WHEN TANK IS ON ROOF

If tank is elevated about 35 ft. above highest fixture, which would be about 25 ft. above the roof, all the computations given herein will apply for branch connections and main risers except that the main riser will have its greatest diameter at the top. It will be seen that 35 ft. elevation will give the necessary 15 lb. pressure at the highest fixture.

FRICTION IN ELBOWS

Friction caused by elbows should be added to straight pipe friction. Each elbow in a line will add friction equal to a length of straight pipe forty times the diameter of the pipe:

Pipe Size	¾	1	1¼	1½	2	2½	3	3½	4
Equivalent length of straight pipe in feet	2.5	3.3	4.1	5	6.7	8.3	10	11.7	13.3

The water supply formula herewith makes it possible to accurately compute the flow of water in gallons through any pipe with any friction head and also gives formula for the additional head due to water entering the main, which, if extremely accurate calculations are necessary, should be added to the head required for friction; generally, however, this can be neglected as it is comparatively small.

WATER SUPPLY FORMULA

CF = Cu. ft. per min. discharged
G = Gal. per min. discharged
H = Friction head of water in feet = pressure $\times$ 2.31; if water is raised vertically, deduct number of feet raised, from head due to pressure.
L = Length of pipe in feet—including horizontal and vertical runs.

$$CF = 0.16\sqrt{\frac{(3d)^5 \times 3\,H}{L}} \quad (1) \qquad G = 1.2\sqrt{\frac{(3d)^5 \times 3\,H}{L}} \quad (2)$$

$$H = \frac{(0.16 \times CF)^2 \times L}{(3d)^5} \quad (3) \qquad H = \frac{(1.2\,G)^2 \times L}{(3d)^5} \quad (4)$$

The above formula neglects the head due to entry, which need not be computed except when L is very short. H_1 = head due to entry in feet.

$$H_1 = \left(\frac{0.83\,G}{d^2 \times 13}\right)^2 \text{ or } H_1 = \left(\frac{0.16\,CF}{d^2 \times 13}\right)^2$$

Example.—Required the discharge of a 2 in. main with pressure 30 lb. 100 ft. horizontal run and 30 ft. vertical run.

$$H = 30 \times 2.31 - 30 = 39.3. \quad \text{Formula (2) } G = 1.2\sqrt{\frac{(3 \times 2)^5 \times 3 \times 39.3}{100 + 30}} = 100.8$$

In the above case the head due to entry would be $H_1 = \left(\frac{0.83 \times 100.8}{2 \times 2 \times 13}\right)^2 = 2.56$ ft.

Usually this can be neglected except for very close calculations.

PART II

CHAPTER XVI

VENTILATION

INTRODUCTION

VENTILATION is the science of supplying air having all the properties necessary and conducive to good health.

Early in the progress of the art it was considered that a room was well ventilated when a sufficient quantity of outside air at proper temperature was brought in. With buildings widely separated so that the outside air was not contaminated by contact with large groups of people, and the various operations of industry, this method usually provided sufficient ventilation. In the thickly populated districts of our large cities, where the buildings are large and close together, air is vitiated by contact with great masses of people, and by the various manufacturing processes and industrial activities far beyond the allowable limits for good ventilation. One good example of outside air contamination comes from the large number of motor vehicles in the streets producing great volumes of dust, objectionable odors, and poisonous gases.

Good ventilation, therefore, implies more than the supply of any given quantity of outside air. The various constituents, and the quality of the air itself within the ventilated space must be considered individually, and the verdict as to the satisfaction resulting from ventilation must be rendered in accordance with the perfection of each of these factors, and their relation to each other. It is immaterial whether the air is introduced direct from outdoors, whether it passes through a purification process, or if, after being purified, it is recirculated.

To be well ventilated the air in a room must have the ability to remove the proper amount of heat from the human body normally clothed. In other words, it must have the proper cooling power, or effective temperature, as determined by its temperature humidity and air motion. This factor of ventilation is taken up in another section. The air must contain the required amount of oxygen for supporting human life, be free from harmful bacteria, and low in dust count. It must be reasonably free from bodily and other objectionable odors, and harmful gases, and must be supplied to all parts of the room in sufficient quantity to maintain a proper value for each of these factors.

The Synthetic Air Chart as developed by E. Vernon Hill with a few modifications to incorporate the latest information obtained from the Research Laboratory offers a convenient means of determining the percentage of perfection of each of the above factors entering into good ventilation, and, therefore, the percentage of perfection of ventilation in any room or building. The Synthetic Air Chart is taken up in another section.