Case No. 4.—Radiators are often enclosed in boxes with a grill in front or recessed in the wall with a grill placed in front of them as in Fig. 8. In such cases, the height, *D*, is very important. With *D* equal to 2½ in., the heat transmission will be reduced 20 per cent, and with *D* equal to 6 in., the heat transmission is reduced 10 per cent. It is assumed in this case that the entire front of the box is provided with an open grill.

Case No. 5.—Sometimes a grill, as shown in Case 4, is partly replaced by a solid panel with openings above and below as in Fig. 9. With the openings the full length of the radiator and 6 in. in height and with *D* not less than 4 in., the heat transmission will be reduced 25 per cent. As *D* is reduced in height, the heat transmission will also be reduced and with *D*, 2½ in., the reduction will be 40 per cent.

Case No. 6.—Radiators are often placed under seats as in Fig. 10. In this case the distance between the top of the radiator and the bottom of the seat becomes very important and should be not less than 3 in. and if possible it should be made 6 in. Under favorable conditions, when *D* is at least 3 in. and *A* is equal to 6 in., the heat transmission will be reduced from 15 to 20 per cent. When *D* is small, however, say 2 in., and *A* is reduced to 4 in., this reduction may be 35 or 40 per cent.

In tests[1] by Prof. K. Brabbee will be found other cases than those cited above.

EFFECT OF POSITION

The effect of position on the heat transmission of a radiator is a subject that has been investigated only to a very limited extent. The experiments that are available show that the heat loss from a radiator is about the same whether it is placed at the floor, at the ceiling, or in the center of the room. It seems to make very little difference whether it is placed close to the wall or in the middle of the room. Placing a radiator close to an outside wall heats the wall immediately behind the radiator and if no insulation is placed behind the radiator this may represent a loss of from 3 to 5 per cent.

[1]Reported by George Stumpf, Jr., in *Heating and Ventilating Magazine*, May 1914, p. 23.

PIPE SIZES FOR STEAM HEATING

THERE are two broad divisions that may be very definitely made in the subject of steam main sizes. The first covers the distribution of the steam, and the second its use. The conveyance of steam for any considerable distance is a problem by itself, needing separate analysis and altogether different handling than any of the problems concerning the use of the steam after it has arrived at the building to be heated. Steam flow tables should be used for distribution, and tables giving the capacities of steam mains and branches, radiator connections, etc., under standard or average conditions of use should be applied for sizing the pipes within the buildings.

The velocities of flow used in the distribution of steam are only limited by the available or allowable drop in pressure, while the velocities within the buildings where the steam is used are limited by the critical velocities or the velocities which will allow of sufficient separation of the condensation so that defective circulation or water hammer will not occur.

During periods of maximum load on distributing mains, the velocity of flow is often so far above the critical velocity that little, if any, condensation is withdrawn by the drips. At the ends of the runs and especially where the pipe sizes are smaller, the velocities used should be well below the critical velocity so that the condensate is completely withdrawn and not carried into the branch supply mains within the buildings.

There is no formula of flow available for estimating the friction drop of mixtures of steam and condensation or water primed from the boiler. Excessive moisture in the steam, or boiler priming, may so increase the drop in pressure that an entire failure in operation may result. It is, therefore, good practice to provide hand hole or equivalent cleaning means at the bottom of all boilers and a permanent surface blow for boiling off, so that clean water and dry steam may be always maintained. It is quite probable that field research where boilers are priming would show a surprisingly high friction drop in the steam main.

Steam mains should not be dripped on the main trunk lines, and the riser connections and laterals pitched back to the mains. Much better results are obtained by dripping the mains to take care of their condensation, and then pitching the riser connections and laterals to first floor radiators away from the main, and providing additional drips to take care of their condensation separately. In a carefully designed plant, no branch or lateral larger than the supply to a single radiator should be pitched back against the flow of steam, and if it is not certain that the velocity is below the critical limit, the pipe should be provided with a separate drip.

The following tables for the carrying capacities of pipes as used in steam heating installations with the exception of dry returns have been de-