trations: Time, July 6, 1887; gang 60 men, 16-inch pipe, 2 yarners, 2 calkers, 4 to 10 men digging bell-holes, 30 bell-holes per day, 400 feet of pipe laid and jointed in ten hours.

CHAPTER V.

HYDRANTS, GATES, AND SPECIALS.

STREET intersections are obviously suitable places for hydrants and gates.

A hydrant so placed serves more territory than one placed midway between cross streets, and at the intersection of important thoroughfares and large mains the four-way hydrants carrying four hose-nozzles are in every way suitable, if post-hydrants are chosen.

For the narrow crowded streets of a large city the flush hydrants are better than the post, but, as a rule, the small water-works which have sprung up all over the country during the last few years are fitted with hydrants of the post pattern.

If a post hydrant is not placed near a street corner, it is well to put it on a division line between two estates, for the chances that it will in the future be an obstruction are smaller in this position than they can well be in any other. The distance apart for hydrants may be 200 or 500 feet, according to circumstances, but the larger distance should not be exceeded without the best of reasons.

It has become a well-established custom to place gates on street lines, and the ease with which gates so placed can be

found is a sufficient reason for not departing from the custom except in some special cases. In unpaved streets a gate-box located at a corner on a street line may be a source of trouble if the travel about the corner is considerable, for the wearing of the road will soon leave the box projecting above the surface to a dangerous extent. In cases where this condition of things is likely to obtain, the writer has thought it wise to move the gate ten feet away from the street line, and it is fair to ask if a uniform distance of ten feet would not have some advantages over a strict adherence to street lines.

The superintendent or the engineer or his assistant should follow the pipe-laying gang closely enough to locate every gate and special before it is covered by the back-filling gang. If one should perchance miss the location of something, he will be both surprised and amused to see how wild and yet how confident will be the guesses of a bystander who saw the gate covered the day before, and then tries to assist one in finding it.

In locating and making notes for future reference, a little judgment is required to enable one to choose permanent and easily-found landmarks.

Fences and stone-bounds come first, as a rule, and the post-hydrants furnish excellent measuring points. Lamp-posts are reasonably permanent, but trees and hitching-posts illustrate the "mutability of human affairs" of Dominie Sampson. A rough sketch, with no regard to scale, will be found more intelligible after sixty days than a written description.

As a rule, it does not pay to build gate-boxes so that a man can get into them to oil and pack the gates. In paved streets where digging is both expensive and inconvenient for the

public, large brick manholes are of course demanded, but for town and country the cast-iron gate-boxes, well known to the trade, leave little to be desired.

The writer has heard of main-pipe specifications which called for a bed of concrete under each gate and hydrant. Under a hydrant in wet, uncertain ground the concrete may have some value, but under a gate there seems to be no call for it; indeed, it may be a source of trouble should the pipe settle a little and the gate be unable to follow. When a hydrant is placed in an ideal manner, it has a firm foundation in a large flat stone or good earth, good backing of stone or well-rammed earth and perfect drainage. If a sewer is not available, fair drainage may be secured by surrounding the base of the hydrant with broken or round stone, provided the ground has any absorbing power, and in clay, a small well may be sunk at some distance from the hydrant, enough below it and of sufficient diameter to contain three or four times as much water as the hydrant-barrel will hold. A small drain is then run from the hydrant to the well and the well is pumped out as often as need be.

Frost-jackets seem to be going out of fashion. Without doubt they have little value in sandy or gravelly soils. In clay the action of the frost may be expended on the jacket and so save the barrel some straining, but men of experience are not wanting who declare that the use of frost-jackets may be safely abandoned.

Generally speaking, the plugs for main pipe furnished by the foundries are unnecessarily heavy, unless made from special patterns.

In Figure 18 is shown the pattern adopted and used by the writer for the past five years.

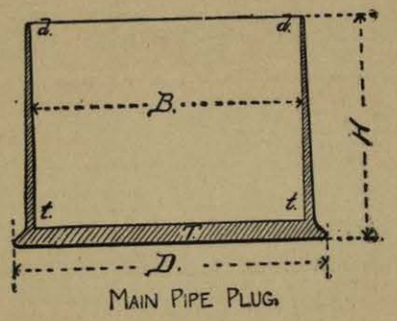

FIGURE 18.

The following table gives the dimensions for plugs to be used with four, six, eight, and ten inch pipe:

Size of Pipe.	D	B	H	T	*t*	*d*
4	5¼	4	6	⅜	¼	⅛
6	7¼	6	6	½	¼	⅛
8	9¼	8	6	½	¼	⅛
10	11¼	10	6	½	¼	⅛

The sleeve shown in Figure 19 differs from the ordinary pattern only in having an inside rim which furnishes a support against which the joints can be made. The diameter of this rim should be fixed with some care and with reference to the outside diameter of the pipe with which the sleeve is to

be used; for unless the sleeve will slip over a pipe from which the spigot end has been cut, the chief advantage of this special casting will be lost.

