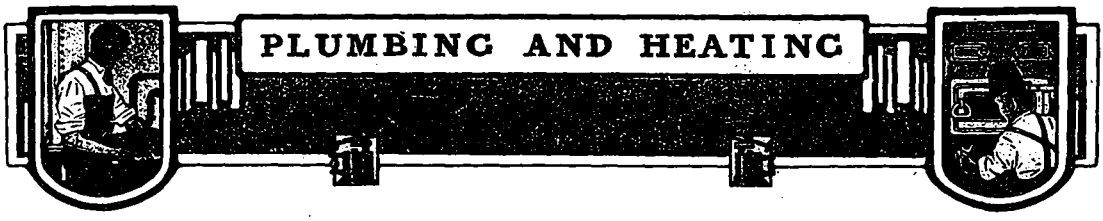

Principles of Steam Radiation

By Martin J. Quinn, Consulting Engineer

Thorough Knowledge of Proportions of Piping System, as Well as Those of Boiler and Radiating Surface, Necessary to the Successful Installation of Steam Heating Plants

IT will be most readily agreed to by those who have had a large experience, that the successful designing of steam heating plant calls for not only a thorough knowledge of proportions, so far as they apply to the boiler and radiating surface, but also in respect to the piping system, having regard to the class and character of the building in which it is to be installed, and the average architect and builder understands that the conditions existing in each individual building, must be the guide by which the heating engineer will arrive at a decision as to what system will prove most successful from the standpoints of economy, efficiency and convenience, *i.e.*, whether he will use a single-pipe gravity system, a two-pipe system, an overhead system, false water lines, etc., etc.

With the object of making clear what conditions call for the use of these various systems, we will make reference to the accompanying drawings.

In the first place, it must be understood that it is a physical impossibility to maintain the same pressure above the atmosphere at the boiler and the farthest ends of the piping system, and a misunderstanding or ignorance of this fact, has led to more trouble in connection with steam heating plants, than any other feature of them; and so important is it that the designer should have a complete knowledge of the existing physical conditions, that we deem it wise to describe and illustrate some features at greater length, than perhaps, at first sight, would seem necessary in order to provide a proper foundation upon which to base future articles upon the subject.

In Fig. 1, we show a cylinder which may be taken to represent the boiler, having a branch taken from the top representing the steam main, and connected to a loop, which may be taken to represent a return pipe, the latter however, not having any connection with the bottom of the boiler.

If we assume that the cylinder contains air, pumped to a pressure of one pound per square inch, it will be seen that this pressure will be communicated to the loop through the small pipe, and that it will force the water down on one side and up on the other side of the loop, until the difference in the level between the two is twenty-eight inches (approximately), or the amount of the "head" which equals one pound pressure, and this illustrates the conditions which will exist in a steam system where there is a difference of one pound between the pressure in the boiler, and that at the end of the steam main, and if there is a difference of two pounds, the water at the farthest end of the main will be twice the height above the normal water lines, or approximately four feet eight inches; and this being so, it will be readily seen, that, even with the normal water line several feet below the level of the steam main, the latter will become flooded unless proper care is taken to equalize the pressure.

In Fig. 2, we attempt to show the reason for the inequality of steam pressure, throughout the system.

In this case we show a boiler filled with water to the normal water line, and a steam main, which may be for the sake of argument one hundred feet long, and a return main connected to the end of it, as a relief, and passing back and entering the bottom of the boiler.

Let us assume that air is being constantly pumped into the boiler, and maintaining a pressure in the latter of five pounds, and throughout the length of the main it is escaping through a series of small holes, as at "B" "B" "B."

It will be seen at once that if the pipe is at all restricted in size that the pressure will be slightly reduced after it passes the first opening, and reduced again and again as it passes each succeeding opening, so that the lowest pressure will be at the farthest end of the main, while that in the boiler remains constant.

Now, it will be readily understood, that if the pressure in the boiler remains at five pounds, it will be equal in all directions, so that not only will it escape through

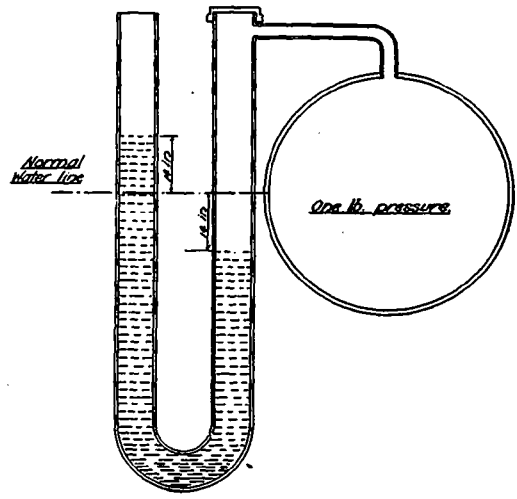

Fig. 1—ILLUSTRATING THE CONDITION WHICH WILL EXIST IN A STEAM SYSTEM WHERE THERE IS A DIFFERENCE OF ONE POUND BETWEEN THE PRESSURE IN THE BOILER, AND THAT AT THE END OF THE STEAM MAIN.

the top pipe, but it will also force the water down and out through the return pipe, and up to a height at the other end of the system, which will depend entirely upon the resistance of the air at that point.

In this instance we show a difference of two pounds, so that the water rises approximately four feet eight inches, or, if there were a difference of say two and a half pounds it will be readily seen that the main steam pipe would be flooded at the far end, and in that event it would either entirely cut off the flow of the steam, or the latter, in forcing its way through the water, would produce