cool air to give the proper delivery temperature. By cooling a portion of the total amount of the air, the dehumidifier, pump, motors and water piping are smaller than in the system using all the air through the washer. As the major portion of the reheating is done by the by-passed air, smaller size reheaters are used. This type of system provides a constant supply of air regardless of load, and a decrease in the total refrigeration required for the season.

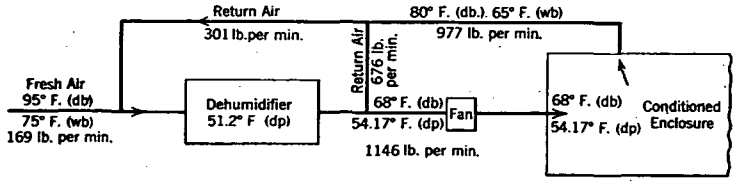

FIG. 3. DIAGRAM OF BY-PASS METHOD

Example 2. By-pass Method. (Fig. 3). Same data as Example 1. Instead of passing all the air through the dehumidifier to be cooled, a portion of it is passed through and the balance is mixed with the conditioned air at the leaving end of the dehumidifier, the mixture being so proportioned that the resultant conditions will be those required to give proper maintained conditions in the enclosure.

Setting forth the conditions as shown in Fig. 3, it is now necessary to calculate the quantity of air to be passed through the dehumidifier, the quantity by-passed, and the dew-point temperature it is necessary to carry in the dehumidifier to give the conditions sought.

There are three unknown quantities to be determined and these may be solved in two successive steps.

Let

x = the percentage of air to be by-passed.
y = the percentage of total air through the dehumidifier.
t = the dew-point temperature to be maintained in the dehumidifier.

The quantity x of 80 F air must mix with y quantity of dehumidified air to give a resultant of 65 F. Also, x quantity of air at 56½ F (dp) must be mixed with y quantity of dehumidified air to give a resultant of 54.17 F (dp). It is assumed, of course, that the air passing through the dehumidifier is saturated, that is, the dry-bulb, wet-bulb and dew-point temperatures are the same.

Therefore,

$$80x + yt = 68 \quad (1a)$$
$$56.5x + yt = 54.17 \quad (1b)$$
$$23.5x + 0 = 13.83 \quad (1c)$$

$$x = \frac{13.83}{23.5} = 59 \text{ per cent of air by-passed.}$$

$$y = (1 - x) = 41 \text{ per cent of total air through washer.}$$

The second step is to determine the dew-point temperature in the dehumidifier. Substituting in either Equation 1a or 1b and solving will give the desired results as follows:

$$(80 \times 0.59) + t \times 0.41 = 68 \quad (2a)$$

$$t = \frac{68 - 47}{0.41} = 51.2 \text{ F (dp)} \quad (2b)$$

As the total weight of air is 1146 lb per minute and 41 per cent is required through the dehumidifier, the work done would be

1146 × 0.41 = 470 lb through dehumidifier
− 169 lb fresh air
301 lb recirculated air

Refrigeration required would be

Total heat at 65 F = 29.85
Total heat at 51.2 F = 20.85
9.00 Btu per pound

301 × 9.0 = 2709 Btu per minute

Total heat at 75 F = 37.72 Btu per pound
Total heat at 51.2 F = 20.85 Btu per pound
16.87 Btu per pound

169 × 16.87 = 2851 Btu per minute
2709 + 2851 = 5560 Btu per minute, total

$\frac{5560}{200}$ = 27.80 tons of refrigeration required. This is 63 per cent of that required when all the air passed through the washer.

LOCAL RECIRCULATION METHOD

The local recirculation system cools and dehumidifies a small portion of air and by means of nozzles which are usually specially designed, the air is introduced into the conditioned enclosure at a high velocity (1200 to 1500 fpm) in such a way as to induce the air in the enclosure to circulate and mix with it to give the proper predetermined conditions.

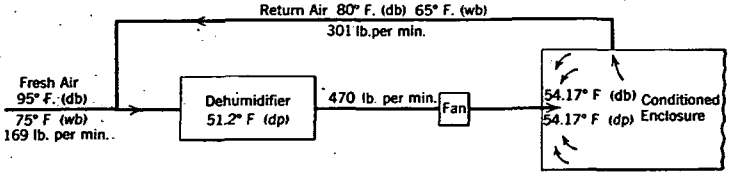

FIG. 4. DIAGRAM OF LOCAL RECIRCULATION METHOD

Example 3. Local Recirculation Method. (Fig. 4). Same data as Example 1. With this method a small quantity of air is used and discharged into the enclosure at a relatively high velocity to give the air in the room an induced circulation. This is done by omitting the reheaters and discharging the air into the enclosure at the dew-point temperature.

With the cut-and-try method it is found that a dew-point temperature of 51.2 F is necessary to pick up the heat and moisture in the enclosure, that is, the dry-bulb and dew-point temperatures are the same.

$$\frac{199736 \times 55.2}{(80 - 51.2) \times 60 \times 13.35} = 470 \text{ lb per minute}$$

The 470 lb per minute is the same as that required through the dehumidifier in the by-pass system and as the temperature is the same, the refrigeration load will be the same, the only difference between the two methods being the additional fan horsepower in the by-pass method, which is negligible, and the larger sized duct work.