CHAPTER I.

THE DISTRIBUTING SYSTEM.

Materials — Salt-Glazed Clay — Cast Iron — Cement-Lined Wrought-Iron—Thickness of Sheet Metal—Methods of Lining — List of Tools — Tool-Box — Derrick — Calking Tools—Furnace—Transportation—Handling Pipe—Cost of Carting—Distributing Pipe.

IN considering the subject of which this book treats, it will be the writer's endeavor to be brief and practical.

He assumes that those for whom these papers will have the most interest have had little or no experience in actual construction, and desire information and suggestion upon the simplest details.

MAIN PIPES.

Materials.—Cast iron, wrought iron with cement or with a protecting coating by some special process, wood, and steel are the materials used in making pipes for the distributing systems of town and city water-supplies.

Salt-glazed vitrified clay pipes have been used by Mr. Stephen E. Babcock, C. E., of Little Falls, N. Y., in that village, and also at Amsterdam and Johnstown in the same

State, for conduits in gravity systems. At Little Falls the conduit is over 30,000 feet in length and is mainly of 18 and 20 inch pipe. The low first cost of clay pipe would certainly entitle its claims to careful investigation in planning a low-pressure gravity system of supply. Mr. Babcock has prepared a very elaborate set of specifications for furnishing and laying this pipe, which would be of value to any one who wished to use it.

The writer frankly acknowledges a preference for cast-iron pipe for all but special cases. He is not unmindful of the fact that the town of Plymouth, Mass., after an experience of thirty years, is this summer (1887) extending its distributing system by adding 20,000 feet of 4 to 16 inch cement-lined wrought-iron pipe; nor that the town of Dedham, Mass., has had no reason thus far to regret that its water-mains are of this material. Without going further, the cities of Fitchburg and Worcester, Mass., seem to offer experience with this sort of pipe to justify the opinion that the chances for poor work and poor material are greater with it than with cast iron, and the advocates of cement-lined pipe admit, I think, that honest and skillful work is indispensable to the success of this method. We must admit that when made and laid upon honor, cement-lined pipe has an advantage over cast iron in not reducing its original diameter by incrustations, nor is the "advantage out' when we reply that the cleaning machine of Mr. Keating or of Mr. Sweeney may be used to restore tuberculated iron pipe to its original diameter, for the application of these machines cannot be effected without expense.

With its acknowledged advantages of strength and ease in laying, cast-iron pipe is heavy and, in its larger sizes, expensive

to handle. This limits the length in which sections of it can be used, and so does not permit of any reduction in the number of joints to the mile.

In the effort to produce something which should be free from these disadvantages of cast-iron pipe, wrought-iron pipe treated by a protective process is now upon the market, and has been introduced to a limited extent. Of this it is fair to say that it is still on trial, and some time must yet elapse before its durability can be said to be proven.

Of wood, the writer has no knowledge by actual experience, but its use seems to be limited to a small territory in the West.

Unlike cast-iron pipe, which is bought ready for use, cement-lined pipe is put together in part at some convenient yard or shop in the town which is to use it, and its final construction is carried on in the trench where it is to lie.

The foundation of this sort of pipe is a sheet-iron drum nine feet in length, made in three sections in the 16-inch and larger sizes, and in single sheets in the 4 to 14 inch diameters.

The thickness of metal varies with the sizes; for example we may use,

For 4-inch	pipe,	metal of	21	Birmingham	Gauge,
" 6	"	"	19	"	"
" 10	"	"	17	"	"
" 12	"	"	15	"	"
" 14	"	"	14	"	"
" 16	"	"	14	"	"

with double-riveted seams, using 12-pound rivets for 16, 14, and 12 inch pipe, 10-pound for 10-inch, 6-pound for 6-inch, and 5-pound for 4-inch pipes.

