor for assembling parts of the thrust block.

5. The 1/4" holes can best be located by placing the rotor and crank all on the assembly post. With bolts in place thru rotor, mark location for holes on crank by tapping with a hammer. Oil hole in the crank is bored to reach the 1/2" hole. This will supply oil to the steel shaft.



DISCS "A" AND "C" ARE CUT FROM FRONT END BOARDS OF GRINDER BODY USING CIRCLE CUTTER. SEE FIG. 4. CUT DISC. "B" FROM ¼" PLYWOOD OR PLAIN ¼" THICK LUMBER. BORE ½" DIA. HOLES IN CENTER OF EACH PIECE, THEN STARTING WITH PART "E," PLACE OVER ASSEMBLING POST WITH SLOT DOWN. ASSEMBLE OTHER PARTS AS SHOWN. USE 1½" NAILS AND GLUE. MAKE COUNTER-BORES AND ¼" HOLES AFTER ASSEMBLING. PUT THE FOUR ¼" BOLTS IN HOLES WITH HEADS IN COUNTER-BORES. ATTACH BURR WITH 1½ x 8 WOODSCREWS.

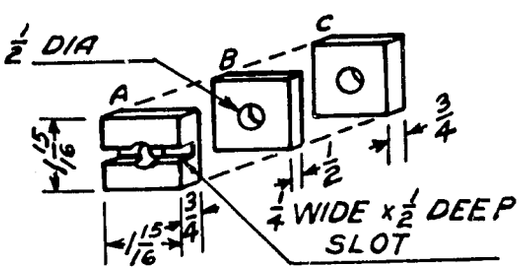
(2) EXPLODED VIEW OF ROTOR



(3) EXPLODED VIEW OF STATIONARY BURR HOLDER.

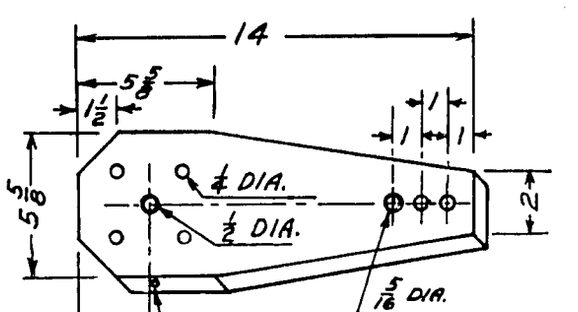
6. Attach hopper to top of stationary burr holder with screws. See Figure 2.

7. Cover



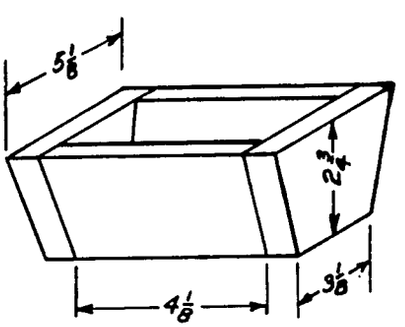
AFTER BORING HOLES AND CUTTING SLOT, ASSEMBLE PARTS A, B AND C USING SMALL NAILS AND GLUE. TOTAL THICKNESS OF A, B AND C IS 2"

(4) EXPLODED VIEW OF THRUST BLOCK.



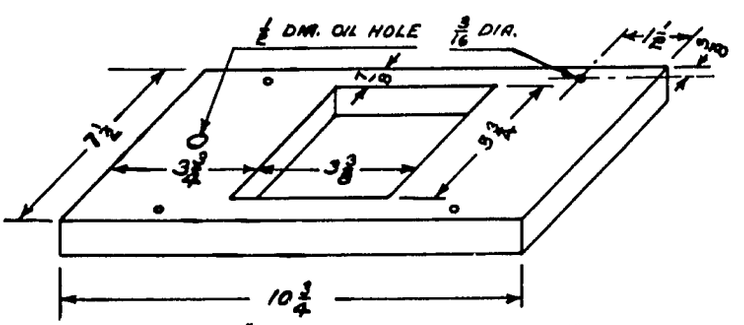
MAKE OF 1" LUMBER. BORE 1/4" HOLES TO LINE UP WITH HOLES IN ROTOR.

(5) CRANK



MAKE OF 1" LUMBER

(6) HOPPER



MAKE OF 1" LUMBER. LOCATE OIL HOLE TO LINE UP WITH OIL HOLE IN GRINDER BODY

(7) COVER

8. Four 1/4" x 4 1/2" carriage bolts with nuts and 8 washers.

9. Two steel washers for 1/2" diameter bolts.

10. Two 1/8" diameter x 2" cotter key. If a larger diameter cotter key is used, drill the hole to suit. The hole should not in any case be more than 5/32".

11. Three steel washers for 1/2" bolt.

12. One 1/2" winged nut.

13. One 5/16" diameter carriage bolt threaded 1 1/2". File square shank under head to roundness. Length 4 1/2".

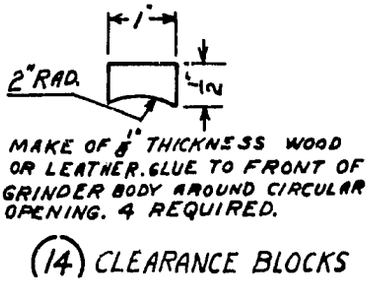
14. Clearance Block - The purpose of the clearance block is to keep the crank from rubbing the front of the grinder. Locate the clearance blocks at even quarters around circular opening in front of grinder body.

15. Rotor Drum Band - In making this part and attaching it to rotor read the discussion under Rotor (2).

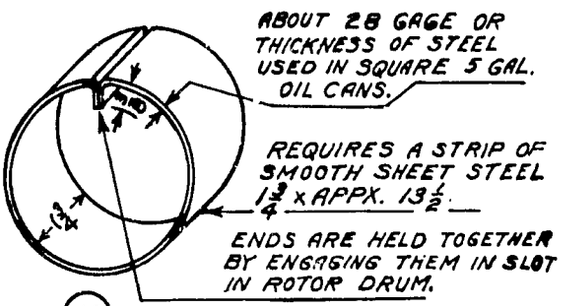
16. Steel Shaft - Threading is U.S. standard. 1/2" x 13 threads per inch.

17. Grinder Stand.

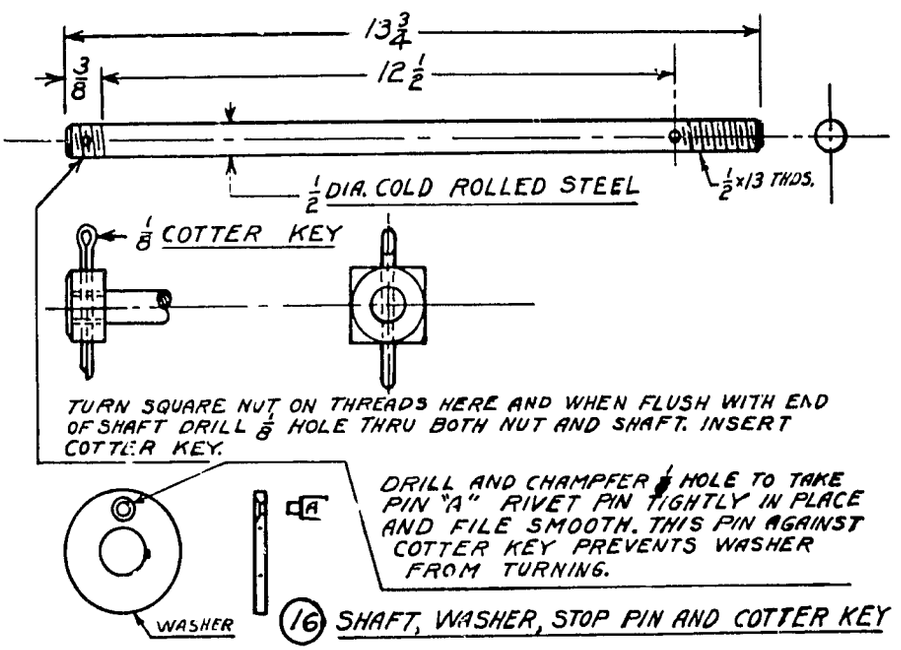
18. Two cast iron burrs. See materials.



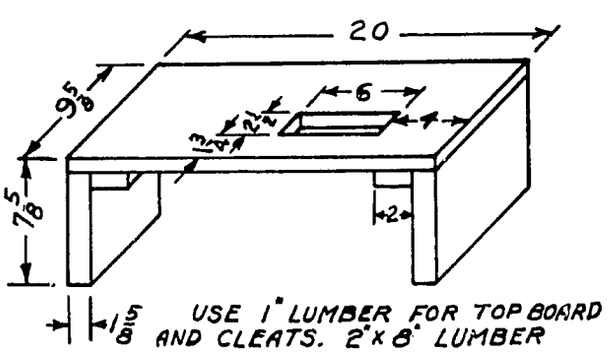
(14) CLEARANCE BLOCKS



(15) ROTOR DRUM BAND



(16) SHAFT, WASHER, STOP PIN AND COTTER KEY



(17) GRINDER STAND

FINAL ASSEMBLING

After all parts are completed the next step is to fully assemble the mill. The rotor with burr attached is placed in its position in the circular opening. Attach the crank. Next put the stationary burr holder in position and insert the steel shaft thru both parts. Put

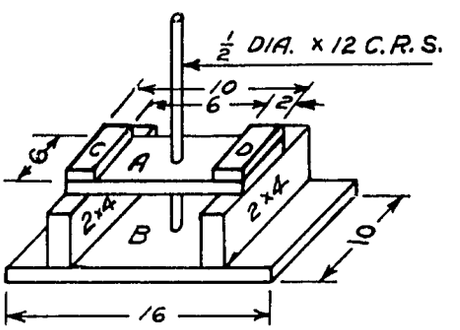
the thrust block in place, insert the cotter key, put on steel washer and run up the winged nut. In making the final adjustment it may be necessary to add one or more steel washers between thrust block and burr holder or to shorten the thrust block. When the winged nut is tight, there should be a little play between the cotter key and the bottom of the slot in thrust block.

Before putting on the cover turn the rotor and observe the burrs carefully. They should remain flat to each other when rotor is turned. If there is an opening which travels around as the rotor turns, a shim is needed under the burr on the rotor. Mark the place and note thickness of shim required. If the opening remains stationary a shim is needed under the burr on the burr holder. Remove the necessary part and add a shim. Of course, both burrs may need shims. A little glue under the shims makes a permanent job.

NOTES -

The purpose of the following is to facilitate and speed up the job of making the mills. It is assumed the mills will be made in a carpenter shop as a business. The notes along with Figures 3 and 4 describe two devices that will be found very useful in shops making these mills.

NOTE 1 - See Figure 3. The use of the assembly post is described under (2) and (3). In constructing the assembly post, care should be taken to make it very solid and strong and the steel post must be square with the surface marked "A" in Figure 3. A good way is to build the entire wood part of the device "C" and "D" before boring the holes for the steel post. When ready to bore these holes, bore thru "A" first, then push the bar thru to "B" and testing carefully with a square move top of bar until it tests square both ways then strike the bar on its top end to mark position of the auger hole in "B". Last, put on "C" and "D".



ALL WOOD PARTS ARE 1" LUMBER EXCEPTING THE 2 PARTS MARKED 2x4.

FIG. 3. ASSEMBLY POST

NOTE 2 - See Figure 4. The purpose of this device is to cut the circular discs out of the end boards of the grinder body. Test each on the assembly post to be sure the holes are square thru these members. Use a round file if the member does not lay flat on "A" of the assembly post. Place the pieces one at a time on the rod of the disc cutter. Remove the steel rod from the assembly post and pass the steel rod of the disc cutter thru both holes of the

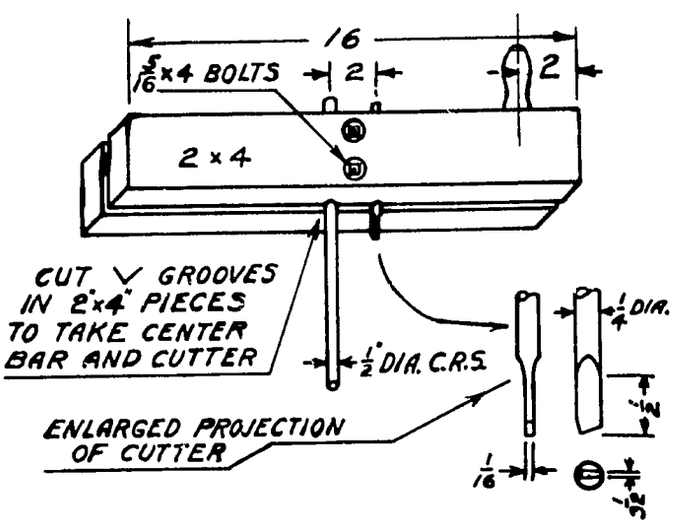


FIG. 4 DISC CUTTER

assembly device. The assembly device with disc cutter in place should now be held in a bench vise or fastened to a wall so the shaft is horizontal and at a convenient height for turning. Turn the crank and exert a gentle pressure to bring the cutter into play.

The steel cutter should be of tool steel. A six inch length of drill rod is excellent. If this is not available, a screw driver with approximately a 1/4" diameter shank can be shaped up with a file to do the job. In operating the disc cutter cut only half way thru the member then reverse and complete from other side.

For greater strength the cutter can be made more then 1/16" in thickness. This will make the discs that compose the rotor drum fit too loosely even after the steel band is on but the difficulty is easily corrected by giving the drum several turns of heavy wrapping paper before the steel band is applied. The paper should be glued to the drum.

EVALUATION

To date the grinder has not been field tested. Shop tests have been successful.

Material From - Designed by W. B. Booher
3627 Devon Drive, Warren, Ohio.

HOUSING AND CONSTRUCTION

TUBEWELL SAND AUGER

ABSTRACT

This slower cutting auger can be used where tubewell drilling is more difficult. A smaller version can drill sand from inside a casing pipe.

TOOLS AND MATERIALS

Tube, 6" outside diameter, 18" long
steel
Steel plate, 6 1/2" x 6 1/2" x 3/16"
Acetylene welding and cutting equipment
Drill

DETAILS

This simple cutting head is quickly made and requires less torque to turn than the "Tubewell Earth Auger." It can also hold loose soil or wet sand, but is somewhat more difficult to empty. One made to fit inside your casing can be used to remove loose, wet sand.

