sure but the pressure that may exist while the water is flowing. For example, if the static pressure were 15 lb per square inch at the branch take-off the branch piping should be made to consume 9 lb in friction. If a pressure of 40 lb existed the branch should consume 34 lb in friction. The exact existing pressure can never be known owing to the uncertainty of the amount of flow. The average length of a branch is approximately 15 ft which, with the fitting resistance, gives an equivalent length of about 25 ft. With the size of tapping used as given in Table 1, the loss in a branch is approximately 8 lb per square inch when delivering the amount specified in the same table. If the actual length of the branch should then exceed 30 ft or if the pressure available is less than 15 lb per square inch, the branches should be made one size larger than those specified in Table 1.

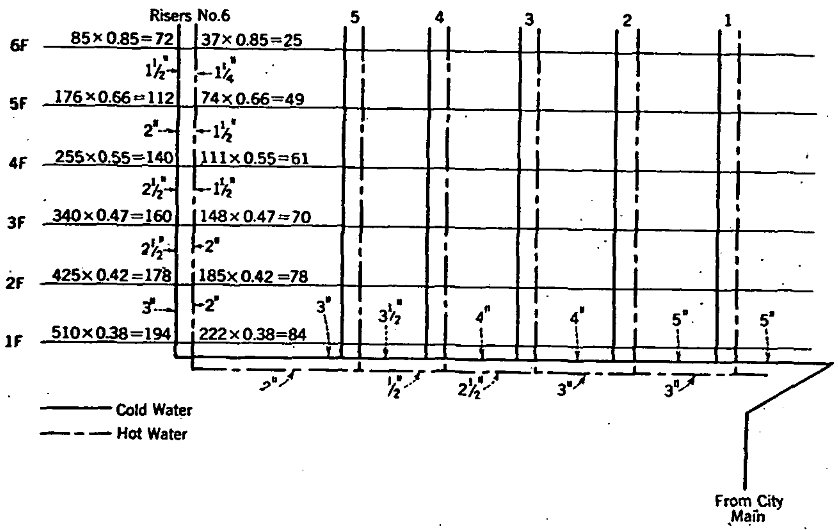

FIG. 3. UP-FEED RISERS FOR A SIX-STORY APARTMENT HOUSE

Example 3. To design an up-feed system as fed from city pressure, assume a 6-story apartment consisting of 6 risers as shown in Fig. 3 and assume that the pressure in the main is 70 lb per square inch. The static pressure for 60 ft of head is about 26 lb per square inch leaving but 44 lb for friction. The next consideration is the friction consumed by the meter. In this case it is taken at 15 lb leaving 29 lb still available. Allowing 6 lb at the fixture and 8 lb loss through the branches, leaves 15 lb still available for friction through the piping. With 60 ft of actual length in the risers and allowing 50 per cent for fitting resistances gives about 90 ft of equivalent length of pipe. The allowable loss per 100 ft, if most of the friction were taken in the risers, would be:

$$\frac{15 \text{ lb}}{0.90} = 16 \text{ lb per square inch}$$

It is advisable to design the headers with as small a loss as possible so that the pressure at the remote riser is almost the same as at the others. The fixture value for the cold water at each floor is 17.1 which is equal to 85 gal per floor, and is obtained as follows:

1 Water closet (1¼-in.)	=	9.7
1 Bath (¾-in.)	=	2.7
1 Lavatory (½-in.)	=	1.0
1 Kitchen sink (½-in.)	=	1.0
1 Laundry (¾-in)	=	2.7
Total cold water	=	17.1 fixtures × 5 = 85 gal
Total hot water	=	7.4 fixtures × 5 = 37 gal

Calculating the per cent of flow by means of Formula 1, the amount flowing at each floor is determined as shown on riser No. 6 of Fig. 3. The pipe sizes can then be determined from Table 4 so that the friction does not exceed the available amount of 16 lb per square inch per 100 linear feet of pipe. Thus on the 3rd floor the riser at some time must carry 160 gpm. From Table 4 it will be found that the friction through a 2½-in. pipe for this amount is about 10 lb per square inch per 100 ft of pipe while through a 2-in. pipe the loss is over 30 lb per square inch. A 2½-in. riser must then be used at this point. The sizes at the other floors are similarly determined. The sizes of the mains are also similarly determined but, as already stated, with less friction drop. Thus the main between the 4th and 5th riser which supplies Risers Nos. 5 and 6 or 12 floors, the per cent of flow at some one time may reach:

$$\frac{224}{12+2} + 10 = 25 \text{ per cent, which is equal to:}$$

$$85 \times 12 \times 0.25 = 255 \text{ gpm}$$

From Table 4 it will be found that a 3½-in. pipe will accommodate this with a loss of but 5 lb per square inch.

STORAGE TANKS

In the selection of storage tanks the rules of practice vary greatly. A generally accepted assumption is that simultaneous use of the fixtures will take place once each hour. The simultaneous flow per minute is thus taken as one hour's storage, which is a purely empirical rule but one which seems to meet most demands. In the case of Fig. 2 there are 3337 cold water and 1043 hot water fixtures making a total of 4380 fixtures. By means of Formula 1 it is found that the per cent of simultaneous use for the 8 cold water and 8 hot water risers supplying 11 floors each, or 176 floors in all, is about 11 per cent giving a simultaneous use of 482 fixtures. At a 5-gal-per-fixture value this gives 2410 gal which is taken as one hour's supply. A five-hour storage capacity would then demand a 10,000-gal tank, and a 10-hour storage, one of 20,000 gal capacity. The latter size would be the better practice insuring service during prolonged pump repairs. These figures do not include the fire or stand pipe storage which must be governed by the prevailing code.

HOT WATER TANKS AND HEATERS

The fixture method is probably as rational as any for determining the capacity of the tank and heater, allowing a safety factor of two to meet the trend of prevailing practice, which is equivalent to taking the peak load flow per minute as a half-hour supply. In the case of Fig. 2 this gives an hourly requirement of:

$$5 \text{ gal} \times 1043 \text{ fixtures} \times \left(\frac{224}{88+2} + 10\right) \text{per cent} \times 2 = 1300 \text{ gal}$$

Two 750-gal tanks with a heating capacity of 750 gal per hour each would