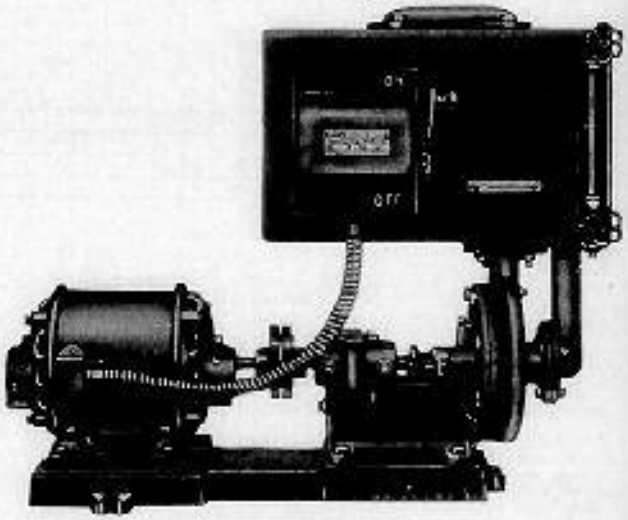
(a) Manual Control, using two Dunham Sub-Atmospheric Reducing Valves, adjusting these so as to furnish a uniform sufficient flow of Sub-Atmospheric Steam. This method and method B are used in the "D" series system.

(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.

DH Series System



This small pumping equipment for heating residences with coal, gas or oil fuel is for use on installations with gravity returns to boiler having a total equivalent direct radiation load of not more than 2000 sq. ft. (excluding piping).

The pump (DH2A) is of the Jet Exhauster principle. It is to be installed on a low foundation or grouted directly to a suitable basement floor as its location has no relation to the boiler water line. It should be located as remote as possible from principal living rooms.

Surge Chambers and Differential Controller for this system are shipped assembled (See Fig. 1175A, page 32) and can be located in the piping where best suited, and wired to pump motor using armored wire or conduit.

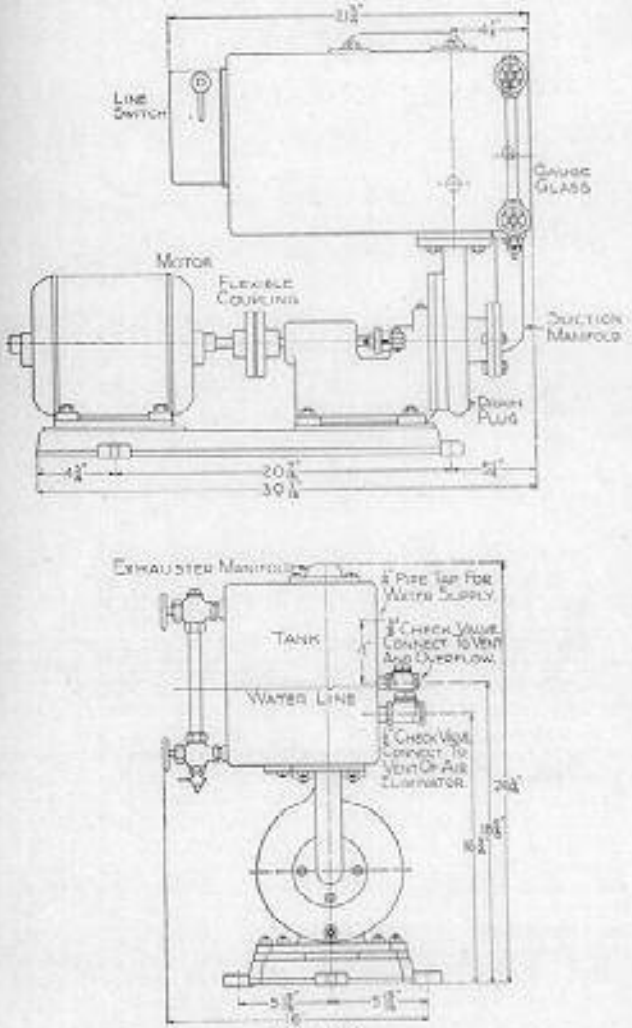


Fig. 1049A

Dimensions DH2A Pump. Side and End Elevations

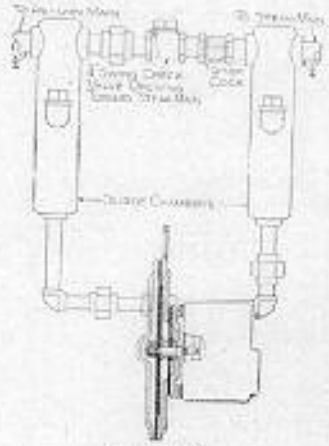


Fig. 1175A

Dunham Differential Controller for "DH" Series

The Equalizer, into which the Surge Chambers are installed, should connect preferably towards the end of the largest Steam Main. (See Fig. 1057B, page 33.)

The Dunham Differential Controller maintains a greater vacuum in the returns than in the radiation. A section thru the diaphragm casing is shown in Fig. 1175A. The casing is divided into two chambers which connect to the return piping and steam piping respectively. The diaphragm stem connects the two diaphragms together and is also fastened to the switch mechanism which is located directly to the right of casing as will be seen from the illustration. A spring in the switch mechanism deflects the diaphragms toward the mechanism and when the pressure difference or differential is below a given point, the switch will be in an "on" position, causing pump to operate. When a sufficient differential is obtained the diaphragm will be deflected over in the opposite side of the casing, causing the switch to be in its "off" position, which will stop the pump. The pump will remain stopped until a portion of the differential is lost due to equalization in the system, when the diaphragm of the casing will have traveled to the opposite position and will again start the pump.