The first step in the making of this sort of pipe is the putting into these drums a lining ½ to ¾ of an inch in thick-

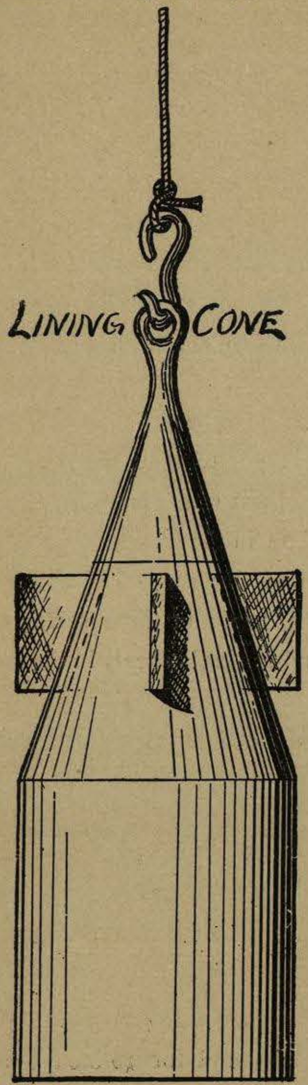

FIGURE 1.

ness of cement mortar mixed sand and cement half and half.

The pipe is placed on end over a hole in a low platform, and a lining cone is let down into it from a crane, a derrick, or a simple windlass, and drops through the hole in the platform just far enough to allow the pipe to be entirely filled at its lower end with the mortar. Enough mortar is then shoveled into the top of the pipe from a high platform to make the lining, and the cone is drawn slowly through. The surplus cement as it falls over the top during the upward movement of the cone is shoveled back into the mixing-box, or into another pipe if there be one at hand ready for lining, but no cement that has once set is fit to be used again. After the cone is drawn the pipe should stand 20 minutes or more before it is moved; it is then taken to the grouting table, the ends scraped, and the whole surface examined for defects. If at any points the cement has settled into wrinkles these should be scraped down, and any holes filled with pure cement.

With platforms and swinging crane arranged to place ten pipes on end at once for lining, eight men can fill 100 14-inch pipes in a day, and three men more can grout and patch them.

The grout can be poured in with a dipper, and then spread by rolling the pipe and applying from each end common dust-brushes fastened to long handles.

Before applying the grout the lining is brushed with water, using the long-handled brushes.

The lining cones are made either of cast iron or of sheet-metal, but if the latter is used they must be filled with cement to give them weight.

LIST OF TOOLS.

Whatever be the material chosen for main pipe, the trenching tools will be the same. In the matter of pipe cutting and jointing, cast iron and wrought iron call for very different treatment and appliances. During days which are too stormy for work and over night, all tools should be securely packed in tool-boxes, which may be built according to the following sketch :

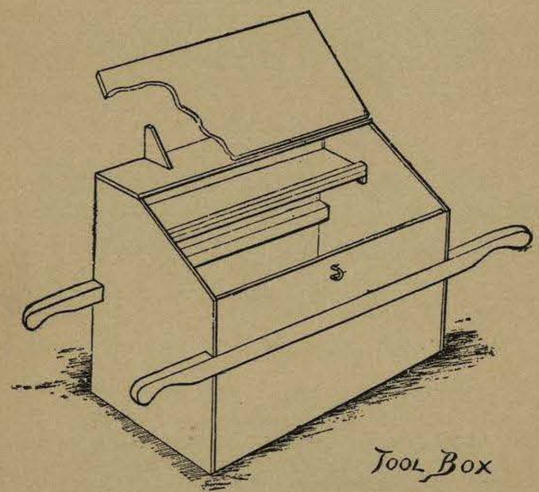

FIGURE 2

The same carpenter who makes the boxes can make also a derrick after the sketch given in Figure 3, which will be found strong enough for pipes weighing a ton and easy to handle as soon as three men get the knack of carrying it.

This should be made of straight-grained 4x4 sticks, 14½ feet long, held together at the top by a 1-inch bolt. The link of ⅞ round iron drops one foot, and ⅜ carriage-bolts should

be put through the end of the sticks to keep them from splitting. The large cleat on the right is to be bolted on with two ⅜ carriage-bolts about 20 inches from the bottom of the leg, and a hard-wood pin driven in about the same distance from the bottom of each of the other legs. For pipes larger than 20 inches a 4-leg derrick with a windlass may be found more convenient.

