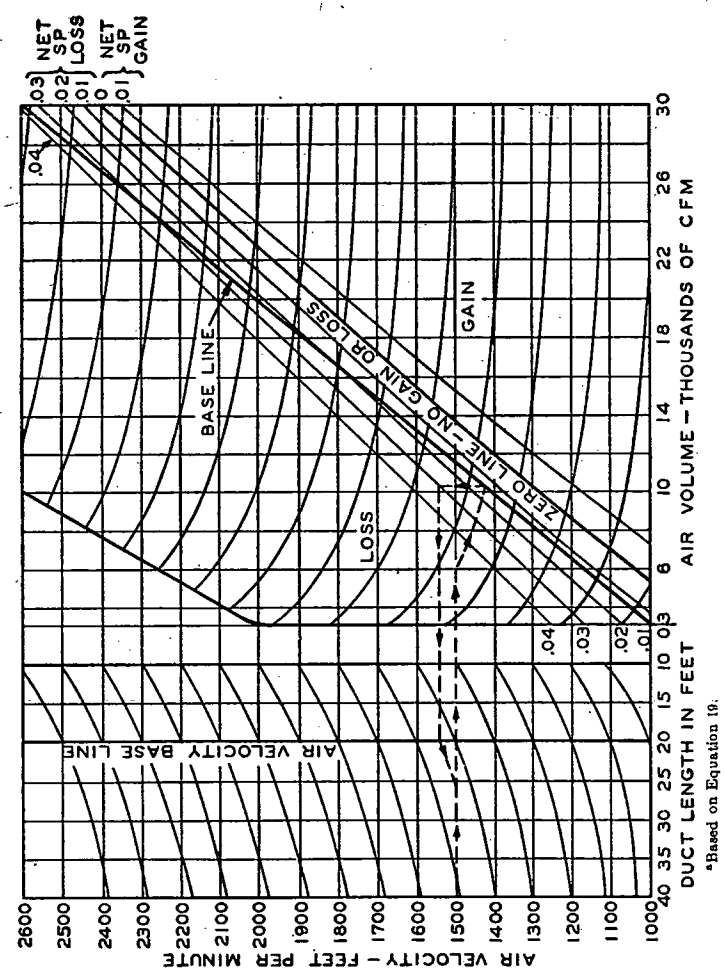

Fig. 13. Static Regain Chart[a] *For Determining Velocity in Ducts Carrying 3000 to 30,000 cfm.*

[a]Based on Equation 19.

figured separately.) The *duct length* of any section should include the equivalent length of any elbows occurring within the section.

The static regain charts are intended primarily for constructions where regain takes place unaccompanied by radical change in direction; thus, in Fig. 14 they are strictly applicable along the main run A to E, and at the junction of Sections F and G, but not at the junction of Sections A and F. Although some regain will usually occur at the branch take-off (where velocity is generally reduced), there are so many varieties of elbows and branch take-off connections, that estimation of an *average* value of regain would be quite impracticable.

The static regain method finds its widest application in the design of long duct runs containing numerous successive outlets (usually designated the

outlet run). An outlet run is typified by Sections C–D–E in Fig. 14. On larger systems several methods of duct sizing may be combined to secure equal or approximately equal pressures at all outlets. Example 6 shows the method of approach as applied to a very small system.

As with any other method of duct design, balancing dampers should be installed in each branch, and each outlet should be equipped with means of regulating air volume.

Example 6: (Static Regain Method). A duct layout is shown in Fig. 14. The fan delivers 8000 cfm. Outlets 1, 2, 3 and 4 deliver 1500 cfm each, and outlets 5 and 6, 1000 cfm each. The operating pressure loss at all outlets is 0.12 in. water. Initial trunk velocity is assumed as 1500 fpm; the area of the trunk duct will then be 5.33 sq ft, and the size will be 48 x 16 in. It is assumed that for this example it is desirable to maintain a 16 in. depth on all duct sections. Determine the sizes of duct sections B, C, D, E, F and G so that substantially the same static pressure will be obtained at each of the outlets, and find the total pressure loss of the system.

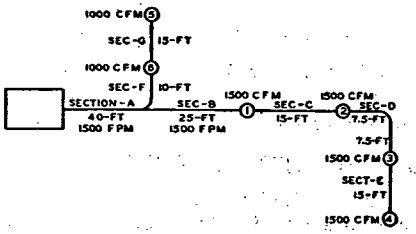

Fig. 14. Duct Layout for Example 6

Solution:

1. Size Section F by the equal friction method so that it has the same rate of friction loss as Section A. Section A is equivalent to a 29.2 in. round duct (Table 2) and the pressure loss from Fig. 2 is 0.13 in. per 100 ft. For 2000 cfm flowing at this rate of pressure loss, the indicated round duct diameter for Section F is approximately 17 in. (Fig. 2). This is equivalent to a 15 x 16 in. duct, which will be used for Section F. The velocity in Section F will be 1200 fpm.

2. Determine the pressure loss in Section F. Actual length of duct is 10 ft; equivalent length of elbow take-off is assumed as 10 W, or 12.5 ft. Therefore, the total equivalent length is 22.5 ft. The pressure loss in F = 0.13 in. $\times \frac{22.5}{100}$ = 0.03 in. water.

3. Using Static Regain Chart, Fig. 13, size Section B for a net pressure loss equal to the loss in F, or 0.03 in. water as follows:

The operation is indicated by arrow heads on the dotted line on Fig. 13. On Fig. 13, start at the velocity in Section A (1500 fpm) at left margin. Proceed horizontally to 6000 cfm ordinate, and then run parallel to the curved lines to intersect the diagonal Base Line. From this point, rise vertically to the 0.03 net static pressure loss line, and from this intersection proceed horizontally to the Air Velocity Base Line. Proceed parallel to curved lines to intersect ordinate for 25 ft equivalent duct length, and then move horizontally to left margin and read the velocity (1500 fpm).

Since Section B carries 6000 cfm, the area required will be $\frac{6000}{1500}$ = 4 sq ft, and the size of duct will be 36 x 16 in.

4. Using Static Regain Charts (Figs. 12 and 13) determine size of Sections C, D, E and G, but instead of allowing 0.03 in. net loss, which was used for Section B, proceed from the diagonal Base Line vertically to the *no gain or loss* diagonal. The procedure for Section E is shown by the dotted line and arrows on Fig. 12: starting from 1040 fpm velocity, which is the velocity in Section D.

Duct sizes determined by the given procedure are listed in Table 7 on next page.