kiln dried, cut to segmental section, and bound together into a circular form by heavy steel banding wires. These staves are provided with tongue and grooves, as shown. The outside is waterproofed by tar and usually an additional waterproof tar-paper covering is provided. The inside is lined with tin to cut down radiation losses and prevents any charring of the wood which might occur. The sections of casing can be obtained in lengths up to eight feet and are fitted together with mortise and tenon joints four inches long. The shell is usually four inches thick. The pipe is generally of wrought iron or steel, and all joints not adjacent to special fittings are made with heavy, long pattern couplings. The pipe itself is frequently wrapped with a special winding of asbestos paper secured in position by copper wire. Metal sealing rings are used at the joints of the casing when a watertight construction is desired. Girders and rollers for supporting the pipe are placed about eight feet apart. Special fittings are enclosed in watertight brick boxes

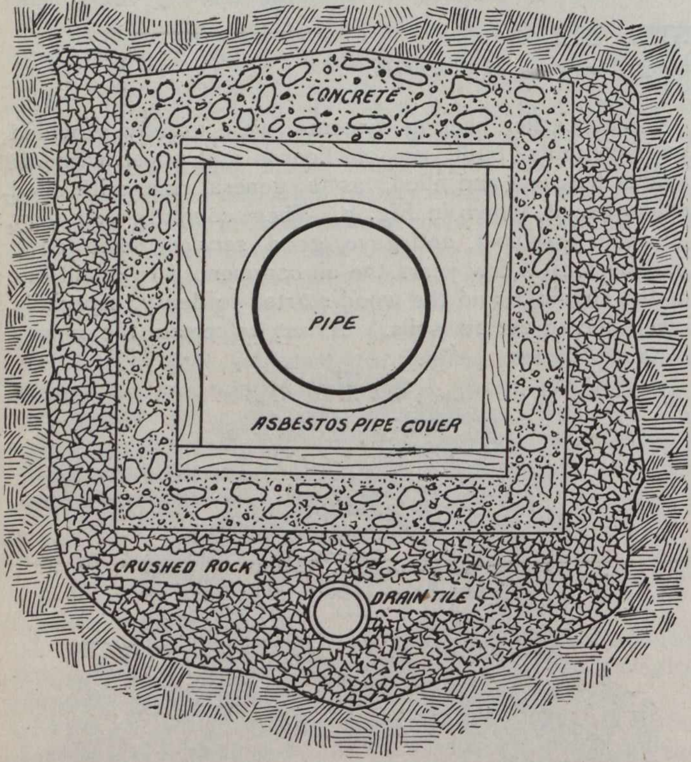

Fig. 7.—Concrete Conduit.

filled with oil-soaked shavings to prevent radiation losses. This conduit must be well underdrained to be efficient, which is usually done by means of single or double lines of 4-inch farm drain tile. It is fairly cheap and quite efficient, and can be readily taken up and repaired. The main objection to this construction is its deterioration, which is more or less rapid. In summer, when the heat is off the system, the wood is said to absorb moisture either from infiltration, from the ground, from leaky sewer pipe, or from broken water mains. The consequent swelling of the wood stretches the wires so that when hot and dried out again they are loose and allow the joints to open. The conduit is not then waterproof and the heat losses consequently increase. It has been noted in several cities that this wooden conduit deteriorates much more rapidly when laid under pavement or in cinders than when under sod.

Another form of conduit that has been used in a few cases consists of one of the wooden constructions already described, surrounded by a concrete shell.

Several heating systems have been recently built with the pipe line covered with an asbestos or similar moulded covering, which is waterproofed. A wooden box is then built around this, as shown in Fig. 7., and the whole then enclosed in a concrete box, thoroughly waterproofed and well underdrained. In some constructions oiled shavings have been used instead of the moulded covering, though less efficient. Concrete alone is not a good insulator so that dependence must be placed on the material surrounding the pipe. This conduit is expensive to lay, but is very enduring and maintains its high efficiency if it has been thoroughly waterproofed when laid. The principal objection to it is the difficulty of getting at the line for repairs or alterations.

The Milwaukee Central Heating Company use a type of conduit similar to Fig. 7, except that they install cast iron pipe with universal joints to carry the steam. This company has about 42,000 feet of main in service and have tried three different types of conduit. Their experience has led them to consider this type superior to either the wood-log construction or the concrete conduit filled with oiled shavings.

Another form of conduit, used at Beaver Dam, Wis., consists of hollow building tile in place of the concrete on the sides and top, as in Fig. 7. If this is once opened for inspection or repairs the tile is rendered useless. It has also been noted that tiles are liable to break in service, and, on the whole, this conduit has not proven very satisfactory.

Recent practice in heating systems has tended towards the adoption of the split glazed tile conduit shown in Fig. 8. The pipe is covered with a moulded or asbestos covering waterproofed by tarred paper or other means. A dead air space is provided between the covering and the tile. The joints of the tile are cemented together when the conduit is closed up. This conduit is very efficient as a heat insulator, cheaper than concrete, and more easily accessible for repairs. If the tiles are not first-class they break and thus destroy the efficiency of the system.

Cost of Conduit Construction.—The cost of conduit construction is a subject on which there is little information available. E. Darrow, in the Electrical World, April 6, 1911, in a paper on "Exhaust Steam Heating as Developed by a Large Central Lighting Station," gives the following costs for glazed tile conduits similar to that shown in Fig. 8.

Size, in inches	20	15	12	10	8	6	4
*Cost per ft.	$19.50	14.75	12.35	9.50	8.40	6.85	5.25

*Including trenching and paving.

For rough calculations this conduit may be said to cost $1 per foot length per inch diameter of steam main.

Conduits as shown in Fig. 7 are said to cost practically the same as the glazed tile. Wooden box conduits as shown in Fig. 5 are said to cost from 35 to 50% of the values given above. When hot water is used and two pipes are necessary, these costs have to be considerably increased.

There will be found in an article on "Wilkes-Barre's District Heating System," in the Engineering Record of September 14, 1912, the data reproduced in Table 4 on the costs of installing in Wilkes-Barre steam heating conduits of the type shown in Fig. 6. All re-paving was done by the city but the heating company was obliged to pay the city for permits to cut through the pavement at the rate of $3 per square yard for asphalt and $2.50 per square yard for brick, the measurements for which in-