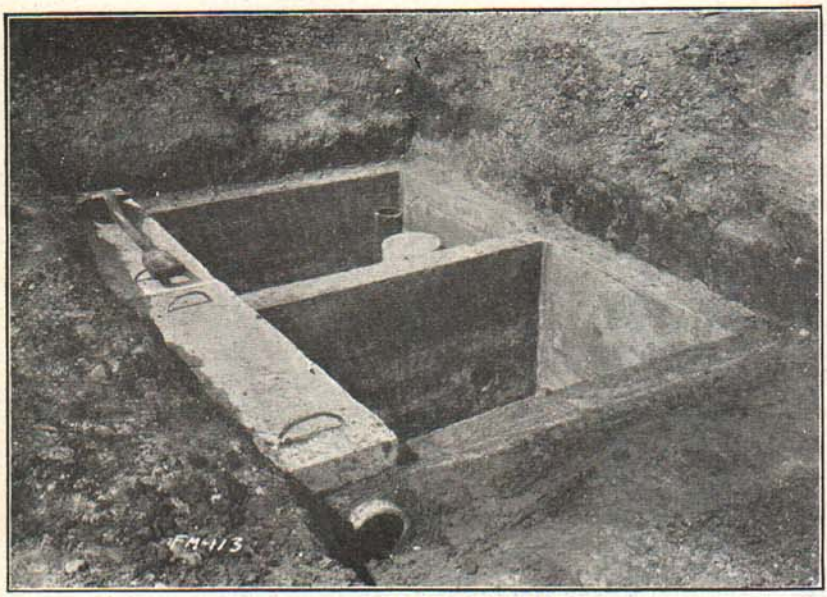
Extension Bulletin No. 118 Revised, December, 1935

MICHIGAN SEPTIC TANK AND TILE SEWAGE DISPOSAL SYSTEM

O. E. ROBEY



MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

EXTENSION DIVISION
R. J. Baldwin, Director

Michigan State College and U. S. Department of Agriculture co-operating.
Printed and distributed in furtherance of the agricultural extension work provided for in the Act of Congress, May 8, 1914.

REASONS FOR THE DESIGN OF THIS TANK

A sewage disposal system for the home should provide the maximum of convenience and safety. To do this it should take care of all the sewage from the bathroom, kitchen sink, and laundry, and safeguard against the possibility of the sewage coming in contact with flies and possible contamination of food. It should also provide a means of treatment and disposal which will afford the greatest measure of protection against the danger of contamination of the water supply.

The Michigan septic tank and tile system has been designed with these requirements in mind. The original plan of the tank was developed about 16 years ago by the agricultural engineering department of the Michigan State College. A few details have been changed since, but the principles remain the same. This plan has been recommended and used in our extension work for the past 15 years and records show that approximately five thousand tanks have been built.

The recent work of the department on the tank has been largely in developing details to simplify construction. The principles upon which the tank operates have long been recognized. Its operation is dependent upon two bacterial actions, first, the action of anaerobic bacteria in the septic tank itself; and second, the action of aerobic bacteria in the soil adjacent to the disposal field.

Disposal Field Most Important

Bacterial action on the sewage at the disposal field is the more important as far as purification is concerned.

To carry out these processes most effectively the following steps are made use of:

1. Breaking down of solids by anaerobic bacteria in the first compartment of the septic tank,
2. Retaining of a definite amount of liquified sewage in the second compartment,
3. Discharging liquified sewage periodically from the second compartment by the siphon into the tile system, (Subirrigation system)
4. Aeration of sewage by bringing it in contact with aerobic bacteria in the soil adjacent to the tile system.

Briefly the operation of the tank is as follows: The sewage enters the first compartment through the sewer inlet. After this compartment becomes full, it begins to overflow through the cross connection into the siphon chamber. See Figure 11. A scum forms on the surface and a sludge accumulates in the bottom of the first compartment, at these two points the anaerobic bacteria are the most active in dissolving or breaking down the sewage.

At a point about midway between the sludge and the scum, in the first compartment a comparatively clear liquid, effluent, collects which passes into the siphon chamber through the overflow tile and is forced out by sewage flowing in from the sewer. This liquid does not run out of the siphon chamber immediately but accumulates until the chamber is partly filled. It is then discharged quickly by the siphon into the tile system where it passes out through the joints of the tile into the soil and comes in contact with the aerobic soil bacteria and is mineralized.

MICHIGAN SEPTIC TANK AND TILE SEWAGE DISPOSAL SYSTEM

O. E. Robey

This tank has been designed to provide the farm home with the same conveniences and service that the sewer provides for the city dweller. The septic tank provides a satisfactory means of disposing of the wastes from the kitchen, laundry, and bathroom, and it also provides the best possible method of safeguarding the water supply against contamination from these wastes.

LOCATION

In planning a sewage disposal system, the first thought is, "Where shall it be located? The most practical location for the tank has been found to be close up to the wall of the house and the piping will usually be simplified by having the tank on the same side of the house as the bath room (Fig. 1). The tank should be placed, however, as far away from the well as possible. If it is necessary to place the tank near the well, special care should be taken to do a watertight job of concreting;

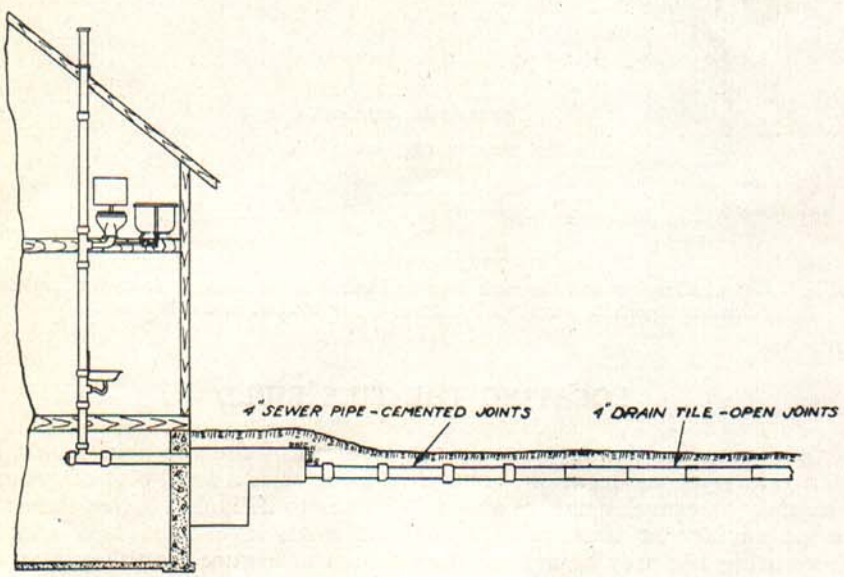


Fig. 1.—A typical septic tank installation.

also, in this case, sewer pipe with cemented joints should be used for the outlet for at least 50 feet away from the well.

