Chapter 13

THE HOUSE PLUMBING SYSTEM

ONCE you have the rough shell of the house completed, the job of roughing in the plumbing system should be done. This will consist of installing all the pipes through the walls and ceiling for the fresh-water supply and the drainage system as well as installing the various outlets for the plumbing fixtures. The fixtures themselves will be installed after the interior walls have been finished.

Considerations

As is the case with electrical wiring, plumbing for residential work is often regulated by local building codes, which vary greatly. In well settled localities, the plumbing codes may possibly insist that the entire plumbing system be installed by a master plumber. This is done to insure the health of the entire community. A faulty plumbing system in a built-up community can be a definite hazard to health. Other codes, not quite as strict, may demand only that the installation of the system be done in such a fashion that it will meet with the approval of local health and building inspectors. In rural areas there may not be any code whatsoever and any sort of plumbing system can be installed by anyone who cares to do the job.

Because the comfort and, in most cases, the health of the various members of the household will depend on an adequate plumbing system, it is foolish to install any system that is not perfectly safe from the standpoint of health or will not insure the household an adequate supply of hot and cold water.

Not so very many years ago, installing a plumbing system was an almost hopeless undertaking for anyone except those who had had years of actual experience. Pipe joints had to be made by hand with hot lead, traps had to be made on the job by the plumber, and there were only a few basic fittings manufactured. Making up the various joints and fittings called for a type of skill that could only be acquired after long training. Today, thanks to the plumbing industry, there are fittings ready made to meet every requirement and the main trick involved in installing a system is to know which fitting to use and how to use it. But even so, many persons may not feel that they possess the necessary skill to do the entire job of installing a house plumbing system by themselves. To these we suggest calling in a plumber and working along with him on the job. There is a good deal of rough unskilled work to be done on a plumbing job and if you do this work while the plumber devotes his energies to the more involved problems, you will be pleasantly surprised to find how fast the work will go and how much can be saved. And helping to install the plumbing system is the best way to gain an understanding of how it works so that in the future, if something should go wrong, you will be in a good position to know where the trouble might lie and how it should be fixed.

But regardless of who does the work, be sure that a first-class system is installed. Do not take any short cuts or let anyone else take them on your house plumbing system.

THE WATER SUPPLY

There is no point in a plumbing system unless there is an adequate supply of fresh water. Hence, perhaps the best place to start when you think of plumbing is right at this factor. If you are building where there is a convenient city water main, your water supply is no problem. After the system is installed in the house, it is connected to the water main. The job of connecting the house line to the main is usually done by the city or the water company and there is a slight fee charged. If you do not live near city water, you have to think about some other source for the water supply—wells, rivers, lakes or springs.

Drilled Wells

By far the most efficient private water supply in most cases is that obtained from a drilled or artisian well. See Fig. 1. These wells are sunk deep into the ground to the point where they reach water-bearing stratum. This may lie many hundreds of feet under the surface. These wells are expensive and may possibly cost over $1000 before you have obtained a sufficient flow of water. They cannot be sunk by the home-owner, for the drilling requires special power equipment. But in spite of their high costs, drilled wells are usually the best, because they can be counted on to supply plenty of fresh water and they will not go dry during drought periods as will wells that are not very deep. Along with the well you will also need pumping equipment. This consists of a deep-well pump run by electricity and a storage tank.

Dug Wells

Dug or shallow wells can be dug by hand and cost far less than drilled wells. See Fig. 2. In soil where water is not far below the surface, this type of well may prove perfectly adequate for small homes and where the demand for water is not too great. The well need only be dug deep enough to insure an adequate flow of water. The inside of the well is lined with rocks or concrete tile, and it should be provided with a tight fitting lid to keep out insects and rodents. A shallow-well pump and a storage tank are required.

For years, dug wells provided an adequate water supply for most rural homes. The chief objection to them today is that, while they provided an adequate supply of water in the days when bathing was regulated to Saturday nights and the over-all water demand of a house was slight, they often are not able to keep up with the load imposed on them by regular daily bathing, automatic washing machines and garbage-disposal units.

If you plan to dig a well yourself, the help of another man is required. One does the digging while the other hauls up the dirt and rocks in a bucket. Great care should be taken in doing this work because in certain soil conditions there is the constant and very real danger of cave-ins.

Driven Wells

This type of well is common in sections of the country where it is possible to get down to the water-bearing stratum without running into hard rocks. The well consists of 2″ or 3″ extra-strength wrought-iron pipe. One end of the pipe is fitted with a drive-well point. The other end of the pipe is fitted with a drive head. The pipe is then sunk into the ground by striking the drive head with a maul. When one sec-

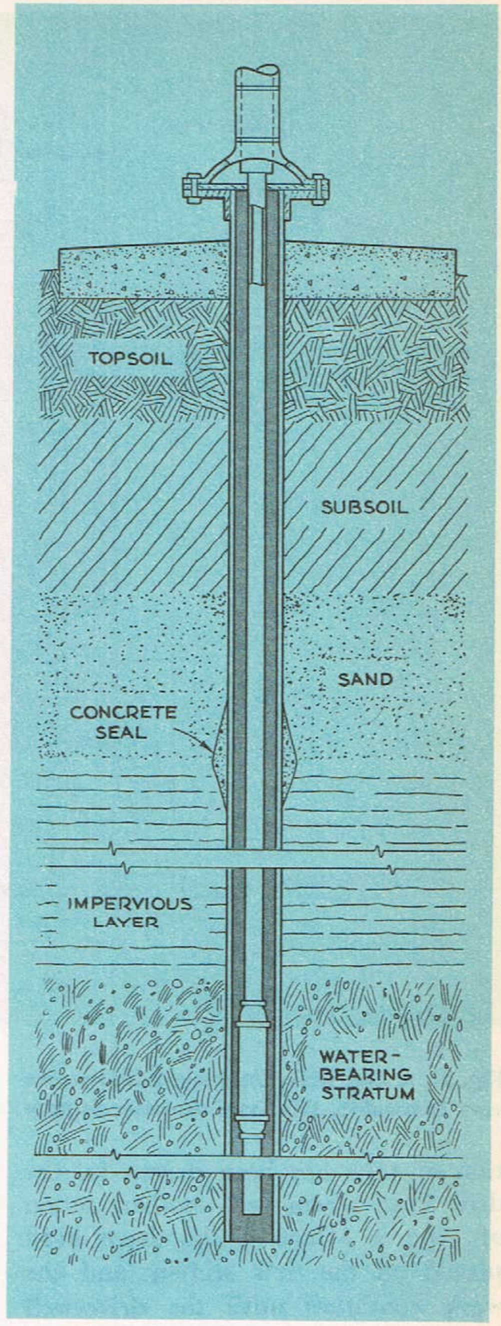

Fig. 1. A drilled well.

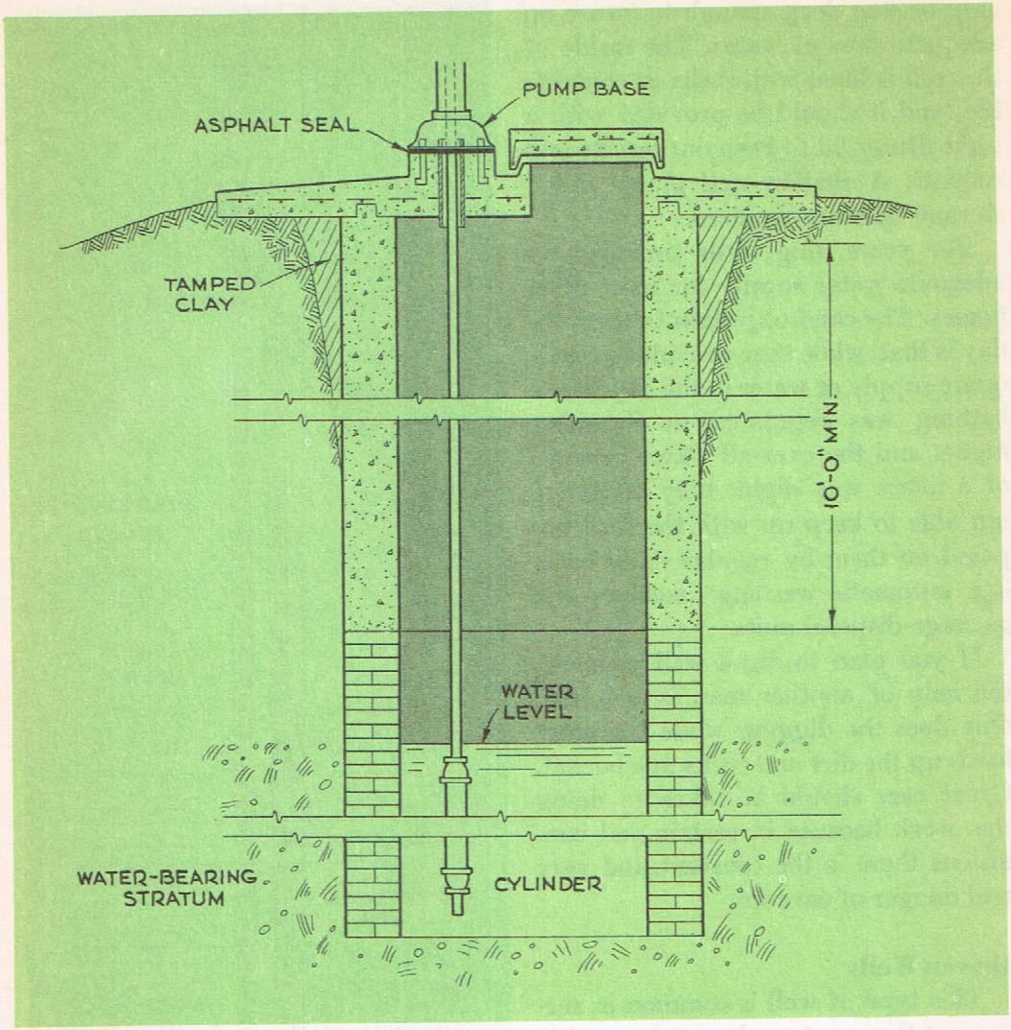

Fig. 2. A dug well. Unless conditions are very favorable, this type of water supply may have difficulties in meeting the water demands of modern housekeeping.

tion of pipe has been driven in, the drive head is removed, another section of pipe is attached, the drive head placed on the new section, and the work continues until the drive-well point strikes water. This method of making a well is impossible in soil where there is a lot of rocks because if the point strikes a rock, it must be pulled back out and started at some other point. The drive point cannot be driven through rock.

In spite of science, in spite of local characters with their divining rods, digging a well and finding an adequate supply of water at the bottom is still far from being a sure thing. It often happens that while your next door neighbor found an abundant supply of water with a 14-foot dug well, you may have to go 15, 20, 25 or even 30 feet and will end up with nothing more than a dry hole in the ground. The same holds true for drilled wells; where one will bring in an ample flow of water at 300 feet, another one in the next lot will have to go down 400 or 500 feet or even deeper.

Sometimes the various mineral conditions in the water will play a part in the decision of which type of well is best. There may be a vein of iron deep in the ground that affects the water coming from drilled wells and necessitates expensive filtering equipment before the water can be used for domestic purposes. On the other hand, a dug well in the same location might be free of iron but have the unfortunate habit of going dry at times. So before you select any particular type of well, get as much information regarding the local water conditions as you can. Check with neighbors, plumbers and local well-diggers, and find out which type of well seems to offer the best possibilities.

Lakes, Rivers and Springs

Many homes located near surface water draw their water supply for all purposes other than drinking and cooking from a lake, river or spring. Bottled water is used for drinking and cooking. Providing the supply is moderately pure, there is nothing wrong with this arrangement except that it is not always convenient.

Springs are often utilized for drinking as well as for the other purposes. Here again as in the case of dug wells, unless the spring has a very good flow it may not be able to keep up with the demands of the modern home.

Once you have a water supply, have the water tested before you do another thing. You not only want to have it tested so that you are sure it is pure for drinking, but you also want to know what minerals and chemicals it contains because this mineral and chemical content is an important factor in deciding which type of pipe to use for the house plumbing system.

TYPES OF WATER PIPE

In spite of what you may hear, be told or read, there is no one metal used for water pipes that is suitable for every water condition that you might run into. To be sure, certain types of pipe have definite advantages over others, but in so far as the pipe's ability to withstand the corrosive action of certain kinds of water goes, it is impossible to generalize.

