on the indirect radiation or convectors used for heating the air. On systems requiring mechanical ventilation, the air temperature may be controlled by means of thermostats with dampers in the air ducts.

The heater shown in Fig. 7 usually serves several classrooms. The thermostat causes the double-mixing damper to vary the mixture of warm air from the heater and tempered air from the by-pass air way so as to maintain optimum conditions in the room. The thermostat also causes the diaphragm valve on the radiator to close when the room becomes too warm. The cumulative damper in the by-pass air way is remotely operated by hand. When it is closed all the air and all the heating power of the re-heaters goes to the coldest or slowest-to-heat room automatically. The zoning damper also is manually controlled. When the leeward

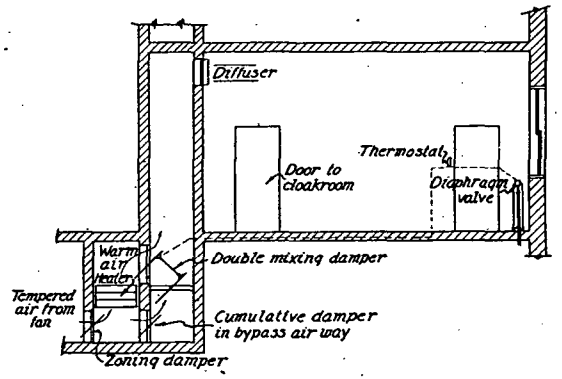

FIG. 7. ARRANGEMENT OF AUTOMATIC CONTROL FOR A CLASSROOM

zoning dampers are closed a heavy interior air pressure can be delivered against cold winds.

Many states and cities have enacted rules and regulations governing installations where public health and comfort are involved.

While automatic fuel burners are well-adapted to the intermittent service required in schools and churches and respond admirably to the several thermostatic controls, care should be exercised in the location of burners, as well as the mechanical blowers, often used with them on account of the noise which may accompany operation of machinery. (See Chapter 12, Heating by Oil).

OFFICE HEATING

The highest mental alertness is necessary to secure business efficiency and in this equation heat is a very important factor. Too much heat is quite as destructive to efficiency as not enough heat, so that it is incumbent upon some sort of automatic heat control to furnish comfort. Office buildings as a class consume more heat in proportion to the floor space than other types of buildings, and when compared with the productive floor areas the heat consumption in such buildings shows a decided waste unless controlled very efficiently.

It is not usually necessary to maintain the office-hour temperature during the hours of non-occupancy. It should not be necessary to overheat a large space just because some small part of that space requires extra warm conditions. Still another factor is that excess temperatures are likely to follow the sun, and that the leeward side is overheated before the windward side gets comfortable. To meet all these requirements in an acceptable manner and at the same time to give due regard to efficiency and economy of operation of the complete heat installation, automatic heat control is required.

Hot water is an ideal heating medium for office buildings, since the temperatures in the radiators can be controlled at the source within practical limits if the requirements within the building are identical throughout or are met by exactly proportioned heating surfaces.

To meet the different temperature requirements in different parts or sections of a building, the piping can be zoned and the flow of water automatically restricted to the sections requiring a lower temperature, and possibly arrested entirely during many hours. The periods of non-occupancy can be satisfied very acceptably by lowering the temperatures of the circulating water. (It is not recommended that the flow of heat be reduced by retarding the general water circulation).

While it appears that the major requirements would be met with this method of heating, at least from the standpoint of automatic and efficient control, very few office buildings are today heated by forced circulation hot water. Steam, circulated at close to atmospheric pressure, is used almost universally.

Several methods of steam heating in large office buildings are in use, all of which employ automatic heat control to a greater or lesser degree.

One method is that of maintaining temperatures in the radiators which will balance as nearly as possible the heat given off by the radiation against that required by the losses from the structure. These temperatures are controlled by varying the pressure or vacuum within the radiator. The higher the vacuum the lower will be the temperature, and thus the temperature in the radiator will be reduced. This method is sometimes supplemented with thermostatically operated valves in rooms or spaces where overheating is likely to occur, or where the same temperatures are not desired in all the rooms or spaces of the building.

Another method employs automatic control on the steam supply to the system as a whole, but with fixed restrictions in the openings to radiators or groups of radiators. The component of the outside elements—temperature, wind, sun—is utilized to anticipate the inside heat requirements by means of a thermo-element placed outside of the building. The steam may be supplied at pressures below atmosphere or above atmosphere as requirements demand.

Another method embodies the use of a system of thermostatically operated valves. The building is first divided into sections or zones which may have quite different heat requirements. With this method of control;

First: The zoning should be done with reference to the compass, since the north and west quarters in most localities require considerably more heat during the heating season than do the south and east quarters.