The tank should not be placed under porches, in the basement, or where it will not be readily accessible if it should need cleaning. It may however be placed under a driveway if the cover is sufficiently reinforced.

DEPTH

Where practical, the top of the tank should be one foot below the surface of the ground. On absolutely level ground, this is not possible, see Figure 1. In such cases, the tank should be level with the surface and mounded over with earth. On level ground, it is not possible to have fixtures in the basement of the house.

Where the soil is sufficiently rolling so the surface of the ground at a short distance from the house is about the same level as the basement floor, it is possible to have fixtures in the basement. In this case, it is best to locate the tank some distance from the house in order to make it accessible, Figure 2.

Before determining the depth of the tank, carefully read the next paragraph on "Locating the Tile Field". The depth of the tank is determined to a large extent by the lay of the tile field. The top of the tank should be regulated so that the outlet tile will only be 18 to 24 inches below the surface.

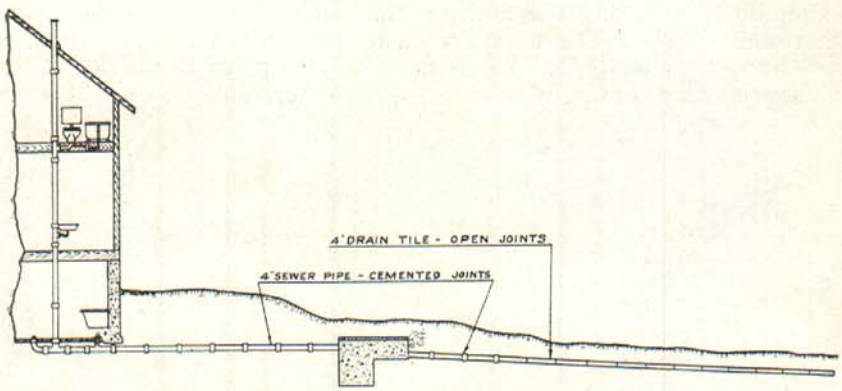


Fig. 2.—On rolling ground the tank may be located some distance from the house. This arrangement permits of fixtures being located in the basement.

LOCATING THE TILE FIELD

In planning for the septic tank, the location of the tile field should be given primary consideration. The ideal location is a level plot of ground of a sandy or gravelly nature about 18 inches to 24 inches lower than the ground surface at the tank. If only a small level area is available, the aerating tile may be arranged as shown in Figure 3 or they may be arranged as in Figure 4, in one continuous line where a long level

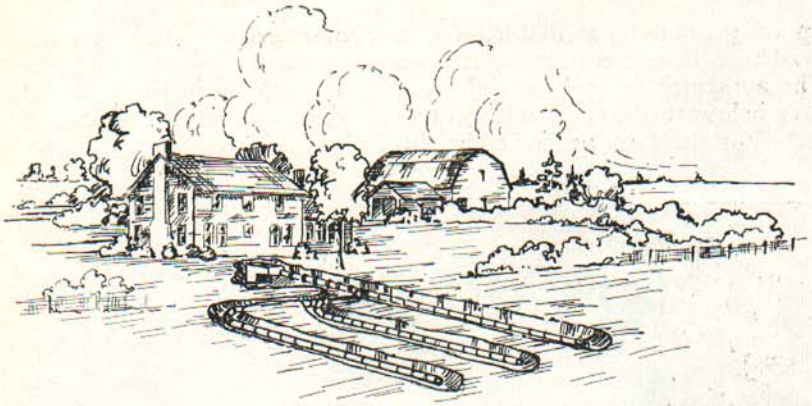


Fig. 3.—A level plot of ground is an ideal location for the subirrigation tile.

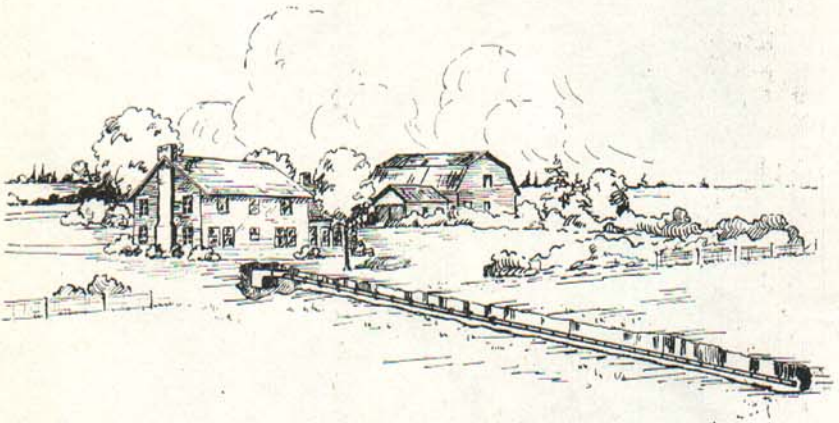


Fig. 4.—One line of tile may be used for the subirrigation system if the tile can be laid at a uniform depth.

