or, using the values from *Example 5*:

$$r_b + 2r_{be} = 0.26 - 0.04 - 0.12 = 0.10 \text{ in.}$$

$$r_d + r_{de} = 0.26 - 0.04 - 0.02 - 0.12 = 0.08 \text{ in.}$$

The loss in the elbows will be assumed to be $\frac{L}{W} = 12$ or 10 additional equivalent feet, the friction loss of head per 100 equivalent ft is then

for duct (1) $$\frac{0.10}{0.15 + 2 \times 0.10} = 0.286 \text{ in.}$$

for duct (2) $$\frac{0.08}{0.10 + 0.10} = 0.4 \text{ in.}$$

Using Friction Chart Fig. 1, the duct diameter of Section B, to carry 750 cfm with a loss of 0.286 in. per 100 ft, is found as 10 in., and the duct diameter of Section D, to carry 750 cfm with a loss of 0.4 in. per 100 ft is 9.8 in. Equivalent rectangular ducts are 10 × 8 in., the velocity in both ducts is 1350 fpm.

The actual loss in ducts (1) and (2) is:

$$0.04 + 20 \times \frac{0.286}{100} + 15 \times \frac{0.286}{100} + 0.12 = 0.26$$

$$0.06 + 10 \times \frac{0.4}{100} + 10 \times \frac{0.4}{100} + 0.12 = 0.26$$

For final survey of ducts selected see Table 6 (Tabulation of Results).

3. Static Regain Method

When this method is used, the velocity is reduced at each branch or take-off so that the recovery in static pressure due to this reduction will offset the friction in the succeeding section. This method is based on the convertibility of static pressure and velocity pressure, as discussed in a preceding section on Pressure Changes. If no friction or dynamic losses occurred, the change in velocity head would be completely converted into a regain in static pressure, which for standard air would be:

$$H_r = \left(\frac{V_1}{4005}\right)^2 - \left(\frac{V_2}{4005}\right)^2 \qquad (18)$$

where

H_r = theoretical head recovered (static regain), inches of water.
V_1 = initial velocity of standard air, feet per minute.
V_2 = velocity of standard air after reduction, feet per minute.

Under ideal conditions, 0.7 to 0.8 of the velocity head is actually recovered, but for practical design an average recovery of 0.5 is assumed. The actual velocity head recovered H_r, then becomes

$$H_r = 0.5\left[\left(\frac{V_1}{4005}\right)^2 - \left(\frac{V_2}{4005}\right)^2\right] \qquad (19)$$

The advantage of the static regain method is that it provides a convenient means of designing a long run of duct (or an entire system) so that essentially the same static pressure will be obtained at each outlet. This simplifies *outlet selection* and *system balancing*. On large systems or very long runs, where it may not be feasible or economically desirable to design for zero static pressure loss between outlets, the method may be used to size

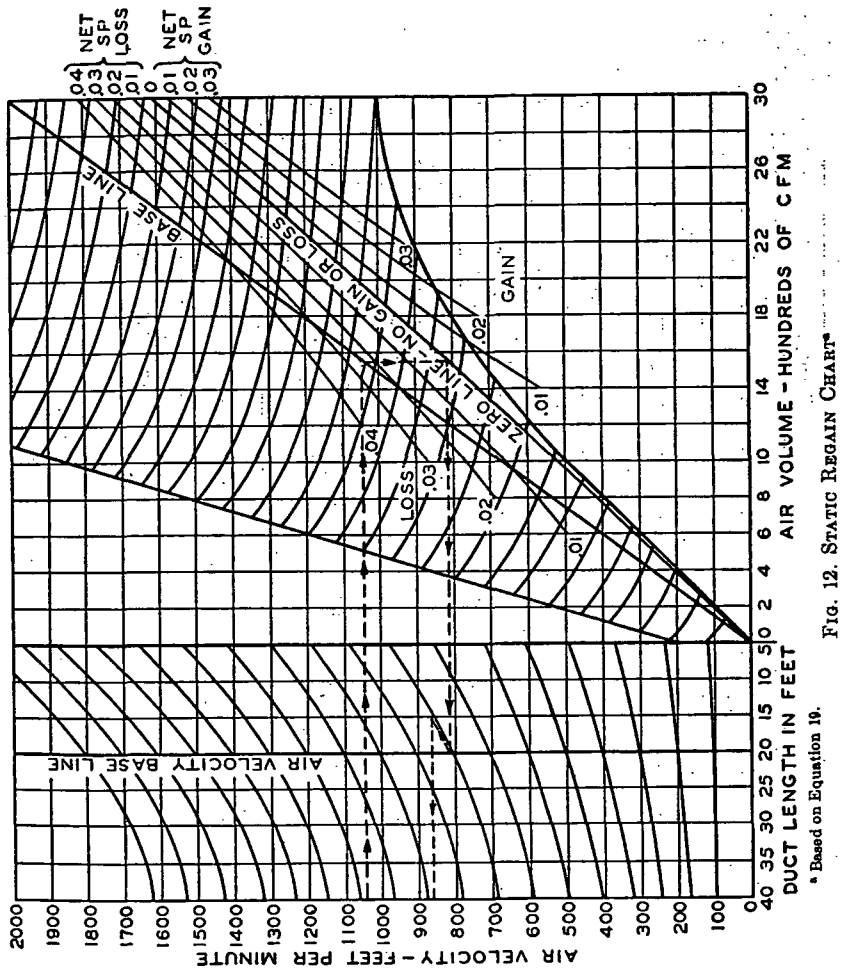

FIG. 12. STATIC REGAIN CHART* *For Determining Velocity in Ducts Carrying 0 to 8000 cfm*

* Based on Equation 19.

ducts for a *uniform predetermined loss*. This loss or gain is *net*, that is, it is the friction loss compensated by any static pressure gain made available by a change in velocity. (The latter effect is commonly neglected in the Equal Friction Method.)

Charts for the practical application of the principles of static regain to duct design, are presented in Figs. 12 and 13. These charts are based on Equation 19, as applied to rectangular ducts of average construction with dimension ratios of 3 to 1 or less. Note that the *gain* or *loss* indicated on the charts is the net gain or loss in the duct section considered (normally the distance between two outlets); it should not be confused with static pressure loss per 100 ft, or total pressure loss in the duct. The total loss or gain in the *outlet run* is the summation of the losses or gains in the successive sections figured. (Losses in outlets, coils, or similar items are