Practically any water taken from the ground will have certain corrosive

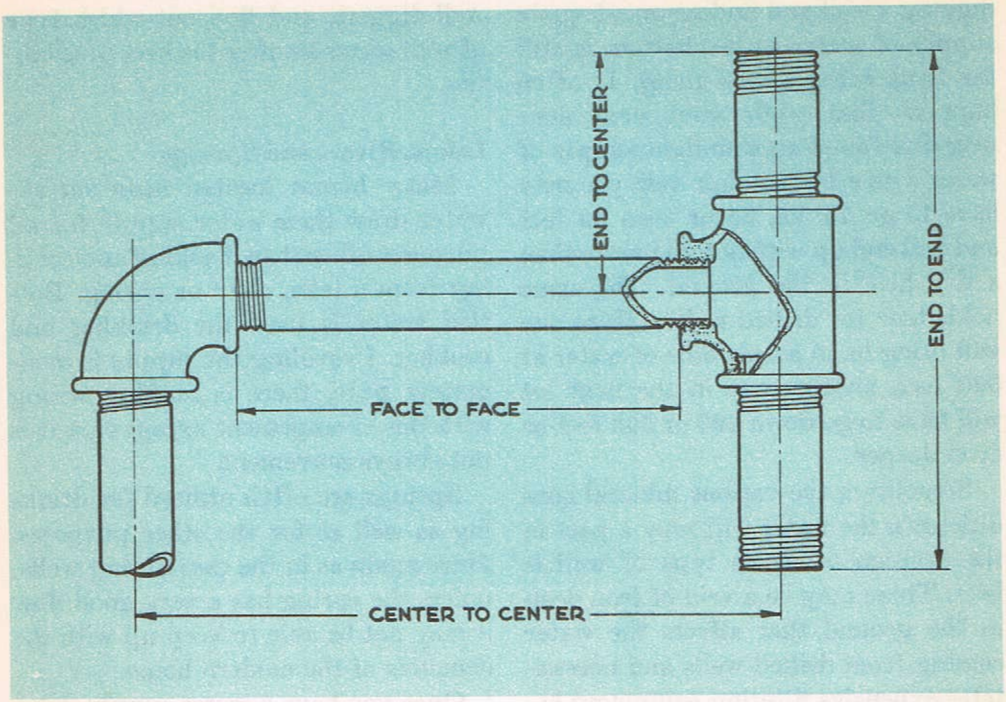

Fig. 3. When cutting and measuring iron pipe, be sure to take into account the fact that the pipe will extend some distance into the fitting.

characteristics. In the case of iron pipe, the corrosive quality of the water will cause rust. If the water is very corrosive, the rust inside the pipe will in time become so great as to completely clog up the lines and prevent water from flowing through. It will also cause the pipes to fail in time—usually at the joints, for here the metal is at its thinnest. In the case of yellow brass pipe, water containing certain specific corrosive elements will dissolve the zinc from the copper-and-zinc alloy and cause the pipe to fail. Red brass and copper are highly resistant to corrosion, but even they can be damaged by certain types of water.

Hard water, that is, water containing a high percentage of mineral salts, is usually less corrosive than soft water. On the other hand, these minerals in the water will attach themselves to the sides of the pipe, thus reducing the flow of water. This is more apt to happen in the hot-water system than in the cold supply because as the water is heated, it tends to release these minerals more readily than when cold.

Once you know what minerals and chemicals are contained in the water, select the pipe that will give the longest service. Even if this should be the most expensive type of pipe on the market, it will still be cheaper in the

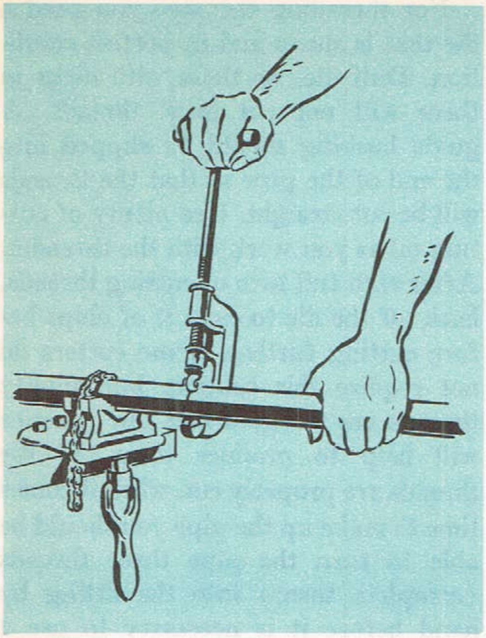

Fig. 4. You will need a pipe vice and cutter if you use galvanized-iron pipe for the plumbing system.

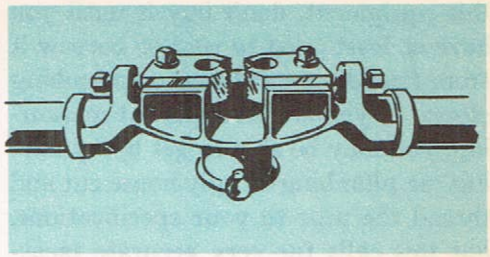

Fig. 5. Stock and die used for cutting threads on iron pipe.

long run than having to replace the plumbing system in a few years. On the other hand, when an inexpensive type will give as good service as the expensive, it is sensible to select the cheaper.

Fresh-Water Supply Pipes

The three most popular pipes used for the house fresh-water supply—and this includes the hot as well as the cold system—are galvanized steel, brass pipe and copper tubing. Of these three, galvanized steel is the least expensive and has been used for years in domestic plumbing systems. A somewhat similar type of pipe but one that is more expensive and more resistant to corrosion is genuine wrought-iron pipe.

GALVANIZED STEEL PIPE

Making Joints

Galvanized steel pipe comes in lengths of 20 feet. Sections of pipe are joined together with threaded fittings. These threads will extend a certain distance into the fittings or couplings and this fact must be taken into consideration when measuring and cutting the pipe. To allow for the distance that the pipe extends into the fittings at each end, the pipe must be cut a little longer than the actual distance between the fittings. See Fig. 3. Allow about ½″ for fittings such as valves, couplings and elbows at each end of ½-inch pipe. Allow 9/16″ for 1-inch pipe and 11/16″ for the 2-inch pipe used in the drainage system.

To work with galvanized steel pipe you are going to need a pipe vice, a pipe cutter, (Fig. 4) a reamer, a die for cutting the pipe threads and two pipe wrenches for making up the pipe. See Fig. 5. If you do not have any of this equipment, don't buy it until you have at least tried to rent or borrow it from friends or hardware or plumbing stores. If you are an expert at measuring, you may be able to get by by having the plumbing-supply house cut and thread the pipe to your specifications, but this calls for very accurate measurement.

Much of the trouble found in plumbing systems with galvanized steel pipe is due to the fact that the pipes were not properly cut and threaded. Poor threads are almost sure to cause leaks at the joints. Unless the pipe is properly threaded, a good joint cannot be obtained, and unless the pipe is cut right, it is impossible to get it properly threaded. The tool used for cutting galvanized steel pipe must have a good sharp cutting wheel. Be sure that the cutter is properly centered and that the cut is made at the exact point marked on the pipe. The first cut must be square. If it is not, then make a fresh start. After the pipe has been cut, ream it out to remove the burr left by the cutting. This is an important step because if these little burrs are left inside the pipe, they will collect sediment and this may in time cause a serious stoppage.

For threading the pipe you need a die that is sharp and in perfect condition. Dull dies or those with nicks in them will not cut good threads. A guide bushing should be slipped into the end of the pipe so that the threads will be cut straight. Use plenty of cutting oil as you work with the threader. After each full turn of cutting threads, back off the die to clear it of chips before cutting further. Some cutters do not require this caution, but quality threads are the goal and this practice will help to produce them. If the threads are properly cut, when it comes time to make up the pipe you should be able to turn the pipe three threads (complete turns) into the fitting by hand before it is necessary to use a wrench. The explanation of this is that pipe threads are tapered so that the deeper the threads extend into the fitting the tighter the joint becomes. Actually, a well-cut threaded joint should be absolutely water tight by itself, but to take care of any small irregularities in the threads, it is wise to use pipe dope or pipe compound over the external pipe threads. Do *not* get any of this compound on the internal threads or it may cause an obstruction in the line.

BRASS PIPE

Brass pipe is somewhat more expensive than galvanized steel pipe. On the other hand, you can use brass pipe one size smaller and still get the same volume of water as with the larger galvanized steel pipe. This is because the inside of brass pipe is smooth while the interior of galvanized steel is rough. A rough interior causes a certain amount of friction as the water flows through and therefore produces a slow-down. Brass pipe is cut and threaded in the same manner as galvanized steel pipe. While it is possible to use the same cutter and dies for brass as for steel, special equipment is available that is intended only for work with brass and this should be used when possible. These cutters and dies, because they are made for work in brass which is a soft metal, should *not* be used on galvanized steel pipe. Ordinary pipe wrenches can be used to assemble brass pipe but they will leave burrs on the outer surface, which are a sign of less than perfect workmanship. For a first-class job, special friction vices and wrenches should be used with brass pipe so that the surface is not damaged.

In making up joints, use wicking as well as pipe compound. The wicking should be twisted around the external threads in the same direction that the threads are turned into the fitting.

COPPER TUBING

Copper tubing has one great advantage over either brass or galvanized iron and that is the ease with which it can be installed. See Fig. 6. Tubing comes in long rolls up to 100 feet in length. See Fig. 7. The tubing is strong enough to withstand handling but it is also soft enough so that it can be bent around obstructions, saving both time and the cost of various fittings. This is a great help for the amateur plumber because with rigid pipes it is necessary to have the exact measurements for a run of pipe between two fittings, but with copper the tube can be cut a little too long and then be bent slightly until it is just the right length. Copper tubing, like red brass, will withstand very well the corrosive elements found in most water.

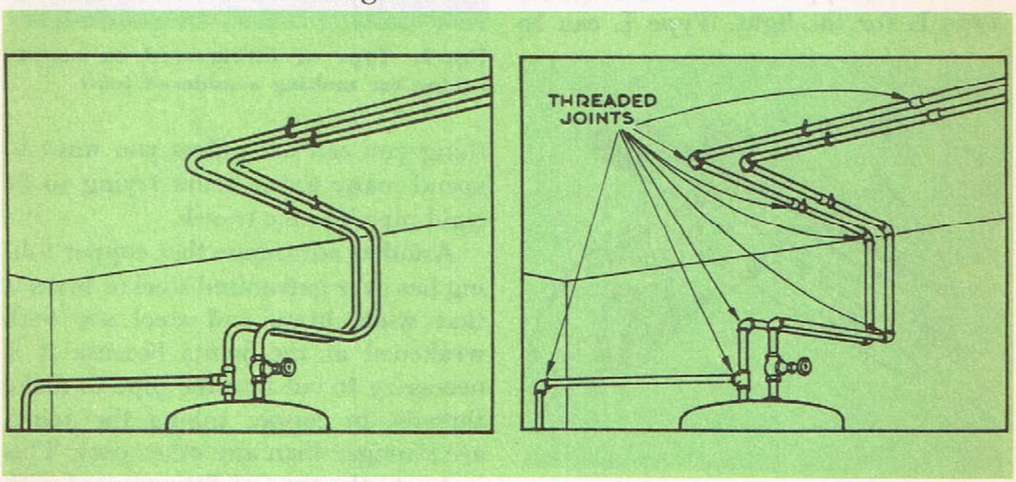

Fig. 6. Copper tubing (left) has a great advantage over rigid pipe (right) in that the copper tubing can be installed with a minimum of fittings.

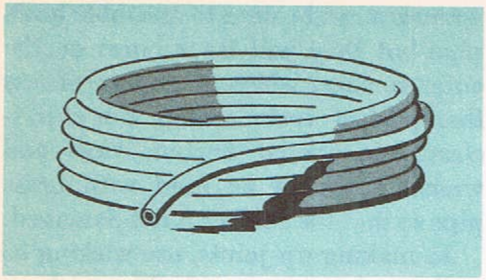

Fig. 7. Copper tubing comes in rolls up to 100 feet in length.

One common mistake made about copper tubing, however, is the belief in its ability to withstand freezing. It is true that water inside soft-drawn copper tubing can be frozen several times before the tube itself is damaged, but repeated freezings will burst it eventually. Hard-drawn tubes will be damaged by freezing just like other types of rigid pipe.

Copper tubing is either hard drawn or soft drawn. There are also two wall thicknesses, type K for the heavy and type L for the light. Type L can be

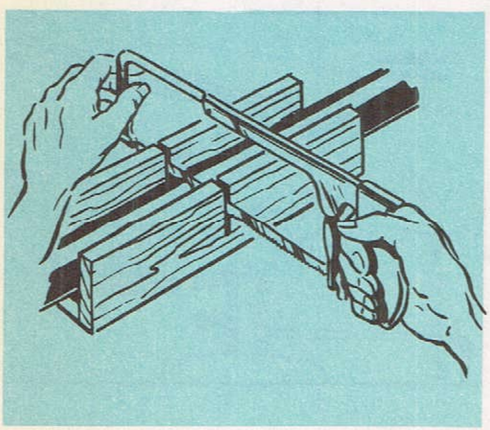

Fig. 8. Cutting copper tubing with a hacksaw and a simple wood jig.

used in most instances, unless the water happens to be extremely corrosive, in which case the heavier type K should be used. Tubing comes in sizes from ⅛″ to 2″. Tubing can be used for the entire system, including the service entrance. In fact, if you had difficulty in digging a trench from the house to the source of water because of large rocks and it is impossible to get a straight trench, copper tubing is about the only

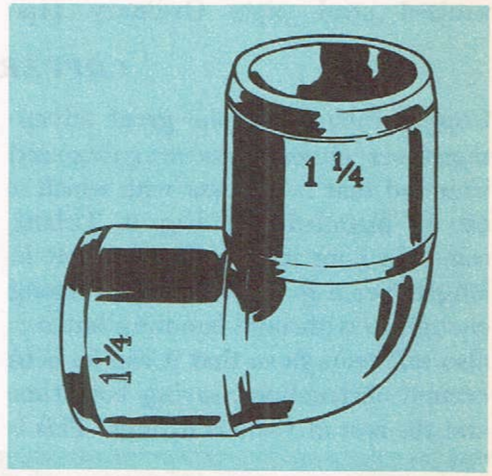

Fig. 9. Type of fitting used on copper tubing for making a soldered joint.

thing you can use unless you want to spend many extra hours trying to fit rigid pipe into the trench.