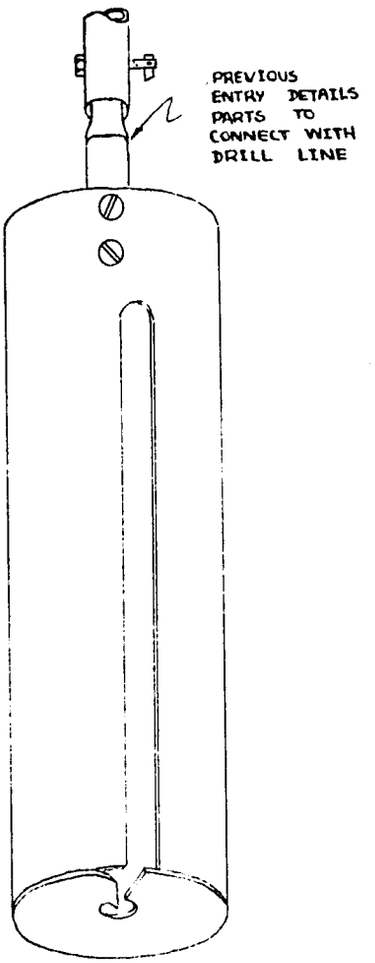


FIG 1

EVALUATION

This particular design needs field trial, although very similar devices have long been used with power drilling equipment.

Material From - Mainly based on information found in Armed Forces Technical Manual "Wells," Technical Manual 5-297 AFM 85-23 published by the U.S. Army and Air Force, 1957.

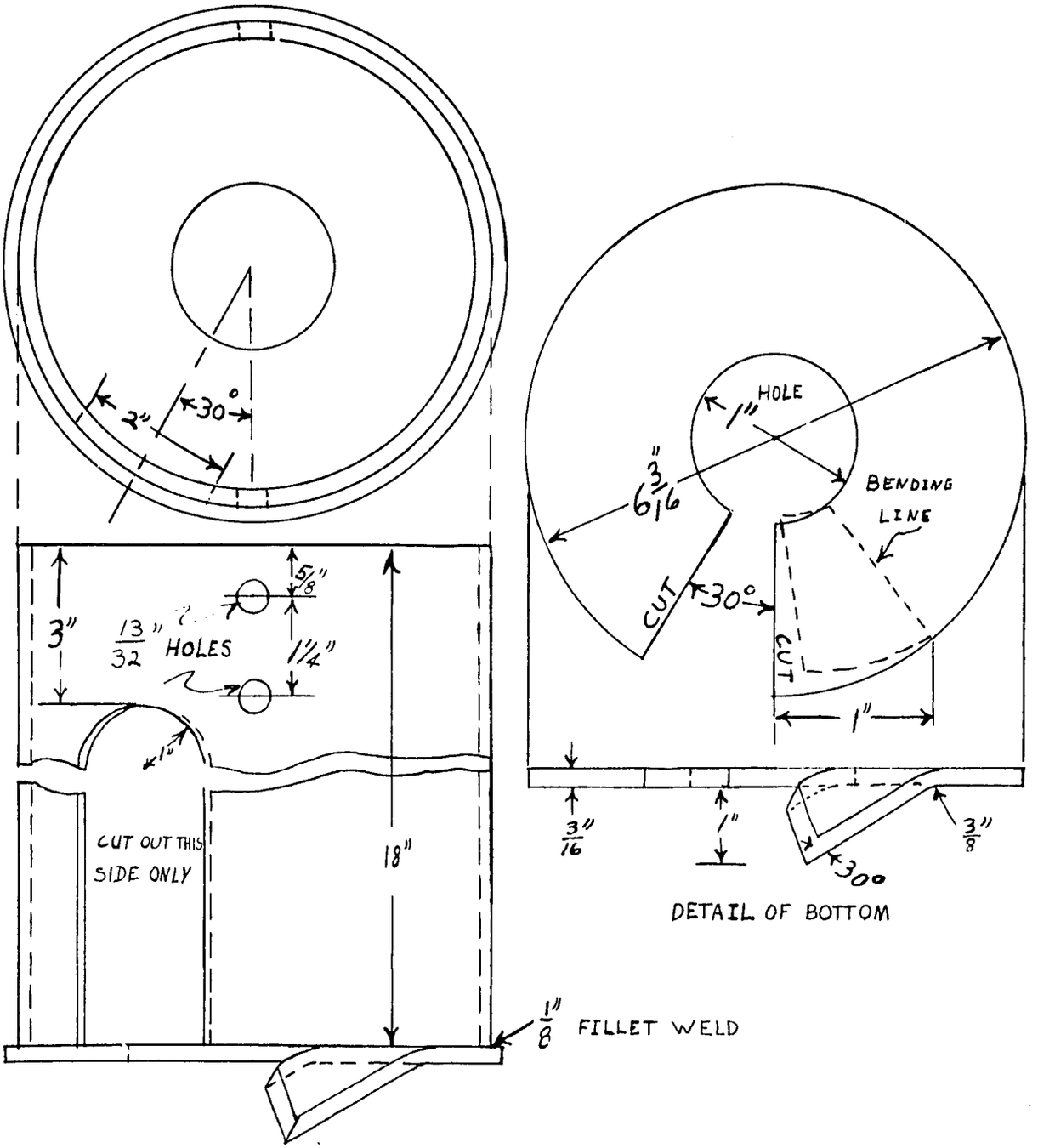
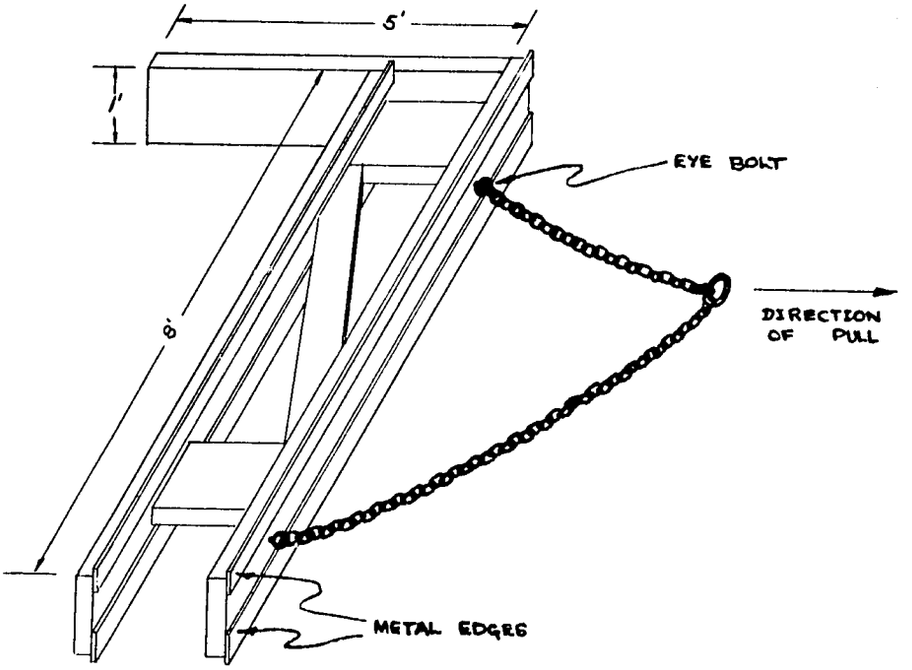

2"
30°
3"
13/32" HOLES
5/8"
1 1/4"
1"
CUT OUT THIS SIDE ONLY
18"
1/8" FILLET WELD
1" HOLE
6 3/16"
BENDING LINE
CUT
30°
CUT
1"
3/16"
1"
3/8"
30°
DETAIL OF BOTTOM

FIG. 2

DRAG GRADER

ABSTRACT

This simple metal edged wooden grader is designed for two medium sized work horses or oxen.



TOOLS AND MATERIALS

3" x 12" lumber
  2 pieces 8' long
  1 piece 5' long
  2 pieces 1' long
3" x 6" lumber
  1 piece 4 1/2' long
4 metal edges 1/4" to 1/2" thick, 4" wide, 8' long.
17 lag screws 7" long, 5/8" diameter.
2 eye bolts, 3" diameter eye large washers
12 feet heavy chain
32 woodscrews, 3" flat-head steel.

DETAILS

The angle between the 5' and 8' beams should be made 30° if ditch cleaning is anticipated. The unit can be scaled down for use with one animal. The metal edge overhangs the surfaces of the 8' beam by one inch. Each is screwed on with eight large woodscrews or carriage bolts.

The position of the scraper is adjusted by changing the hitching point on the chain. The metal edges are attached to both top and bottom so the drag can be turned over to reverse the direction in which material is cast.

EVALUATION

This model was used for dirt and gravel roads in midwestern United States about 1925.

Material From - Peoria VITA chapter

INTRODUCTION TO CONCRETE CONSTRUCTION

ABSTRACT

Concrete is a strong, durable and inexpensive construction material when properly prepared. This brief summary in conjunction with later entries will give you a good introduction to concrete construction.

TOOLS AND MATERIALS

None - general information

DETAILS

After concrete has set, there is no simple non-destructive test to evaluate how strong it is. Therefore, the entire responsibility for making concrete a strong material in accordance with specifications rests with the supervisor on the job and the people who prepare, measure and mix the ingredients, place them in the forms, and watch over the concrete while it hardens.

The most important factor in making strong concrete is the amount of water. Beginners are likely to have too much. See the entry on a slump cone for further details.

The proper proportion of all the materials, designed for the application, is essential. The concrete calculator will help give the proper proportions and amounts for your job.

Properly graded, clean, sharp aggregate and sand is required to make good concrete. When we glue two pieces of paper together, we spread the glue evenly and in a thin layer, and press firmly to eliminate air holes. In concrete, the cement is the glue, and the sand and aggregate the material being joined.

By properly graded we mean that there are not too many of any one size grains or pebbles. Visualize this by thinking of a large pile of stone all 1 1/2" in diameter. There would be spaces between these stones where smaller pebbles would fit. We could add to the pile just enough smaller stones to fill the largest voids. Now the voids would be smaller yet, and even smaller pebbles could fill these holes; and so forth. Carried to an extreme, the pile would become nearly solid rock, and only a very small amount of cement would be needed to stick it together. The resulting concrete would be very dense and strong.

Sharp aggregate and sand is desirable. Smooth, rounded stones and sand can make fairly good concrete, but sharp, fragmented particles work better because the cement as a glue can get a better grip on a rough stone with sharp edges.

It is extremely important to have the aggregate and sand clean. Silt, clay, bits of organic matter will ruin concrete if there is very much present. A very simple test for cleanliness makes use of

a clear wide-mouth jar. Fill the jar about half full of the finer material available, the sand and small aggregate, and cover with water. Shake the mixture vigorously, and then allow it to stand for three hours. In almost every case there will be a distinct line dividing the fine sand suitable for concrete and that which is too fine. If the very fine material amounts to more than 10% of the suitable material, then the concrete made from it will be weak.

This means that other fine material should be sought, or the available material should be washed to remove the material that is too fine. This can be done by putting the sand (and fine aggregate if necessary) in some container such as a drum. Cover the aggregate with water, stir thoroughly, and let stand for a minute, and pour off the liquid. One or two such treatments will remove most of the very fine material and organic matter.

Another point to consider in the selection of aggregate is its strength. About the only simple test is to break some of the stones with a hammer. If the effort required to break the majority of aggregate stones is greater than the effort required to break a similar sized piece of concrete, then the aggregate will make strong concrete. If the stone breaks easily, then you can expect that the concrete made of these stones will only be as strong as the stones themselves.

In very dry climates several precautions must be taken. If the sand is perfectly dry, it packs into a smaller space. If you put 20 buckets of bone dry sand in a pile, stirred in two buckets of water you could carry away about 27 buckets of damp sand. The chart does not take this extremely dry sand into account. If your sand is completely dry, add some water to it or else do your measurements by weight instead of volume. The surface of the curing concrete should be kept damp. This is because water evaporating from the surface will remove some of the water needed to make a proper cure. Cover the concrete with building paper, burlap, straw, or anything that will hold moisture and keep the direct sun and wind from the concrete surface. Keep the concrete moist by sprinkling as often as necessary; this may be as often as three times per day. After the first week of curing, it is not so necessary to keep the surface damp continuously.

Mixing the materials and getting them in place quickly, tamping and spading to a dense mixture is important. This is covered on the entry on mixing.

Reinforcing concrete will allow much greater loads to be carried. Later entries describe the proper installation of reinforcing rods. Design of reinforced concrete structures can become too complicated for a person without special training, if they are large or must carry high loads.

Principal Reference - "A Building Guide for Self Help Project" Department of Social Welfare and Community Development, Accra, Ghana.

CONCRETE CALCULATOR

ABSTRACT

This easy to use chart will allow quick and accurate calculation of the amounts of material needed for concrete construction.

TOOLS AND MATERIALS

Straight Ruler and pencil
Information about the project: Area of concrete needed in square feet; thickness in inches; kind of work to be done (see definitions under DETAILS); wetness of sand (see definitions under DETAILS).

DETAILS

Use the alignment chart as follows. Make a light pencil mark on the left-most scale representing the area of concrete needed. Make a similar mark on the slanted thickness scale. Draw a straight line through these marks intersecting the third scale. This is the volume of your concrete. If your project has a complex shape, add up the volumes of all the parts before proceeding.

Now mark the total volume of concrete on the third (volume) scale, and the kind of work on the fourth. (See definitions.) A line through these two points will give the amount of fine aggregate needed. Continue on a zig-zag course as shown in the KEY to calculate the coarse aggregate, sacks of cement, and water.

It may be necessary to make slight adjustments to the mix, depending upon the type of aggregate used. The final mixture should be wet enough and workable enough to go into the forms fairly easily, requiring light spading or tamping to produce a dense mixture. Too much moisture produces a weak cement. The figures in the alignment chart do not allow for waste which may run as high as 10%.

