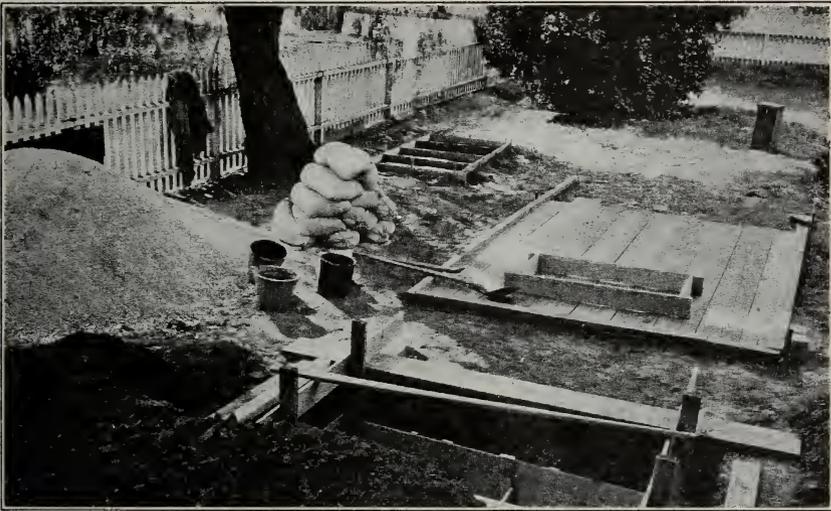


UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

CIRCULAR 270
SEPTEMBER, 1923
(Revised May, 1927)
(Reprinted October, 1929)

A FARM SEPTIC TANK

W. B. HERMS AND H. L. BELTON



Forms in place and materials ready for the pouring of the concrete.

THE FUNCTION OF THE SEPTIC TANK

The septic tank is an unventilated, watertight compartment into which all raw sewage from the household is discharged in order that the more solid materials may be liquified, largely deodorized, and rendered less dangerous preparatory to final disposition. It is not a so-called cesspool, neither is it a panacea for all sewage-disposal ills. It should not be relied upon to purify the sewage; that is, the effluent from a septic tank is not much less dangerous than the sewage which enters the tank, but it can be much more readily disposed of and that in a thoroughly safe manner.

The useful bacteria which cause liquefaction are already present in the sewage and require only the proper conditions—namely, the exclusion of air and freedom from disturbance—to carry on their good work. These conditions are secured in a dark, unventilated tank, provided with baffle boards to prevent agitation and to allow the entering sewage to settle quietly to the bottom. The products of liquefaction are to a large extent dissolved in the water of the sewage, forming a liquid which may be readily disposed of and leaving behind a small portion of solid organic matter—comparatively inoffensive—which settles as a sludge and forms sooner or later a scum on the

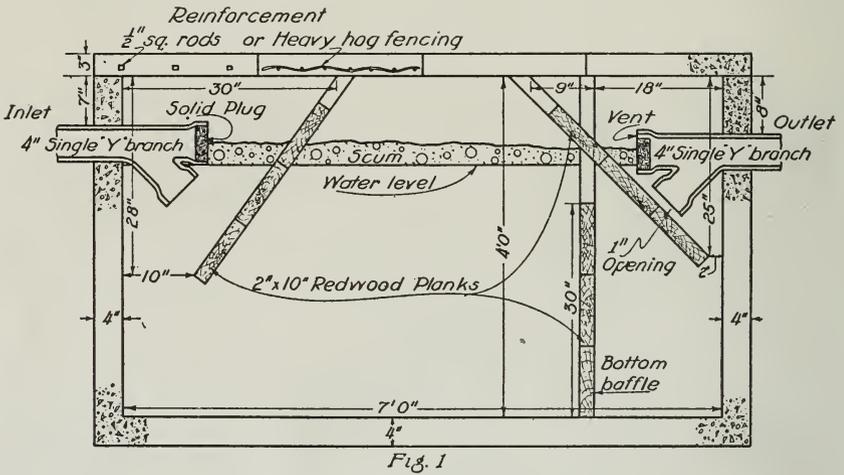


Fig. 1.—Longitudinal view of septic tank.

surface. Cleaning out the tank is usually unnecessary for several years. A tight-fitting, removable cover is needed to allow access in case of trouble or possibly necessary cleaning.