Another advantage that copper tubing has over galvanized steel or brass is that while brass and steel are both weakened at the joints because it is necessary to cut into the pipe to make threads, in copper tubing the joints are stronger than any other part. This is due to the type of fittings used with copper.

There are two methods of making joints in copper tubing: one with a soldered type of fitting, and the other with a flanged compression type of fitting. Copper tubing can be cut with a hacksaw. Considering the fact that it is going to be necessary to do considerable cutting, it is well worth the effort to make a jig somewhat like a miter box so that the pipe can be cut with ease. See Fig. 8. There are also special tube-cutters that can be used for this purpose. Care must be taken when working with soft copper not to squeeze it in a vice or with a wrench so that it becomes dented, because this would act as an obstruction. If the end of the tubing is damaged in handling, it can be restored to shape with a sizing tool. After the tube has been cut, ream out the burr.

Soldered Fittings

As shown in Fig. 9, the fittings for soldered joints are made so that the openings at each end are slipped over the copper tubing. Before this is done, the ends of the tube should be carefully cleaned with steel wool or emery cloth until the metal is shiny. The inside of the fitting should be thoroughly cleaned in the same manner. See Fig. 10.

If the surfaces of both the tube and fitting that are to be soldered are not clean you will not get a good joint.

After the metal has been polished until it is bright, apply a non-corrosive soldering flux to the tube and the fitting where they have been cleaned. See Fig. 11. Slip the fitting over the end of

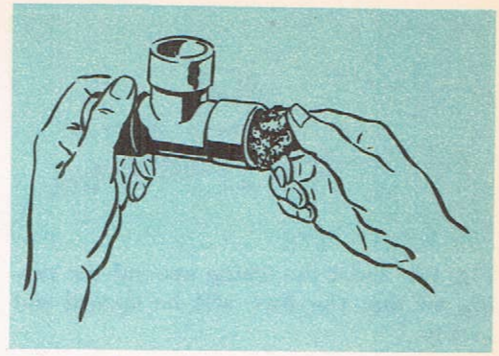

Fig. 10. Polish both fitting and end of pipe with steel wool until the metal is bright.

the tube and then turn it around several times so that the flux will be spread out evenly and all portions of the metal will be covered. See Fig. 12. The next step is to solder the joint. Some fittings are provided with a little hole in the side into which the wire solder is fed. Other types have no such hole, and the solder is fed in around the edges of the fitting. See Fig. 13. In either case, the

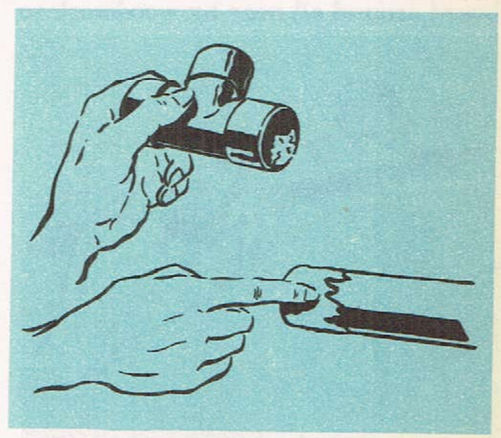

Fig. 11. Flux should be applied to the inside of the fitting as well as to the outside of the pipe.

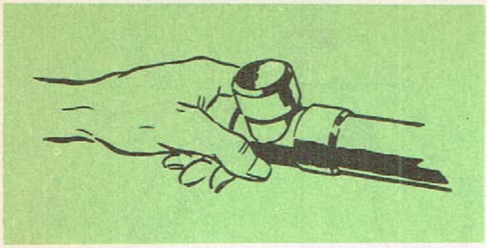

Fig. 12. Twist the fitting around the tubing so that the flux will be spread out evenly.

soldering procedure is about the same. The fitting must be heated and this can be done either with a gasoline blowtorch or an air-acetylene torch. See Fig. 14. There is some advantage in using the acetylene torch because it produces a more concentrated flame and, therefore, can be used more conveniently in close quarters where there is woodwork or other inflammable material present. But whichever type of torch is used, *be careful* about fire. The best plan is to put pieces of asbestos board around all near-by woodwork so

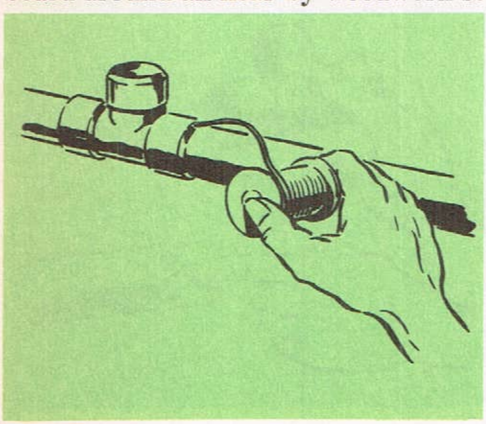

Fig. 13. If the fitting has been properly heated, the solder will be drawn into the joint until the joint is full.

that there will be less danger of setting something on fire. Hold the flame of the torch on the fitting and tube until the flux begins to boil. After this, remove the torch and start feeding in the wire solder either through the hole in the fitting or along the edges. If the joint is not hot enough, the solder will not be drawn into it, so be sure that both fitting and tube are properly heated. On the other hand, if you get the metal too hot, you will not get a

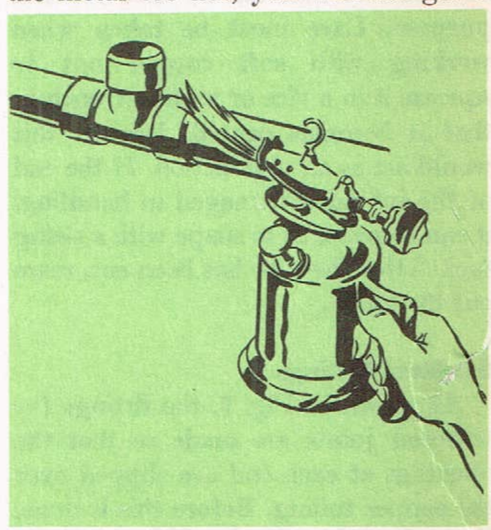

Fig. 14. The fitting must be heated sc that the solder will run into the joint.

good joint. Feed the solder into the fitting and when no more is drawn up it means that the fitting is properly soldered. A ring of solder will appear around the edge of the fitting. Wipe the excess solder off with a brush. See Fig. 15. Give the joint time to cool, and then rub the ring of solder down with steel wool to make a neat job of it. Usually, you will have to make at least two joints at the same fitting. In such cases, it is necessary to wrap the joints that you have previously soldered with wet cloths so that the fitting can be

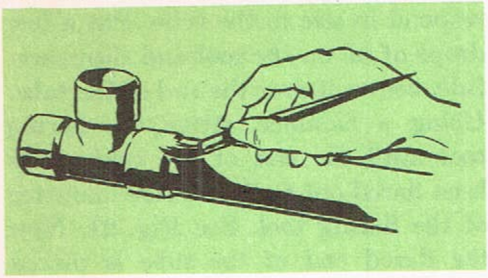

Fig. 15. A brush can be used to remove excess solder from around the edge of the fitting.

heated up again to make the succeeding joints. If this is not done, the first joint will melt when you re-heat the fitting for the second or third one. See Fig. 16.

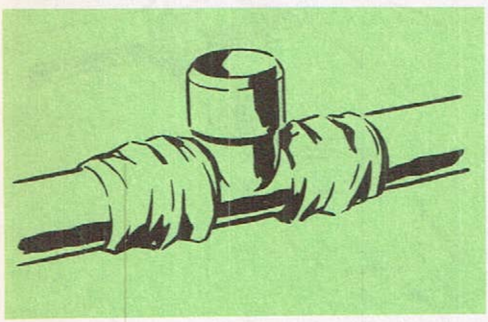

Fig. 16. When it is necessary to make additional connections with soldered fittings, cover the soldered joints with wet rags so that the joints already soldered will not melt when the fitting is heated.

Flared Fittings

The other method of making up joints in copper tubing is to use the flared fitting. See Figs. 17 and 18.

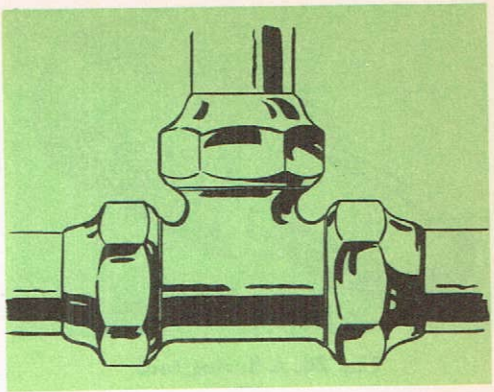

Fig. 17. A completed flared fitting.

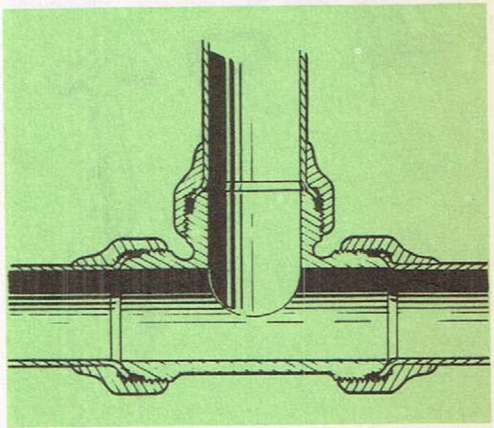

Fig. 18. The interior view of a flared fitting.

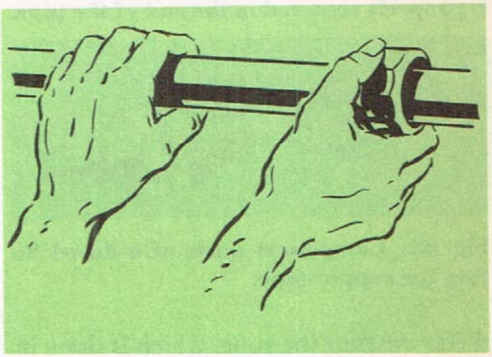

Fig. 19. Slip the union nut over the pipe before you flare the pipe.

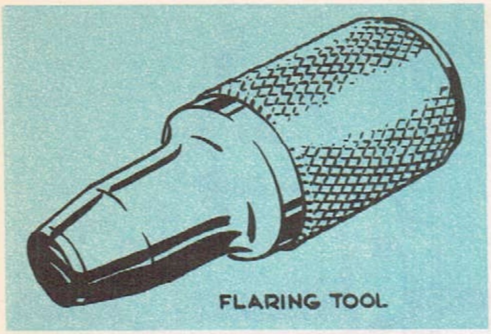

Fig. 20. A flaring tool.

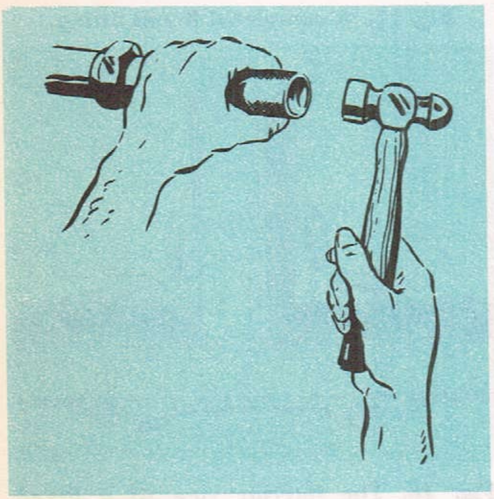

Fig. 21. Make sure that the flaring tool is properly centered in the end of the pipe.

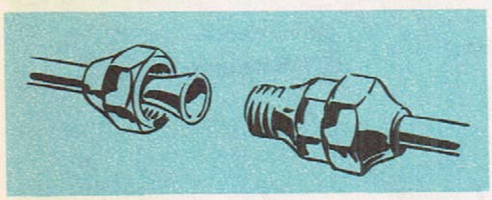

Fig. 22. Component parts of a flared fitting for copper pipe.