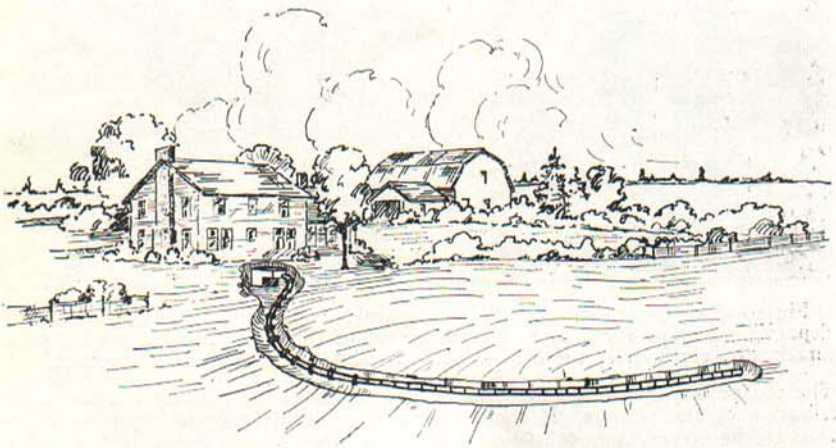


Fig. 5.—On irregular ground, the tile may be laid on a contour and thus kept at a uniform depth.

strip of ground is available. On irregular ground, the line may be curved to follow a contour of the same elevation shown in Figure 5.

The aerating tile system consists of four inch drain tile laid about 18 inches below the surface with not more than two inches of fall per 100 feet.* For the tank described in this bulletin, 75 feet to 100 feet of tile

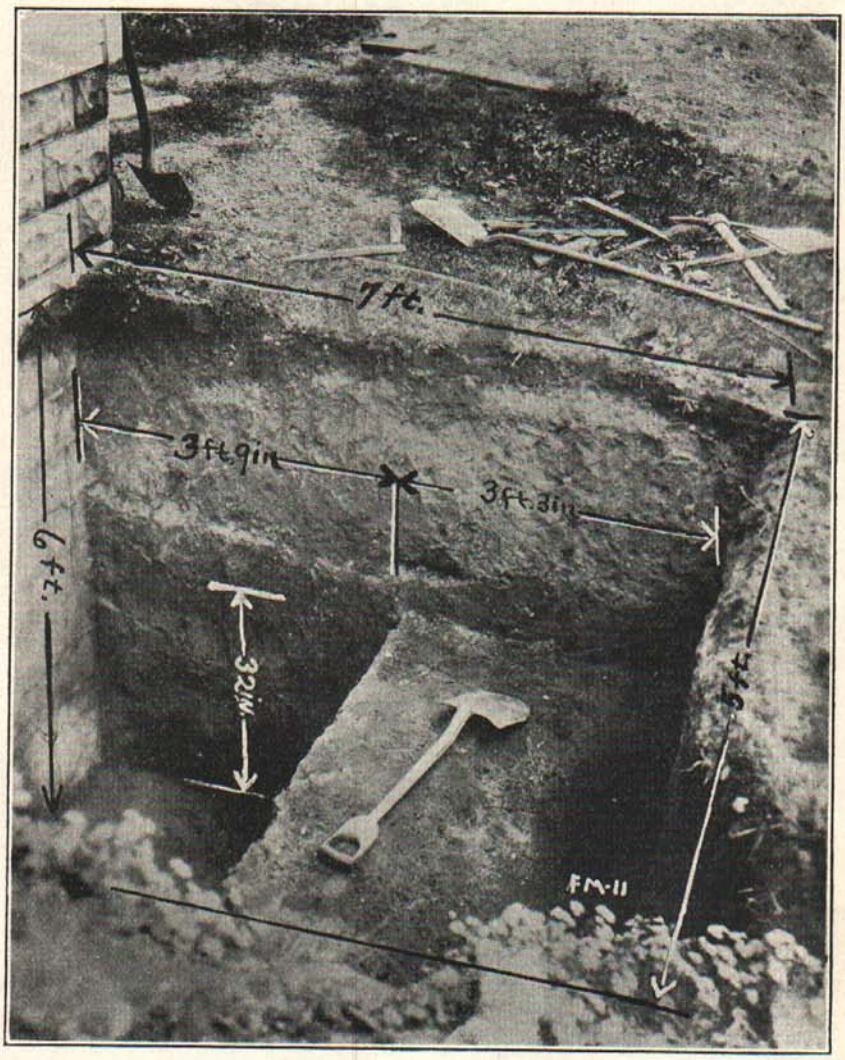


Fig 6.—The excavation for the tank should be made as shown above. The depths given allow for a foot of earth on top of the tank. For lesser or greater amounts of earth cover the 6-ft. dimension should be decreased or increased.

*The reason for laying the tile lines practically level is to insure a more uniform distribution of the sewage. If the tile line has considerable fall, the sewage will collect at the lower end, creating a saturated area which destroys the bacterial action in the soil and prevents the mineralization of the sewage.

will be required on sandy soil and 100 to 200 feet will be necessary on heavier soils.

When the effluent is discharged by the siphon from the siphon chamber, it practically fills the tile lines. It is not necessary to have the tile lines connect to any drainage system. The effluent seeps into the soil through the joints of the tile. In the soil, it comes in contact with aerobic bacteria which brings about the final step in its purification.

EXCAVATION

Where the excavation for the tank is adjacent to the wall of the house, the wall should be cleaned of loose dirt and used as the outside form for the concrete. The excavation should be laid out as shown in Figure 6. Either the side or the end of the deep compartment may be placed next to the house.

MATERIAL REQUIRED

For the construction of a tank and tile system the following materials will be needed:

3 yards of gravel
4 barrels of cement
20 pieces of round iron, ⅜" x 3' 3" (reinforcements for cover slabs).
1-4" glazed sewer pipe
2 four-inch sewer pipe Tees (Glazed clay)
75 to 200 feet of four-inch glazed drain tile
1 siphon
50 feet four-inch glazed sewer pipe
(Needed in some cases for protection to the well.)

Sufficient four-inch sewer pipe to connect the tank with the house. In most cases, however, the tank is placed adjacent to the house so that very little or no sewer pipe will be required.

SIPHON*

The siphon may be made from the following pieces of pipe and fittings. The letters indicate the pieces shown in Figure 7.

A, 1 piece 2" black pipe 9" long threaded one end
B, 1 piece 2" black pipe 6" long threaded one end.
C, 1 piece 2" black pipe 6" long threaded both ends.
D, 1 piece ¾" black pipe 8" long threaded both ends.
E, 1 piece ¾" black pipe 13½" long threaded both ends.
F, 1 piece ¾" black pipe 8" long threaded one end.
G, 1 ¾" return bend.
H, 1 ¾" black elbow.
I, 1 2" x 2" x ¾" cast tee.
J, 1 2" return bend open pattern.