Typhoid stools and other infectious matter should be disinfected, preferably by boiling, before discharging into the toilets. Disinfectants must not be added in quantities to the sewage, as they may destroy the useful bacteria in the tank.

LOCATION

The septic tank, if properly constructed of concrete, may be placed as near the house as circumstances permit, even beneath the porch if necessary, thus securing an adequate final disposal system even with very limited yard space. However, it must be kept in mind that a leaky septic tank near a well or spring is dangerous. The tank is usually constructed so that the top is flush with the ground or slightly

lower. This will place the top of the outlet line twelve to sixteen inches below the ground level, a depth which has been found to be most satisfactory when good soil conditions for drainage exist. A high water table at certain seasons of the year, heavy clay loam, or hardpan near the surface may make it advisable to keep the top of the tank six or eight inches above ground level so that a drainage outlet nearer the surface may be obtained.

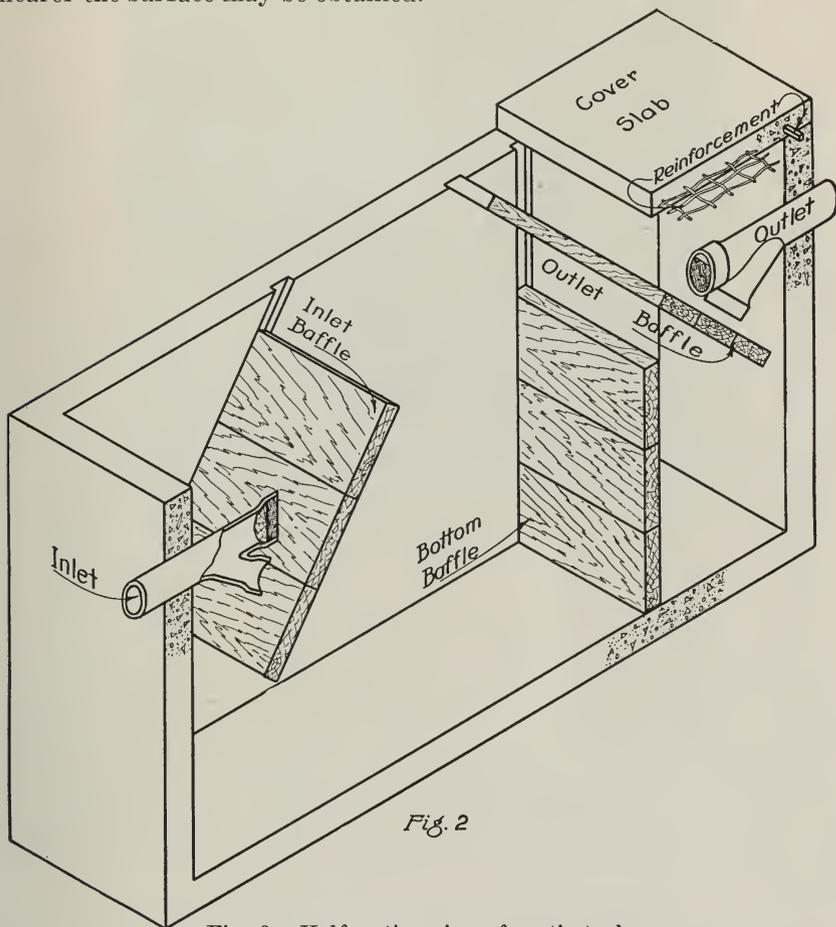


Fig. 2.—Half-section view of septic tank.

TYPE OF TANK

The tendency in septic tank plans is in the direction of simplicity. Many different types have been recommended from time to time, commonly multiple chambered. However, a single-chambered septic tank provided with baffle boards to control local currents and with

outlet one inch lower than inlet (figs. 1 and 2) is recommended.* Tanks of this type have been in successful operation in California for over ten years.