After cutting the tube, which is done in the same manner as for soldered fittings, the first step is to slip a sleeve nut on the section of tubing. See Fig. 19. Next, the end of the tubing is burred and then flared out with a flaring tool. See Fig. 20. This tool must correspond in size to the tube. Put a few drops of oil on the tool and then carefully center it over the end of the tube. Using a hammer, strike the flaring tool until the end of the tubing has been flared out to the outside diameter of the flaring tool. See Fig. 21. Now the flared end of the tube is placed (See Fig. 22) over the fitting and the sleeve nut is run up and tightened with a wrench. See Fig. 23.

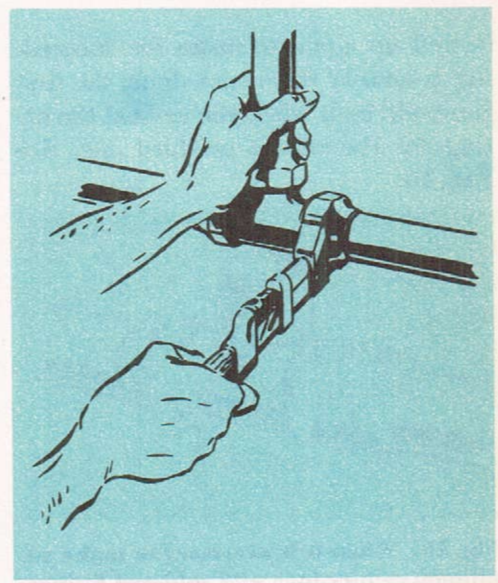

Fig. 23. Tightening up a flared joint with a monkey wrench.

The best practice is to use the same type of pipe throughout the fresh-water system. There is litle to be gained by using half copper and brass and half galvanized steel. In fact, connecting copper to steel may cause trouble. Brass and copper, however, can be used in conjunction with one another without harm.

PIPE SIZE

The size of pipe used for the fresh-water system will depend not only on the type of pipe used but also on the pressure of your supply.

If your water pressure is not very strong, the distribution mains should be 1″ or 1¼″. If the supply pressure is high, the mains can be reduced to ¾″, but this may not always be sufficient to take care of future expansion of the plumbing system, such as might arise if another bath were to be installed. In the long run, it is probably best never to use a supply main under 1″. Short branch-lines to the washstands, toilets, etc., may be ½″ pipe, and the kitchen sink and laundry should have ¾″ lines. These sizes are for galvanized steel pipe. If brass or copper is used, pipe a size smaller can be used.

CAST-IRON SOIL PIPE

Cast-iron bell and spigot pipe over 2″ is used for the drainage inside the house and for the vent system. These pipes come in standard lengths of 5″ and up to 6″ in diameter. For most purposes, a 4″ pipe will be sufficient except for the kitchen sink-drain, where a 2″ pipe is used.

Cast-iron pipe is cut with a cold chisel. See Fig 24. First of all, the pipe should be lightly scored around the point where the cut is to be made. Make this line as square as you can. Now, with the pipe supported on some 2″ x 4″'s, start making deeper cuts along the line with the cold chisel. Turn the pipe after each blow. After you have gone around several times the pipe will break clean at the cut line. Before you assemble the pipe, strike it at each end with a hammer. If you get a clear ring, the pipe is sound.

Vertical Joints

Making up the joint in cast-iron pipe is a complicated business, but with a little practice you should not find it too

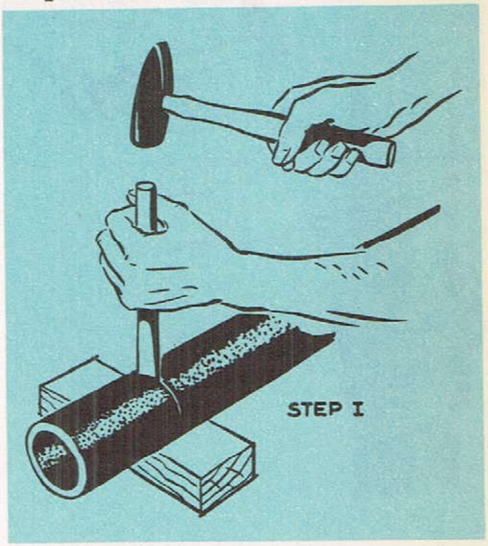

Fig. 24. Cutting soil pipe with a cold chisel.

difficult. The ends of pipe to be joined should be clean and bone dry. When working in a vertical line, the bell end of the pipe should face up. Insert the spigot end of the next section of pipe into the bell end and then secure this length of pipe to a framework with metal strips or by some other means so that it will not fall over. Now pack twisted oakum into the bell until it is about 1″ from the top. For a 4″ soil pipe, you will need about 5 feet of oakum for each joint. The oakum should be solidly packed into the bell with a tool called a yarning iron. See Figs. 25 and 28. If any of the fibers of the oakum protrude, they should be burned off with a blow-torch. After the oakum is well packed into place, the joint is ready to be caulked with lead.

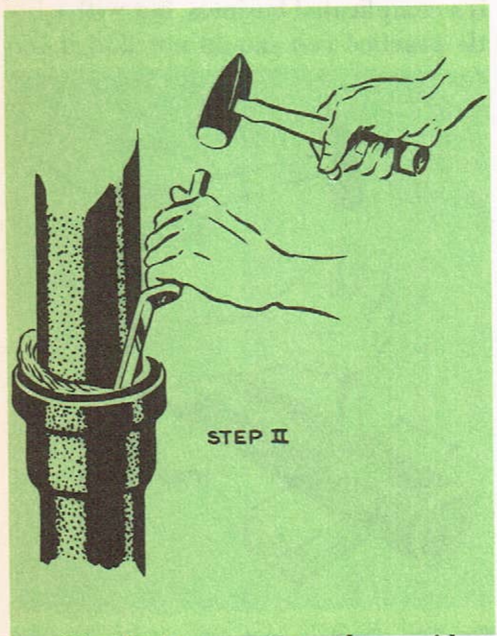

Fig. 25. Packing in the oakum with a yarning iron.

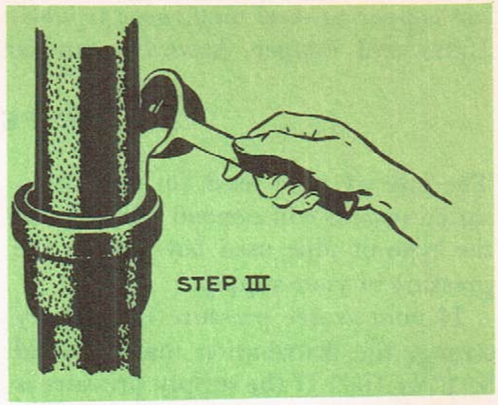

Fig. 26. Pouring in the hot lead.

You will need about 3 pounds for 4″ pipe. Needless to say, enough lead should be melted at one time for several joints. Lead can be melted in a gasoline-fired melting pot. When the lead is molten, pre-heat the ladle that is used to carry the lead so that it will not chill the molten lead before you get it to the joint. Take the hot ladle and push back some of the dross or slag that lies on the surface of the lead and then scoop up a ladleful of lead. Do not disturb the molten lead in the pot any more than is necessary. The lead must be poured into the joint in one operation. Move the ladle around as you pour so that the joint is filled uniformly. See Fig. 26. Do not pour hot lead on a wet joint because the moisture will cause the hot lead to fly out. It is wise to keep your face away from the joint while you pour so that if any of the lead does fly out it will not hit you. The joint should be completely filled until the lead is a little above the rim of the hub—about ⅛″ or so.

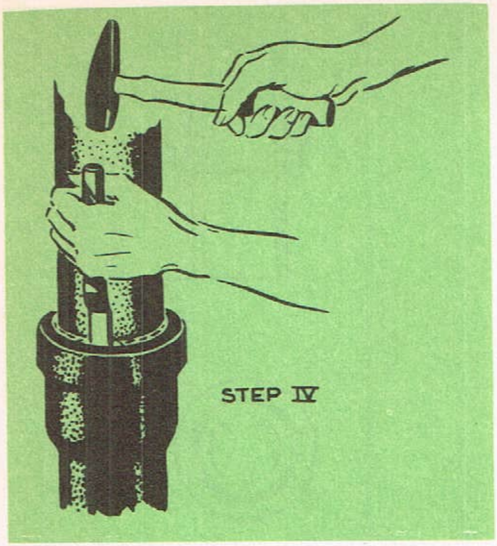

Fig. 27. Caulking a vertical joint.

The next step is the final caulking of the joint and this can be done just as soon as the lead is cool. Caulking backs the lead firmly inside the joint. See Figs. 27 and 28. It must be done because lead will shrink slightly as it cools and, therefore, unless the joint is caulked it will not be tight. The first step in caulking is done with an outside-caulking tool. Place the end of this tool on the lead and then strike it gently with a hammer. If you strike it too hard, you may jar the lead loose from the joint. Tap all around the leaded joint and then change to an inside-caulking tool. Heavier blows can be struck with this. Finish off the caulking with a caulking tool that fits into the space without binding.

When working with a section of pipe that has been cut, great care must be taken to be sure that the cut end is properly centered in the bell of the section below. See Figs. 29 and 30. If the end is not properly centered, you will not get a good joint.

Some codes permit joints in cast-iron pipe to be made with a commercial jointing-compound that requires no caulking or with shreaded lead, which is calked cold.

Horizontal Joints

For making horizontal joints, the same general procedure is used as for the vertical joints. The joint is first packed with oakum. To introduce the lead, a contraption called a joint-runner is required. See Fig. 31. It is made of asbestos and is wrapped around the pipe just above the hub. Get the runner on as tightly as possible; the clip that holds the runner together should face up. This is the point at which the lead is poured in. Tap the runner after it

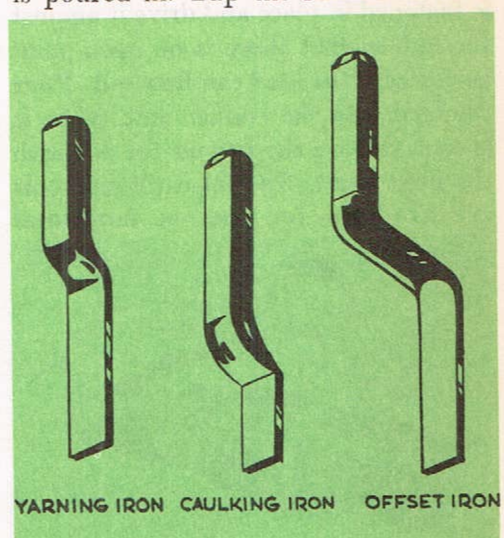

Fig. 28. Three tools you will need to make up joints in cast-iron soil pipe.

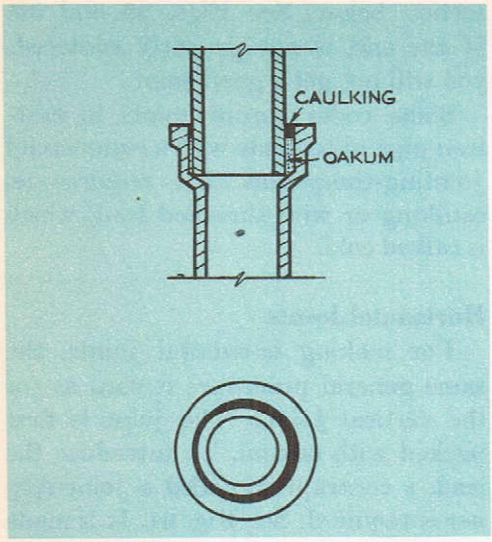

Fig. 29. Care must be taken in making up a joint with a section of pipe that has been cut, to get the end properly centered in the bell end. The joint shown above is off center and may cause trouble.

is fastened in place and drive it against the hub so that there is no open joint here where the lead can flow out. Pour the lead into the runner and, when it is cool, remove the runner for use with the next joint. Special caulking tools are available for use on horizontal

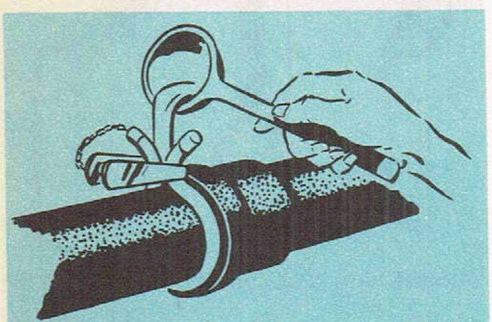

Fig. 31. Pouring lead for a horizontal caulked joint by means of a joint runner.

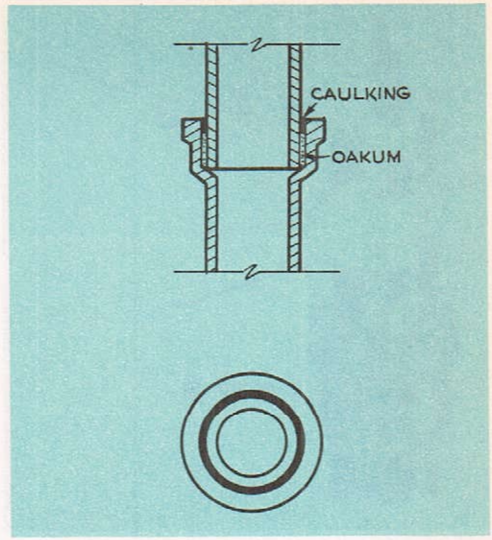

Fig. 30. Correct method of centering the end of cut pipe for making a caulked joint.

joints so that the underside of the joint can be caulked.