*The purpose of the siphon is to distribute evenly the effluent throughout the length of the tile system. The siphon is so constructed that it permits the liquified sewage to accumulate in the siphon chamber to a depth of about 14 inches. When the proper amount has accumulated, the siphon automatically discharges the whole amount into the tile system. There are no moving parts in the siphon. Its action depends upon compressed air which collects under the bell. By discharging the effluent periodically and evenly, bacterial activity in the soil is maintained.

The bell of the siphon is a three-gallon butter crock partly filled with concrete and supported by three one-half inch iron rods inserted in the concrete in the crock.

Concrete should be put into the bottom of this crock until the unfilled portion measures six inches deep. The one-half inch iron rods used

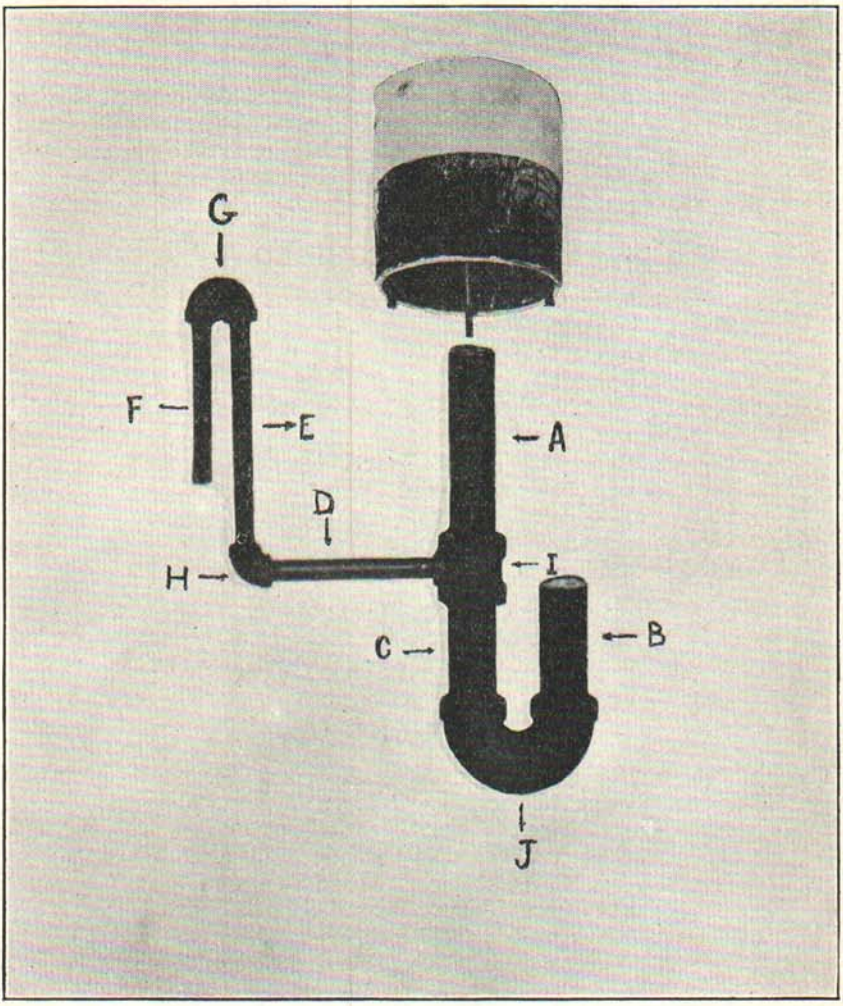


Fig. 7.—The siphon may be made of pieces of pipe and three gallon butter crock.

for legs should project one and one-fourth inches above the crock. The crock must be as near nine and one-half inches inside diameter as possible.

Sometimes there is difficulty in securing some of the described fittings for the siphon and a siphon made of pipe and fittings will be partly

rusted out after 10 or 12 years. Cast iron is a more durable material for this purpose. A cast bell and siphon made after the above plan can now be purchased for about the same price that they can be built. Your county agent can tell you where this can be secured or the agricultural engineering department, Michigan State College, East Lansing, will furnish this information.

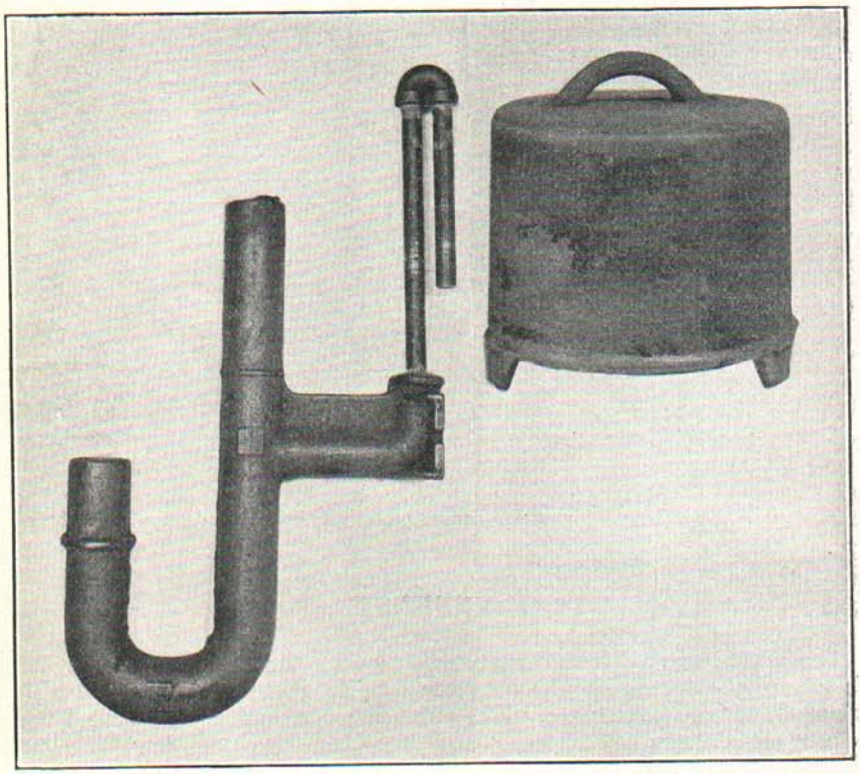


Fig. 8.—A cast iron siphon and bell.