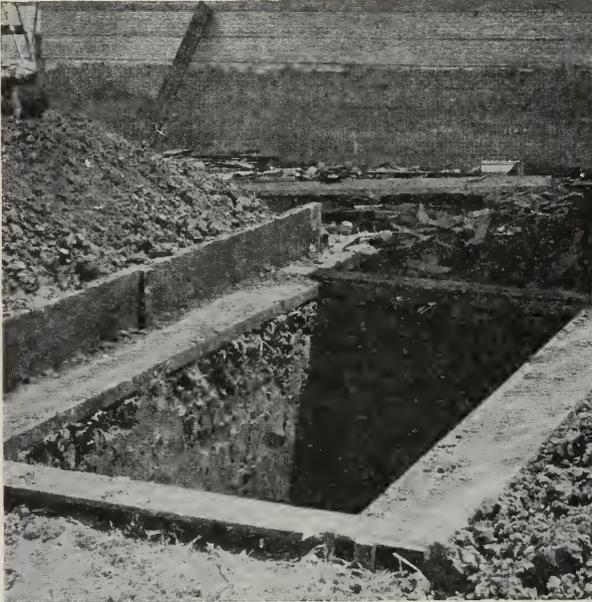


Fig. 3.—The 2-inch by 10-inch planks laid about the hole are later used for baffle boards.

SIZE OF TANK

The size of the septic tank depends upon the number of persons contributing to the sewage. For a household of ten persons or less, the inside dimensions of the tank should be approximately 3 feet wide, 7 feet long, and 4 feet deep. A smaller tank than this, even for smaller families, is not recommended. The dimensions for larger tanks, as well as those for the size of tank described in this circular, are given below:

Number of people	Inside measurements			Thickness of concrete			
	Width	Length	Depth	Sides	Ends	Floor	Top
10	3 ft.	7 ft.	4 ft.	4 in.	4 in.	4 in.	3 in.
16	3½ ft.	9 ft.	4 ft.	5 in.	5 in.	4 in.	3½ in.
20	4 ft.	10 ft.	4 ft.	6 in.	6 in.	4 in.	4 in.

* Grease traps are not necessary when waste fats and grease from the kitchen are carefully deposited with the garbage.

pendicular walls. Under ordinary conditions the hole is excavated to a depth of 5 feet below the bottom of the frame. This places the tank 5 inches, and the top of the outlet pipe 16 inches, below the



Fig. 5.—Squaring up and starting the side wall form.



Fig. 6.—The side wall sheathing should be well nailed and the boards drawn closely together.

surface. Local conditions, however, determine the depth of the hole. If the earth walls can not be used as an outside form, the hole must be made larger to accommodate forms of wood.

The Forms.—The forms should be made of common lumber surfaced on one side, the outside dimensions to correspond to the inside dimensions of the tank. Figure 4 gives the necessary dimensions for construction of the inside form for a tank 3 feet wide, 7 feet long, and 4 feet deep, capacity for 10 persons.

Side Panel.—The sheathing, which may be 1 inch by 6 inches, is nailed firmly to the 2 by 4-inch studding (*A*, fig. 4).

End Panels.—These panels are held to the 2 by 3-inch studding (*B*, fig. 4), which fits between the 2 by 4-inch studding (*A*) and the end of each side wall sheathing. Two number 8d common wire nails



Fig. 7.—Nail the 1 by 2 baffle board cleats firmly in position after trimming the wall sheathing.

(*C* and *D*, fig. 4), at each corner hold the 2 by 3-inch studding (*B*) in the proper position. Six 1 by 6-inch cross braces (*E*, fig. 4), three 6 inches below the top and three 6 inches above the bottom, hold the forms to the proper width. The 1 by 2-inch strips (*F*, fig. 4) nailed on the sides of the form to make a groove for the baffle boards, should be slightly beveled on the edges to insure easy removal of the side wall forms.

For convenience in setting the form in position, the studdings (*A*) should project 2 feet above the top edge of the wall sheathing. After the form has been lowered into the hole, it should be blocked up level to allow for a 4-inch bottom of concrete, and squared up in the hole so the walls will be of the same thickness. One inch by six inch

hanging boards (fig. 11) are then nailed across the 2 by 4-inch studding (A) and also nailed firmly to the 2 by 10-inch plank frame which was placed about the top edge of the hole. The blocking is then removed and the form is ready for concrete.