Threaded Joints

If you wish to save yourself the job of having to make up caulked joints in cast-iron pipes, you can use special pipes of this type with threaded joints. They are especially designed for drainage work so that the interior of the pipe at the fitting or joint will be perfectly smooth and free from shoulders that might catch solid matter passing through the line. Of course, this type of pipe is more expensive than the bell and spigot type and more care is required in cutting and fitting the sections together. On the other hand, the same degree of skill is not required in making the joints, the work goes faster and is much neater.

Wiped Joint

This joint is used when it is necessary to join lead pipe to lead or to brass or copper. The first step is to prepare the two sections of pipe as shown in Fig. 32. This can be done with a rasp. The ends of the pipe should then be painted with plumber's soil for 4″ or so. After the soil is dry, the

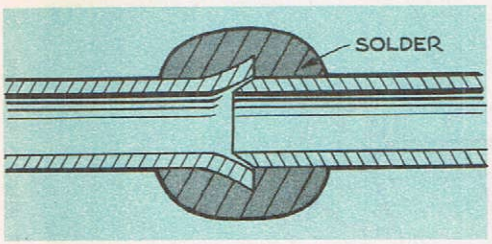

Fig. 32. How the ends of pipes should be prepared for making a wiped joint.

pipe should be shaved about 1¼″ back until the metal is bright. Rub candle wax over the shaved portion to prevent it from tarnishing. Both ends of pipe should be treated in this manner.

Solder used for wiping joints should be 60 per cent lead and 40 per cent tin. The solder should not be overheated.

Before the solder is poured, put the two sections of pipe together and support them above the floor so that there are at least 4 inches under the joint.

The cloth used to make the joint is herringbone ticking, and it should be folded until you have a pad with 16 thicknesses of ticking. This should be warmed and then rubbed with mutton tallow without salt. The pad is held under the joint while the solder is poured slowly back and forth over the top of the joint. The solder that runs off the sides can be caught in the cloth and patted against the underside. The pouring continues until the solder on the joint becomes plastic. When the solder over the entire joint has become plastic, the pouring ceases and the plastic is worked into a joint that has the shape of an egg.

Solder that runs off the joint and onto the floor can be reheated and used again.

INSTALLING THE PLUMBING SYSTEM

Before you can do much in the way of getting the plumbing system installed, you must obtain the roughing in measurements for the type of fixtures that you are going to install. These roughing plans will give you all the dimensions of the fixtures, their minimum height from the floor and distance from the wall, and the location of the holes in the wall and floor for the supply lines and waste pipes. You can get these measurements from your dealer when the fixtures are purchased.

If your first floor is made of wood, the first thing you should do is to make the openings in the floor of the bathroom and kitchen so that waste lines to the fixtures can be brought in. Holes can be made by first drilling through the flooring with a brace and bit and

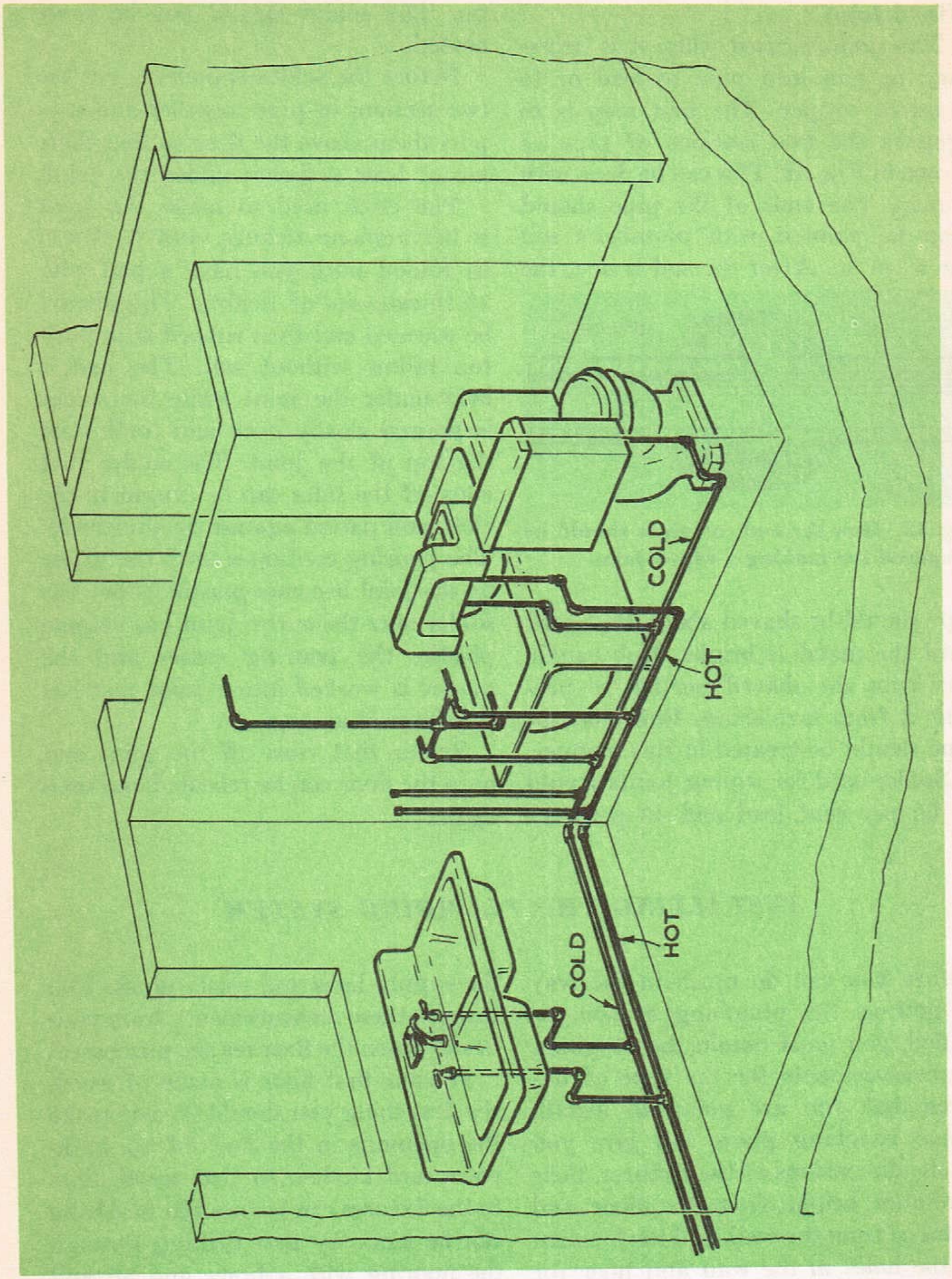

Fig. 33. Layout for the fresh-water supply system.

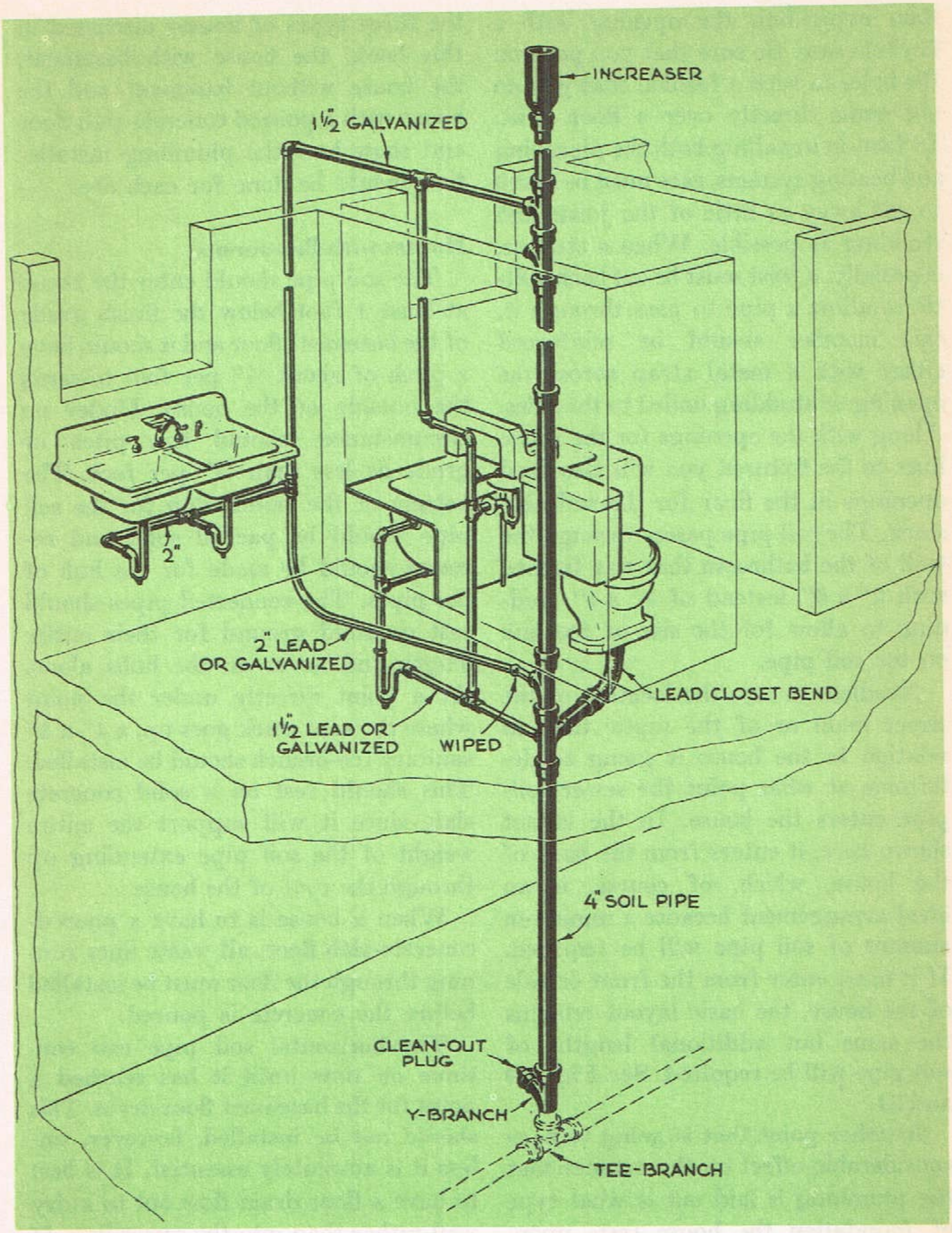

Fig. 34. Layout for connections to the soil stack.

then expanding the opening with a keyhole saw. Be sure that you position the holes in such a fashion that you do not come directly over a floor joist. In fact, in installing both the plumbing and heating systems, care must be taken to cut away as little of the joists and studding as possible. When a stud or, especially, a joist must be cut back a little to allow a pipe to pass through it, this member should be reinforced either with a metal strap across the opening or studding nailed to the sides. Along with the openings for the waste lines to the fixtures, you will also need openings in the floor for the soil-pipe stack. The soil pipe passes through the wall of the bathroom that was framed with 2″ x 6″ instead of 2″ x 4″ studding to allow for the size of the hub on the soil pipe.

Needless to say, the location of the street main or of the septic tank in relation to the house is going to determine at what point the sewer soil-pipe enters the house. In the layout shown here, it enters from the back of the house, which, of course, is an ideal arrangement because a minimum amount of soil pipe will be required. If it must enter from the front or side of the house, the basic layout remains the same but additional lengths of soil pipe will be required. See Figs. 33 and 34.

Another point that is going to have considerable effect on the manner that the plumbing is laid out is what type of foundation the house rests upon. For the purpose of clarity, let us take the three types of houses discussed in this book, the house with basement, the house without basement and the house with a poured concrete-slab floor and show how the plumbing installation should be done for each one.

Homes with Basements

The soil pipe should enter the house at least 1 foot below the finish grade of the basement floor and it should have a pitch of about ¼″ per foot towards the outside of the house. Under no circumstances should this pitch or grade be less than ⅛″ per foot. The bottom of the trench dug for the soil pipe should be packed solid and recesses should be made for the hub of the pipes. The connected pipes should rest on solid ground for their entire length and never on the hubs alone. At a point directly under the point where the vent stack goes up, a 4″ x 4″ sanitary tee-branch should be installed. This should rest on a solid concrete slab, since it will support the entire weight of the soil pipe extending up through the roof of the house.

When a house is to have a poured-concrete-slab floor, all waste lines running through the floor must be installed before the concrete is poured.

