Coincidence Factor and varies from 0.50 in some institutional groups to 0.90 in areas where loads are principally for heating and heat is turned on at about the same time each morning. Consideration should also be given to the net total load on a line, based on a study of the loads in the various buildings, in order to determine the relative merits of providing one or more separate supply lines to serve all-year loads. Such lines will permit turning off the mains that supply strictly seasonal space-heating loads during the summer months.

When the lengths of pipe, steam quantities, and initial and terminal pressures have been chosen, the pipe sizes can be calculated by means of Babcock's pressure drop formula given in Table 2 of Chapter 21. The district-heating industry, however, uses *Unwin's* formula for determining pipe sizes because pressure drops can be determined simply and directly from a chart. This formula has been checked by tests, and found correct within ranges of velocity used in district heating. A convenient chart developed from this formula is available from the *National District Heating Association*,[7] and provides a simple, yet accurate, means for determining pipe sizes.

Conduits for Piping

Conduits for underground steam pipes are used to protect the pipe and insulation from external damage and to provide a space in which the pipe is free to expand or contract while held in proper alignment. The conduit should be constructed of non-corrosive materials, or, if of metallic content, should be suitably protected against corrosion. It must be of adequate strength to withstand the earth and traffic forces to which it will be subjected. The conduit should be reasonably waterproof and in many cases provision should be made to drain seepage from its inside. With any form of conduit unless it is actually below water level, provision should be made to completely exclude water or to carry away ground water and prevent it from collecting around the conduit. This is often accomplished by placing a layer of course gravel or stone underneath and partly surrounding the conduit with one or two lines of tile having open joints which serve to carry the water to a sewer or other suitable outlet. Proper foundations should be provided to prevent settlement and to insure proper pitch of piping at all times.

Manholes may be required at intervals to provide access to valves, traps, and expansion joints. They should be drained. Some safe means of disposing of condensate from piping should be provided.

There are many types of conduits. They fall into six following general classifications: Box-type, Solid-pour, Prefabricated, Tile, Monolithic, Granular Fused, and Waterproof. Cross-sections of a few of the typical types are shown in Fig. 1.

Box-type conduits are typical of those built with common materials and have many variations. Conduit A, Fig. 1, shows a commonly used type in which a corrugated metal form is placed as an inverted U over the insulated pipe line installed on a concrete slab. The concrete may be reinforced or not, depending upon the load on the conduit. Drainage is provided by the drainage pockets filled with crushed stone or gravel and may be installed on either or both sides of the conduit. They conduct water from the top of the conduit to the drain below which is connected to the sewer or some other disposal facility. Variations of the concrete-box type have side walls constructed of hollow vitrified tile, concrete blocks, or other suitable materials, and covered with a reinforced concrete slab. The top

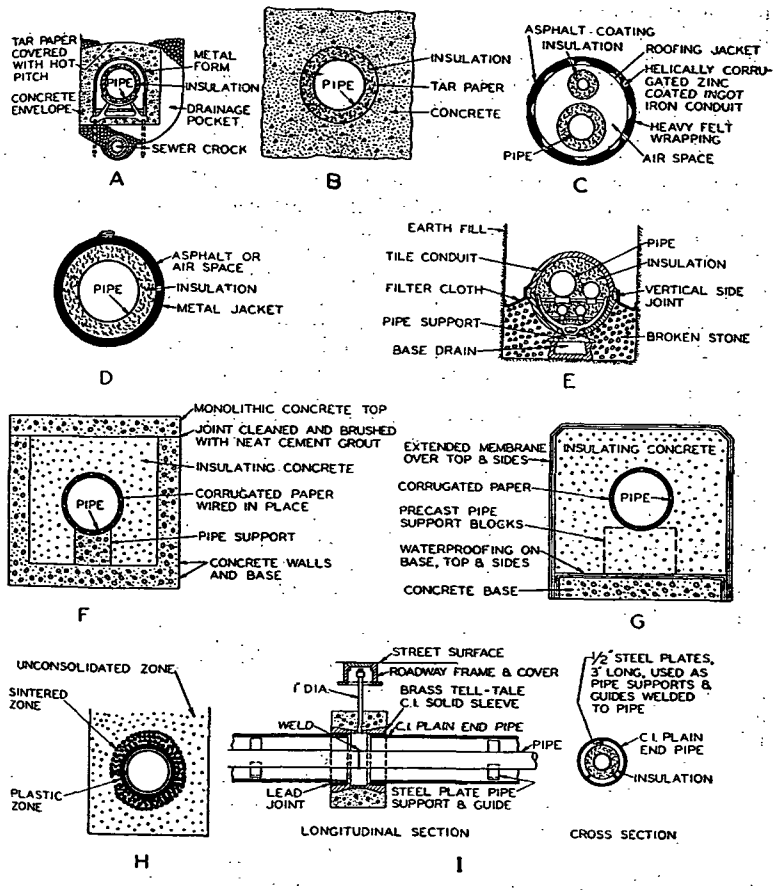

FIG. 1. A FEW TYPICAL CONDUITS FOR DISTRICT HEATING USE

and sides are sometimes covered with a waterproofing membrane of asphalt or hot pitch and roofing paper.

The solid-pour construction, Conduit B, Fig. 1, is also usually made with common materials and consists of poured structural concrete which is vibrated and tamped around a conventionally insulated steam line. If the insulation has a high compressive strength it can support the pipe, otherwise the pipe should be supported independently. Reinforcing is sometimes used to prevent settlement. An eccentric space may be left around the pipe by using insulation larger than the outside diameter of the pipe to permit upward movement of the pipe during the warm-up periods. During construction, pipe is suspended by wires. Precautions should be taken to prevent the pipe from floating. The top of the conduit should be coated with asphalt emulsion or tar to help seal shrinkage cracks. Anchor stresses are higher with this type of construction. Variations of this type