reverberant or both, the intensity at the 5-ft station may be almost doubled and the noise level increased nearly 3 db thereby. The simplest method of handling this problem, and one which errs in the direction of safety, is to treat the room as though all the air were being supplied by one supply opening. Thus, if two outlets, each supplying 1000 cfm are used, the value 2000 cfm should be used with Fig. 11. Although this method may place an unwarranted limit on velocity when used in a large room, it is seldom that such a room has a noise level low enough to justify a more complicated though more exact procedure.

In general, return grilles are selected for velocities about half the supply velocity, and when this is done, they may be neglected in sound computations. However, if supply and return grilles are the same size, resulting in the same face velocity, they must be treated as two supply openings. That is, if 1000 cfm are supplied and exhausted through grilles of the same area, 2000 cfm must be used in the solution with Fig. 11.

SELECTION OF SUPPLY OPENINGS

After the heating and cooling load calculations have been made (Chapters 5 and 6), and a suitable supply air temperature selected, the volume of air required for each space can be determined. The next step is to determine the velocity at which the air may be introduced into the space quietly and without creating objectionable drafts.

Present day grille design coupled with the introduction of effective acoustical treatment for minimizing fan and duct noises have made grille face velocities in excess of 1500 fpm feasible, and 600 to 1200 fpm is now common practice. This range of velocities is approximately three times higher than common practice values of a few years ago.

Since high velocities make for smaller ducts and supply openings, and therefore savings in space as well as greater flexibility in locating the duct work to the best advantage, selection of design velocities is a very important step. The selection of proper velocity requires that the designer have reliable data applicable to the particular make of supply opening proposed for usage. Even under these circumstances, the problem is one of *cut and try* because permissible velocity may be limited by either noise or throw.

A method for selecting supply openings is outlined below in the form of a sample cooling problem, using numerical values which have no reference to any particular make of supply opening.

1. The load calculations have been made; a suitable temperature differential has been selected (it is to be understood that the data referred to from this point on are based on this temperature differential), and the volume of air required determined. Assume that Fig. 13 represents a small general office having a noise level of 40 db and that 2400 cfm must be supplied for proper conditioning.

2. Select a tentative location for the supply opening or openings, having in mind the type of grille most likely to effect proper distribution. In this particular case, two supply openings having a wide spread appears to be a logical choice.

3. Data from which to determine velocity which corresponds to 2400 cfm and a noise rating at least 5 db below the noise level of the office may be presented in a number of forms, one of which is shown in Fig. 11. (Fig. 11 represents assumed values only. In practice similar data should be obtained from the manufacturer whose supply openings are being considered. Several similar charts or tables may be necessary to cover any one manufacturer's complete line.) From Fig. 11 it will be noted that for 2400 cfm the type of grille selected may be used at velocities up to 725 fpm without exceeding 35 db; that is, 5 db below the noise level of office.

4. Having determined the velocity, the core area becomes fixed at 3.31 sq ft or 397 sq in. per supply opening. In this problem, the two grilles in question are so close together that consideration of their combined area in determining the permissible velocity from the standpoint of noise introduces little error.

5. The type grille selected has thus far been found satisfactory from a noise standpoint, provided the face velocity does not exceed 725 fpm. The next consideration is throw, which may be assumed to be 16 ft, and by reference to a manufacturer's catalogue the proper correlative test data may be checked with the throw assumed. It is of course evident that one or more types of grilles may satisfy the requirements, and that in any one type there will be a choice of supply opening proportions. It will also be evident that the tentative selection of a supply opening having a wide spread may be unsatisfactory from the standpoint of throw, in which event a second choice should be made and the procedure repeated.

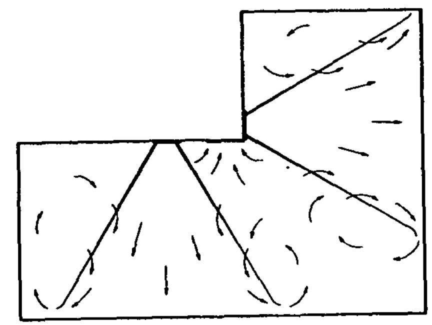

FIG. 13. PLAN VIEW TYPICAL GENERAL OFFICE

In the case of a heating problem, the method of solution is the same, but the manufacturer's data should, of course, be based on tests with air above room temperature. However, if data based on chilled air are used for a heating problem the grille selection will err on the side of safety.

TYPES OF SUPPLY OPENINGS

Grille, register or supply opening design for attaining uniform distribution and minimum air resistance consists of various fixed and adjustable arrangements. Some types are designed with directing air blades, fins, bars, louvers, or thin metal strips shaped into a series of grooves or tubes, all of which may be set into a suitable round, square or rectangular frame. In order to attain desired long or short air throws, the emergence of air from the supply opening may be directed to straight, deflecting, converging or jet air streams depending upon the supply opening design. Designs which direct the air stream to produce an ejector effect within the enclosed space tend to mix the room air with the conditioned air.

There are several types of centrally located ceiling or wall type supply openings. One of these consists of several round, hollow, cone-shaped flaring members with one or more of the smaller members acting as ejectors and injectors. An idea for producing even distribution of air consists of a perforated ceiling made of a suitable architectural surface and installed a small distance below the normal ceiling level of the room. In the space