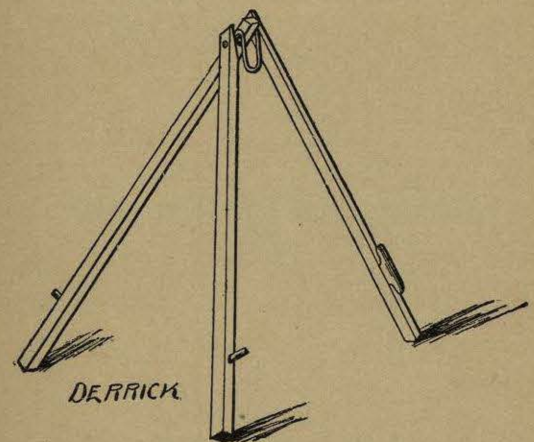

FIGURE 3.

For 6-inch pipe two 8-inch double blocks will give power enough, but for 16-inch a quadruple and triple block in combination will be needed.

The number of picks and shovels required depends, of course, upon the number of men that are to be employed. One shovel to a man is enough, but if the digging is likely to be hard, double the number of picks will not be too many to allow time for sharpening. A shovel with a welded strap does better work than one in which the strap is riveted, and for anything but scraping up from a platform, a round point is better than a square point.

FIGURE 4.

Provide three, four, or half a dozen steel crowbars 5½ to 6 feet long, 2 or 3 sledges weighing, say, 10, 15, and 20 pounds

and 2 tunneling bars, if the digging will permit of this sort of work. The tunneling bars are easily made by welding on to a piece of 1-inch pipe 8 or 10 feet long a chisel-shaped piece of steel 2 or 3 inches wide.

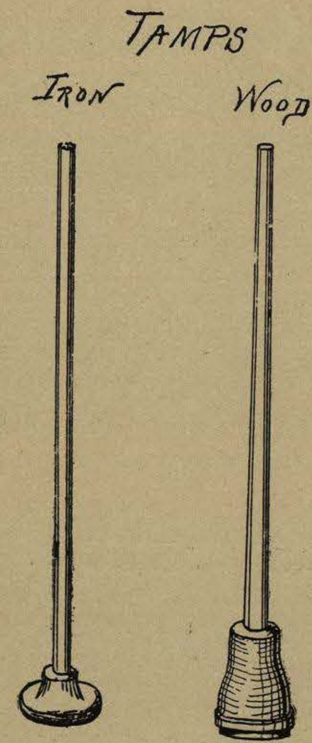

FIGURE 5.

For ledge-work, drills made of 1⅛-inch octagon steel, forged to cut a 1¼-inch hole, with sledges weighing 6 to 8 pounds, and a spoon for scooping out the dust and drillings, will be required.

Carrying sticks for lifting 4, 6, and 8 inch pipe, of the shape shown in the sketch Figure 4 (page 16), are useful; larger sizes of pipe are handled more easily by rolling.

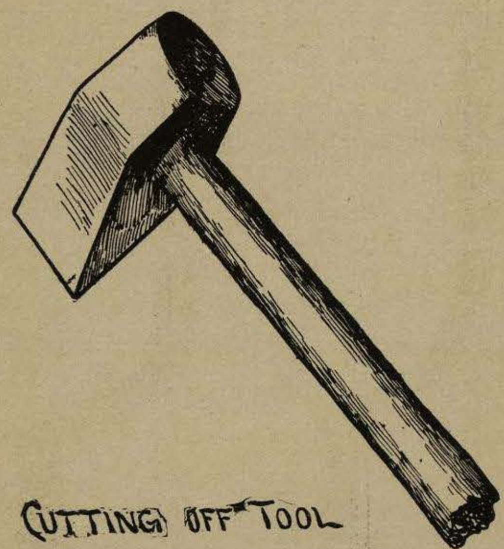

FIGURE 6.

Skids 6 feet long of 2x4, 4x4, or of 4x6 spruce, according to the weight of the pipe, will be needed to throw across the trench.

When water is not available for back-filling some kind of tamp will be needed, and sketches of two patterns are given on page 17 (Figure 5).

