antimony, or its equivalent, be used. All piping or tubing is, generally, subjected to a hydrostatic test of at least three times the working pressure, but not less than 150 psig.

The more common forms of application of panel heating fall into the following general categories: (1) imbedded piping for ceilings; (2) imbedded piping for walls; (3) imbedded piping for floors; (4) air heated ceilings, walls or floors; (5) electrically heated ceilings, walls or floors.

Imbedded Piping for Ceilings

When piping is imbedded in ceilings, the construction used is generally one of the following:

a. Pipe or tubing is imbedded in the lower portion of a concrete slab, generally very close to its lower surface. If plaster is to be applied to the concrete, the piping

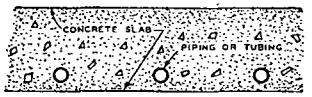
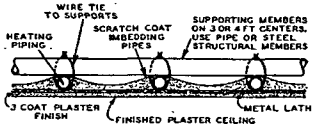


FIG. 1. COILS IN STRUCTURAL CONCRETE SLAB



Suspended Plaster Ceiling

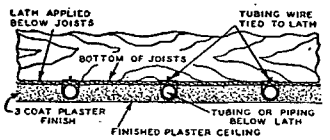
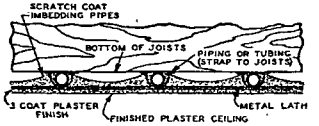


FIG. 3. COILS IN PLASTER BELOW LATH



Plaster Ceiling Below Joists

FIG. 2. COILS IN PLASTER ABOVE LATH

may be placed directly on the wood forms. If the slab is to be used without plaster finish, then the piping is installed about ½ in. above the undersurface of the slab. Fig. 1 shows this method of construction. It is important that any local construction codes which may affect the position of the piping be consulted.

b. Pipe or tubing is imbedded in a metal lath and plaster ceiling. If the lath is suspended to form a hung ceiling, the piping may be suspended as a prefabricated pipe coil so that the lath may be held by wire to the underside of the pipe coil. Plaster is then applied to the metal lath, care being taken to imbed the coil, as shown in Fig. 2.

c. Copper tubes of the smaller diameters are attached to the underside of wire lath or gypsum lath. Plaster is then applied to the lath to imbed the tubing, as shown in Fig. 3.

d. Other forms of ceiling construction utilize prefabricated panels of metal, composition board, wood paneling, etc., having water warm piping, tubing or channels built into the panel sections.

Coils are usually of the sinuous type, although some header or grid type coils have been used in ceilings. Coils may be of either ferrous or non-ferrous piping or tubing, with coil pipes spaced from 4½ to 9 in. on centers, depending on the required output, pipe or tubing size, and other factors.

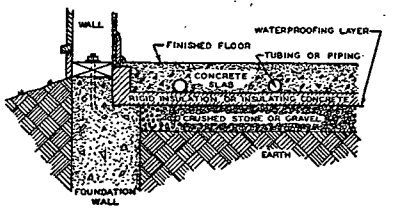


FIG. 4. COILS IN FLOOR SLAB ON GRADE

Where plastering is applied to pipe coils, a standard three-coat gypsum plastering specification[1] is followed, with a minimum of ⅜ in. of cover below the tubes when the tubes are installed below the lath. Generally, the surface temperature of plaster panels should not exceed 120 F, and this is usually met by limiting the water temperature in the pipes or tubes in contact with the plaster to a maximum temperature of 140 F. Insulation should be placed above the coils to reduce the *reverse loss* which is the difference between the heat supplied to the coil and the net useful output to the heated room.

Imbedded Piping for Walls

Although not so universally used as ceiling panels, wall panels may be constructed by any of the methods outlined for ceilings.

Imbedded Piping for Floors

The construction for piping imbedded in floors will depend upon whether (a) the floor is laid on grade, or (b) the floor is above grade.

a. Both ferrous and non-ferrous pipe and tubing are used in floor slabs which rest on grade. The coils are constructed as either sinuous-continuous pipe coils, or arranged as header coils with the pipes spaced from 6 to 18 in. on centers. The coils are generally installed with 1½ to 4 in. of cover above the coils. It is recommended that insulation be used to reduce the perimeter and reverse losses. Fig. 4 shows the application of pipe coils in slabs resting on grade. Generally, a waterproofing layer is desirable to protect insulation and piping.

b. Where the coils are imbedded in structural load supporting slabs above grade, construction codes may affect their position. Otherwise, the coil piping is installed in the same manner as described for slabs resting on grade.

Air Heated Ceilings, Walls, and Floors

Several methods have been devised to warm the interior room surfaces by circulating heated air through passages behind these surfaces. In some

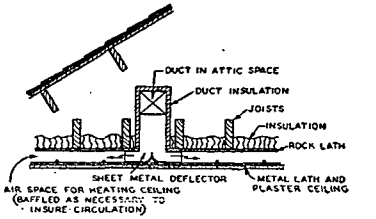


FIG. 5. WARM AIR PLASTER CEILING CONSTRUCTION