Water mains should be as carefully graded as gas or sewer pipes, and have air balls of the self-acting kind (Fig. 1) fixed at all the highest points, and full-

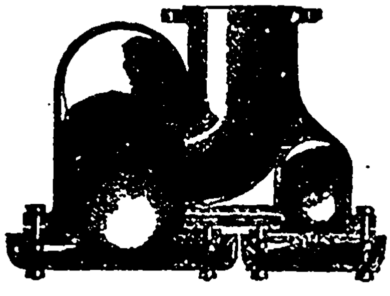

FIG. 1.

sized sluice valves at all the lowest points and dips, so that the whole system may be emptied and cleaned when necessary, and freed from deposits of grit and slime.

It must be remembered that water will run through water without moving the water adhering to the sides of the pipe it is passing through, and if the mains are larger than is needed to pass the supply taken from them, and the water is soft and pure, the motionless water clinging to the sides will set up an action with the metal and become hardened and turn into a brown calcareous matter, and continue to grow and diminish the bore of the pipe until there is just sufficient room to pass the necessary stream, when it will stop and continue in that shape for any length of time. For example, I inspected a fire hydrant intended to protect an isolated hall in a corner of a town, and found that it would not deliver any more water than the common bib water tap on the kitchen sink. On cutting the three-inch main to find the cause, I found it calcarized and the bore reduced as above stated, and the whole of that branch line for about one half mile had to be relaid with new pipes. Had the terminating sluice valve been open full wide once a month, and the dead water clinging to the sides of the pipe let out, along with any calcareous scales that might have started to form, it would never have been necessary to relay, and the hall would not have been in jeopardy for several years.

A 30-inch earthen pipe having cemented joints, that carried water from one storage reservoir to another on the moor land, got its bore diminished by fine rootlets passing through the cracks in the cement joints, growing inside and choking the interior. The calcareous matter growing on the inside of water mains can be removed by a machine called a ferret, which is so constructed that the pressure of water turned on behind it will force it through a moderate length of water pipe, and during its passage it will scrape the inside clean. When this method is used, clean-out doors must be provided at short intervals.

Neither large nor small water filters are of any use except proper provision is made for cleaning them easily, because no matter what material is used for a filtrate there is a limit to its usefulness. The best filters are made from either animal charcoal well pressed together, so that the water must pass through the coal, or magnetic carbide of iron. For purifying fresh water that is void of sewage deposits, about 15 inches of fine washed, clean, sharp sand and 20 inches of gravel will make a suitable filter, if the top layer is removed and clean washed; then spread on again about once each week. This will make the water of a bright color and pure. If I were to build a filter on a large scale I should have a graded concrete bottom, so that the water on escaping from the filtrate material would come together and form a stream to enter the distribution pipes. I would then have a false grated bottom, bearing on pillars, to hold the filtrate material. I would run the water to be treated over shallow troughs, the bottoms pierced with very fine holes at a convenient elevation above the filter, so that all the water intended to be filtered would fall into the filter in a fine spray similar to a needle bath; falling a distance say of four feet, in the form of a fine spray, the water would be aerated. I would also make a good system of ventilation that would insure a strong current of air to be continually passing between the cemented and false grating floor at the bottom of the filter. The water should pass slowly through at a pressure of about two feet above the face of the sand.

When water is delivered to consumers the shut-off tap usually fixed in the sidewalk near the street line should be of the screw-down pattern with the valve working loose inside, so that when full open it would allow water to pass through towards the house, but it would not allow any to return back into the mains. The tap would have a double action; it would not only make a first-class stop tap, but also a foot or check valve. (See sketch of the loose valve inside the bib tap shown.) This would prevent any fluid being forced or

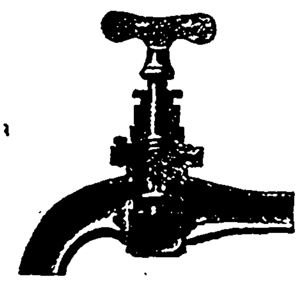

FIG. 2.

drawn into the street mains, and effectually prevent the return of hot and tainted water from water-heating boilers, steam and range boilers, etc., which is at present very prevalent.

Lead water pipes when laid in the earth should not be near any metal, because a galvanic action will be produced; nor near an electric car line, for the electricity will damage the lead if the soil it lies in is damp and a good electric conductor. Nor should it be laid near any tile or other drain, because a leakage of water would find a downward way of escape, and could not be easily found; nor under any manure pipe, or near dirt or filth of any kind, because when the water is motionless in the pipe it will absorb some of the foul gas thrown off from such filth through the lead coating, and become tainted. Lead is the handiest metal for small water pipes, because it can be easily bent to any angle. When damaged by frost or water hammer it is easy to repair without removal. When laid underground it will sink with the soil, stretch, or give and take a little without injury. On the other hand, when rigid iron is used it will break before bending, and if damaged a full length has to come out. It is very unfortunate that a chemical action sets up between pure soft water and lead, which poisons the water when it stands motionless in the pipe for a few hours, and thousands have been seriously injured in health by drinking and cooking with water poisoned in that way. The water that poisoned the Louis Philip family of Claremont contained seven-sixteenths of a grain of lead per gallon, and the water taken from the same source had injured to various degrees thirty-four per cent. of