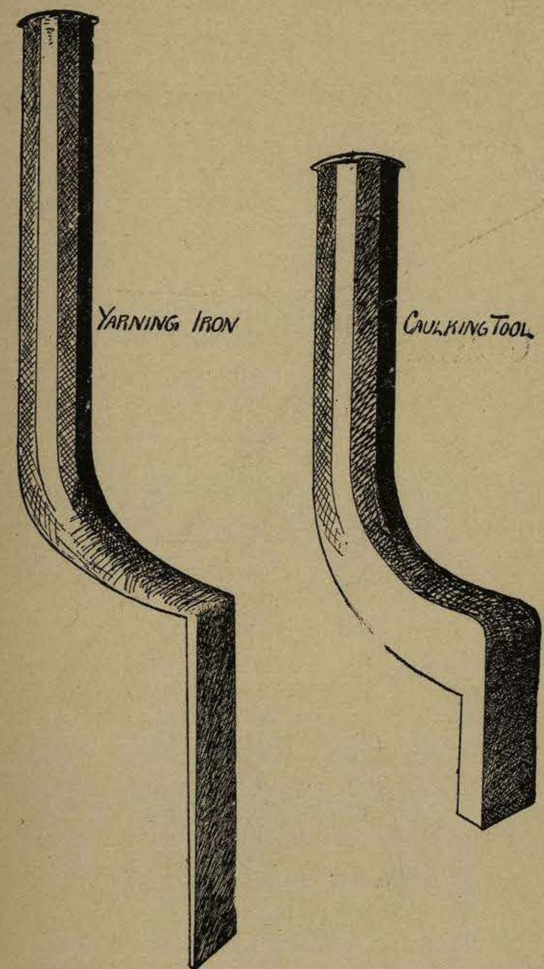

FIGURE 7.

If any considerable amount of rock-work is expected, either as ledge or boulders, a second derrick will be needed, with some spare rope and a few pieces of chain.

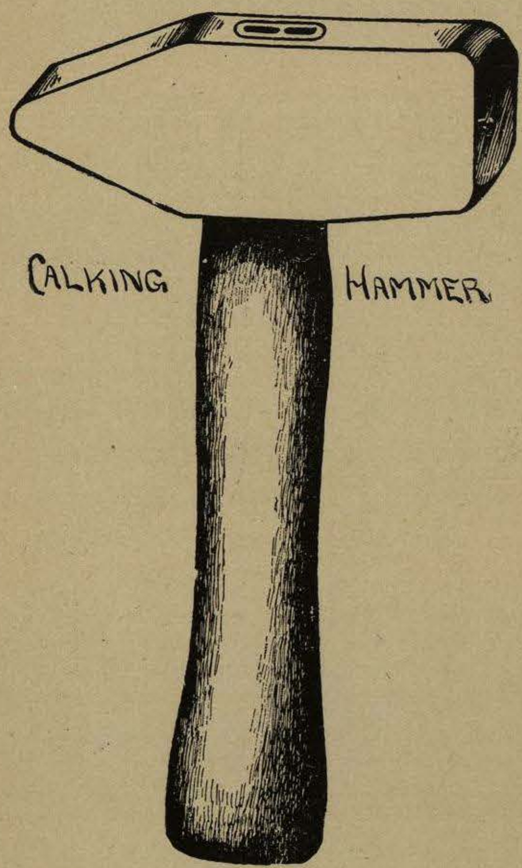

FIGURE 8.

For cutting cast-iron pipe provide two or three long-handled chisels, such as blacksmiths use for cutting off cold

iron (see Figure 6, page 18), and a pair of light sledges or striking hammers. For cutting wrought-iron pipe boiler-makers' chisels and hammers are the proper tools.

For making lead joints in cast-iron pipe, yarning and calking tools and short-handled calking hammer. One yarning-

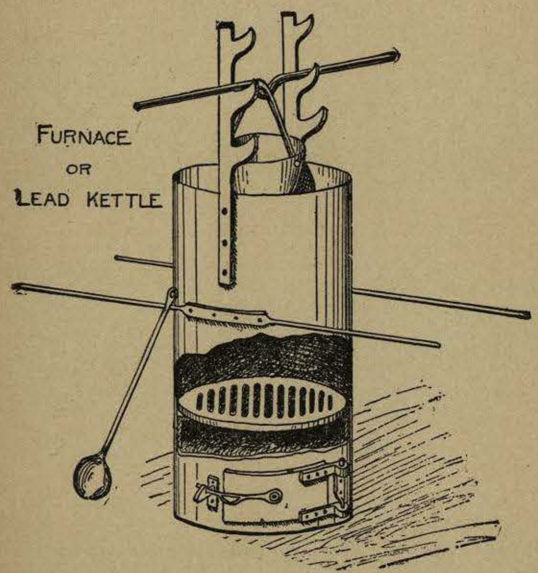

FIGURE 9.

iron and four calking tools varying in thickness from ⅛ to ⅜ of an inch make a convenient set.