FORMS

Forms may be made of any ordinary lumber. If, however, the forms are to be used several times, they can be made after the plan shown in Figure 9. These forms can be removed very easily without damage. For the "take-down" forms the following material will be needed:*

3 pieces 2″ x 4″ x 6′ dressed four sides (pieces a, b, c, slab forms).
4 pieces 1″ x 4″ x 12′ dressed four sides (cut 3′ 7″ long for slab form partitions). Fig. 12.

*Forms of this type have been built at demonstrations in nearly every county where there is a county agricultural agent. Before building a form inquire of your county agent, you may be able to rent one.

5 pieces 2″ x 4″ x 16′ dressed four sides (cut 2 pieces of a, b, c, from each 2″ x 4″ x 16′). Fig. 9.
17 pieces 1″ x 6″ x 12′ matched flooring (cut 2 pieces 4′ 4″ and 2 pieces 20″ long from each board).
20 3″ strap hinges.
3 lbs. 6d nails.
1 lb. 8d nails.

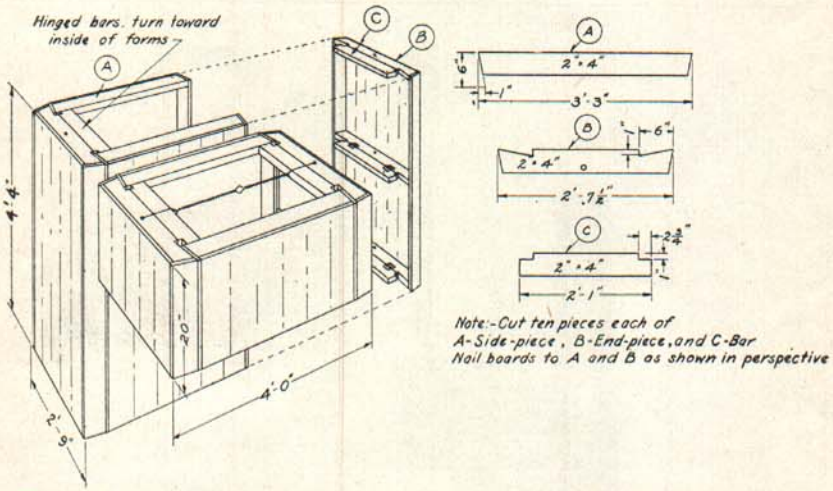


Fig. 9.—"Take down" forms are convenient when several tanks are to be built.

EXPENSE

The actual outlay for all materials for the tank and aeration tile exclusive of the forms should not exceed $35. Two men should be able to make the forms, excavate, place the concrete, and lay the tile in from two to three days.

BUILDING THE TANK

The Concrete

After the excavation has been made, mix sufficient concrete*, comparatively dry, to make a floor four inches thick in the deep compartment. Tamp the concrete and then set up the forms for the walls of the deep compartment. Fill in around the forms with concrete of a quaking consistency until the bottom of the siphon chamber has been reached.

*The proportions of cement and gravel should be 1 to 5 if bank run gravel is used. By bank run gravel is meant the material as taken from the pit and which contains grains or pebbles of all sizes. The best concrete is made from gravel in which the size of pebbles is properly graded from fine to coarse with about half as much sand as gravel. Sizes not over one and one-half inches in diameter may be used for this work. Sand is the material of such size as will pass through a screen having one-fourth inch mesh or openings, and gravel is the material which will not pass through the same screen. Material which contains more than two-thirds sand is not desirable.