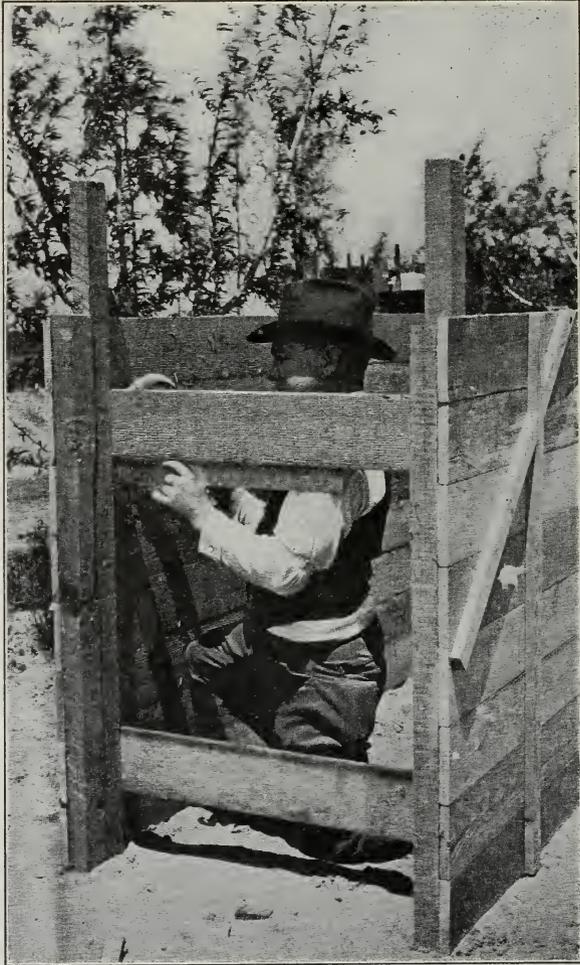


Fig. 8.—Assembling side wall forms and placing the 1 by 6 cross ties in the proper position.

Construction of Tank.—The tank should be constructed with 4 to 6-inch sides (see table, p. 4) and 4-inch bottom. The top must be 3 inches thick and reinforced. A 1:2½:4 mixture of concrete material

is recommended; i.e., 1 sack or 1 cubic foot of cement, $2\frac{1}{2}$ cubic feet of sand, and 4 cubic feet of crushed rock. Both the sand and the rock should be clean and free from organic matter. The sand should vary from fine to $\frac{1}{4}$ inch in size, the rock from $\frac{3}{4}$ to 1 inch in size. Clean, well-graded gravel may be substituted for the rock and sand. This should be mixed in a proportion of one bag of cement to $4\frac{1}{2}$ cubic

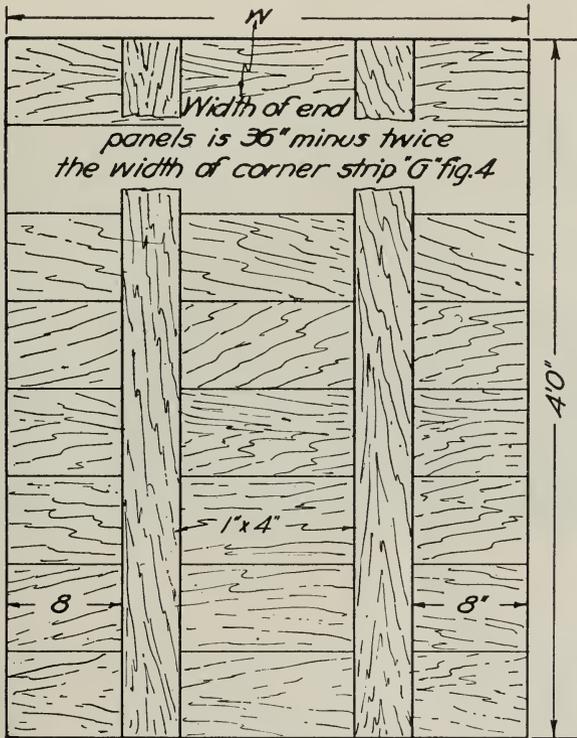


Fig. 9.—Four number 4d box nails, one at each corner, hold the end panels to the 2 in. x 3 in. studding B, fig. 4.

feet of gravel. Enough water should be added to give the entire mixture a jelly-like consistency. Too much water is harmful, as the strength of the concrete is reduced by adding more water than is necessary for a workable mixture. The concrete should be thoroughly tamped as it is poured, thus insuring smooth, watertight walls. A 1 inch by 2 inch V-shaped strip will be found convenient for tamping and working the concrete into place.

