1. Study the plan of the building and note the amount of air to be supplied to each enclosure.

2. Select number of outlets for each enclosure, considering air quantity required and distance available for throw or as radius of diffusion. The same factors, as well as distance from floor level available as mounting height, structural characteristics of the space and consideration of appearance, will determine the type of outlet used.

3. Arrange location of outlets in space. Usually the outlets will be evenly spaced to distribute air uniformly throughout the enclosure. Sometimes, however, more air should be supplied and directed towards zones having exceptional heating or cooling loads. An important point to consider is the combination of proper outlet location and efficient duct design (see Chapter 32). Consult manufacturers' tables for recommended location and spacing of outlets.

4. Select size of outlets according to air quantity handled, permissible throat or discharge velocities or effective throw, taking into consideration other factors such as noise level, static pressure resistance, etc. It will generally be found that most selection tables for grille type outlets are based on capacity and throw, whereas data for ceiling or wall diffusers are usually based upon capacity and permissible outlet velocity. Choice and arrangement of either type of outlet should, however, satisfy the requirements of all aspects of air distribution. Therefore, type, location and size of any outlet should be checked against manufacturers' ratings to determine whether the selection made would satisfy the requirements of the job. The most important questions to be considered are:

a. Can drafts occur because of divergence between rated throw (radius of diffusion) and distance between outlet and nearest obstacle of air stream (wall, beam, pillar, ledge, etc.)?
b. Can drafts occur because of excessive cooling temperature differential and too low mounting height of the outlet?
c. Can drafts occur because of too low velocity causing a drop in cooling installations?
d. Will the outlet operate at too high a velocity and thereby cause an excessive increase in noise level?
e. Will the outlet operate against an excessive static pressure resistance?

Balancing the System

In designing an air conditioning system it should be the aim of the engineer to size ducts and outlets in such a manner that proper distribution of supply air takes place. In practice, however, this is almost impossible and therefore additional means for regulating air distribution are required to *balance* the system. Some of these means are:

1. Reducing the effective area of some supply openings by blank-offs.
2. Placing dampers in the supply and return (exhaust) openings.
3. Placing dampers in the supply and return (exhaust) ducts.
4. Using combinations of dampers in both supply and return (exhaust) ducts.

In selecting the desired type of damper or balancing method, the following points should be kept in mind:

1. Unfavorable effect on air stream and noise level should be avoided. This will often eliminate blank-offs and dampers installed in the supply and return (exhaust) openings, unless such dampers are of special design.

2. It should be possible to alter the volume control setting and measure the amount of air handled without difficulty. This will be particularly difficult to achieve in the case of blank-offs.

Generally speaking, it is most satisfactory to install dampers in the supply duct at some distance back of the outlets, so as to avoid disturbing the air flow. Dampers in both supply and return air ducts, form the most flexible means of controlling supply of air to the room and static pressure within the room. Means of volume and directional control are discussed in

detail in a following section of this chapter. Many types of air distribution control devices are now commercially available.

DIRECTIONAL AND VOLUME CONTROL

Duct Approaches to Outlets

In order to obtain proper direction of flow and distribution of air from outlets, it is necessary that the air stream approaching the outlet be of uniform velocity over the entire connection to duct, and perpendicular to the face.

Grilles and directional outlets cannot compensate for improper approach. Any attempt to secure a low face velocity and a high duct velocity by con-

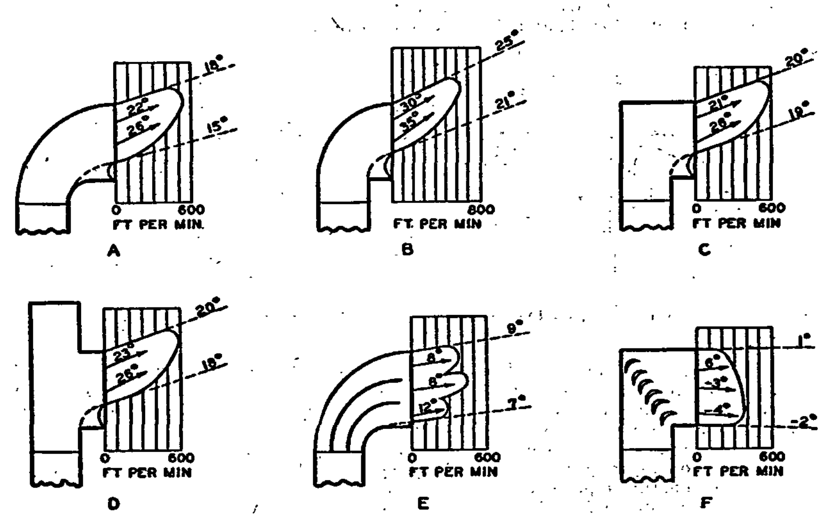

Fig. 6. Outlet Velocity and Air Direction Diagrams for Stack Heads with Expanding Outlets

Stack 14 in. x 6 in. Outlets 14 in. x 9 in. Stack Velocity 500 fpm
A. Rounded Throat and Rounded Back.
B. Square Throat and Round Back.
C. Square Throat and Back.
D. Square Throat and Cushion Chamber.
E. Rounded Throat and Back and 2 Splitters.
F. Square Throat and Back and 6 Guide Vanes.

structing an expanding chamber directly behind the grille, is likely to be unsuccessful because the enlargement angle, even in a straight duct, cannot be greater than 7 deg at each side if the stream is to fill the outlet without turbulence.

In elbow outlets or stack heads at the top of vertical stacks, it is necessary to provide splitters or guide vanes in the elbows regardless of the shape of the elbows, whether of rounded, square or expanding types. Cushion chambers at the top of the stack heads have no beneficial effect. The direction of flow, distribution and velocity (measured 12 in. from outlet) of the air, based on tests,[5] are shown in Fig. 6 for various types of stack heads expanding from a 14 in. x 6 in. stack to 14 in. x 9 in. outlets, without grilles. The air velocity for each was 500 fpm in the stack below the elbow, but the direction of flow and the distribution patterns are generally indicative of