The horizontal soil pipe can continue on now until it has reached a point for the basement floor drain. This should not be installed, however, unless it is absolutely essential. It is best to have a floor drain flow out to a dry well rather than into the sewer line. If the drain must discharge into the sewer line, the drain should be fitted with a deep-seal trap.

The first vertical piece of soil pipe coming off the sanitary tee-branch is a Y branch. One side of this is fitted with a brass clean-out plug so that, in the event the sewer line should become clogged, there will be an opening into it at a convenient location. If you are not going to have a basement floor drain, the end of the sanitary tee-branch can be plugged to serve as a clean-out.

The vertical stack can continue up again until it arrives at the spot for installing the branch to take care of the toilet, bathtub and washbasin drains. This branch is a double-topped T with a 2″ tapping. The next section is a 4″ x 2″ tapped sanitary tee.

The soil stack continues up farther until you reach the point where a 4″ tapped sanitary tee is installed for the vent line from the fixtures. The exact location of this tee will depend on what future plans you have for the attic. If a bathroom is going to be installed later on, this fitting should be installed above the highest fixture in the attic bath, and you will also need a double-topped sanitary tee at the bathroom floor level for the future additional fixtures. The openings in this tee should be capped until it is ready to be put into use.

In cold climates, special care must be taken with the portion of the soil pipe that is above the roof in order to prevent frost from forming inside the pipe and blocking it up. One

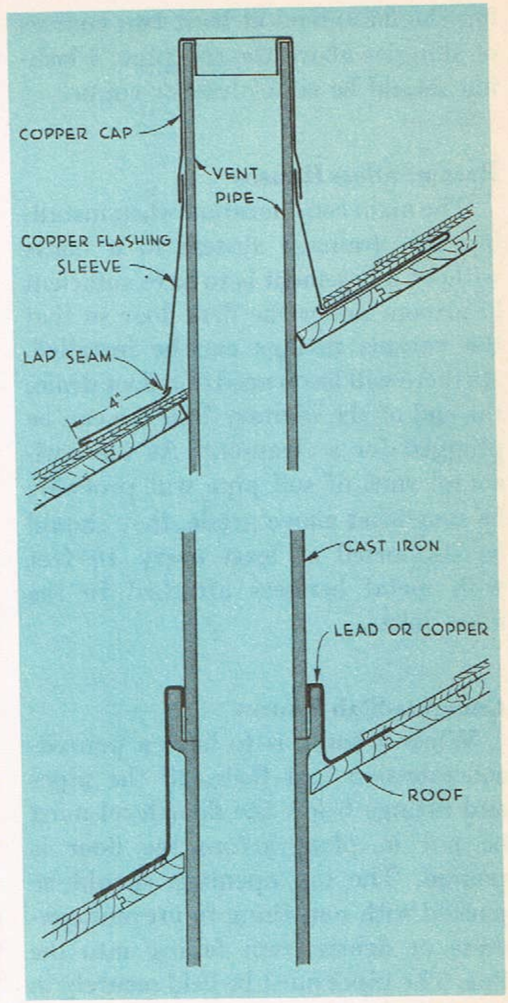

Fig. 35. Several methods of flashing around the soil pipe and roof.

method of doing this is to increase the size of the pipe by means of an increaser. The increase in size should take place at least 12 inches below the roof.

The opening between the roof and the soil pipe must be carefully flashed to prevent leaking. Fig. 35 shows several methods of flashing. The flashing should extend at least two courses of shingles above the soil pipe. Flashing should be either lead or copper.

Basementless Houses

The main consideration when installing the drainage system in a house without a basement is to have sufficient headroom under the first floor so that the various fittings can be installed. As there will be no need of a floor drain, the end of the sanitary base tee can be plugged for a clean-out. As the horizontal runs of soil pipe will probably be somewhat above grade, they should be supported at least every 10 feet with metal hangers attached to the floor joists.

Concrete-Slab Houses

When a house is to have a poured-concrete-slab first floor, all the pipes and fittings below the floor level must be put in place before the floor is poured. The top openings should be packed with something to prevent concrete or debris from falling into the line. The pipes must be held securely in place so that there will be no chance of their being moved out of position by the fresh concrete. The pipes themselves should not be encased in the concrete. Slip loosely fitting metal sleeves around them before the concrete is poured. Pipes and fittings that are to be covered with concrete must be especially durable as it will be almost impossible to replace them. Cast iron, copper, brass and lead are suitable.

Fixtures

Once the soil stack has been completed, you can go to work and install the waste lines to the various fixtures. The first one to take care of is the closet bowl and this is the most difficult one you will run into. As the closet bowl is going to rest on the floor, there is almost sure to be a slight amount of movement between it and the cast-iron waste pipe. The joint between the bowl and the pipe must, therefore, be flexible enough to take up this movement without cracking the bowl and yet be tight enough so that it will not leak. A more flexible type of joint is required when the bowl is set on a wood floor than on a concrete slab because of the relatively large amount of expansion and contraction that is to be expected.

A type of closet connection that is suitable for both concrete and wood floors consists of a 4″ lead bend that is attached at one end to a brass ferrule by means of a wiped joint. The other end is soldered to the closet-bowl floor plate, which is of brass. See Fig. 36. The joint between the bowl and the floor is made tight with an asbestos gasket and the bowl is secured to the flange by means of hold-down bolts. The brass ferrule is caulked to the hub of the cast-iron soil pipe.

As soon as you have completed the connection to the closet bowl, pack the opening with old rags and cover up the work so that it will not be damaged if something heavy drops on it. The bowl itself will not be installed until the bathroom walls have been completed. In fact, the installation of all the fixtures should be put off to the very end of the job. This should be done not only because you will find it much easier to complete the walls if the fixtures are not in place but also because the fixtures are very easily damaged and to have them lying around out of their crates while you are doing heavy work might result in serious harm to them.

The next job is to rough in the drain and vent system for the lavatory, bathtub and kitchen sink. Refer to your roughing-in dimensions and locate the position of the lavatory trap. Start here with a tee fitting and run up the vent line for the lavatory and bathtub traps. This will be made out of 1½″ galvanized pipe. As you will note, a short distance above the lavatory this line is offset to allow room for the medicine closet, which is going to be installed directly over the lavatory. The top of this line is fitted with a tee and then one side continues on to the tapped sanitary tee in the vent stack. The other side of the line continues on over to the kitchen sink, where it drops down and will be connected later on to the kitchen-sink trap.

All joints in the galvanized pipes should be made up with pipe compound so that they will be tight.

Fig. 34 shows how the bathtub and the lavatory are connected into the soil stack. In this particular case, 1½″ galvanized pipe with drain fittings has been used, but the job can also be done with lead. You may find that lead, in spite of the wiped fittings involved, will be less difficult for this job because of the fact the lead is flexible and easier to work with. If lead is used, it will have to be connected to a brass tee under the lavatory. The waste line from the bathtub and lavatory are connected into the soil stack at the double-topped fitting to which the closet is also connected.

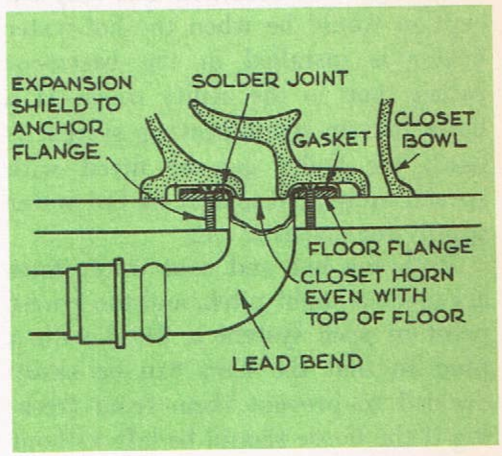

Fig. 36. How the toilet bowl is connected to the drainage system.

The waste line from kitchen sink to soil stack can be galvanized steel or lead. There should be no trouble in getting the right measurements and cutting the pipe to exact size.

Slip joints on fixtures should only be used on the fixture side of the trap. They should not be used on the sewer side because they are not tight enough to prevent the passage of sewer gas through the joint. All joints on the sewer side of traps must be either threaded, soldered, wiped or caulked.

THE FRESH WATER SUPPLY

You will find that installing the fresh water system is a simple business compared to the drainage system.

Fig. 33 shows the layout of these lines for houses with first floors and those with concrete slab floors. There will be no radical difference in the lines between houses with basements and those without basements. The only exception would be when the hot-water heater is installed in the basement rather than in the utility room. If a hot-water or steam-heating system is used, the boiler can be fitted with special equipment to heat the hot-water supply for domestic use.

Both the hot and cold water lines are given a slight pitch, and the lowest point of each system is fitted with a plug so that the lines can be easily drained to prevent them from freezing if the house should be left without heat. Considerable fuel can be saved if the hot-water pipes are insulated.

When bringing the supply lines to the bathroom lavatory, the cold-water line should be placed so that when the fixture is connected up, the faucet on the user's left will be the cold water.

All lines should be given proper support in the manner described earlier in this chapter. Pipes that are not secure will vibrate when water under pressure flows through them, and in time the joints will open up and leak.

As soon as the lines are in, the rough walls around the bathtub can be put in and the tub installed. The lavatory, kitchen sink and water closet will go in later, after all the walls have been completed. The lavatory should stand about 30 inches off the finished floor.

There is no fixed standard as to how high off the floor the kitchen sink should be. The main point to watch out for is not to have the sink too low so that someone working in it will have to bend over. The women of the house should have the deciding voice in exactly how high the kitchen sink should be.

The water-closet bowl is attached to the floor plate with bolts and the heads of these bolts are covered with porcelain caps, which are fastened in place with plaster of paris. The line between the flush tank and the bowl is made up with slip joints.

HOT-WATER HEATERS AND STORAGE TANKS

An adequate supply of hot water is a "must" in any modern home, and it will certainly pay to get the very best type of equipment for heating it. The domestic hot water can be heated by the furnace boiler or by means of an independent hot-water heater. Of course, if you use some sort of warm-air heating system, you must have an independent heater. Many persons have the idea that water heated by the furnace boiler is not costing them any-thing. This is not correct by any means. Additional fuel will be required to heat the hot water in winter, when the system is in full operation, as well as in summer, when the system only goes into operation long enough to heat the water for the plumbing system. The only type of furnace that is suitable for heating the hot-water supply all year around is one that is fully automatic, such as a gas or oil burner.

Independent hot-water heaters run on either gas or electricity. Both types are very efficient and are fully automatic. The deciding factor as to which one to use is the local gas and electric-power rates. These heaters have a built-in, insulated, hot-water storage tank. The tanks are made of galvanized iron, copper, or steel lined with glass.

The size of storage tank required will depend on the number of persons in the household.

Fig. 37 shows the method of connecting up a gas or electric hot-water heater. A tee is attached to the hot-water line at the top of the heater, and to this is attached a hot-water relief valve. A line is run from the relief valve to the floor, where it empties into a bucket, or is run outside of the house. The purpose of the relief valve is to prevent the hot-water storage tank from exploding if the pressure inside becomes too great. The line to the floor is necessary to prevent anyone's being burned by the hot water and steam escaping from the valve. When the local water supply has a very lime content, the relief valve should be placed on the cold-water entrance pipe to the heater because it will not become coated with minerals in this location as readily as if it were installed on the hot-water line.

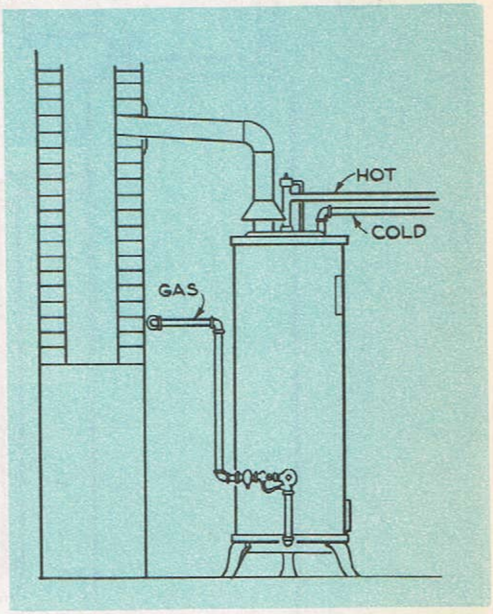

Fig. 37. Method of connecting lines to gas or electric hot-water heater.

Gas-fired heaters should be equipped with a vent from the top to allow the fumes from the heater to be carried outside. The vent stack can be of metal, but this type is not always suitable because of the condensation of the fumes on the inside of the line. It is better to use special asbestos vent pipes.

Fig. 38 shows the method of connecting a hot-water storage tank when the water is to be heated by the furnace boiler. A horizontal tank is used rather than a vertical one, and the tank should be insulated to prevent heat loss.