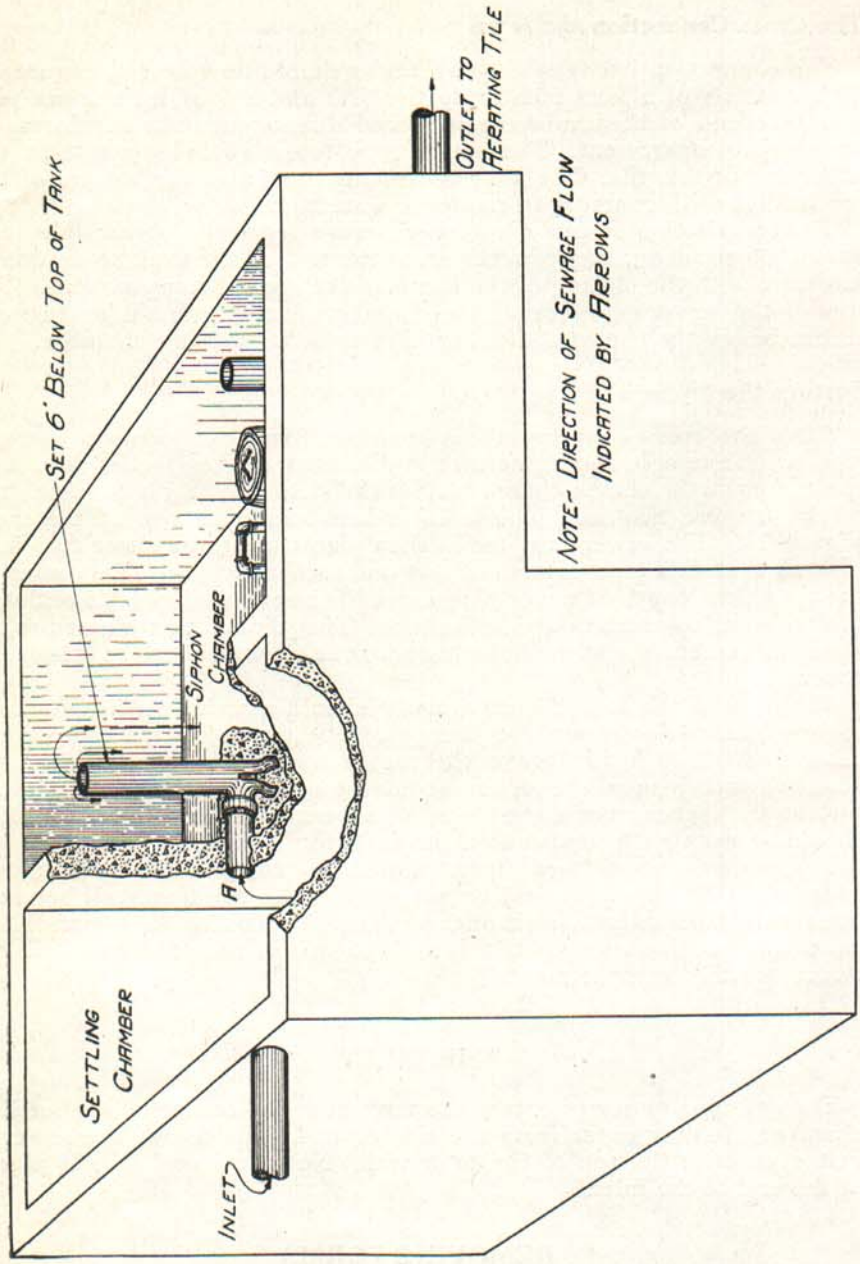


Fig. 10.—The liquified sewage flows from the settling chamber into the siphon chamber through the cross connection A which consists of a 4-inch drain tile and a 4-inch sewer pipe tee.

The Cross Connection

The connection between the two tanks should now be set, Figure 10. This consists of a four inch drain tile (A) and a four inch sewer pipe tee. One end of the drain tile is placed directly against the forms of the deep compartment. The sewer pipe tee is placed upright at the other end of this tile. The joint is cemented and also the bottom of the tee is filled with concrete to render it watertight.

This connection is put diagonally across from the sewer inlet and should be set about eight inches from the end of the tank so as not to interfere with the placing of the forms of the second compartment. The top of the sewer pipe tee of the cross connection should be just six inches below the top of the sewer inlet into the settling chamber.

Setting the Siphon

After the cross connection has been set, the next job is to set the siphon. Dig a hole about one foot in diameter and ten inches deep near the center of the siphon chamber. Set the siphon in this hole so the top of the longest two inch pipe is 13 inches below the top of the tank, Figure 11. The sewer pipe tee is then placed over the short two inch pipe so that this pipe extends about one inch above the side outlet of the tee. One length of sewer pipe should be inserted in the side outlet of the tee so as to extend outside the tank. The joint of this tile at the tee shoud be cemented and the hole made for the siphon should be filled with concrete.

The floor of the second compartment should now be put in with concrete which is dry enough so that it can be tamped. The floor should be leveled off 20 inches below the top of the first compartment form. The two inch pipe of the siphon should be measured to see if it stands just seven inches above the floor as shown in Figure 11. The floor should be even with the bead on the cast iron siphon.

The second compartment form should be set up and the tank wall completed. The form should be set so that the dividing wall between the two compartments is six inches thick. The notch A, Figure 11, is cut about two inches deep in this wall to permit the passage of air between the two compartments.

THE INLET

The soil pipe or sewer enters the tank near the corner of the settling chamber. It may enter from the side or end. The top of the sewer is just even with the top of the tank wall. No elbow or baffle is placed at the end of the inlet.

REMOVING FORMS

The tank forms should be left in place long enough for the concrete to set. In removing forms, care should be used to prevent cracking the concrete. The "take down" forms shown in Figure 9 can be removed by turning the hinged bars until they are free. The side and end forms can be loosened by forcing them inward and then lifting out.