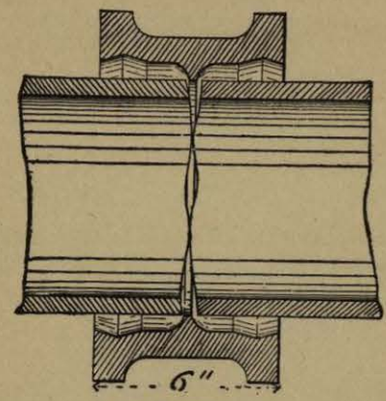

FIGURE 19.

Sleeves are all but indispensable in bringing two parts of a pipe-line to a junction between two rigid points, and they may be found useful in assisting one to use up pieces of pipe without bells. Some foundries make their special castings with bells all around, while others send out their single and double brancnes, with spigots on one end of the main run. The writer has found the "bells all round" pattern to be the most economical in the way of using up the pieces, but on every job of magnitude cases will arise in which the spigot-end special will save cutting pipe.

If practicable, main-line junctions should be made with specials a size or two larger than the pipe—that is, two 8-inch

lines may cross each other at right angles, though a 10-inch double branch, and the New Bedford pipe plan by Mr. Coggeshall, given in a previous chapter, furnishes another case in point.

BACK-FILLING.

The best possible work in back-filling a trench is done with water, but oftener than not, perhaps, we must be content with ramming and tamping the dry earth. If time enough is put into it, and there is only one man shoveling to each man with a tamp, good work can be done without water, but such a method is expensive, and with contractors, as a rule, it is not in favor. The best results with dry earth are obtained when the dirt is spread evenly in layers, not more than six inches thick, and each layer is thoroughly tamped and trodden before another is added.

If he works as he should, the man in the trench will find the pounding and treading harder than shoveling, and to even things the shoveler and tamper may change places several times during the day. If water is used it should not be in such excess as to make "pudding" in the trench, and the amount of wetting must be proportioned to the absorbing power of the filling. The water does its work by carrying down the fine particles of earth as it soaks away, and more than enough to do this thoroughly is not needed.

If the trenching has been properly done, the top of the street—that is, the good gravel, or the macadam—has been put by itself on one side and should be raked over, and the stones and fine material separated; the stones to be put in just under the surface which is to be finished with the fine material. The

amount of crowning to be given the top of trench should depend upon the thoroughness with which back-filling has been done, the size of the pipe, and the character of the soil. If a trench has been well filled a rise of six inches is ample, and if this does not settle down even with the road after one or two hard rains it will have to be cut down if the road surveyor does not want to wait for wear and tear to level it. Some contractors prefer to fill without much tamping, crown the trench a

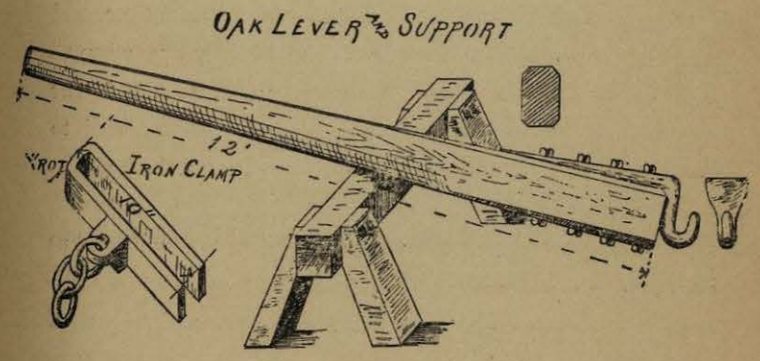

FIGURE 20.

foot, and then either repair the road after a month or two or deposit with the superintendent of streets a sum large enough to cover the cost of repairs. If sand has been taken from the trench it will ruin any road if allowed to come near the surface, by working up through a thin layer of good road material. If sheet piling has been used it may be removed after the trench is half filled by means of a clamp and lever shown in Figure 20. A 4x6 stick, a piece of chain, and a pile of blocks may be made

to do the same work, but not so conveniently. The apparatus shown in Figure 20 is copied in part from a blue print presented at one of the meetings of the New England Water-Works Association by Mr. William B. Sherman, M. E., of Providence, R. I. The horse should be well braced with iron rods, and may be protected on top by a plate of light tank-iron.

FILLING NEW PIPES.

Pipes should be filled slowly and carefully, because under certain conditions great damage may be caused by too rapid filling. A long line should be filled one section at a time, and no gate before an empty section should be fully opened until positive evidence can be had that the section is filled. If the line to be filled carries hydrants, the air can be allowed to escape through them, but if these outlets cannot be had air cocks on the summits are necessary.

A special form of air-cock can be had in the market, but for ordinary use any convenient form of corporation cock may serve the purpose by arranging a lever-handle and a blow-off pipe to be operated at will. In concluding the main-pipe division of his subject the writer presents in Figure 21 sketches of a tool wagon for use in main-pipe or sewer construction. The drawings are made from blue prints presented by Mr. R. C. P. Coggeshall, Superintendent of the New Bedford, Mass., Water-Works, at one of the meetings of the New England Water-Works Association.