The concrete should be poured evenly about the walls until about 6 to 8 inches has been placed. (Do not crowd the forms out of alignment by pouring too much concrete in one place.) The 1 inch by 2 inch by 5 foot corner strips which extend 12 inches above top of form (G, fig. 4) should then be put in place and the pouring of concrete continued until the point is reached where the 6 by 6 by 4-inch inlet and outlet boxes (fig. 4) should be placed. A small nail driven into the form before it is lowered into the hole will help in locating the

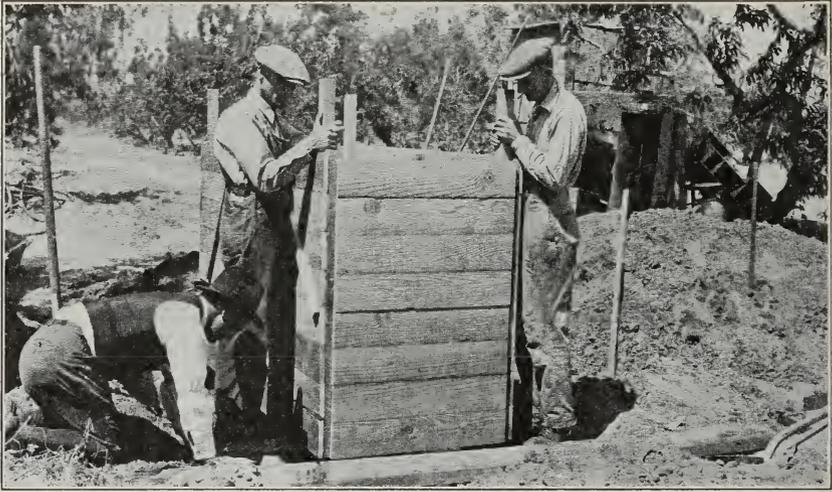


Fig. 10.—The completed form ready to be lowered into the hole.

exact position of these boxes. Continue pouring the walls, truing the top edge with a trowel or block. By pouring the walls first, some concrete will work out from under the wall bottom and spread over the bottom of the hole. This should be tamped and smoothed into place with the tank floor, which should be poured immediately after the walls. Do not allow the concrete floor to extend any higher than the bottom of the forms or they cannot be removed readily.

Construction of Cover.—Level off the ground nearby and stake on edge in parallel lines 3 feet 8 inches apart, two pieces of 1 inch by 4 inch, 8 feet 5 inches long. Cut and nail in position 1 by 4-inch cross pieces forming four rectangular compartments with inside dimensions 23 inches wide by 3 feet 8 inches long (fig. 12). Fill the bottom of these spaces with fine damp earth or sand to a smooth level surface, leaving 3 inches for concrete. Pour about $\frac{3}{4}$ inch of concrete and

immediately place reinforcing, which should be heavy hog fencing or three $\frac{1}{2}$ -inch steel rods. Continue pouring the concrete, leaving the slabs smooth and level with the top edge of the form. Cover all freshly poured concrete with damp earth or sacks.

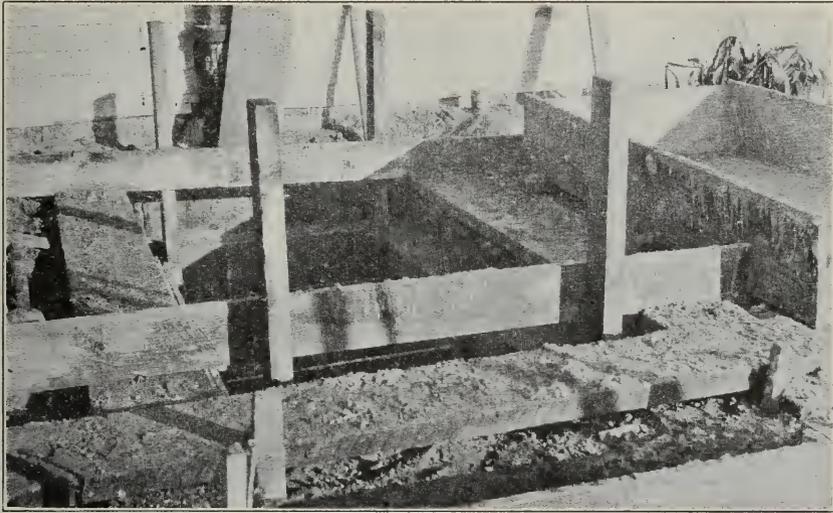


Fig. 11.—A completed tank showing the 1 inch by 6 inch hanging boards supporting the form in proper position.