All materials can be measured in "buckets" instead of cubic feet. The nomograph will still give the correct proportions. The total amount of concrete produced, however, will depend upon the size of the bucket used as the measure. Most buckets are rated by the number of gallons they can hold. To convert to cubic feet, then, you must know that one cubic foot equals 7.5 gallons. A four gallon bucket would hold 0.533 cubic feet. Incidentally, one cement sack holds exactly one cubic foot, so "buckets" can also be substituted for "sacks" on the chart.

Similarly, if your volume of concrete needed is less than 15 cubic feet, you can multiply this by some convenient factor (say 10) and then divide the amounts of materials the chart says to use by the same factor to get the actual amounts needed.

-- Definitions used in the chart are given on the fold-out page.--

CONCRETE

Kind of work - "5" means "5 gallon paste" which is concrete subjected to severe wear, weather, or weak acid and alkali solutions. Examples would be the floor of a commercial dairy.
- "6" means "6 gallon paste" for concrete to be watertight or subjected to moderate wear and weather. Examples: watertight basements, driveways, septic tanks, storage tanks, structural beams and columns.
- "7" means "7 gallon paste" for concrete not subjected to wear, weather, or water. Examples: Foundation walls, footings, mass concrete, etc. where water tightness and abrasion resistance are not important.

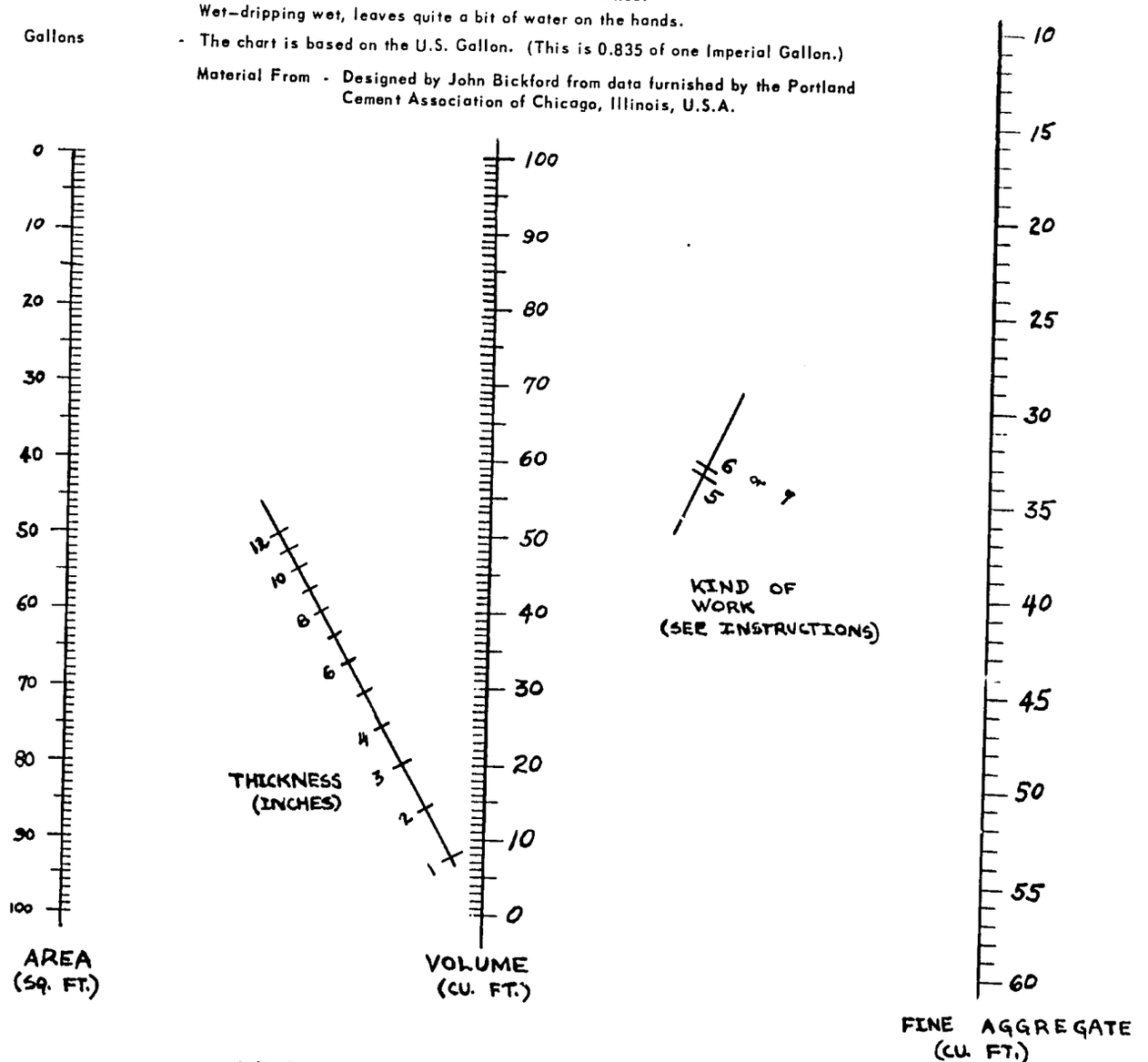
Fine Aggregate - Sand or rock screenings up to one quarter inch in diameter. Should be free from fine dust, loam, clay and vegetable matter or the concrete will have low strength. Particles should vary in size, not all fine or coarse.

Coarse Aggregate - Pebbles or broken rock from 1/4" up to 1-1/2". Nothing coarser than 3/4" should be used for a 5 gallon paste.

Condition of Sand - Dry–feels slightly damp but leaves very little water on the hands.
Average–feels wet; leaves a little water on the hands.
Wet–dripping wet, leaves quite a bit of water on the hands.

Gallons - The chart is based on the U.S. Gallon. (This is 0.835 of one Imperial Gallon.)

Material From - Designed by John Bickford from data furnished by the Portland Cement Association of Chicago, Illinois, U.S.A.



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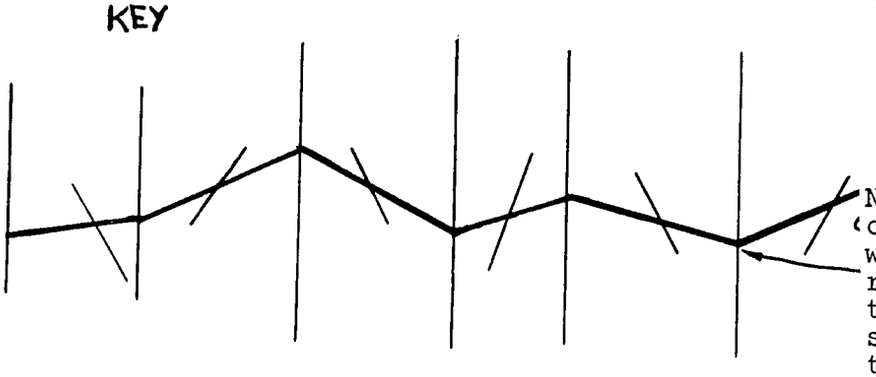
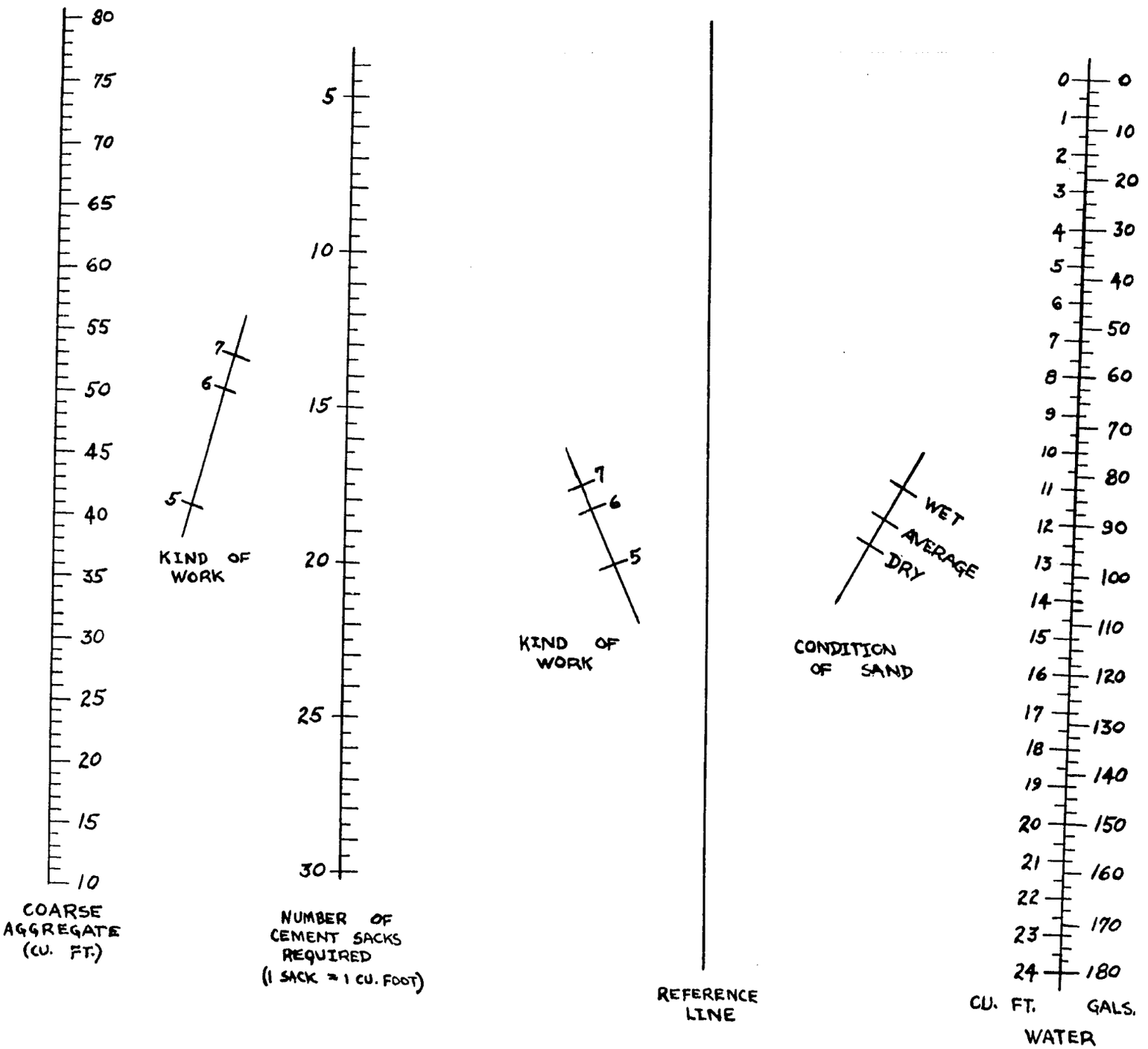


Note- use the number of sacks of cement required, and the kind of work to locate this point on the reference line. A line through this point and the condition of sand will give the amount of water needed.

CALCULATOR



DESIGNED BY JOHN BICKFORD FOR VOLUNTEERS FOR INTERNATIONAL TECHNICAL ASSISTANCE INC. 9/28/62

HAND MIXING CONCRETE

ABSTRACT

Proper mixing of ingredients is necessary to get the highest strength concrete. Hand mixed concrete made with these tools and directions can be as strong as machine mixed concrete.

TOOLS AND MATERIALS

Lumber - 2 pieces
6' x 3' x 2"
Galvanized sheet metal - 6' x 3'
Nails
Saw, Hammer - -
Or concrete for making a mixing floor.
(About 10 cubic feet of concrete are needed for an 8' diameter mixing floor made 2" thick with 4" high rim.)

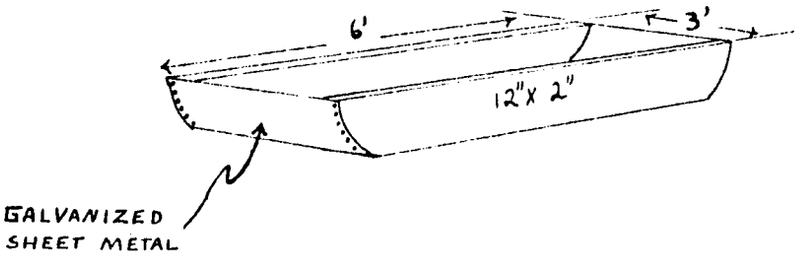


FIG. 1

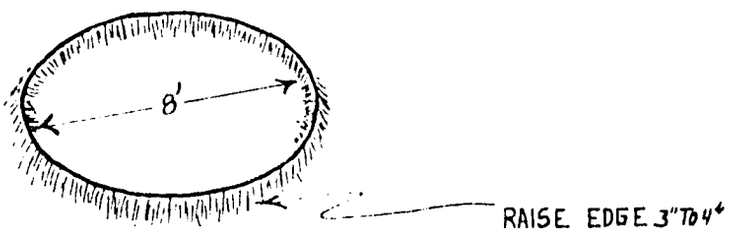


FIG. 2

DETAILS

On many self-help projects the amount of concrete needed may be small or it may be difficult to obtain a mechanical mixer. Under these circumstances hand mixing of the concrete will be necessary and, if a few precautions are taken, the quality of concrete can be made equivalent to that from a mechanical mixer.

The first requirement is a watertight and clean base upon which the mixing can be done. This can be a wood and metal mixing boat (Figure 1) or a simple round floor made of concrete (Figure 2).

The ends of the wood and metal mixing boat are curved to make emptying easier. The raised edge of the concrete mixing floor serves to prevent loss of water from the concrete.

The procedure for mixing is similar to that for mechanical mixers in that the dry materials should be mixed first. As a minimum it is recommended that the pile of stone, sand, and cement be turned completely once. It should be completely turned a second time while the water is being added. Then it should be turned a third time. Anything less than this will not adequately mix all materials. When this last step is completed the mix can be placed as usual.

Correctly placing the fresh concrete in the forms or shuttering is important in making strong structures. The wet concrete mix should not be handled roughly either in carrying to the shuttering or putting into the shuttering. In either case it is very easy, through joggling or throwing, to separate the fine from the coarse material. We have said before that the strongest concrete comes when the various sizes of aggregate and cement are well mixed together . The concrete mix should be firmly tamped into place with a thin (3/4") iron rod.

