

rear plunger is fitted with valves, similar to the damper in an ordinary stovepipe, by means of which water is permitted to pass the machine. The amount of water so by-passed depends upon the available working pressure of the water in the mains.

Method of Cleaning Four-inch Mains.

In cleaning 4-in. mains the first step is to uncover the pipe at certain chosen points. The excavation at such a point is usually about 2 ft. wide by 6 ft. long, and is carried down 1 ft. below the bottom of the pipe. The excavation below the pipe forms the bell-hoile which affords room for the calker to swing his hammer in making up the joints. The pit drains to a pump hole in one corner. This keeps the opening dry and allows the calker to make a good joint after the cable is passed through the main. The openings are usually about 350 ft. apart on 3-in. and 4-in. mains. In pipes of this size the cable is passed through the mains by rods similar to sewer rods.

After the openings have been excavated the consumers are notified that the water will be turned off in the neighborhood drawing from the main to be cleaned. About two hours' notice usually is given before putting the line out of service. As soon as the water is shut off the pipe is cut in the excavation nearest to the gate valve. On 4-in. mains a section of pipe about 2½ ft. long is generally so removed at each excavation. About 1,200 ft. is the usual length of pipe cleared at one draw for this diameter.



Fig. 2.—Method of Drawing Cleaner Through Small Water Mains.

As soon as the sections of pipe have been removed and the water pumped out of the excavations, half-inch rods are passed through the pipe line. The rods are introduced in short sections beginning at the opening near the gate valve. The last rod forced in has a hook on its free end to which No. 27 bright cord is attached. This cord is reeled off of a small hand winch which is placed directly over the excavation. The winch is supported by a frame which is easily taken apart for shipment from one job to another.

The rods are forced through the main by means of a roding device invented by the writer. As fast as the rods reach each opening in turn, the roding device is removed to that opening and the rods are forced on to the next opening. When the last opening, at the end of the 1,200 ft. of main, is reached the bright cord is attached to the ½-in. steel cable which is used to pull the machine through the pipe. The ½-in. cable is passed through a 45° bend, and attached riser pipe, before it is attached to the bright cord, and the bend is then calked into the opening. The steel cable is wound around a heavy, braced winch which is firmly anchored over the excavation farthest from the controlling gate valve.

The cable and cord are pulled back through the pipe by means of the small winch at the gate end. As the end of the cable reaches each excavation it is unfastened from the

cord and passed through the piece of pipe which is to be calked into the line at that point. The cable is again attached to the cord and is pulled to the next opening toward the gate valve where it is again freed from the cord and passed through a piece of pipe of the proper length to seal the opening. This process is repeated until the opening at the gate is reached where the cord is loosened and dispensed with. The cable is attached to the machine which is pulled far enough into the pipe line to allow the calker to fit in and calk a piece of pipe to seal the line at that point. Water-tight joints are then made at all the intermediate openings and the only opening in the line is then the one at the distant end where the heavy winch was located. It will be remembered that a 45° bend was calked into the line at that point. A riser pipe is calked to the bend so that the washings are carried up out of the trench and discharged into the gutter. A piece of string is tied around the cable at the point where it leaves the riser pipe before beginning the scraping operations. By this means it is easy to locate the machine in case it breaks away from the cable in coming through the pipe.

The gate valve back of the machine is then opened, and the water is allowed to run through the pipe until a full stream comes out of the riser pipe. The operators then start to wind up the cable on the large winch and the machine is drawn through the pipe. The loosened foreign matter of all kinds is washed out through the riser pipe. The machine

usually is drawn through the pipe line at the rate of 20 feet per minute. The manner of pulling the cable through the pipe by means of the large, anchored winch is clearly shown by Fig. 2. The water is allowed to escape in this manner until it flows clear. The 45° bend is then removed and the open ends of the pipe are plugged. A jack is screwed up tight between the plugs and left there over night. The next morning the jack is removed, the plugs knocked out, and the work proceeds in the manner described.

Cost of Cleaning Four-inch Mains in Louisville.

The cost of cleaning 4-in. mains for the Louisville Water Company is given below. These costs are for the work done from June 2 to June 12 inclusive, 1909. These dates are selected because at that time the most troublesome section of the city mains were being cleaned. During these eleven days 7,937 ft. of 4-in. mains were cleaned at a contract price for all labor and material of 7 cents per ft. The total cost to the city was, therefore, \$555.59.

Actual Cost.—The actual cost of labor and material used in this job was as follows:

42 4-in. sleeves	\$ 55.88
63 ft. 4-in. pipe	18.26
Yarn	0.60
Lead	12.00
Cement	8.00