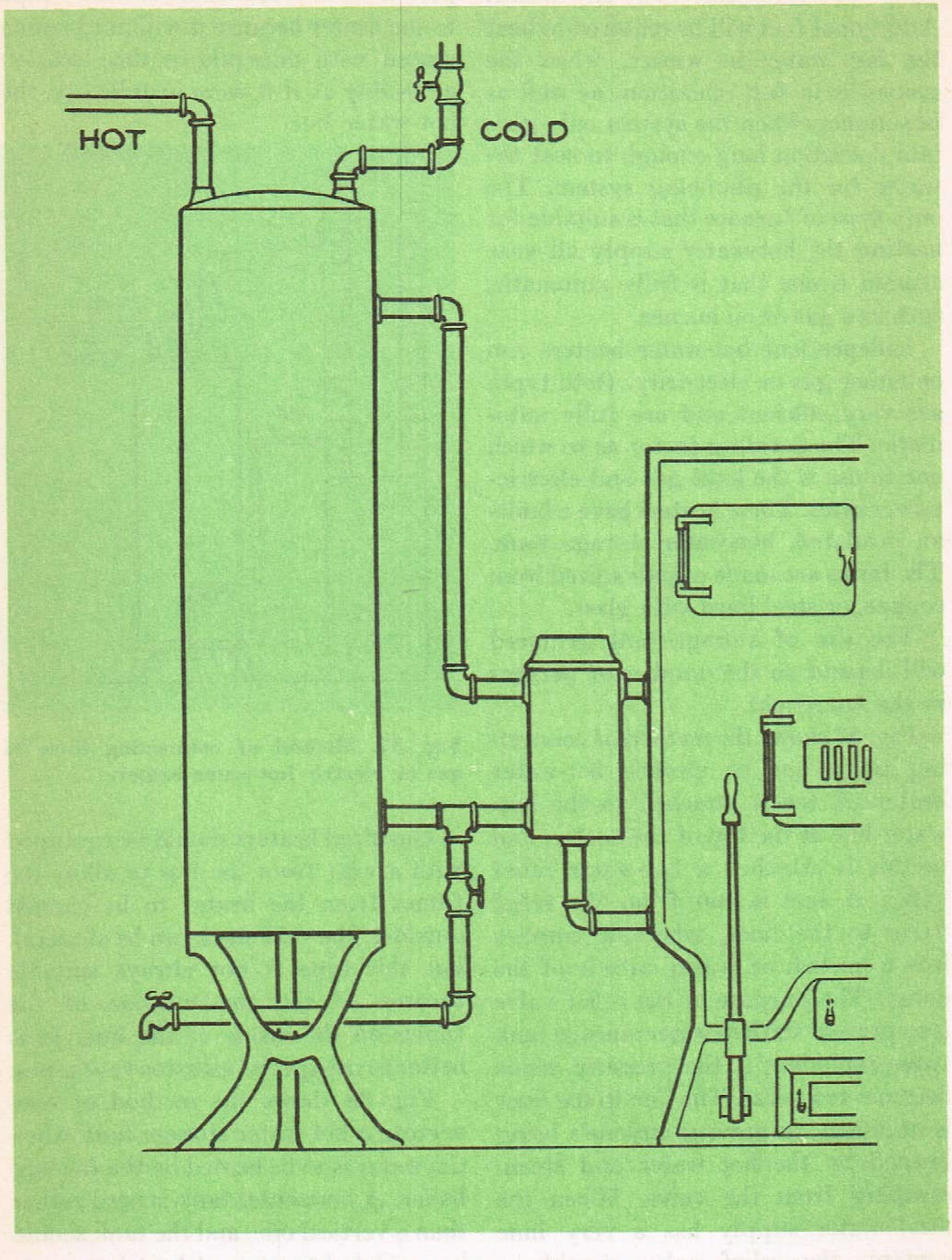

Fig. 38. Connection of hot-water storage tank to furnace hot-water heater.

TESTING THE DRAINAGE SYSTEM

Before fixtures are connected into the drainage system, the work should be checked over to be sure that it is perfectly tight. The simplest way to do this is to fill the system completely full of water. To do this all the openings in the system except one must be closed tightly. You can get a special test plug with a rubber ring that can be placed in an opening and then expanded by means of screws so that it will make an air-tight fit. After all the openings have been closed with these plugs, the system is filled with water. This can be done by pouring water down the top of the vent stack. When the system is full, allow it to stand for a while and then see if there is any drop in the water level in the stack. If there is a drop, go over the work carefully until you find the spot where the water is escaping. If it is a threaded fitting, it may be that the threads were not properly cut or perhaps you neglected to use pipe compound on the threads. In the case of a caulked fitting that leaks there is no easy way to make repairs. The job should be done over again. The joint can be freed by holding a blow-torch to it until the lead melts out.

If water is escaping through cracks in the cast-iron soil-pipe hub, this entire section will have to be removed.

A test on the fresh-water system is not absolutely vital, but it is a wise precaution to take. It can be made by plugging up the openings and running water through the line. The chances are that you will not need any additional pressure in the line to expose any flaws in your work. Sometimes a special pump is used to increase the pressure in the line a little over and above that found in normal fresh-water systems.

THE HOUSE SEWER LINE

The cast-iron soil pipe should extend for at least one section (5 feet) beyond the house. After this, you can use either cast-iron soil pipe or vitrified-clay pipe to carry the waste to the sewer line or cesspool. Clay pipe is the least expensive, but it has the drawback that seepage through the pipe joints will attract tree roots, which in time may clog up the line. This danger can be eliminated to a great extent, however, by installing copper washers inside each joint. The copper will kill any tree roots that come in contact with it. Clay pipe can be joined with cement mortar. The sections are placed together and oakum is packed into the bell to prevent the mortar from getting into the line. The mortar is then worked into the joint, either by hand or using a joint runner. Cast-iron soil pipe can be joined with caulked joints or with special threaded joints. It will last indefinitely.

SEWAGE DISPOSAL

If you are building your home on a lot where there is a near-by city sewer line, you do not have much to worry about as far as sewage-disposal goes. There will probably be a slight charge involved for opening up the main so that your line can be attached and you may find that you will not be able to lay the sewer pipes from your house to the main yourself, but your worries are few compared to those of building in outlying districts where each house must have its own private sewage-disposal plant.

Cesspools and Septic Tanks

There are two types of private sewage-disposal systems that you can use. One is the cesspool and the other is the septic tank. Of the two, the septic tank is by far the superior, and in many localities it is the only system that may be used. The cesspool is more or less out of date today, and its main advantage is the fact that it is a very simple and inexpensive system to install. It consists of a large hole in the ground that is lined on the inside with rocks or concrete blocks set up without mortar. The sewage from the house flows into this tank and the liquids pass through the openings in the rocks or blocks and are absorbed into the earth. The top of the cesspool is provided with a tightly fitting concrete lid to keep out insects and vermin.

The first great drawback to this type of system is that it can easily contaminate wells or near-by water supplies. The liquids that are absorbed into the ground are by no means pure and slowly but surely the earth around the cesspool becomes contaminated.

Even when the cesspool is below a well, there is still a chance that, due to rock formations, the seepage from the cesspool will reach the water supply.

Cesspools are of little use in ground that is low-lying and wet because the earth will not absorb the liquids from the cesspool and you will have to have it pumped out repeatedly.

The septic tank works on an entirely different principle from the cesspool. The waste from the house flows into a watertight tank. It remains there for twenty-four hours or so while the bacteria reduce many of the solids to a liquid state. At the end of this interval, the liquids flow out of the tank into a leaching field made of tile. These tiles are placed fairly near the surface and this allows air to get to the liquids and evaporate them before they have a chance to get very far.

There are several misunderstandings about a septic tank. In the first place, not all the solids that enter the tank are reduced to a liquid state and flow out into the tile field. Some of these solids remain inside the tank as sludge. In time the sludge will accumulate to such a degree that the tank will not operate properly until it has been pumped out. Second, the liquids that flow out of the tank are by no means

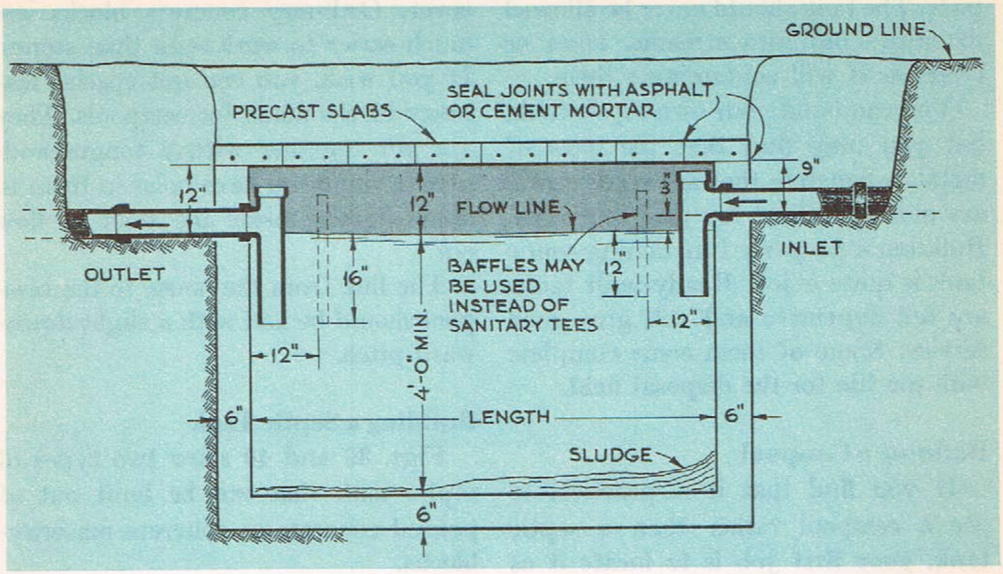

Fig. 39. Detail of the construction of a single-chamber septic tank.

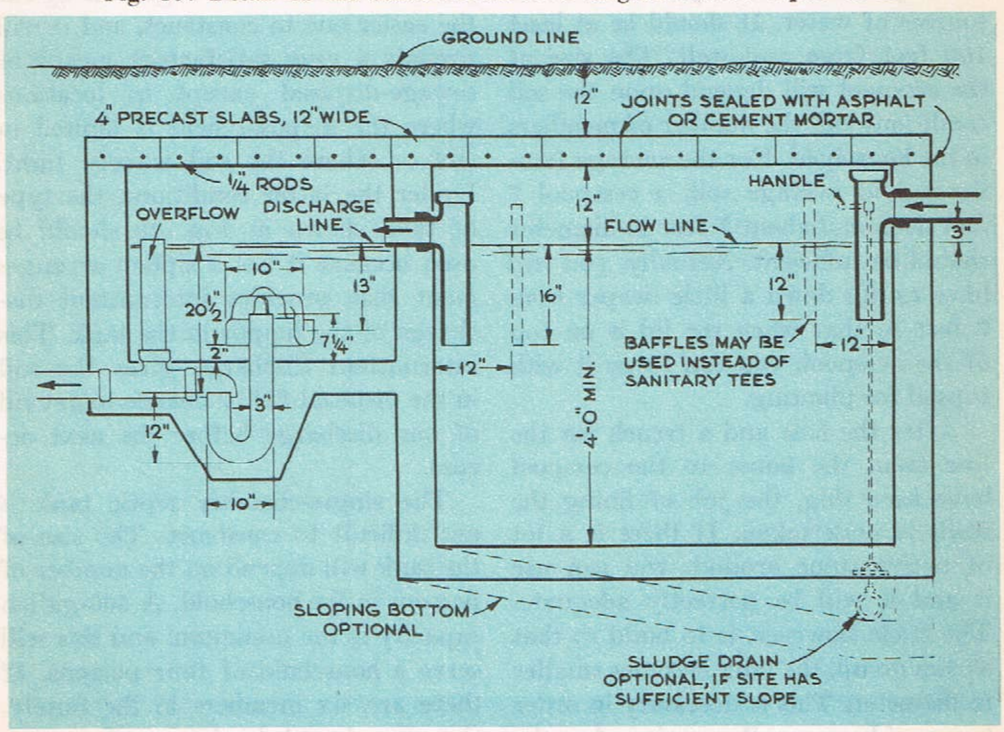

Fig. 40. A septic tank with a dosing chamber.

pure. The tank should never be allowed to empty out into streams, lakes or rivers as it will contaminate them.

You can build your own septic tank, but you may find that the ones of metal or concrete that are ready-made are more practical for your purposes. Building a properly functioning septic tank is quite a job. Ready-built tanks are not expensive and will give good service. Some of them come complete with the tile for the disposal field.

Building a Cesspool

If you find that it is practical to use a cesspool rather than a septic tank, your first job is to locate it as far as possible from any wells or other sources of water. It should be at least 100 feet from any well. The size of the cesspool will depend upon the soil conditions and the number of members in the household. For the average family and in average soil, a cesspool 7 feet deep and about 7 feet in diameter should be sufficient. Actually, you will have to dig down a little deeper than 7 feet so that when the lid is on top of the cesspool, you can cover it with topsoil for planting.

After the hole and a trench for the line from the house to the cesspool have been dug, the job of lining the walls is undertaken. If there is a lot of native stone around, you can use it and it will be perfectly adequate. The trick, however, is to build so that as you go up, the tank becomes smaller in diameter. This is necessary in order to provide a small opening for the cover. Ordinary concrete blocks are much easier to work with than stones. If you wish, you can get special masonry blocks made for cesspools. They are put together with a tongue-and-groove joint and have holes in them to allow liquids inside the tank to flow out.