Be sure to rinse concrete from the mixing boat and tools when finished each day with the work. This will prevent rusting and caking of cement on them for smooth shiney tool and boat surfaces make mixing surprisingly easier, and the tools will last much longer. Also try to keep wet concrete off your skin, for the material is somewhat caustic.

When the shuttering is full the hard work is done, but the process is not finished. The shuttering must be removed and the concrete protected until adequate strength is attained. The hardening action of cement begins almost immediately after the water is added, but the action may not be fully completed for several years.

Concrete reaches the strength used in the designing after 28 days and is strong enough for light loading after 7 days. In most cases the shuttering can be removed from standing structures such as bridges or walls after 4 to 5 days. In small ground supported structures such as street drains it is possible to remove the shuttering within 6 hours of completion provided this is done carefully. Special conditions, usually specified on the plans, may require leaving the shuttering in place for a much longer time.

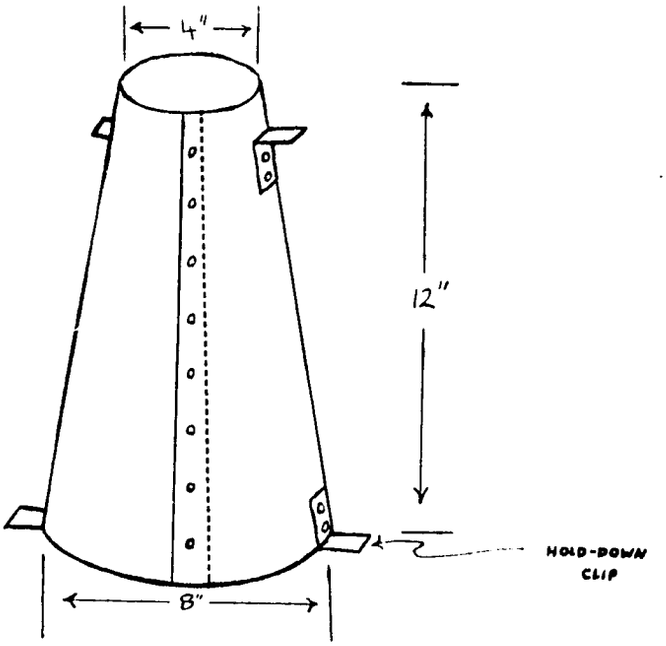
During the early stages of hardening or curing the cement in the concrete continues to need moisture. If there is insufficient water available the cement is unable to complete its job of gluing the aggregate together. Because of this, it is recommended that new concrete be protected from drying winds and the sun, and that the surface of the new concrete be kept damp. For cement floors or open construction a covering of banana or palm leaves will be adequate, but these should be given a sprinkling of water at least once and perhaps twice each day for a period of not less than one week.

Material From - "A Building Guide for Self-Help Projects," Department of Social Welfare and Community Development, Accra, Ghana.

CONCRETE SLUMP CONE

ABSTRACT

The use of this simple device will enable you to determine if the proper amount of water has been added to the mix, which will insure maximum strength in the finished concrete.



TOOLS AND MATERIALS

Heavy galvanized iron
Strap iron - 4 pieces 1/8" x 3" x 1"
16 iron rivets 1/8" diameter x 1/4" long
Wooden dowel 24" long, 5/8" diameter

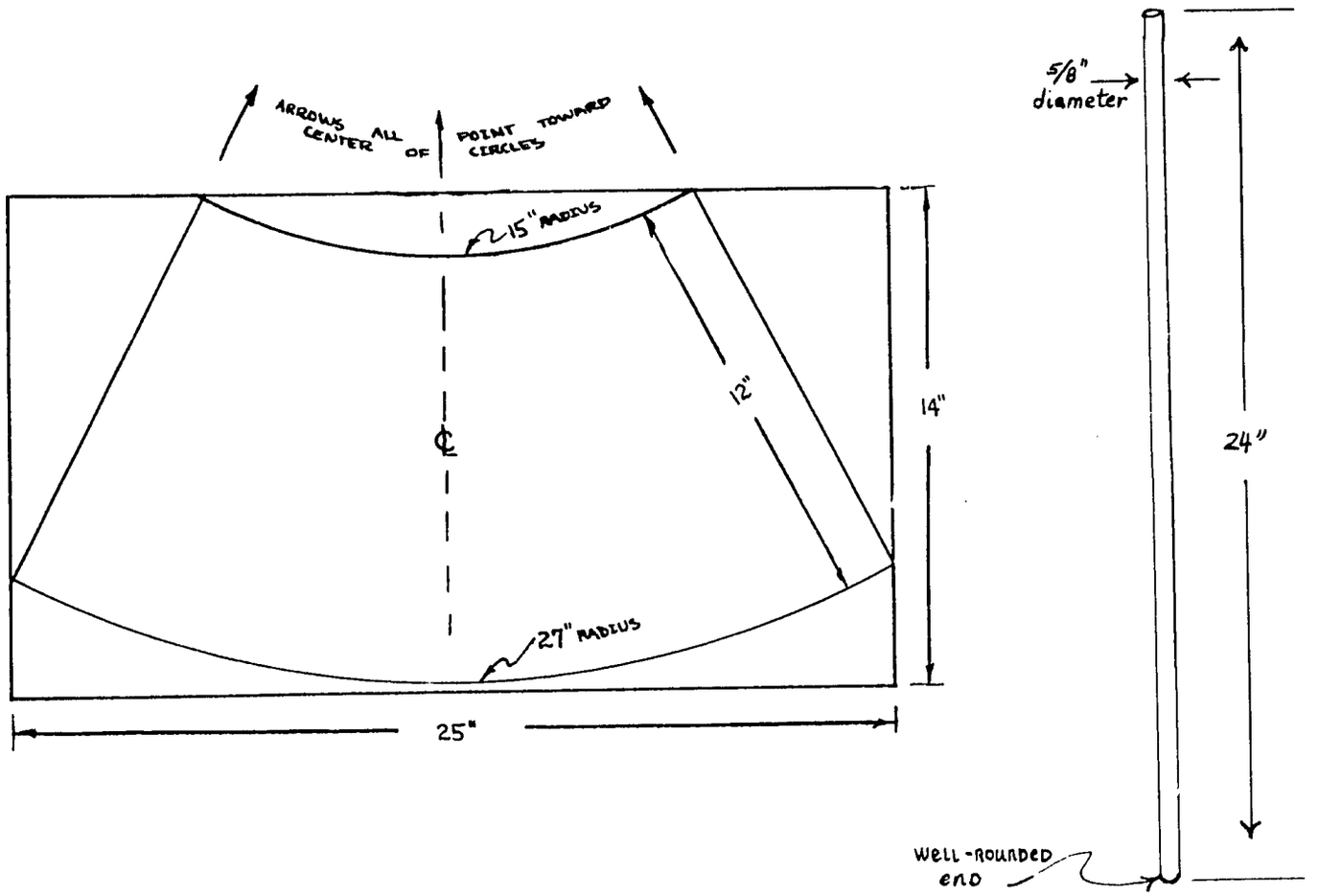
DETAILS

In making reinforced concrete, it is important to have just enough water to make the concrete settle firmly into the shuttering (forms) and around the reinforcing when it is thoroughly tamped.

The easiest way is to look at the mix and at the way the workmen place the wet concrete. If the mix appears soupy and the aggregate shows up clearly in the mix, then it is too wet. At the same time it will be noticed that the workmen dump the mix into the shuttering and do very little tamping because, if they do any amount of tamping, large amount of water will immediately appear on the surface. The workmen will soon complain if the mix is too dry.

A more accurate method of making a decision on the proper amount of water is to use the slump test. This test requires a small cone made of fairly strong metal and open at both ends. Dimensions of the cone and tamping rod are shown in the sketch. Once this simple equipment is available the slump test becomes very easy. The steps to follow are listed below.

1. Set the slump cone on a smooth clean surface and stand on the hold-down clips at the bottom of the cone.
2. Have someone fill the cone to 1/4 of its height and tamp this layer 25 times.
3. Fill the cone to 1/2 its height and tamp this layer 25 times. Avoid tamping the first layer again.
4. Fill the cone to 3/4 its height and tamp 25 times. Avoid tamping the previous layers.
5. Complete filling of the cone and tamp this layer 25 times.
6. Step off the hold-down clips and lift the cone vertically and very carefully off the concrete.



Since this process will have taken only a few minutes the concrete will still be very soft when the cone is removed and the top will fall to some extent while the sides bulge out. This is called the slump. Obviously, if the mix is too wet the concrete will lose its shape completely and become just a soft pile. A good mix, as far as the water-cement ratio is concerned, will slump about 3" to 4" when the cone form is removed. It is well to keep in mind that dirty or muddy water can cause as much trouble as aggregate with excessive fine materials. Use clean or settled water.

EVALUATION

The slump test is a standard test for evaluating wet concrete. This particular cone and rod has been recommended for village construction projects in Ghana.

Material From - "A Building Guide for Self Help Projects" Department of Social Welfare and Community Development Accra, Ghana; received through the Near East Foundation.

QUICK SETTING CEMENT

ABSTRACT

Using calcium chloride as an additive in making concrete results in a faster setting product with high initial strength.

TOOLS AND MATERIALS

Ingredients for regular concrete (any Portland cement), and measured amount of calcium chloride.

DETAILS

In some applications a quick setting concrete is very useful. Situations arise when many repeated castings are desired from the same form or mold. Using an accelerator allows parts to be cast about twice as fast as without it.

However, the mixed batch must be put into the forms faster since the concrete setsup sooner. In general, the batches are small for these applications so that fast setting up is no particular trouble. Moreover, the accelerator does not impair the ultimate strength of the concrete.

The accelerator is best added by mixing one pound clean calcium chloride in each quart of water (1/2 kilogram for each litre) and then using this solution as part of the water used in the concrete mix. Use the solution at a ratio of 2 quarts (2 litres) for each bag of cement (94 lbs. or 43 kg.). Mix the concrete in the usual way.

EVALUATION

This is the method recommended by the Portland Cement Association to accelerate the curing of concrete.

Material From - DESIGN AND CONTROL OF CONCRETE MIXTURES, Portland Cement Association, 33 West Grand Avenue, Chicago 10, Illinois.

HOME IMPROVEMENT

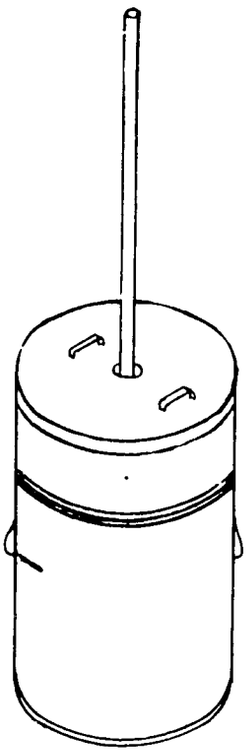
HAND WASHING MACHINE

ABSTRACT

This hand washer is simple to construct and simplifies washing considerably.

TOOLS AND MATERIALS

Tinsnips
Pliers
Hammer
Soldering equipment
Galvanized iron sheeting: 140 cm x 70 cm for tub
100 cm x 50 cm for lid and bottom
36 cm x 18 cm for agitator
Wooden handle - 4 cm diameter, 140 long



DETAILS

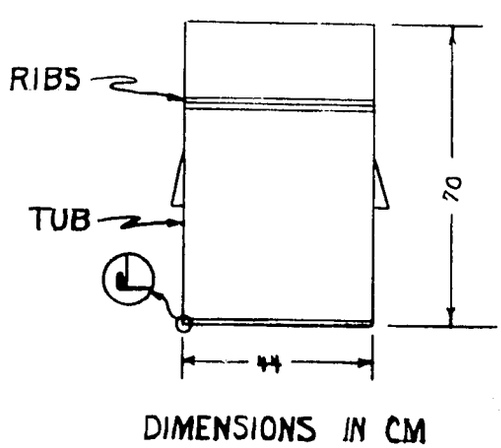
The tub, lid and agitator are made of the heaviest galvanized tin available which can be worked by a tinsmith.

To operate the washing machine the agitator is worked up and down with a quick motion but with a slight pause between strokes. The movement of the water caused by the agitator will continue for a few seconds before additional agitation is needed. On the upward stroke the agitator should come completely out of the water. The agitator should not hit the bottom of the tub on the downward stroke as this would damage both the tub and the clothes.

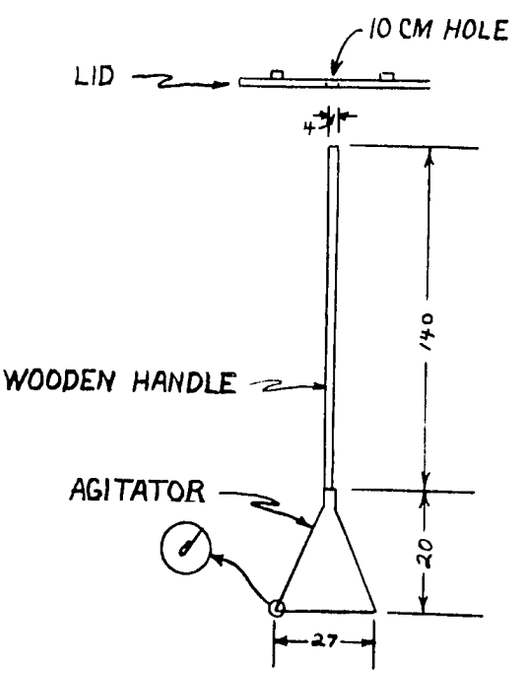
EVALUATION

Has been used successfully in Afghanistan.