TOOL-WAGON.

R. C. P. Coggeshall, Superintendent, New Bedford Water-Works.

This tool-wagon was planned by Mr. Ashley, foreman of this department, and was built by the regular employees during the winter months, at intervals whenever an hour or two could be spared. The cost as given

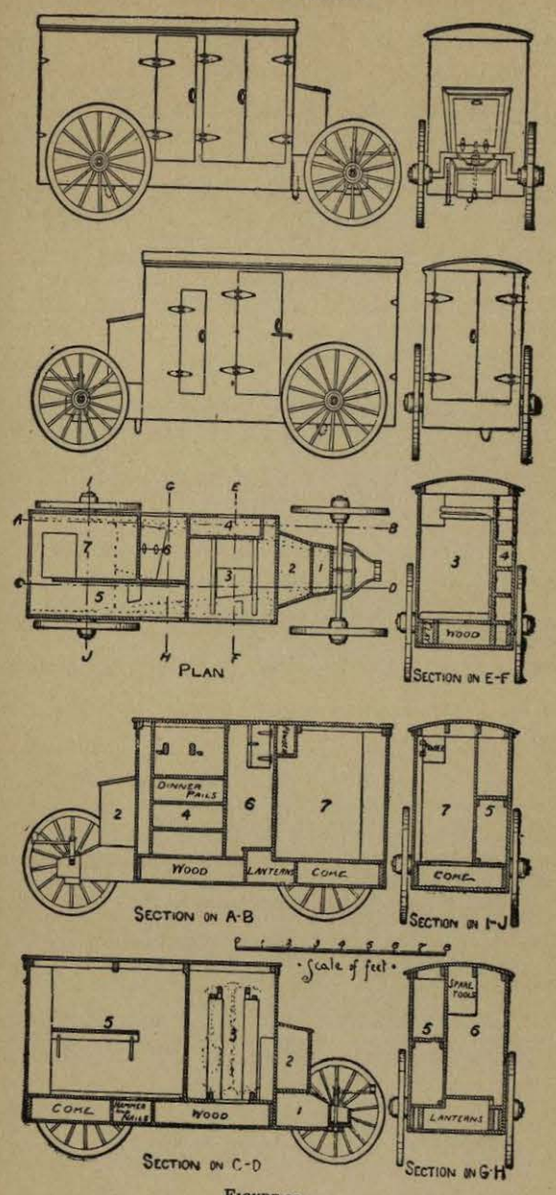

FIGURE 21.

below would in consequence probably exceed the amount at which this tool-wagon could be built by contract.

ESTIMATE OF COST.

Set of wheels and pole	$31 00
Axles, $10; bolts, $3	13 00
Door-pulls, 50c., 4 bolts $1.40	1 90
6 pair hinges, $1; 4 pair back-flaps, 40c	1 40
7 pair strap-hinges, $1.33; 1 dozen hooks, 60c	1 93
3 chain bolts, 90c.; 10 feet chain, $1	1 90
Screws, $4.16; nails, $2.15	6 31
303 feet 1-inch matched pine, planed	15 58
153 feet 1-inch matched spruce	3 52
130 feet 2-inch spruce, planed	2 33
Blacksmithing	30 49
Labor and painting	105 00
Amount	$214 36

CONTENTS.

1.

4 sets of lead and gasket irons,
4 drilling hammers,
1 stone hammer,
2 dozen cold chisels,
6 diamond points,
6 cutting-out irons,
12 joint wedges.

2.

4 lengths hose.

3.

40 picks and shovels,
3 stone sledges,
6 striking hammers,
Hydrant key,
Goose-neck,
Paving-pounder and hammer,
3 stone chains,
3 wheelbarrows of wood,
2 buckets of clay,
6-foot measuring-stick.

4.

20 dinner-pails.

5.

Tackle,
Nails and hammers.

6.

Small locker for spare tools,
Plug drill box,
9 lanterns and oil-can.

7.

Can, powder and fuse, 3 hoes, coil gasket, 6 pigs lead, furnace, 2 barrels coke, lead kettle and spoon, bell pole, saw, tamping bar, 12 buckets, 6 lantern sticks, 4 iron bars, 14 blowing-drills.

CHAPTER VI.

SERVICE-PIPES.

Definition — Materials — Lead vs. Wrought Iron — Tapping Mains for Services — Different Joints — Compression Union Cups.

BY common consent and general usage, the term service-pipe is applied to the tube which conveys water from the street-main to the premises on which it is to be used. In the majority of cases the service-pipe proper ends just inside the cellar wall, and the term house-pipes is a suitable one to apply to the tubes which convey the water from that point to the various fixtures in the building.

There seems to be substantial agreement among those best qualified to judge that lead is the most suitable material for service-pipes, but in spite of this the first cost of lead pipe and the popular prejudice which is often found against it has prevented its adoption in many recently constructed works. This is not the place for a thorough discussion of the subject, but those who care to follow it are referred to a paper by Mr. Walter H. Richards, C. E., Engineer and Superintendent of the New London, Conn., Water-Works, which was published