By furnishing steam at this wide range of temperatures, it is possible to vary the heat output of the radiation thus preventing overheating. For instance, in mild weather, steam is supplied at a low temperature, therefore the radiator will give off only a slight amount of heat (in fact one can hold his hand on the radiator). As the weather gets colder higher temperature steam is furnished until finally in severe weather there may be a pressure on the radiation instead of the high vacuum used in mild weather. See Figs. 1 and 2.

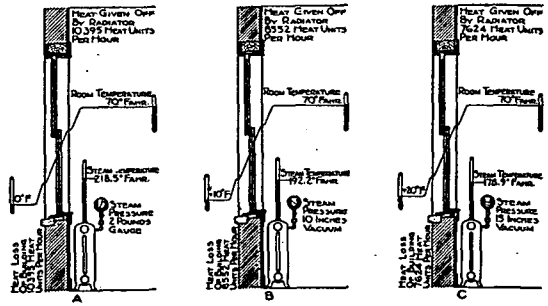

Fig. 1

HEAT CONTROL.—This illustration shows how the room temperature is maintained uniformly under changing weather conditions, by varying the steam pressure so that the heat given off by the radiator equals the heat lost by the building.

It is generally known that water boiling at sea level will generate steam at 212 deg. while up in the higher altitudes where the atmospheric pressure is less, water will boil at much lower temperatures. See Fig. 3. For instance, in Denver which is at an altitude of 5279 ft. above sea level the water will boil and generate steam at about 199.7 deg. fahr.

The same pressure conditions are duplicated in the boiler and system of the Differential Vacuum Steam Heating System. The temperature of the steam is governed by the Dunham control equipment and the Dunham Differential Vacuum Pump which removes the air from the system thereby reducing the pressure on the water in the boiler, or causing the steam to expand through Reducing Valves when they are used.

The term "Differential" is applicable because a relatively constant differential in pressure between the radiator and the return is maintained, so that the air and water will constantly flow out of the radiators. The steam is induced to completely fill them. Due to this "Differential" complete circulation is obtained and the radiators throughout the building are heated uniformly. The "cooler" steam gives a "mild heat," which prevents overheating. This is more healthful, and less destructive to decorations and furniture, than the "hot" steam used in ordinary types of systems.

This system is simple, easy to design and install and very economical in operation.

The system was in the transition process from theory to practical application for many years. There was involved in this problem a complete revolutionizing of the art of heating with the altering of Mechanical Appliances so as to function under the new conditions.

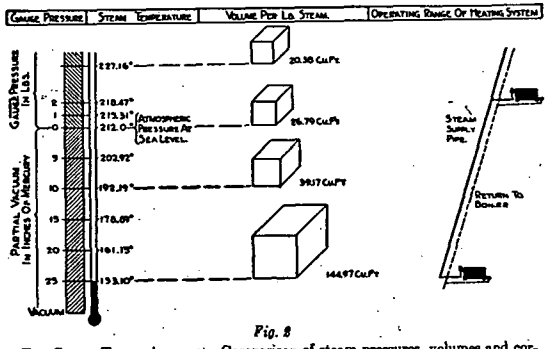

Fig. 3

THE STEAM TABLE APPLIED.—Comparison of steam pressures, volumes and corresponding boiling points. Steam is produced at lower temperatures and circulated just as easily at 20 in. of vacuum as at 2 to 3 lb. gauge pressure.

There are many outstanding advantages in such a system.

First and foremost it affords a solution of the problem of preventing waste of fuel through overheating of buildings including loss from excessive window ventilation in mild weather when only a minimum amount of heat is required.

Mild weather constitutes approximately 95

per cent of the heating season in most localities.

Past experience indicates that this system will effect a fuel saving of 25 per cent or more compared with previous types of steam heating systems.

The Dunham Differential Vacuum Heating System fully meets the needs of a climate where variations in temperature occur during the heating season.

Fig. 4 clearly shows how marked the daily fluctuations in outdoor temperature may be. These changes may be as high as 40 deg. within a period of 24 hours.

Note the wide variations in the daily temperatures, as shown by the heavy irregular curve marked (1). This curve is an actual picture of each day's maximum and minimum temperatures during the heating season of 1926-27.

Curve (2) indicates the average mean temperature over a period of 54 years. Curves (3) and (4) are the highest and lowest temperatures recorded during this period.

A heating system must be designed with sufficient radiation to heat the building satisfactorily on the coldest winter day. Curve (4) governs what heating engineers term the "design basis" for a heating system in or around Chicago. Now note how curve (3) reveals the demand for a flexible heating system—one which will not overheat in mild weather, and yet will provide ample warmth when lowest temperatures are encountered. Weather Bureau records show that there were but 35 hours when temperatures were zero and lower during the winter of 1926-27 and but 131 hours when the temperature dropped to 10 deg. above zero or lower. On March 16, 1927, temperature in Chicago soared to 71, yet during March in other years there have been days when zero temperatures were reached!

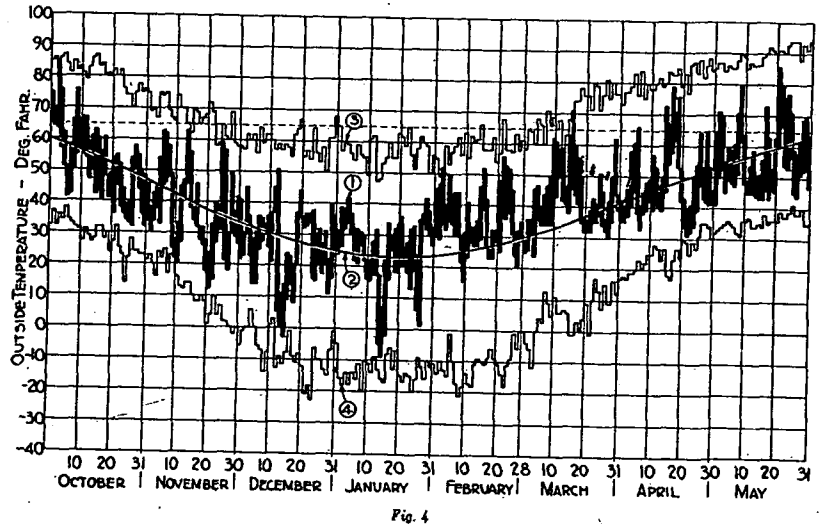

Fig. 4

Official temperatures for Chicago's winter weather, season 1926-27, a record typical of a large portion of the country.

Method of Heat Control

The principal function of this system is to prevent excess heat losses from a building by maintaining a uniform desired temperature in the building and no more. There are three distinct methods of accomplishing this:

(a) Manual Control, using two Dunham Sub-Atmospheric Reducing Valves, adjusting these so as to furnish a uniform sufficient flow of Sub-Atmospheric Steam. This method and method B are used in the "D" series system.

(b) Automatic Control, by the additional function of an automatic valve controlled from one or more Room Thermostats. This automatic valve takes the place of the larger of the Sub-Atmospheric Reducing Valves.

(c) Automatic operation, as used in the "DH" series system and also in the "D" series, in which the boiler is controlled by a Room Thermostat.