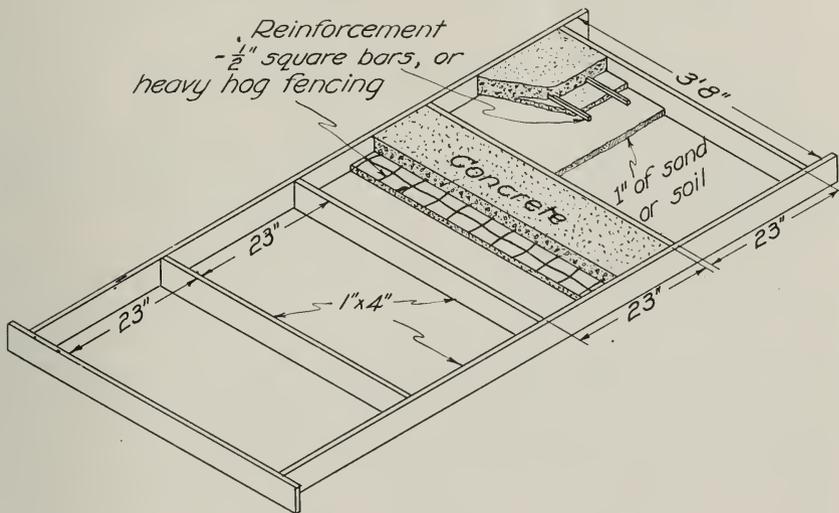


Fig. 12.—The cover slab forms.

Removing Tank Forms.—After the concrete has taken its initial set, usually in about one-half hour, the 1 by 2-inch strip (*G*, fig. 4) at the four corners may be tapped lightly with a hammer and then drawn out. The removal of these strips tends to prevent the cracking of the concrete at the corners. When the concrete has set 18 to 24 hours, the forms may be taken out. First remove the 1 by 6-inch hanging boards and the cross braces (*E*). Remove the 2 by 3-inch corner studdings (*B*) by prying them inward after drawing nails (*C* and *D*). The end panels may then easily removed. The side

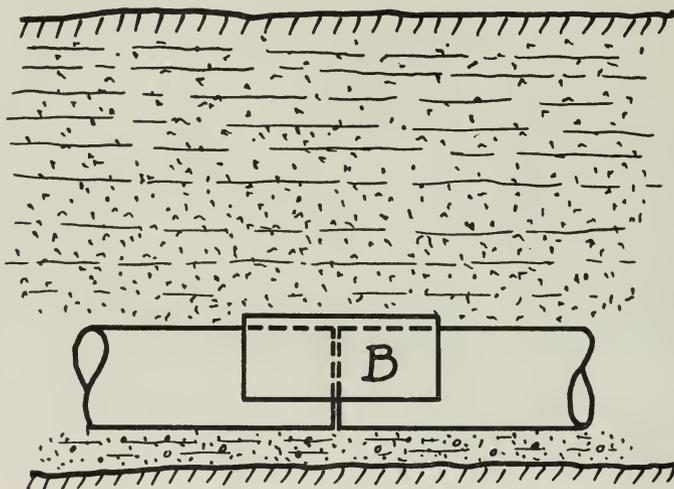


Fig. 13.—Burlap or tar paper (*B*) keeps the loosely filled soil from entering the line.

wall forms can be removed intact, care being taken that the concrete is not chipped off the edges of the grooves into which the ends of the baffle boards are to be inserted. Remove the 6 by 6-inch boxes from the wall.

Connecting the Tank.—The pipe leading from the house to the septic tank should be a 4-inch vitrified sewer pipe with cemented joints, laid to a grade of $\frac{3}{16}$ to $\frac{1}{4}$ inch per foot and imbedded firmly in the ground. A swab made from a piece of burlap on a short stick should be run through each length of pipe after the joint is cemented to clean out any cement that might obstruct the inflowing sewage. The inlet and outlet joints should be firmly imbedded in cement mortar (1 part cement, 2 parts fine sand). The outlet should be placed 1 inch below the inlet. The baffle boards, preferably of redwood, which last indefinitely, should be thoroughly water soaked and the ends trimmed so