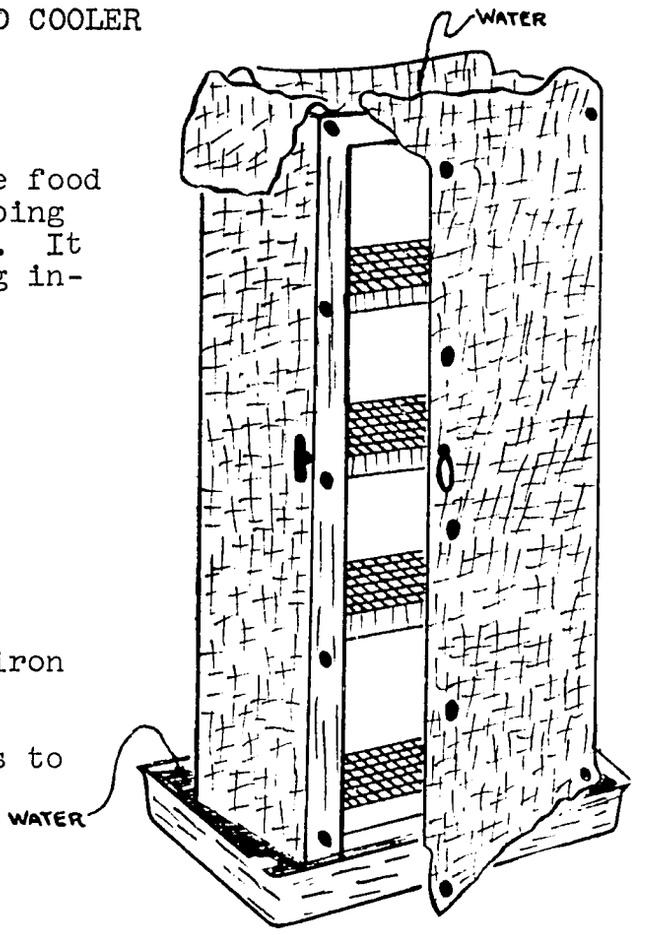
Material From - Dale Fritz, The Asia Foundation



DIMENSIONS IN CM



EVAPORATIVE FOOD COOLER



ABSTRACT

In warm, dry climates an evaporative food cooler will extend the period for keeping food fresh and allow saving leftovers. It also helps to keep crawling and flying insects away from food.

TOOLS AND MATERIALS

Saw
Hammer
Nails, tacks
Burlap or other cloth 2 m. x 2 m.
Wood for frame 3 cm x 3 cm x 13 m.
Pan 10 cm deep, 24 x 30 cm for top.
Screen, hardware cloth or galvanized iron 2 m. x 2 m. (non-rusting)
2 pair hinges
Pan larger than 30 cm x 36 cm for legs to stand in
Paint for wooden parts

DETAILS

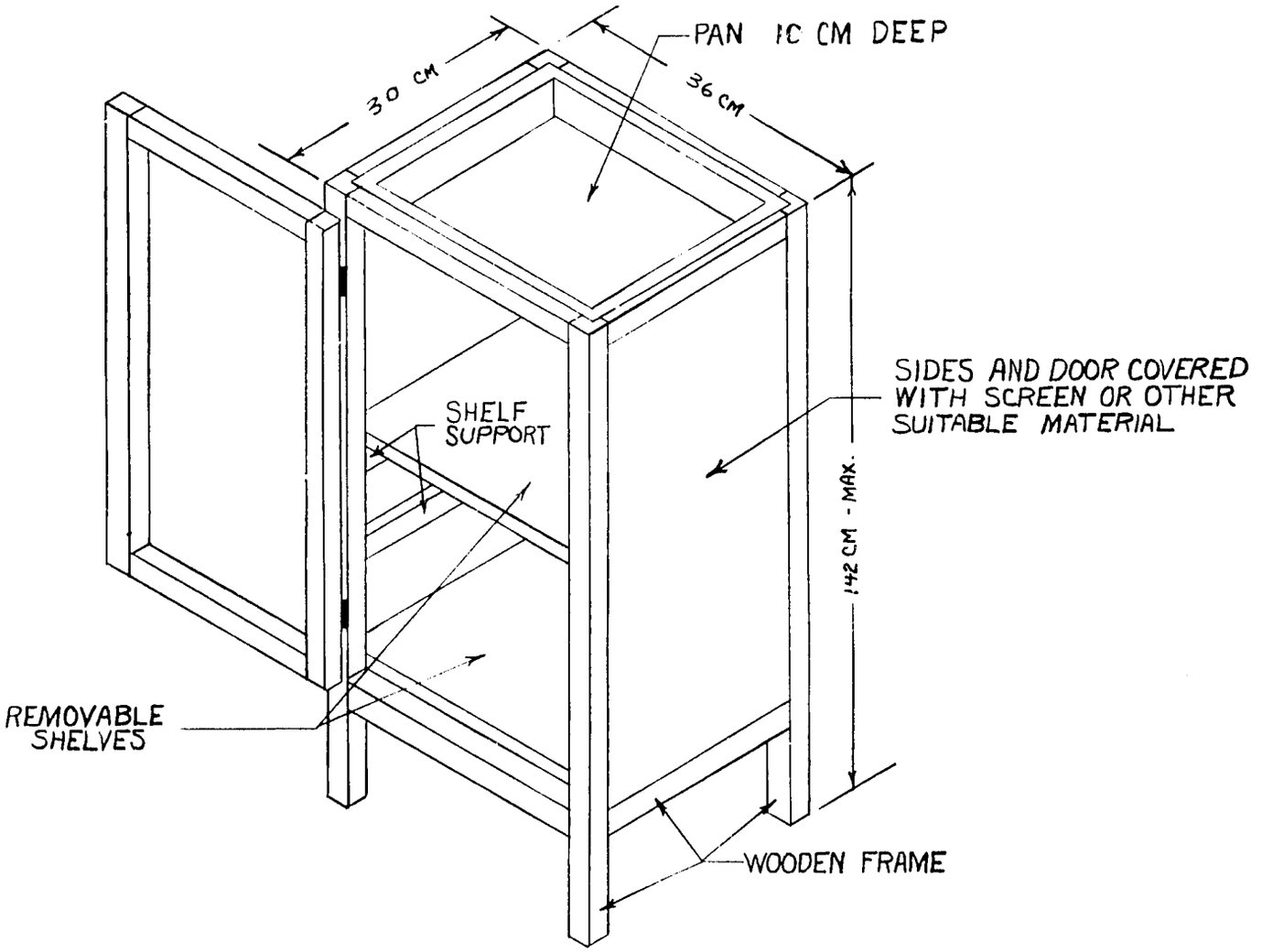
Make the wooden frame to fit the upper pan. This might be the bottom of a discarded 5 gallon oil can. Screen and bracing sticks on the inside top of the frame prevent the pan from falling into the refrigerator. Hinge the door carefully so it swings easily, and make a simple wooden or thong latch. Paint or oil all the wooden parts. Shelves and frame are covered with screening or hardware cloth and tacked in place. Cutting this screen diagonally uses a bit more material, but will strengthen the frame considerably. Make the shelves adjustable by providing several shelf supports.

Two covers of canton flannel, jute burlap (not sisal or henequin burlap) or heavy grade absorbent coarse cloth are made to fit the frame. Wash and sun one cover while using the other. Button or lace the cover to the frame, with the smooth side out. On the front, fasten the cover to the door instead of the frame. Allow a wide hem to overlap the door closing. The bottom of the cover should extend down into the lower pan. Strips 20 cm wide should be sewed to the top of the cover. These form wicks that dip over into the upper pan. Keep both the upper and lower pans filled with water.

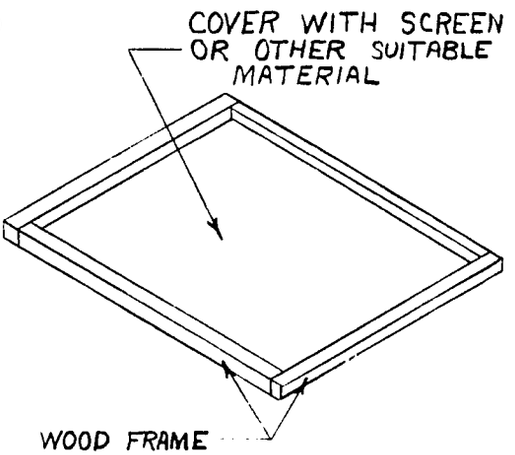
EVALUATION

If the cooler is kept in a breezy spot in the shade, and the climate is dry, it will cool food considerably. The cover keeps flying

insects out, while the lower pan discourages roaches and other crawling types. To be safe, the cooler must be kept clean.



FRAME OF ICELESS REFRIGERATOR



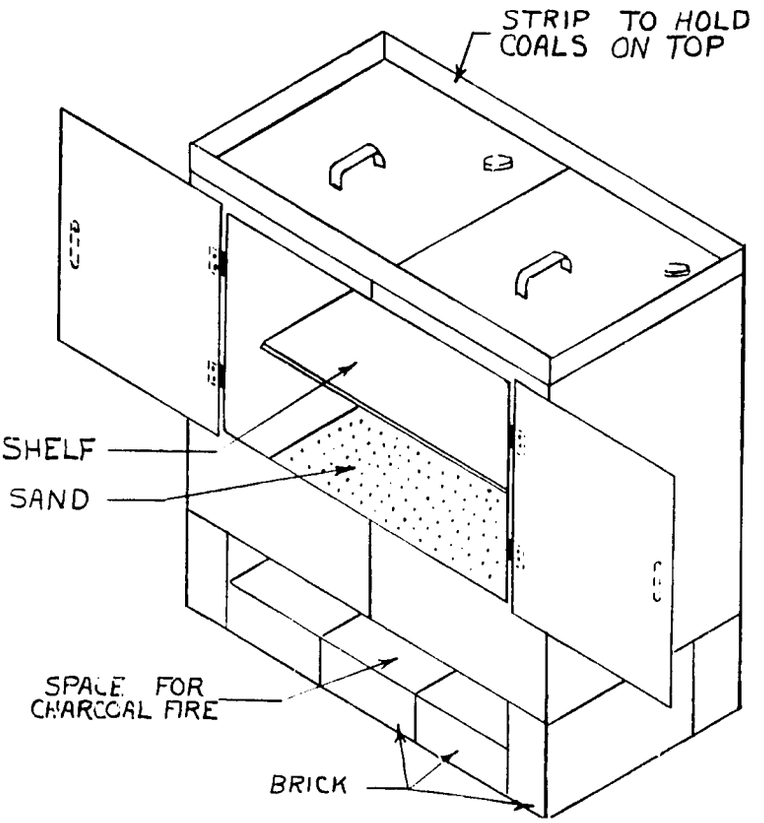
SHELF

Material From - A.I.D. publications

CHARCOAL OVEN

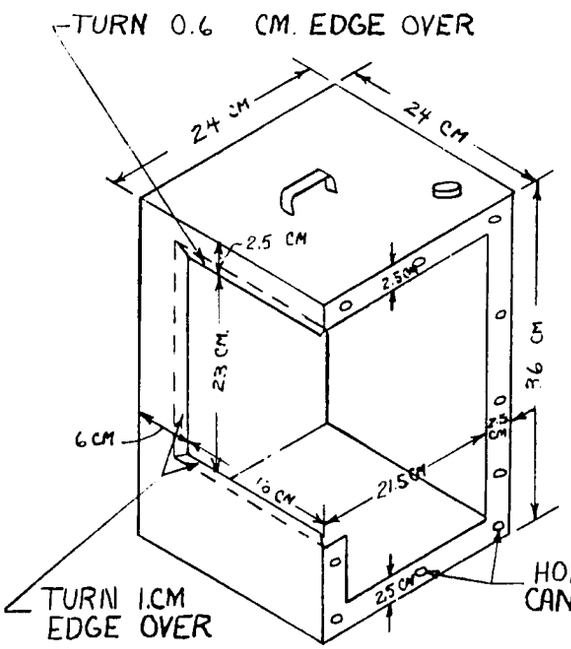
ABSTRACT

This simple charcoal-fired oven is made from two discarded 5 gallon oil tin cans. With practice, all types of baking can be expertly done.



TOOLS AND MATERIALS

Nail for scriber and punch
Tinsnips
Heavy knife to start cuts
Hammer
Screwdriver
Pliers
Metal bar 20 cm long with square corner for bending
Two 5 gallon oil cans
Tin cans to provide shelf material
Light rod 50 cm long, 5 to 7 mm diameter
Two pairs of light hinges
12 machine bolts, nuts, lockwashers, size 8-32 or soft rivets
Bricks for base
Sand



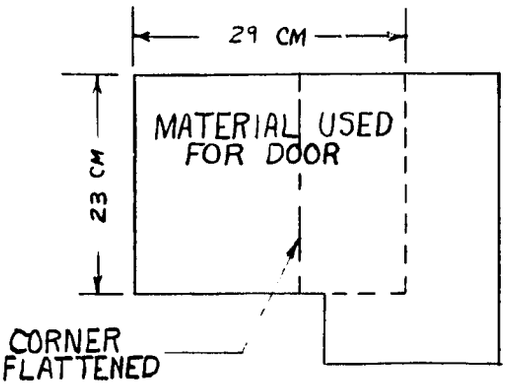
NOTE: OTHER CAN IS CUT REVERSE OF THE ABOVE CAN.

DETAILS

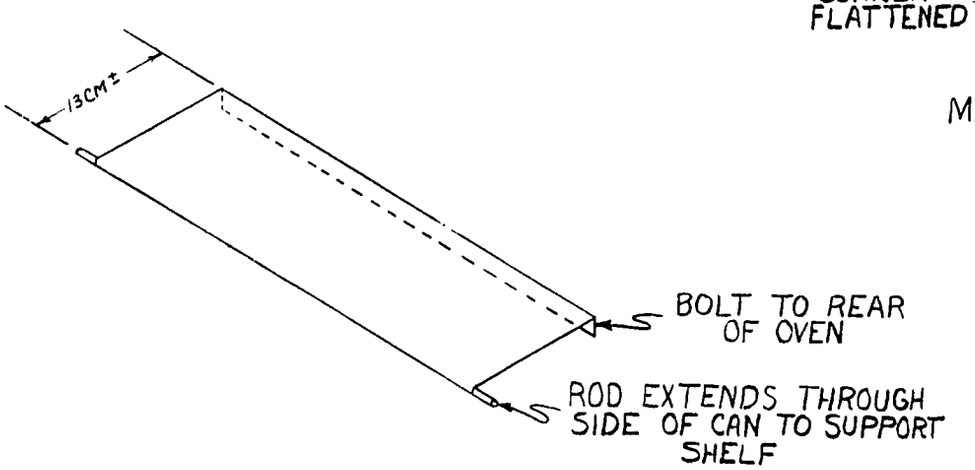
Cut the material from the side of the oven with care so as to preserve the material removed for making the door. Don't cut out the corner with a vertical seam; it is to hard to do, weakens the oven, and the revoved material is hard to make into the doors. Fold the edges of the door and door opening back (1 cm wide) and hammer flat to remove sharp edges. The latch can be made of three thicknesses of metal scraps left over. Clean the oven thoroughly and heat at least once before baking to burn out any residual oil. The strip around the top forms a rim to contain burning coals, to make the oven hotter, or to brown the surface of baked goods.