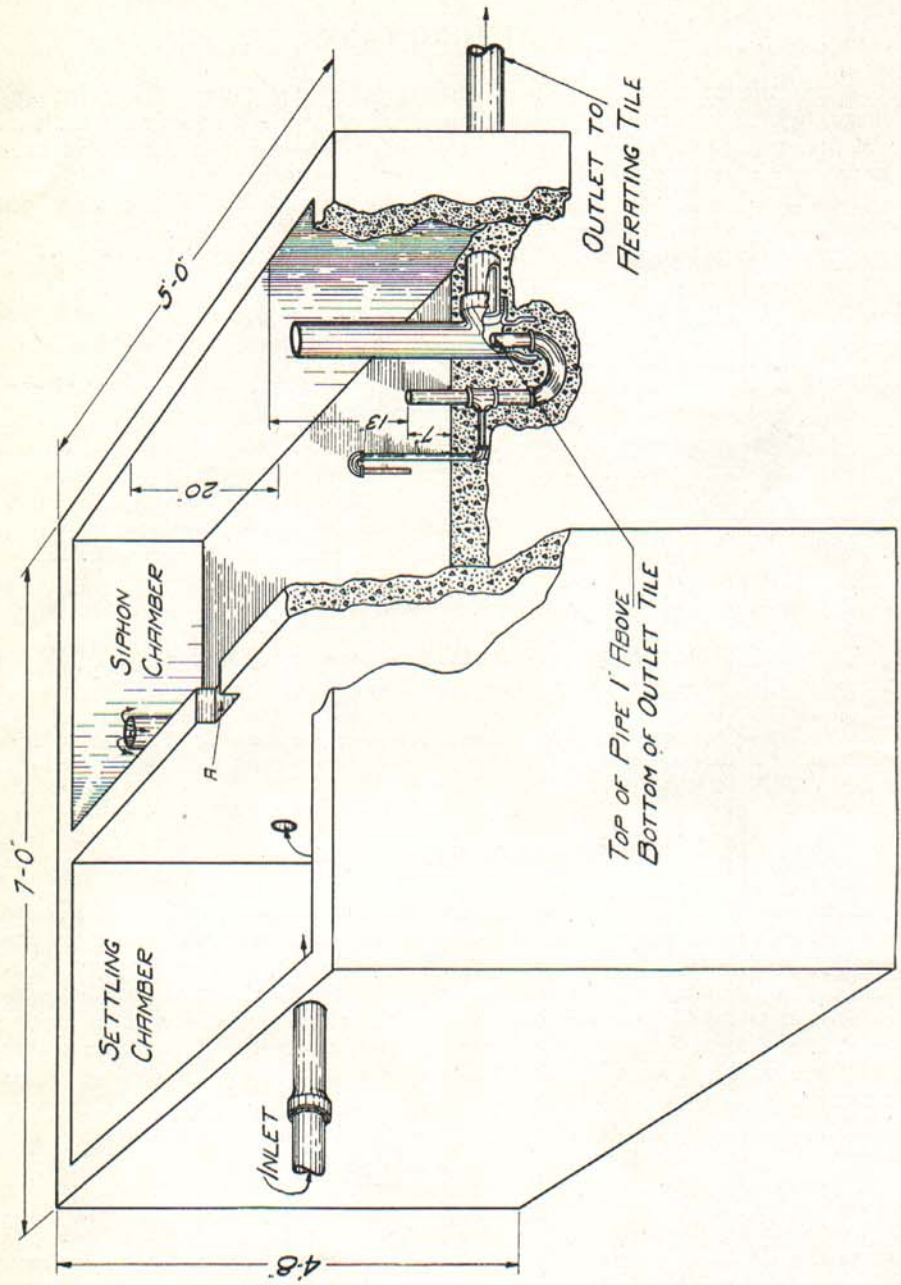


Fig. 11.—Set the siphon plumb and observe the measurement given above.

FINISHING TANK

Wash the interior of both chambers with a mixture of cement and water which is mixed to a consistency of cream and spread on with an old broom or whitewash brush. Two coats should be applied and kept moist while setting. Plastering the interior with a mixture of 1 to 2 of cement and sand, with a small amount of lime added, is also an excellent means of water-proofing it. Before closing the tank pour a pail of water in the two inch pipe of the siphon and set the bell over this pipe.

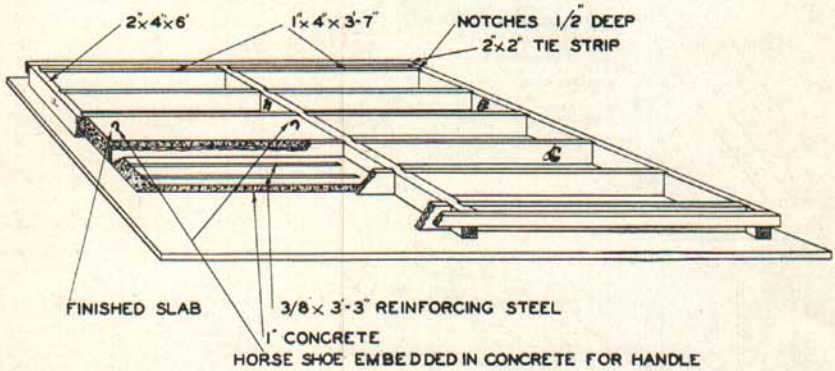


Fig. 12.—Concrete slabs make a convenient cover for the tank. The slabs will fit better if they are arranged on the tank in the same order they were made in the form.

AERATING TILE SYSTEM

Construct the sewer line from the tank to the aeration field, if needed to protect the water supply. All tile joints for at least 50 feet from the well, should be filled with cement and sand, mixed in the proportion of one part of cement to two parts of sand. Use a hoe shaped to fit the inside of the tile to pull out cement which may have dropped in at the joints. If the tank is located some distance from the house, the sewer connecting the tank with the house drain should be laid in a similar manner.

LAYING TILE

Use a string stretched over grade bars and a measuring stick to determine the depth of trench for constructing the tile lines. Lay the drain tile with loose joints. In sandy ground, cover the top half of the joints with tar paper or roofing to prevent sand working into the tile. In heavy clay, dig trench about four inches deeper than required and fill the bottom of the trench with four inches of gravel; lay tile and fill level with the top of tile with gravel, and cover with earth.

SPECIAL CASES

Wet Ground

In heavy undrained soil, the aerating tile plot should be drained by tile laid at a depth of two and one-half to three feet, parallel to and a few feet from the aerating tile. Sometimes the aerating tile can be laid in two lines about 10 to 20 feet apart with a drain tile below and midway between. In this case gravel should be used under the tile as previously explained.

Fig. 13.—Pour a pail of water into the siphon to "prime" it.

Hillsides

When it is necessary to have the aerating system on a hill side, a diverting box shown in Figure 15 may be used. As the box fills the first branches are filled, and, as they become full, the overflow goes to the tiles farther down the hill. This construction prevents the liquid from rushing to the lower part of the tile system at each discharge of the siphon.

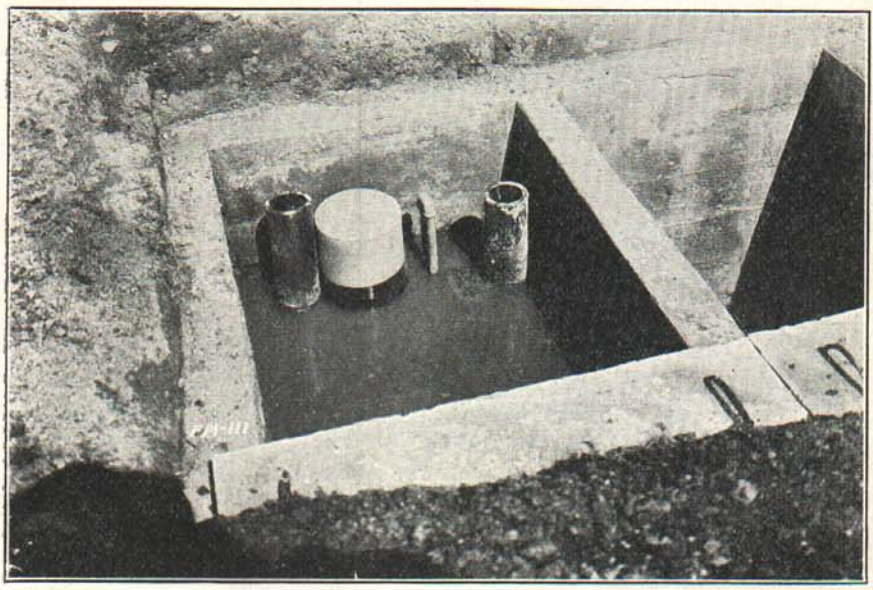


Fig. 14.—Complete the siphon by placing the bell over the two inch pipe.

