tively heated with ceiling radiation when belt drives were used have found it necessary to relocate the radiation at the floor, when direct motor drives were installed on machines. It has been found under these conditions that high temperatures prevail at the ceiling while low temperatures prevail in the working space. Not only operators have been affected under these conditions but also the output of the individual machines. Best results are obtained when the radiators are placed under the windows and adjacent to doors to the outside. The air heated by the radiators under the windows, rises, mixes with the cold infiltrating air from the windows, circulates across the ceiling, gradually settles to the floor, is drawn up by the radiator and the cycle continues. The advantage of placing radiators adjacent to the door is that the infiltration at this point is compensated for, the infiltrating air being warmed before it enters the heated space.

Placing a radiator close to an outside wall heats the wall immediate behind the radiator, but the infiltrating air through this wall absorbs this heat in part, the rest being used to compensate for the transmission losses through the wall.

CHAPTER III

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mains, the velocity of flow is often so far above the critical velocity that little, if any, condensation is withdrawn by the drips.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

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Material for this section especially revised for THE GUIDE by R. V. Frost, Norristown, Pa.