temperatures on any floor, and the B.t.u. carried per square inch of leader pipe per hour to each of these floors. It should be noted that with a very short and well-designed recirculating duct Fig. 48, it is possible to increase the values shown in these curves by 10–15 per cent.

Knowing the B.t.u. loss per hour from any room on any floor (first, second or third), and given any register temperature, using the value of B.t.u. per square inch of leader pipe from these curves, simple division will give the square inch of leader pipe necessary to heat the room to 70 deg. fahr., on a zero day, for which in this case the heat loss has been calculated in Table 77.

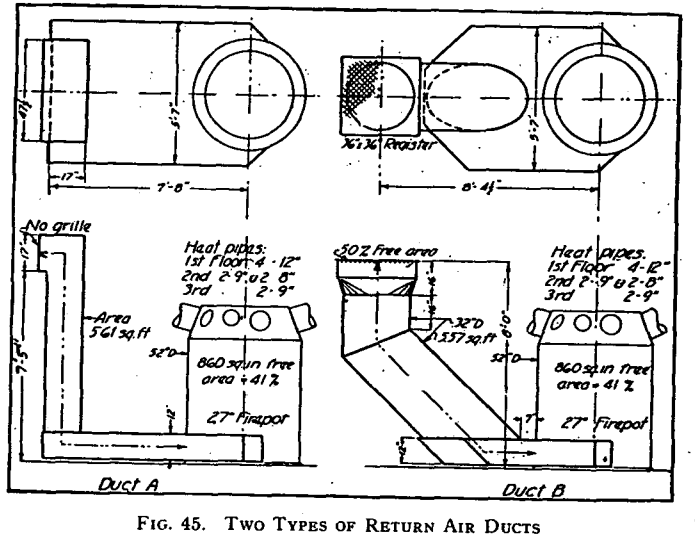


FIG. 45. TWO TYPES OF RETURN AIR DUCTS

Taking the first floor rooms of the house plan shown in Fig. 44, and assuming a register temperature for a zero day of 185 deg. fahr. from the curve for the first floor, it is evident that 1 sq. in. of leader pipe will carry 115 B.t.u. per hour to the rooms. Then dividing the B.t.u. loss per hour from the room by 115 gives the number of square inches of leader pipe necessary to heat the room on a zero day.

From the test data obtained in the seven tests referred to above, it is apparent that the temperature at the registers on the second floor is approximately 10 deg. lower than that on the first floor, or about 175 deg. fahr. In like manner from the second floor curve it is found that 1 sq. in. of leader pipe at this temperature will supply 160 B.t.u. per hr. Dividing the heat loss from the second floor rooms by this value gives the square inches of leader pipe necessary to offset the heat loss from the second floor rooms.





In like manner the test data show a register temperature on the third floor that is about the same as that on the first floor. From the third floor curve it will be seen that at 185 deg. fahr. register temperature 1 sq. in. of leader pipe will carry 215 B.t.u. per hr. The square inches of leader pipe for the third floor rooms is found as before.

In plotting the curves, the average register temperature for any one floor was used in each case. It will be noted from the typical test data, that there is a considerable variation in register temperatures on any one floor. It is therefore evident that the size of the pipe as figured may not be absolutely correct in each case. It is not much in error, however, and in view of the large increase in pipe areas from one size to the next, the error is negligible for all practical purposes.

It is quite evident that the design of a furnace heating system must be based on the B.t.u. loss per hour from each room. This method of computation is quite familiar to the engineer and can be used by any well-qualified furnace man, as fairly simple formulas can be made to cover most types of installation.

It is found that the living room on the first floor of the house under consideration has a heat loss of about 16,600 B.t.u. per hr. With a register temperature of 185 deg. fahr., each square inch of leader supplies 115 B.t.u. and the calculated area becomes $\frac{16,600}{115} \times 144$ sq. in., which requires either one 9-in. and one 10-in. leader, or a special 13½-in. leader.

Following is a table showing the heat loss in B.t.u. per hour from each room of the typical house Fig. 44 and the size of leader pipe as

TABLE 77. HEAT LOSS DATA AND LEADER SIZES FOR A TYPICAL FURNACE PROBLEM

| ROOM | B.T.U. LOSS PER HOUR | SIZE PIPE BY TEST DATA SQ. IN. | SIZE PIPE BY INSTALL. IN. | AREA SQ. IN. |
|---|---|---|---|---|
| **FIRST FLOOR** | | | | |
| Living Room | 15,590 | 144 | 1–9 and 1–10 | 143 |
| Dining Room | 14,040 | 121 | 12 | 113 |
| Kitchen | 8980 | 78 | 10 | 78 |
| Hall | 11,810 | 103 | 12 | 113 |
| Toilet | 2287 | 19 | 8* | 50 |
| **SECOND FLOOR** | | | | |
| Bedroom No. 1 | 6990 | 44 | 8 | 50 |
| Bedroom No. 2 | 8670 | 54 | 9 | 64 |
| Bedroom No. 3 | 8335 | 52 | 9 | 64 |
| Bedroom No. 4 | 7245 | 45 | 8 | 50 |
| Bath | 3254 | 20 | 8* | 50 |
| **THIRD FLOOR (assuming same rooms as second floor)** | | | | |
| Rooms same as second floor with 20 per cent greater heat loss | 8400 | 40 | 8 | 50 |
| | 10,404 | 48 | 8 | 50 |
| | 10,000 | 47 | 8 | 50 |
| | 8700 | 40 | 8 | 50 |
| | 3900 | 18 | 8* | 50 |

*No size used commercially less than 8-in. diameter pipe.