Double Aerating System

Another device sometimes used where unfavorable conditions prevail is the construction of a double line of aerating tile, each with sufficient length to handle the effluent of the tank. A sewage switch is then constructed as in Figure 16, which is used to direct the liquid alternately into the separate tile systems. Using one line of the system at a time prevents the ground becoming water-logged and gives the system not in use time to recuperate and develop favorable conditions for bacterial action. The switch is changed once or more each month.

Other Methods of Disposal

We do not recommend the discharge of the septic tank into open ditches, streams, lakes, or into unused wells, cesspools, or dry wells. The subirrigation tile system is much safer.

Larger Systems

The standard tank, as shown, is designed to serve not more than six people continuously. Where more than this number is to be accommodated, the capacity of the tank may be increased by adding to the length of the tank and tile system. For tanks of greater capacity, this rule is suggested:

Add six inches to length of chambers and 25 to 75 feet of aerating tile for each additional adult above six persons. If for more than 15 persons, the tank should be of special design. The design of sewage disposal

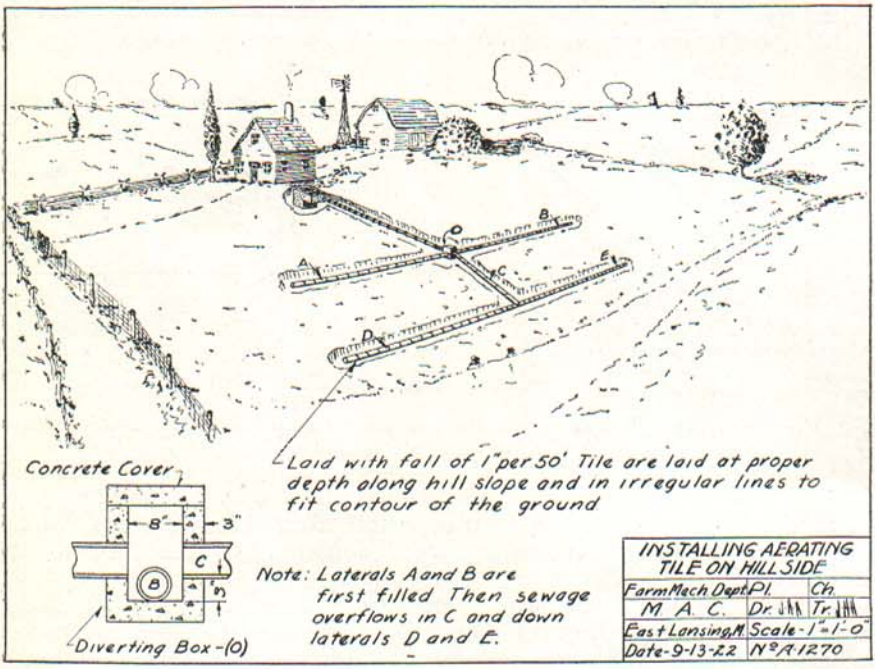


Fig. 15.—On hillsides a special diverting box shown at O may be used to secure better distribution.

systems for creameries, summer hotels, camps, and schools should have special study of the conditions in each case. Information may be had on these from the Michigan State Board of Health, Lansing, Michigan, or from the Agricultural Engineering Department, Michigan State College, East Lansing, Michigan.

CARE AND MAINTENANCE

Fifteen years experience with this method of sewage disposal shows that very little attention is required when properly installed. Occasionally, however, the scum in the first compartment may become too thick or the sludge may have to be removed. Tree roots sometimes clog up the tile system. The tile should be kept as far away from trees as possible especially willows, elms, and trees with similar root systems.

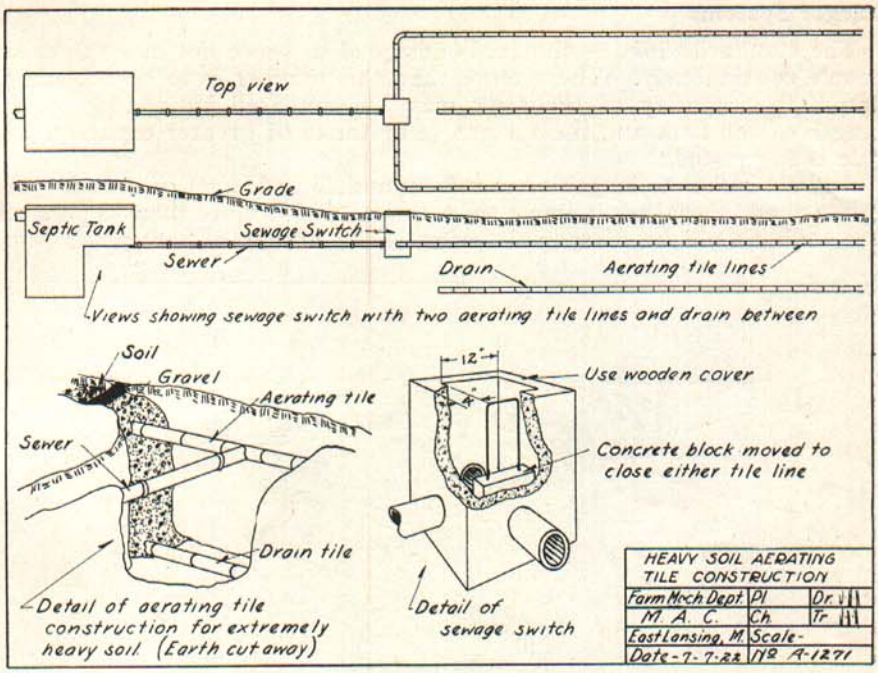


Fig. 16.—On heavy soil it is sometimes necessary to use two tile systems with a switch to alternate the flow.

Practically no trouble has been reported from either the tank of the tile system freezing when they were constructed according to the directions given.

The tank should be examined periodically to see if too much sludge or scum is accumulating. One foot of sludge in the bottom and six inches of scum on the surface does not interfere with the operation of the tank.

The question is frequently asked if soapy water from the sink, bath tub or laundry can be run into the septic tank, also whether washing powders are injurious. It has been found that a septic tank of proper size and design will handle the soapy water from the average home and a reasonable amount of washing powder.