EVALUATION

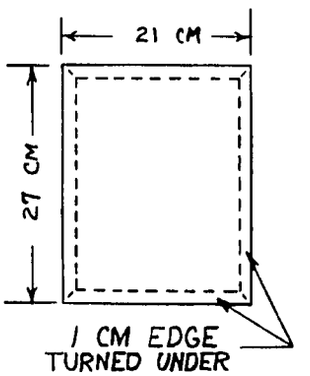
This oven is being used successfully in a number of countries. Baking and roasting are quite effectively done with this simple and inexpensive appliance. Any recipes which involve these processes may be used.



MATERIAL CUT FROM CAN



SHELF



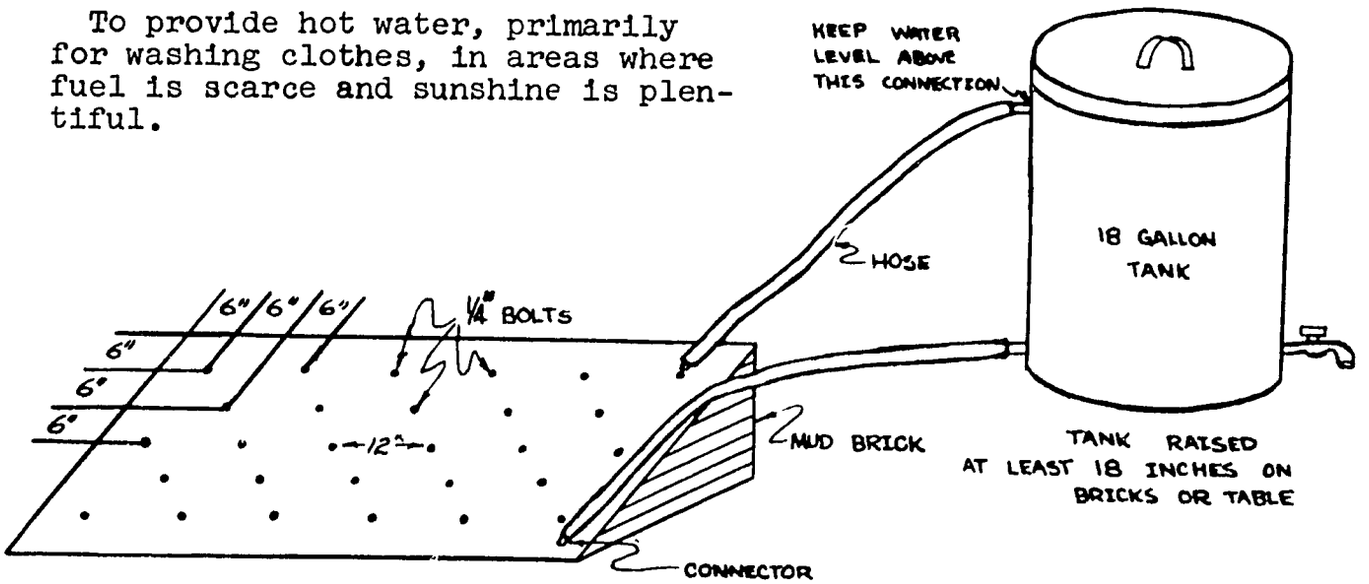
DOOR

Material From - V. C. Pettit, I.C.A.-AID

SOLAR WATER HEATER

ABSTRACT

To provide hot water, primarily for washing clothes, in areas where fuel is scarce and sunshine is plentiful.



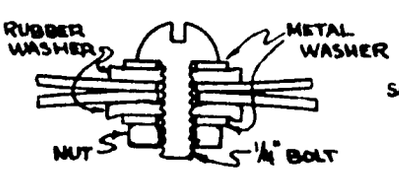
TOOLS AND MATERIALS

2 pieces galvanized sheet metal, 3' by 6' for heater.
2 pieces galvanized sheet metal pipe, 6" long by 1" in diameter for connectors.
2 pieces rubber hose, 4' long by 1" in diameter.
56 metal washers for 1/4" bolts.
56 rubber washers cut from heavy truck inner tube. Inside hole diameter should be 1/8", outside diameter same as metal washers.
28 stove bolts, galvanized, 1/4" long.
1 galvanized sheet metal tank, 18 gallon capacity with faucet, removable lid, 1" hose connectors near the top and bottom.
Tinsmith's tools: hammers, anvils, soldering equipment, etc.
Drill and 1/4" bit.
Screw driver and wrench to fit 1/4" bolts or a pair of pliers.
Quantity of mud bricks.

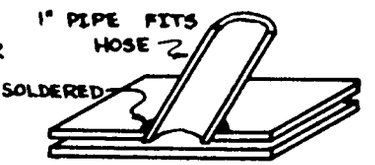
DETAILS

The heater is made by placing the two sheets of galvanized sheet metal together in the form of an envelope. The edges of the sheets are double folded and soldered to make an air tight seal. (See detail below.) To prevent the sheets from being forced apart when the heater is filled with water, it is necessary to reinforce it

EDGE FOLD



BOLT AND WASHERS



CONNECTOR

with 1/4" bolts placed at regular intervals, like buttons in a mattress. To make the bolts water-tight they must have rubber and metal washers on both sides. (See detail on page 153.)

Inlet and outlet connections are provided in the upper and lower right hand corners of the heater for connection to the tank. The front of the heater is painted black to absorb the sunlight rather than reflect it. A flat black paint is better than an enamel.

The tank does not have to be of any definite shape but should hold approximately 18 gallons of water. The hot water will rise to the top and, with the removable lid, it is possible to dip out the hottest water when only a small quantity is needed. When all of the water is to be used it may be drained out of the faucet. The water level must be maintained above the upper hose connection.

When the solar water heater is set up, the heater should be facing southeast to take advantage of the morning sun. The back of the heater should be raised about 18" so the sunlight will strike it as directly as possible. A simple way to raise the heater is to build up the back and sloping sides with mud bricks. Use three small boards (2" by 4") to prop up the back while putting the mud bricks in place. Then, remove the boards and seal any holes with mud to form a dead air space under the heater which will serve as insulation and increase the efficiency.

The heater is connected to the tank in such a way as to allow the water to circulate as it is heated. The upper connectors of the tank and heater are connected with one hose and the lower connectors with the other. The tank is raised approximately 18", using a small table or a brick platform, so the coolest water will be in the heater. As the water in the heater is warmed, it rises and flows out the upper hose into the top of the tank. Cool water from the bottom of the tank enters the heater at the bottom. Insulating the tank will increase the efficiency of the solar water heater by cutting down the heat losses. Any suitable local material may be used, such as straw or sawdust.

EVALUATION

The solar water heater described here was made and tested in Kabul, Afghanistan, for the purpose of providing hot water for use in the hand operated washing machine. Three sizes were made and tested: 2 1/2' x 4 1/2', 3' x 6', and 3' x 8' which are the sizes of sheet metal available in Kabul. The 3' x 6' heater with an 18 gallon tank was most suitable from the standpoint of cost and water requirement. In Kabul, where there is lots of sunshine, the 18 gallons of water were heated to 140° F. between sunup and noon on a clear summer day.

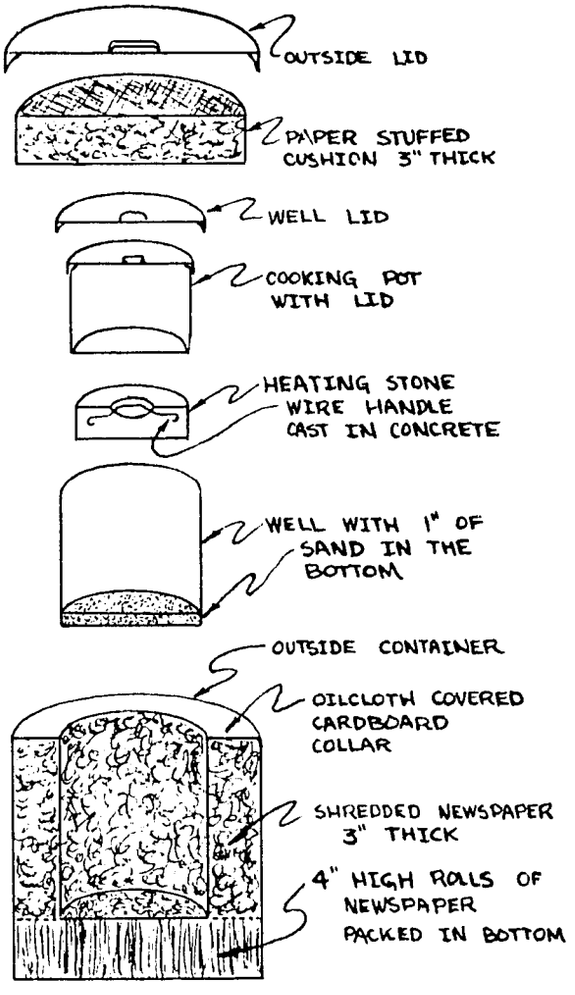
The cost of the solar water heater was $15.00 at prices paid for material and labor in Kabul during the summer of 1961.

Material From - Dale B. Fritz, The Asia Foundation

FIRELESS COOKER

ABSTRACT

In some places where fuel is scarce, this easy-to-build fireless cooker can be a real contribution to better cooking. It works by heat retention through insulation.



TOOLS AND MATERIALS

Outside container with lid -
(15" to 24" in diameter)
Inside container or well -
at least 6" smaller in diameter and 6" shorter than outside container
Cooking pot with lid
1 1/2 yards cloth for cushion
50 sheets newspaper or other insulation.
Cardboard
6 cups sand
4 cups cement
1/2 yard oilcloth for collar (optional)

DETAILS

The principle of the fireless cooker is to keep food cooking with the small amount of heat stored in hot stones by preventing heat loss with a thick layer of insulating material around the pot.

The outside container can be a wooden bucket, kerosene can, garbage can, packing crate or even a hole in dry ground. The inside container or well can be a pail or can with a lid. It must allow for the three inches of insulation between it and the outside container and should hold the stone and cooking pot without much vacant space.

Insulation can be made of shredded newspapers, wool, cotton, sawdust, straw, rockwool, fiberglass or other material. The insulation should be at least three inches thick on all sides, top and bottom. Be sure that it is very dry. The bottom layer of insulation must be strong enough to support the weight of the well, stone, and cooking pot. A natural stone carved to shape or a piece of concrete may be used for the heating stone. The cushion is a three-inch-thick cloth sack filled with shredded newspapers or other insulation and should fit snugly in the outside container. The cooking pot must have a tight lid, and fit nicely into the well with the stone in place. Be sure it can be easily removed when full of hot food.

Direction for building -

Wash and dry the containers and lids.

Cut 4" wide strips of newspaper several layers thick. Roll each into a cylinder with a center hole no greater in diameter than a pencil. Pack these on end into the bottom of the outside container. They will support the well, stone, and cooking pot.

Put the well in place and pack the insulation around it to within 1/2" of the top.

Make a cardboard collar covered with oilcloth. Though this is not necessary, it improves appearance and cleanliness.

Place about an inch of clean sand in the bottom of the well. This will prevent the hot stone from scorching the paper rolls and possibly causing a fire. The stone should never be heated not enough to scorch paper.

To make a concrete heating stone, place a 2" wide cardboard band or collar on heavy paper or board to form a circle the size of the stone desired. Mix 4 cups each of cement and sand washed free of silt, then add 1 1/2 cups of water or until a stiff mush is formed. Fill the collar, casting in a wire handle for lifting the hot stone. Let the stone stand for 48 hours, then remove the collar, place it in cold water and boil for 30 minutes. Cool it slowly.

Use of the Cooker -

It is important to keep the cooking pot and well carefully washed and open, in sunshine if possible, when not in use. The cooker's lid should be left partly open and the stone kept clean and dry.

It is not necessary to use much water when cooking in a fireless cooker for there is little loss by evaporation. Most foods should be brought to a boil and cooked for 4 to 5 minutes on a stove. Then, the covered cooking pot is set on the hot stone in the cooker and the lid is placed on the well. Cereal may be left in the cooker all night. Rice and cracked or whole wheat are especially good. Beans should be soaked over night, boiled for 5 minutes and then placed in the cooker for 4 to 5 hours. Dried fruit should be washed, soaked for an hour in 2 parts water to 1 part fruit, boiled for 5 minutes, then placed in the cooker for 4 hours.

EVALUATION

Fireless cookers have been used and found very successful in many countries.

Material From - "Home Making Around the World"
A.I.D. publication.

HAND-OPERATED WASHING MACHINE

ABSTRACT

This easily operated washing machine can be built by a semi-skilled carpenter of materials readily found in most countries. It can wash six pounds of clothes, can be shared by several families, and is easy on clothes while being effective and sanitary.

TOOLS AND MATERIALS

Tub Construction - Moderately firm softwood (such as Cedro of South America) free from large heartwood growth.

2 pieces - 2.5 x 45.7 x 96.5 cm. - sides
1" x 18" x 38"
2 pieces - 2.5 x 30.5 x 40.6 cm. - ends
1" x 12" x 16"
2 pieces - 2.5 x 15.2 x 40.6 cm. - bottom
1" x 6" x 16"
1 piece - 2.5 x 40.6 x 66.0 cm. - bottom
1" x 16" x 26"
4 pieces - 2.5 x 10.2 x 76.2 cm. - legs
1" x 4" x 30"
2 pieces - 2.5 x 25.4 cm. diameter - round plungers
1" x 10" diameter
2 pieces - 3.8 x 12.7 cm. diameter - round plungers
1.5"x 5" diameter
2 pieces - 2.5 x 20.3 x 91.4 cm. - cover (may be omitted)
1" x 8" x 36"
6 pieces - 2.5 x 7.6 x 20.3 cm. - cover (may be omitted)
1" x 3"x 8"

Operating parts - Moderately firm hardwood such as Caoba of South America.