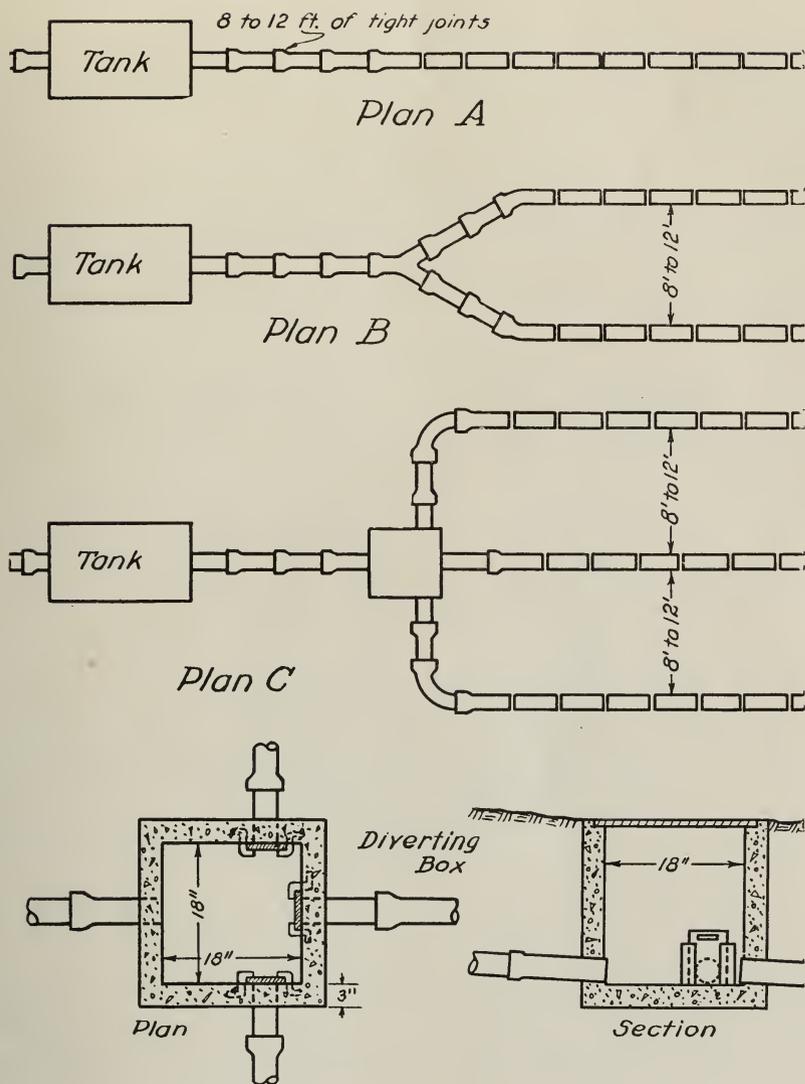


Fig. 14.—Plan A. Single line used when a minimum amount of tile is necessary.
 Plan B. Two-branch line for heavier soils.
 Plan C. Three-branch line through diverting box, used where greater area is needed for distribution system.
 Lower figure—Plan and section of diverting box.

that they fit loosely into the slots in the tank walls. Concrete cast $1\frac{1}{2}$ inches thick by the method described for the casting of the tank cover, may be used instead of redwood baffle boards. The cover slabs should now be put in place. They should be imbedded in mortar with a light mortar joint between the slabs.

FINAL DISTRIBUTION OF EFFLUENT

The effluent from the tank may be utilized for the sub-irrigation of alfalfa, berries or trees, or possibly certain vegetables such as squashes and beans, but not for any vegetable which may be eaten raw. The

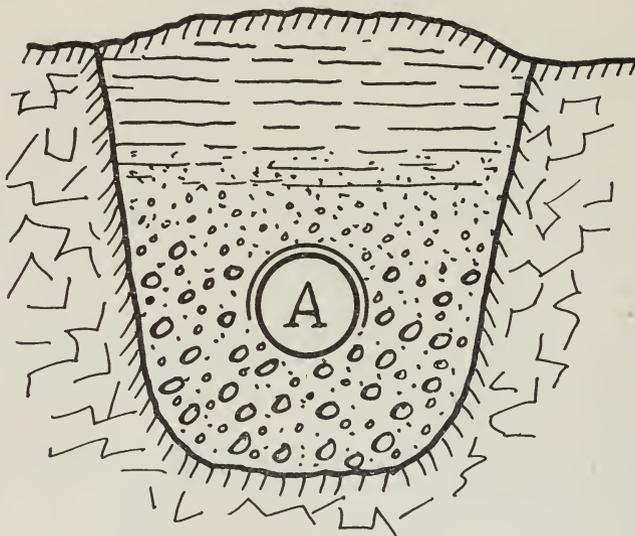


Fig. 15.—A. When drainage is poor, the tile should be laid in twelve to eighteen inches of loose rock or gravel.