The line from the house to the cesspool should be laid with a slight downward pitch.

Building a Septic Tank

Figs. 39 and 40 show two types of septic tank that can be built out of poured concrete or concrete masonry-blocks.

The tank shown in Fig. 39 is by far the easier one to construct, and it will provide a very satisfactory means of sewage-disposal except in locations where the disposal field is limited in size or where the soil is very tight. Under the latter conditions, the type of tank shown in Fig. 40 should be used because it has a siphon arrangement that provides intermittent discharge of the liquids in the tank. This intermittent discharge gives the soil in the disposal field a chance to get rid of one discharge before the next occurs.

The single-chamber septic tank is not difficult to construct. The size of the tank will depend on the number of persons in the household. A 500-gallon capacity is the minimum, and this will serve a household of four persons. If there are six members in the family, the size should be increased to 600 gallons. For a 500-gallon tank, the width should be 3′, the length 6′ and the depth 5′. The inlet should be 9″ below the top of the tank and should be fitted with a sanitary tee. The outlet line to the disposal field is placed 12″ below the top and this also has a sanitary tee.

Fig. 41 shows how the tank is laid out on the site before the excavation work is done. Forms for the tank should be constructed sufficiently level and solid so that they will not be forced out of place by the weight of the concrete. See Fig. 42.

Fig. 43 show how the top of the tank can be cast in sections out of con-

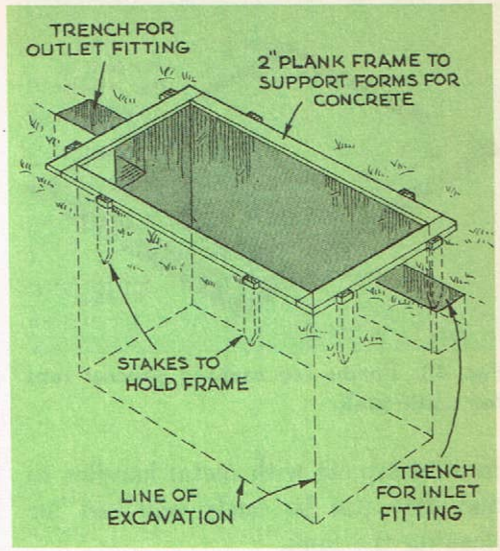

Fig. 41. Laying out a septic tank.

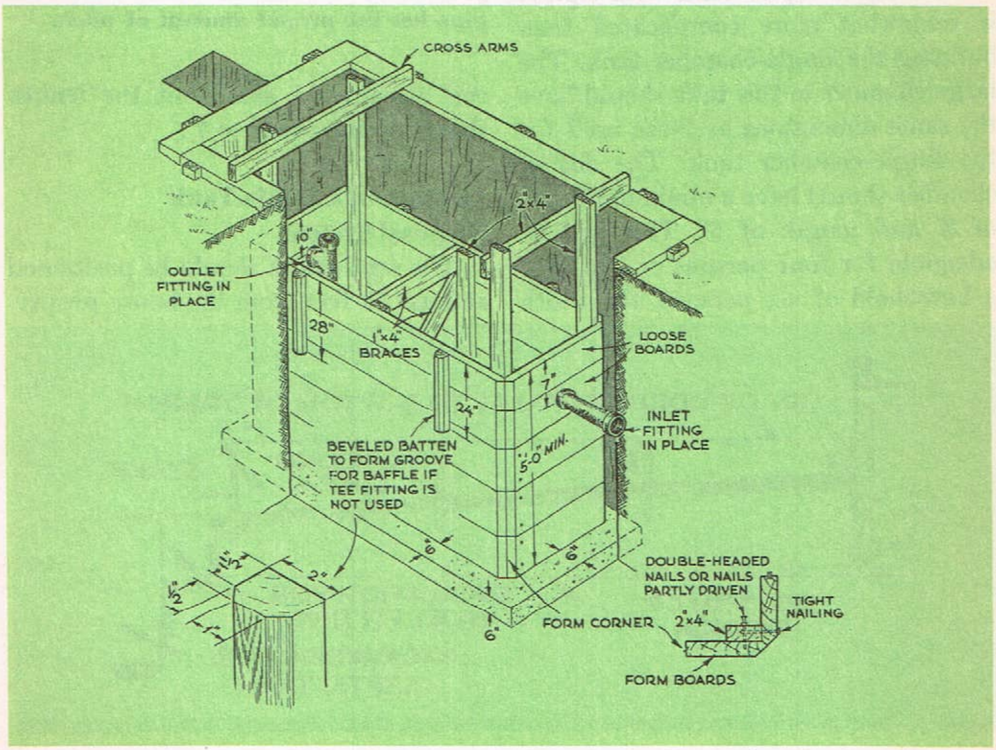

Fig. 42. Construction of forms for septic tank.

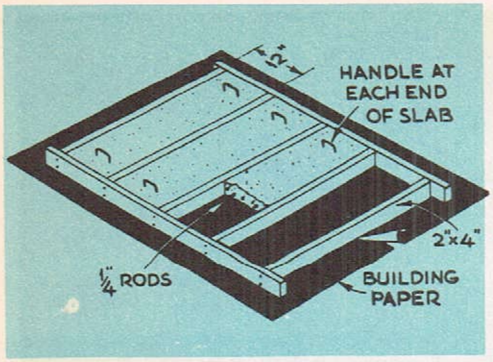

Fig. 43. Forms for making precast tops for septic tank.

crete, complete with metal handles so that they can be easily removed for cleaning the tank.

Building a septic tank with siphon is somewhat more complicated than building the single-chamber tank. The large chamber in this tank should have the same dimensions as those used for the single-chamber tank. The dosing chamber should have a minimum width of 3′ and length of 6′. This will be adequate for four persons or less. For a household of six persons, the width can remain the same but the length should be increased to 7′.

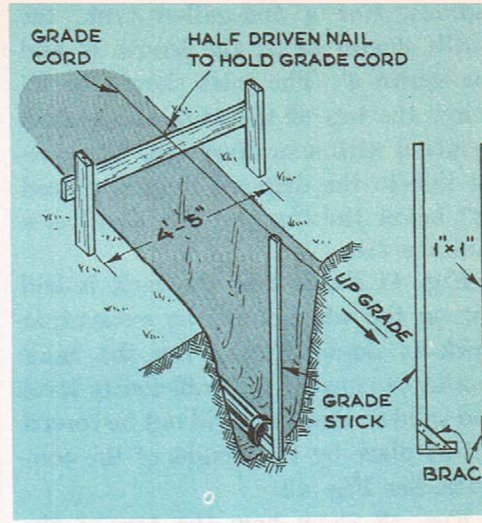

Fig. 44. Laying sewer soil pipe. A simple grade stick is used to insure that each pipe has the proper amount of pitch.

Laying Out a Septic-Tank Disposal System

The septic tank should be positioned at least 50 feet from the house proper.

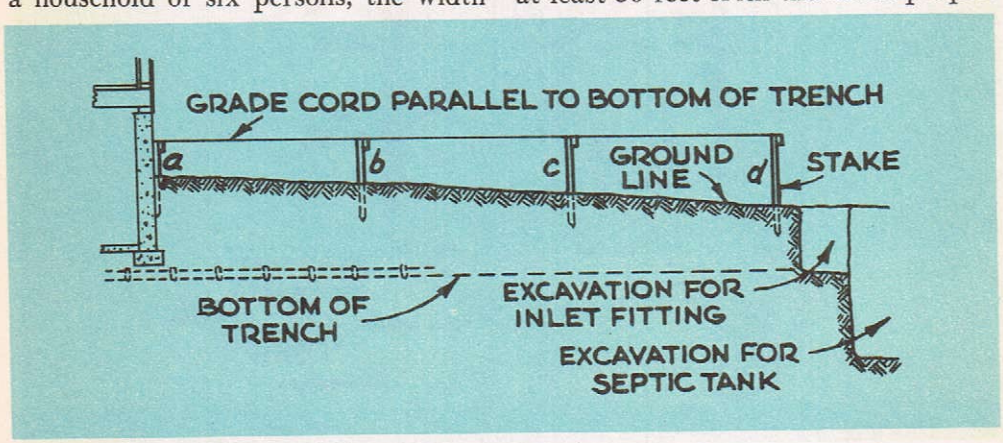

Fig. 45. Use of grade cord to get the proper pitch to the sewer line.

Clay pipe can be used to connect the tank to the house drainage system. The first section of tile can be joined to the cast-iron soil pipe extending from the house with cement mortar, which is also used for the following sections of clay pipe. But be sure that you pack oakum into the bell ends first to prevent the mortar from seeping into the line, and make your connections as tight as possible because if you do not, you will be troubled with tree roots that get into the line and clog it up.

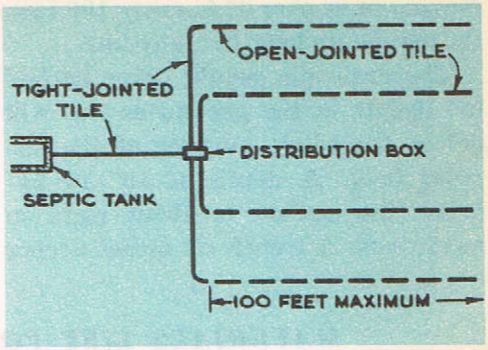

Fig. 47. Suggested layout for septic tank distribution field.

The septic tank cannot be constructed in accordance with the plans given earlier in this section. From the outlet side of the tank, a line of clay soil-pipe with cemented ends is run for about 15 feet. This line, as well as the line from the house, should have a slight downward pitch. The house line should be pitched 1″ in every 10″, while the line coming out the outlet side of the septic tank should be pitched 1″ for every 20″. See Figs. 44 and 45. The end of the outlet line from the septic tank is connected to a distributing box as shown in Fig. 46. This box can be constructed with extra openings that are plugged for the time being but can be opened up at some future date if additional lines in the disposal field are required. The feed lines coming out of the distributing box should be pitched 1″ for every 20″, and it should be made with caulked joints.

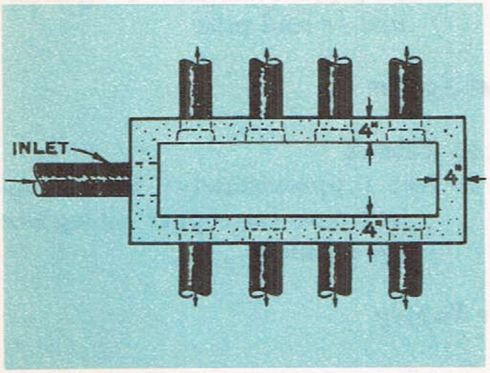

Fig. 46. A distribution box made out of concrete.

Fig. 47 shows the arrangement for a disposal field on level ground. The number of feet of tile and the number of branches will depend on soil conditions and on the number of persons in the household.

For the average-size household and where the soil is not too sandy or clayey but is medium as far as drainage goes, there should be four branches to the line and the total number of linear feet of 4″ drain-tile should be about 350. The disposal field can be made with ordinary 4″ clay tile with open joints or you can use special perforated drain pipes that come in standard 4-foot lengths. Each branch of the line should be given a slight slope, but this should not be over 6″ to every 100 feet, the maximum length of any line.

The drain-tile should never be laid too deeply in the ground as this will defeat the whole purpose of the disposal field. A depth of 18″ to 24″ below the surface is about right in most cases. A trench six inches deeper than this should be dug and a layer of gravel 6″ deep put down for the tile to rest upon. Pieces of tar paper are placed over the joints between the tile sections, which are then covered with another layer of gravel. Finally, straw is placed on top of the gravel and the soil is put back.

MATERIALS LIST FOR PLUMBING SYSTEM FOR THE BASIC HOUSE

Drainage System

1 4″ x 4″ sanitary tee branch
1 4″ x 4″ Y branch
1 4″ clean-out plug
1 4″ x 4″ sanitary tee branch with 2″ tapping
2 4″ sanitary tees with 2″ tappings
8 5-foot sections of 4″ cast-iron soil pipe. Exact number of sections depends on location of sewer and whether basement floor drains are connected into sewer line
1 Increaser for top of vent stack
1 4″ lead closet bend with brass ferrule and floor flange
1 Kitchen sink with fittings
1 Bathtub with shower and fittings
1 Lavatory with fittings
1 Water closet with flush tank and fittings
4 Drain traps for kitchen sink, bathtub and lavatory
6 1½″ drain tees
5 1½″ elbows
30 feet (approximately) 1½″ galvanized pipe
11 feet (approximately) 2″ galvanized or lead pipe

Fresh Water System

7 Tee fittings
50 feet (approximately) ½″ galvanized pipe (or copper tubing one size smaller)
14 Elbows
10 feet (approximately) ¾″ galvanized pipe (or copper tubing one size smaller)

Hot Water Supply

1 30-gallon hot water heater, gas or electric