1 piece - 2.5 x 7.6 x 121.9 cm. long - lever
1" x 3" x 48"
2 pieces - 2.9 cm. square 38.1 cm. long-plungers
1 1/8" square 15" long
2 pieces - 2.9 x 7.6 x 61.0 cm. long - uprights
1 1/8" x 3" x 24" long
2 pieces - 3.2 cm. round 45.7 cm. long - pivot and handle
1 1/4" round 18" long

Metal Parts

4 pieces iron or brass plate - .64 x 3.8 x 15.2 cm. long (1/4" x 1 1/2" x 6" long) - plunger connection
10 rods - 3.6 or .79 cm. diameter (1.4" or 5/16" diameter) 45.7 cm. (18") long with threads and nuts on each end - iron or brass.
20 washers about 2.5 cm. (1") diameter with hole to fit rods
1 rod - .64 x 15.2 cm. (1/4" x 6") with loop end for retaining pivot
6 bolts - .64 x 5.1 cm. long (1/4" x 2" long)

24 screws - 4.4 cm. x #10 - flat head (1 3/4" x #10)
50 - 6.35 cm. (2 1/2") nails
Strip Sheet Metal with turned edge - 6.4 cm. wide, 152.4 cm. long (2 1/2" wide, 72" long)
Small quantity of loose cotton or soft vegetable fiber for caulking seams

Minimum Tools Needed

Tape measure or ruler
Hatchet, Saw
Wood chisel 1.3 or 1.9 cm. wide (1/2" or 3/4")
Screw Driver
Adjustable Wrench
0.64 cm. (1/4") drill, gimlet or similar tool
Draw knife or plane and coping saw (would be useful but not essential)

DETAILS

This model of washing machine should be a decided improvement to conserve clothing over methods now in use in many countries. This is especially true where clothes are beaten or scrubbed on rocks. It will also save a considerable amount of labor. If the cost of this machine is too great for one family, it could be used by several. However, too many users will probably mean severe wear or breakage and competition for times of use.

The machine reverses the principle employed in the usual commercial washer, in which the clothes are swished through the water for various degrees of a circle until the water is moving and then reversed. To keep this machine simple, the clothes stay more or less stationary while the water is forced back and forth through the clothes by the piston action of the plungers. One plunger creates a suction as it rises and the other plunger creates a pressure as it moves downward. Since the principle involves the churning action of the water, the slope at the corners of the machine bottom is important for best action.

The machine needs a rectangular tub for this method of operation. The rectangular box also is easy to build and does not require skilled cooperage methods. In general, any moderately strong wood that will not warp excessively (such as cedro in Central America) will be satisfactory. The sides should be grooved for the ends and bottom of the tub as indicated and bolted with threaded rods extending through both sides with washers to permit it to be drawn tight. The through bolting is important, otherwise, leaks are inevitable.

The size indicated on drawings is considered sufficient for an average family in the U.S. The same principle may be used for a larger or smaller machine provided basic proportions are maintained. The tub should be slightly less than half as wide as it is long to get a proper surge of water. The pistons should be wide enough to move within a couple of inches of each side of the tub. The lever pivot should be high enough to permit the plungers to move up and

down several inches without the edge of a lever hitting the edge of the tub. Likewise, rods on the plungers must be long enough to permit plungers to go well into the water so that clothes come completely out of the water at the highest position.

For efficient use of the above washer, several suggestions are made. Fill thewasher with fifteen gallons of warm or hot water depending on what is available. Stains should be removed, soap rubbed into areas of garments which come in close contact with the body, and especially dirty clothes should be soaked before placing them in the washer. Shaved soap may be dissolved by heating it in a small quantity of water before adding it to the wash water. A six-pound load of clothes is recommended for best cleaning. Wash at a moderate speed (about fifty strokes per minute) for at least ten minutes or longer if it seems necessary. After washing and rinsing clothes, rinse the washer until clean and then replace the stopper. To prevent the wood from drying out and the washer leaking, add one to two inches of water to the washer when not in use.

Instructions for making washer

Mark and groove sides for end and bottom members.
Drill holes for cross bolts.
Cut off corners and trim ends of side members to length.
Level ends and bottom pieces to fit into groove in side members.
Miter bottom and end members together.
Assemble and bolt.
Cut and install legs.
Caulk seams between ends and bottom members with loose cotton or other vegetable fiber to make seams watertight. If joints to sidemembers are carefully made, they probably will not need caulking.
Bore hole and make plug for draining tub. NOTE: This is shown on side in drawing but it is better in bottom of tub.
Make and install pivot members (upright).
Make and install plunger lever. NOTE: the cross pivot member (round) should be shouldered or notched at each pivot to prevent side movement.
Make plungers and install.

EVALUATION

A pilot model of the machine was made by the U. S. Department of Agriculture in their shops and tested in the Home Economics Laboratory at Beltsville, Maryland. Under test conditions a comparison with standard electric commercial washers was very favorable.

Material From - HOW TO MAKE A WASHING MACHINE
V. C. Pettit and Dr. K. Holtzclaw,
A.I.D.

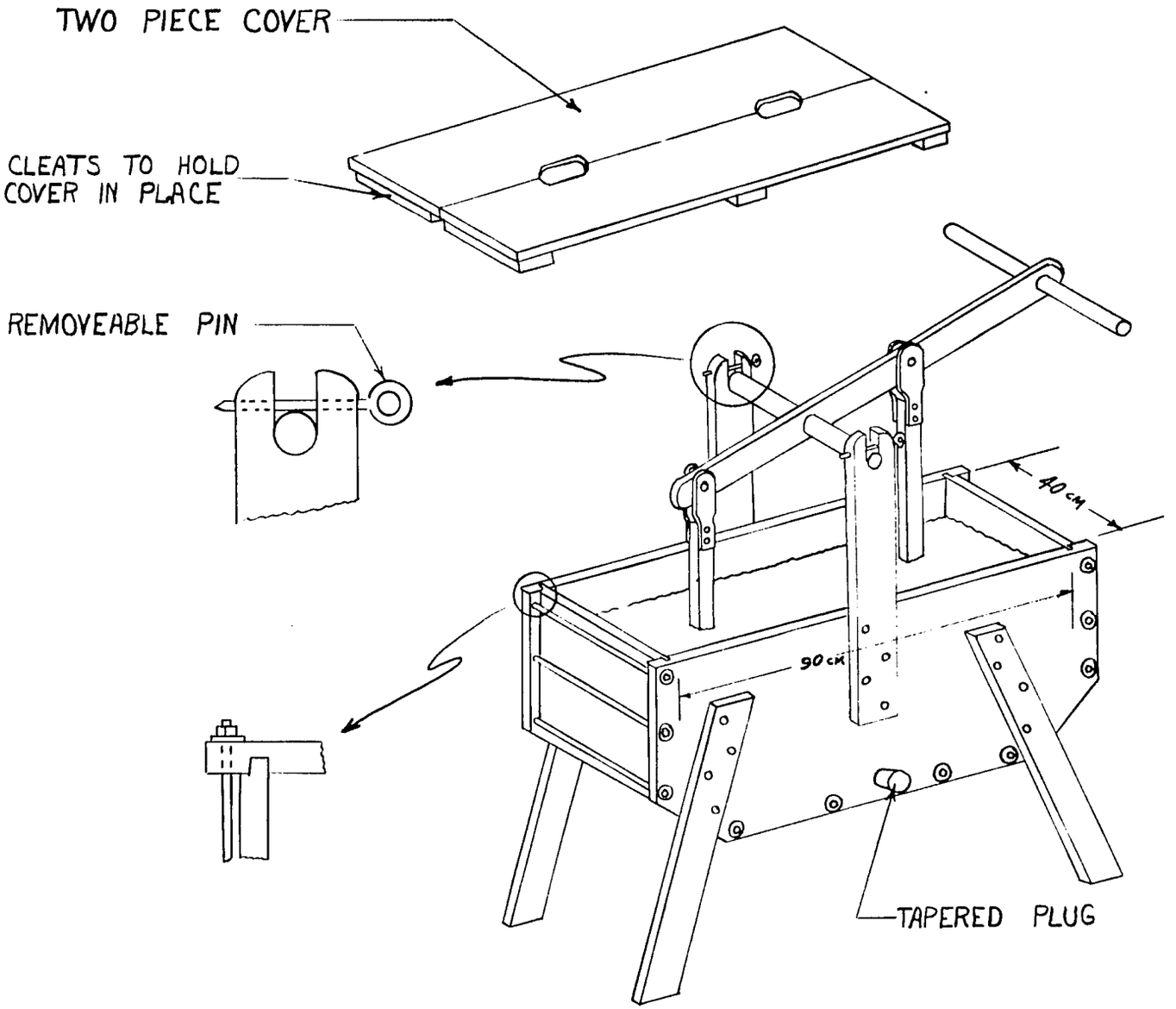
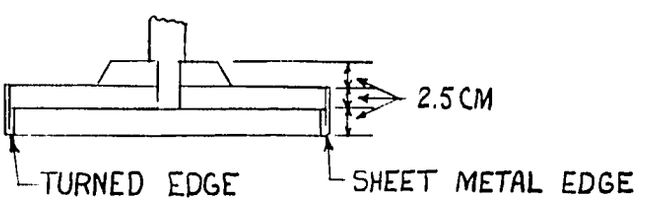
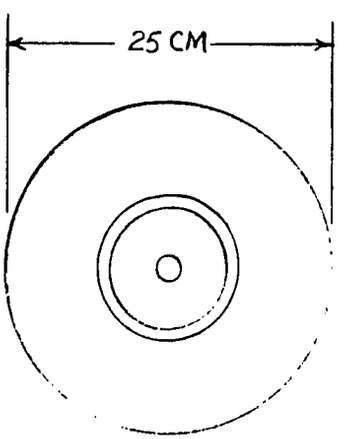


FIG. 1



PLUNGER SECTION



TOP VIEW OF PLUNGER

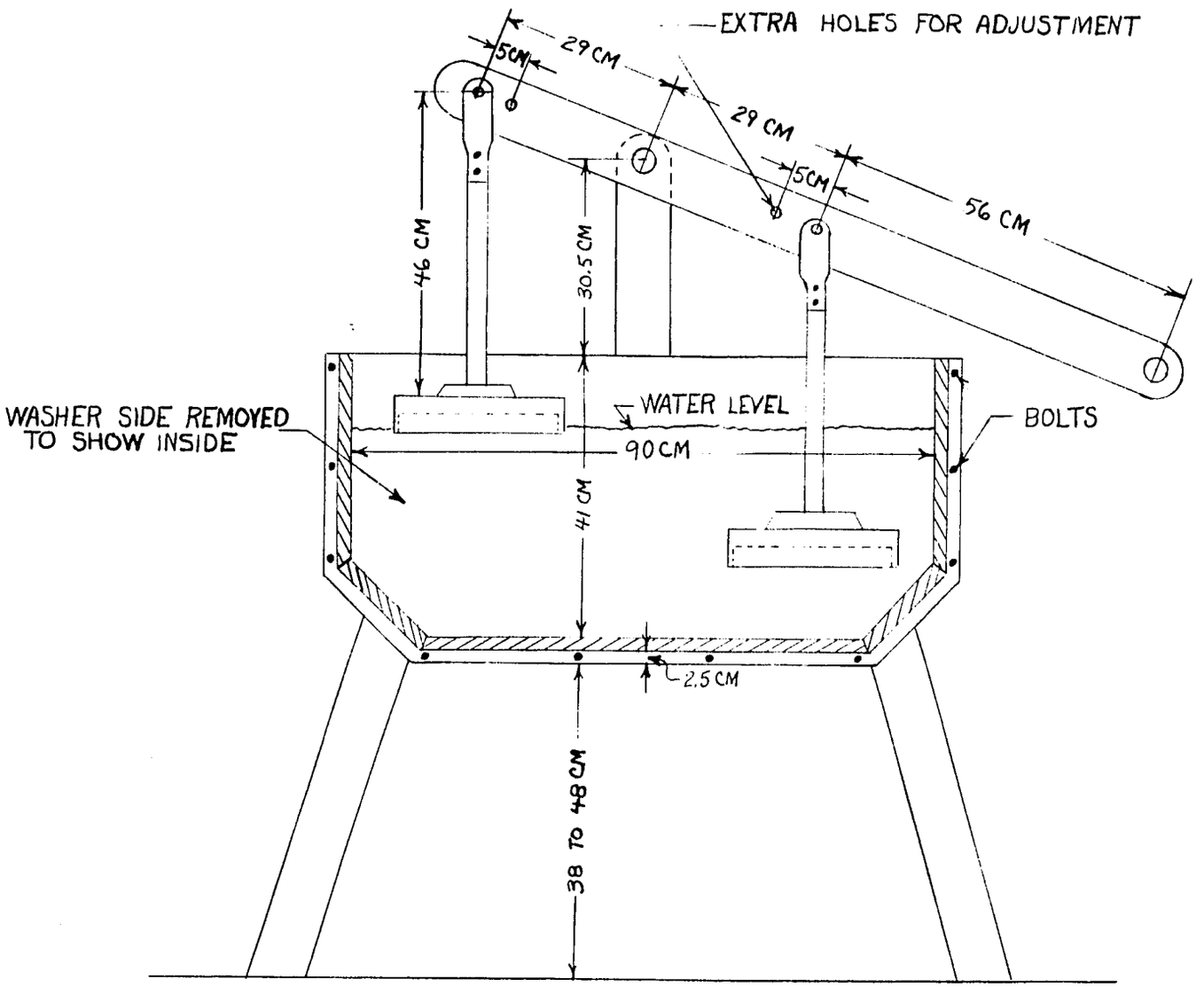

EXTRA HOLES FOR ADJUSTMENT
5CM
29 CM
29 CM
5CM
56 CM
46 CM
30.5 CM
WASHER SIDE REMOVED TO SHOW INSIDE
WATER LEVEL
BOLTS
90 CM
41 CM
2.5 CM
38 TO 48 CM

FIG. 2

EDUCATION AND COMMUNICATION

BAMBOO OR REED WRITING PENS

ABSTRACT

This inexpensive and easily constructed pen has been in use since 3000 B.C. in Jordan. Large block letters to fine writing can be produced by making pens of different sizes.