effluent is ordinarily discharged through 4-inch drain tile. The first 8 to 12 feet should be vitrified sewer tile and laid with tightly cemented joints the same as the inlet pipe. The remainder of the drainage line should be constructed of ordinary 4-inch clay drainage tile. It has been found good practice to lay the drain tile as close together as possible, covering the joints on top with a strip of burlap or tar paper (fig. 13) to keep the loosely filled earth from entering the line.

The arrangement of the disposal tile (fig. 14) after the first 8 to 12 feet are laid, may be in the form of a two or three-tine pitchfork in order to conserve space and to assist, if desirable, in sub-surface irrigation. A diverting box (fig. 14) is recommended when three or

more branch lines are used. A fall of 1 inch to 10 feet is commonly used in sandy soil. One inch in 60 feet is recommended for heavier soils, with a slightly greater opening in the tile joints. When drainage conditions are very poor, or if for other reasons the tile must be laid close to the surface, it is recommended that the drain tile be laid in 12 to 18 inches of rock or gravel in a ditch about 12 inches wide (fig. 15). When the drain is laid on soil, it should be firmly packed, for the effluent seeping from the open joints may cause loosely packed soil to settle, thus causing a settling of the drain tile and perhaps the clogging up of the system. The distributing system should be located as far away from the source of drinking water as possible to prevent contamination by seepage. Under no conditions should the effluent be drained direct from the tank to a dug well or cesspool, if there is any possibility of the seepage from this cesspool contaminating the domestic water supply. Sixty feet is the minimum amount of drain tile to be used for a distributing system under good soil conditions. More tile should be added if needed. One hundred feet is the maximum for any one branch line of a system.

After all cemented joints have set firmly, run 150 or 200 gallons of water into the tank and it is ready for use.

MATERIALS REQUIRED

The materials necessary for a septic tank 3 feet wide, 4 feet deep, and 7 feet long, suitable for ten persons, are as follows:

Concrete Materials.

1 $\frac{2}{3}$ cubic yards crushed rock $\frac{3}{4}$ inch to 1 inch in size.

1 cubic yard sand.

12 bags cement.

(If crushed rock is not available, 2 cubic yards of clean, well graded gravel may be substituted for rock and sand.)

Tile.

Two vitrified single branch Y sewer tile, size 4 inch.

*Vitrified bell neck sewer tile, size 4 inch.

*Standard drainage tile, size 4 inch.

Reinforcing.

4 pieces of heavy hog fencing, size 23 \times 43 inches, or

12 pieces $\frac{1}{2}$ inch steel rods, 3 feet 7 inches long.

* Amounts not figured as local conditions govern quantity required.

Baffle Boards.

3 pcs. 2" × 10" × 10' Rgh. Com. Rdw. or Cedar.

Cover Forms.

3 pcs. 1" × 4" × 12'

Form Lumber.

Side Walls

9 pcs. 1" × 6" × 14'

End Walls and Braces

6 pcs. 1" × 6" × 12'

2 pcs. 1" × 4" × 8'

Hanging Boards and Boxes

1 pc. 1" × 6" × 12'

Baffle Cleats and Corner Strips

3 pcs. 1" × 2" × 14'

Long and Center Studding

2 pcs. 2" × 4" × 16'

Corner Studding

1 pc. 2" × 3" × 16'

} All common lumber surfaced
one side.

Nails

3 lbs. No. 8d common wire nails

2 lbs. No. 6d box nails

COSTS

The average cost of a septic tank is \$27 to \$36 exclusive of labor. The labor of two men for two days is necessary to construct a tank under average conditions.

ACKNOWLEDGMENT

The authors wish to acknowledge indebtedness to E. J. Stirniman for his valuable assistance in the preparation of this circular and to J. P. Fairbank for his suggestions for the improvement of this reprint of the original circular.