A furnace or lead-kettle of the pattern indicated in Figure 9 is common among water-works contractors. There should be a second door opening on to the grate at the point on the sketch where the shell is broken away to show the interior.

TRANSPORTATION.

Before the arrival of the pipe arrangements should be made to have men and teams ready to begin work at a few hours' notice; for, as a rule, vessel captains and railroad companies are in a hurry to be rid of their cargoes. Some trustworthy man should be selected to oversee the unloading and keep tally. In cast-iron pipe it is customary to mark the weight of each piece with white paint inside the bell, and if a memorandum is made of the weight of each piece as it leaves the car or vessels, the pipes will be counted and a check on the weight given in the bill of lading will be obtained.

The pipes may be piled up on the wharf, or taken directly from the cars on to the drays or low gears that are to cart them. If they are to be put directly upon the drays little or no blocking will be needed. Strong and careful men with carrying sticks, and some skids in the absence of a derrick, will soon discover the easiest method of handling the pipe and avoiding shocks and blows. If the pipe is coming out of a vessel and is to be piled up on the wharf, 2x4 spruce sticks in market lengths should be placed between the tiers, and strong skids used to roll the pipe from the deck ashore, and blocking be freely applied to prevent bunting, striking, or rolling. In the experience of the writer, six active and fearless men easily took 16, 6, and 4 inch pipe from a vessel and piled it securely on a wharf faster than the crew could get it out of the hold with a steam derrick.

In carting cast-iron pipe convenience and necessity will determine the kind of vehicle to be used, but in carting cement-lined pipe it is well to insist that the wagon shall have

springs that the chances for cracking the cement lining may be reduced. The cost of carting must vary so much with circumstances that the writer can do no more than quote some figures from his own experience. Three bids were received in the spring of 1887 for carting an average distance of about two miles over good roads and streets with no steep grades:

680 tons of 135-lb. 16-inch pipe.
100 " 34-lb. 6-inch pipe.
100 " 20-lb. 4-inch pipe.
One of $1 per ton gross.
One of 67⅝ cents per ton gross.
One of 64 cents per ton gross.

At the lowest figure the teamster appears to be satisfied that he is making a fair profit, but his horses and men are working hard for it.

When the town of Middleboro, Mass., constructed its water-works the writer was informed that the carting was done for fifty cents per ton, but the average hauls were short and the roads good.

Considerable judgment is required on the part of the teamsters who deliver the pipe on the street to distribute it so that it will not fall short or run over in laying, so that it will not cause excessive risk to night travelers while it is awaiting the coming of the workmen, so that it will not be in the way of entrances to private estates or of merchants whose teams wish to receive or discharge goods. If circumstance will permit, it will save time for the pipe-layers to have the pipe laid on the street with all the bells pointing one way, and that in the direction of the movement of the gang. This with reference to bell and spigot pipe; with other patterns this condition does not exist.

In directing the teamsters on which side of the street to deliver the pipe, consider on which side of the trench the bulk of the dirt is to be thrown, and have the pipe dropped on the side opposite to that, and thus avoid having to lift the pipe over an embankment of loose earth.

CHAPTER II.

FIELD WORK.

Engineering or None—Pipe Plans—Special Pipe—Laying Out a Line—Width and Depth of Trench—Time-Keeping Book—Disposition of Dirt—Tunneling—Street-Piling.

IT is well understood by the readers of THE ENGINEERING AND BUILDING RECORD that the best preparation for any considerable amount of main-pipe laying is found in a careful survey of the proposed line, which shall take note of every feature which is likely to affect the work. Cross streets or roads, existing or proposed, brooks, bridges, drains, culverts, sewers, gas-pipes, and old water-mains, if there be any, should be indicated on plan and profile, and forethought given to schemes for avoiding and overcoming evident obstacles.

Let me warn the novice that, in spite of his most earnest forethought, obstacles that could hardly be foreseen even by one of experience will almost certainly arise, and he can at best only strive to reduce the number of the unexpected difficulties.

The need for laying pipes to line and grade is an imperative one on the main line from a reservoir in a gravity system; is almost as necessary with any main larger than ten or twelve