TOOLS AND MATERIALS

Dry bamboo 15 x 1 x 1/2 cm.
Small rubber band or fine wire
Sharp knife
Fine sandpaper

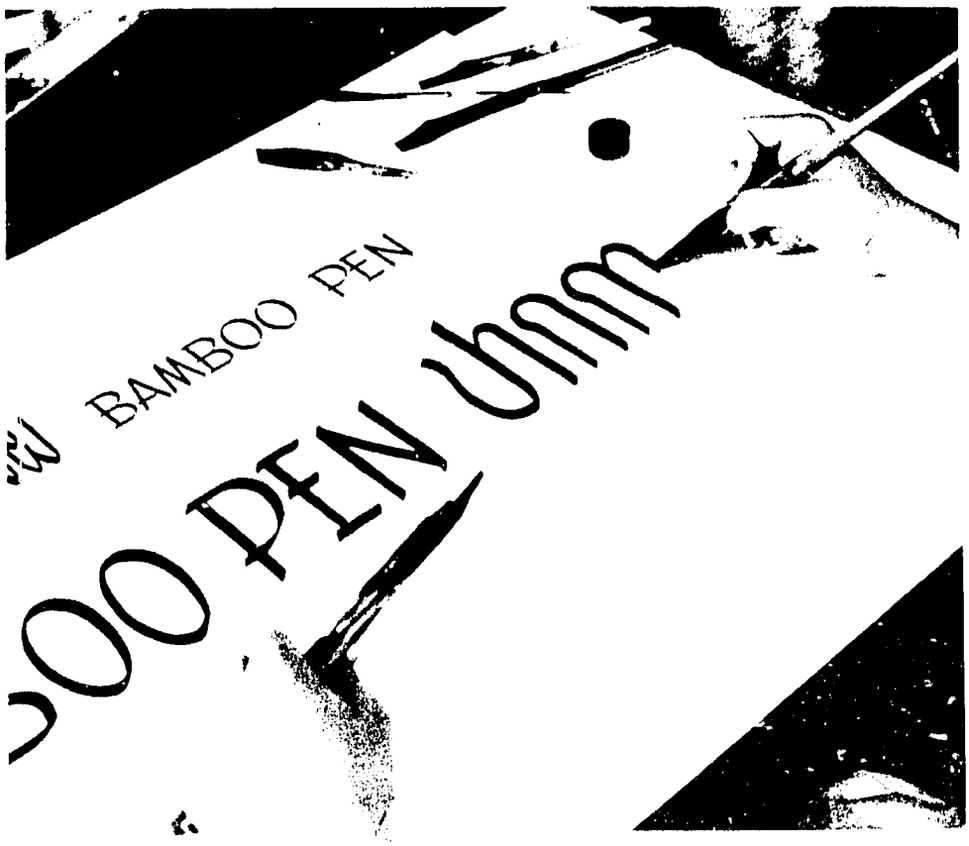


FIG 1

DETAILS

Whittle one end of the bamboo to the desired width, and shave it down to the proper flexibility. (See figure 2) Be sure that the writing tip is made out of the harder and more durable material near the surface of the bamboo.

Cut the end straight across with the sharp knife and smooth with the sandpaper. By gently "writing" with the dry pen on the sandpaper, the point of your pen will be shaped to the proper writing angle for your hand.

Place the tip end of the knife at least 3 mm. from the point of your pen and rotate to drill a hole about 2 mm. in diameter for retaining the ink.

After practicing with a few models, it will be apparent that frequent re-inking is necessary. A two-piece reservoir pen can be constructed as shown in Figure 3. Attach the thin

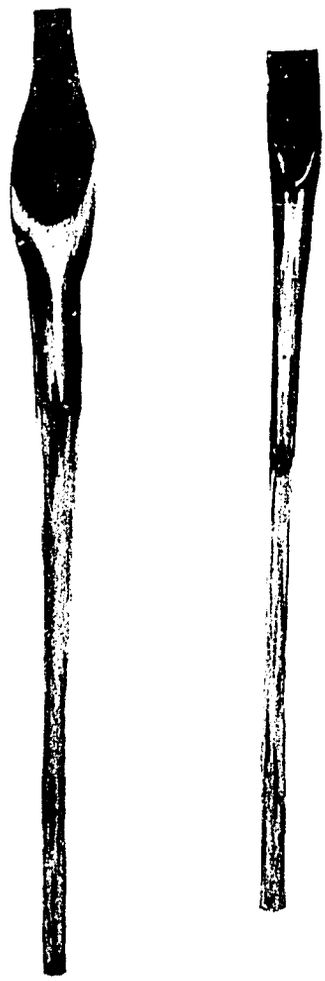


FIG 2

cover plate to the pen by wrapping a small rubber band or fine wire around the notches provided for this purpose.

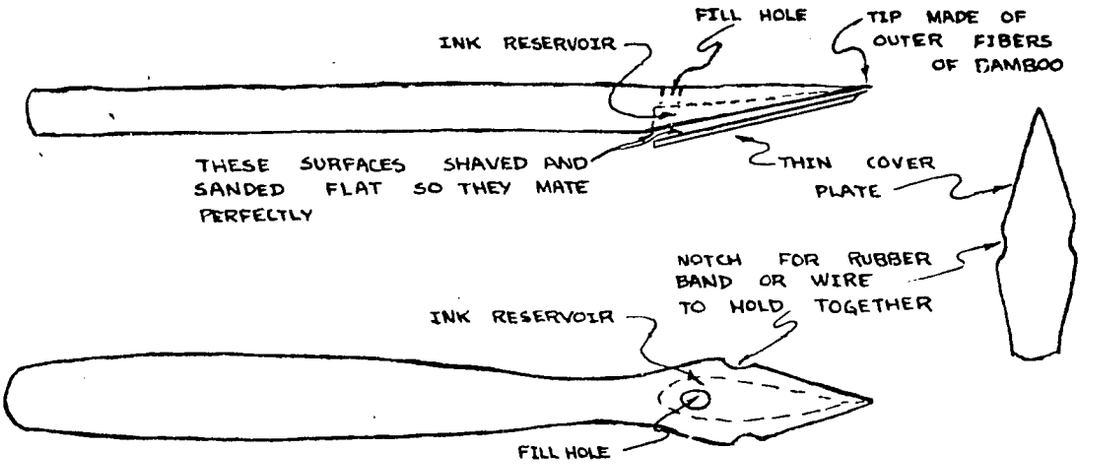


FIG. 3

EVALUATION

These have found use in Thailand and Jordan.

Original Material From - THE MULTIPLIER, Vol. 3 Issue #10, published by the Department of State Agency for International Development.

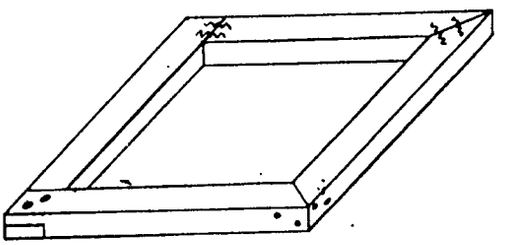
SILK SCREEN PRINTING

ABSTRACT

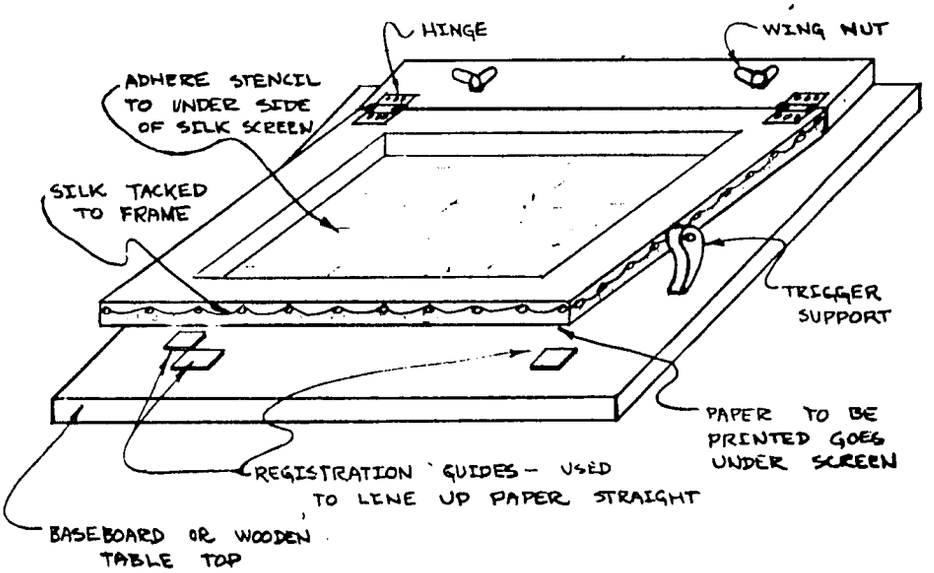
Silk screen printing is a simple and inexpensive method for producing multiple copies of visual aids, posters, etc. A squeegee is used to force very thick paint through the parts of the silk screen exposed by the stencil to the paper placed underneath.

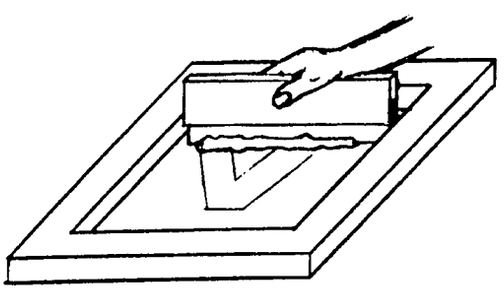
TOOLS AND MATERIALS

Hinges (about 1" x 3")
Wing or regular nuts
Squeegee
Trigger support
Frame
Baseboard or smooth table top
Silk or other sheer cloth
Thumbtacks
Silk screen paint
Paper for copies

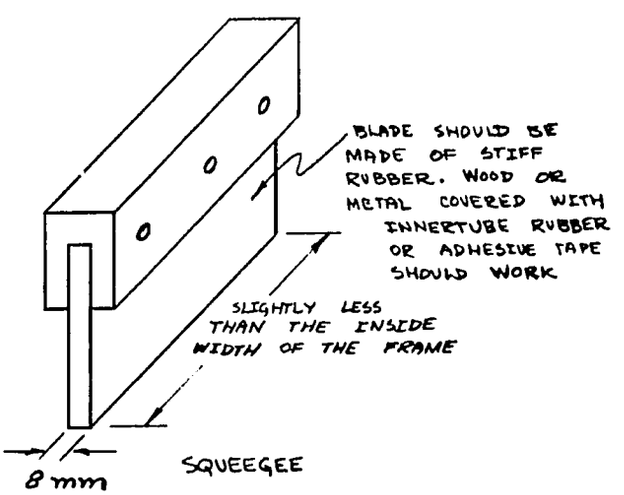


FRAME
SHOWING VARIOUS JOINT CONSTRUCTIONS





SQUEEGEEING PAINT ACROSS SILK



DETAILS

1. Study the drawings, then construct a frame as illustrated using approximately (1.9 x 5 cms.)(3/4" x 2") plywood or other wood. The exact size of the frame is determined by the size of the largest prints to be made. Average inside frame dimensions might be (38.1 cm. x 50.8 cm.)(18" x 24"). Make sure the corners are square and that the frame lies flat against a flat baseboard or table top, which can also be made of 1.9 cm (3/4") plywood.

2. Stretch the silk very tightly over the underside of the frame using tacks or thumb tacks every 1" or 2 cm. Tack either in the center of the underside of the frame or pull the silk over the outside bottom edges and tack around the outside. Make sure that the threads of the fabric are lined up with the frame edges. A few coats of shellac over wooden frame will make it more durable and less apt to warp.

3. Cut stencil and adhere to screen according to instructions.

4. Place the paper cardboard, etc, to be printed under the screen and stencil; draw a couple of spoonfulls of finger paint or other water-soluble paint in a line across the edge of the silk just inside one end of the frame.
(Oil soluble paints work well, but require a solvent cleanup; also, the viscosity of the paint should be like auto transmission grease, not thin enough to fall through the screen of its own accord.)

5. Pull the paint across the silk surface using an edge of the squeegee blade. This squeezes the paint through all the open areas of the paper stencil. Lift screen. Remove print and replace with next piece to be printed. Pull paint back the other way for the next print. The desired technique is to place an amount of paint on the screen which, together with the right blade pressure, will produce an acceptable print with one stroke of the squeegee.
Make certain that dried paint particles do not get in the paint as they could damage the screen.

6. If more than one color is to be printed, registration becomes an important feature and can be achieved by the following method:

(a) Print the first color using registration guides. Registration guides can be made of thin cardboard or several layers of tape. (Thicker guides can cause silk to break when squeegee blade presses the silk against the guides.)

(b) A piece of wax or thin translucent paper is taped on one edge to the baseboard beneath the second screen to be printed.

(c) Print a trial image of the second screen onto this paper.

(d) Raise the screen.

(e) Slide the sample of the first printing into position beneath the taped wax paper until the desired registration with the first printing is achieved.

(f) Once registered carefully hold the first printing sample in position, and remove the wax paper.

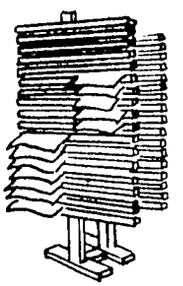
(g) Tape new registration guides on three sides of the first printing sample.

(h) Now proceed to print the second color. Subsequent colors are printed by returning to Step (b).

7. Several colors can be printed over one another if transparent paints are used. The size of the printed area can be restricted by using paper masks.

8. Pull off stencil. Clean wet paint out of silk and frame by unscrewing wing bolts, taking the frame to a convenient wash area and holding under running water.

9. Optional: A drying rack pictured here is helpful when many prints are to be dried.



DRYING RACK MADE WITH 2" x 2" UPRIGHTS WITH 1" x 1" CROSS BARS ABOUT AN INCH APART

Material From - John Tomlinson, VITA Participant