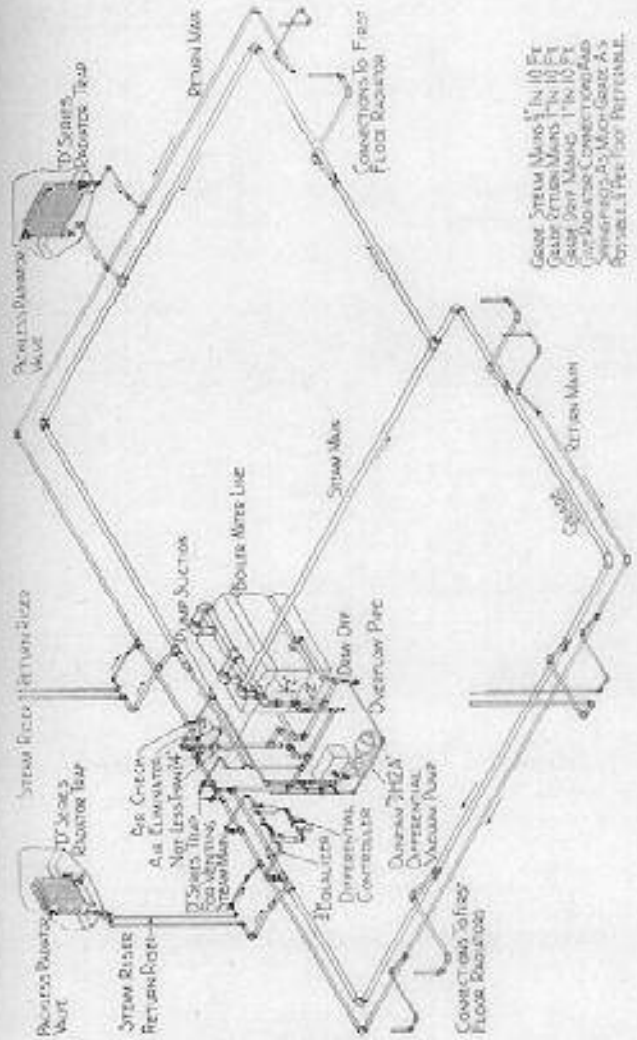


Fig. 1057B

Isometric View of Dunham Differential System, "DH" Series

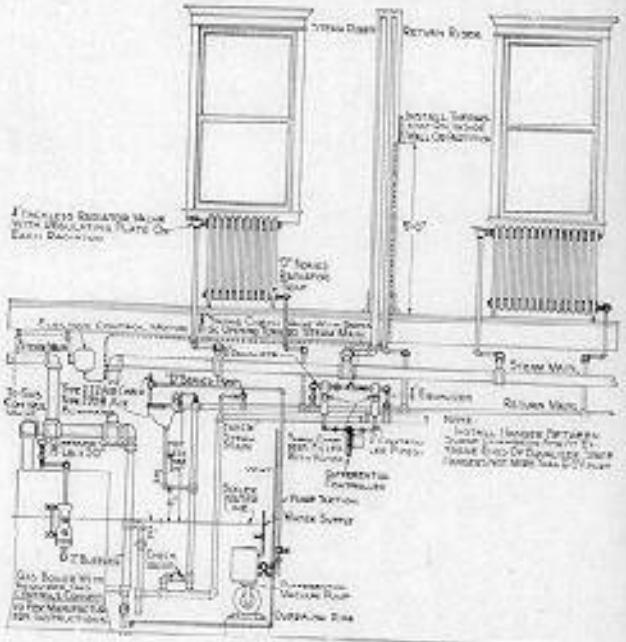


Fig. 1059D

Dunham Differential System, "DH" Series, with gas fired boiler.

Material Included with DH2A Pump

1 Differential Controller with Surge Chambers, Check Valve and Stop Cock.
1 ¾-inch Check Valve for Pump Suction.
1 ⅜-inch Check Valve tested tight for Pump Vent.
1 ½-inch Rubber Coupling for Pump Suction.
1 ¾-inch Rubber Coupling for Cold Water Supply.

All check valves are tested for tightness at factory.

Gauge

The gauge recommended for the boiler for this system is a 5-inch, Type 550 Dunham Compound Gauge, with 30-inch by 15 lbs. graduations. Include a syphon with gauge cock, see page 165.

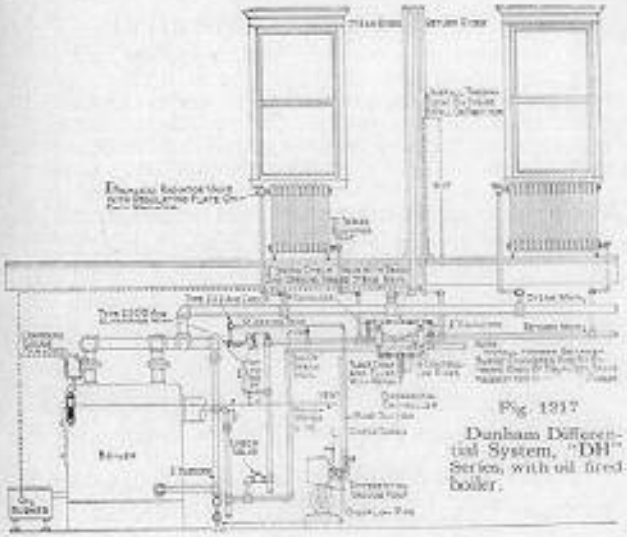


Fig. 1217

Dunham Differential System, "DH" Series, with oil fired boiler.

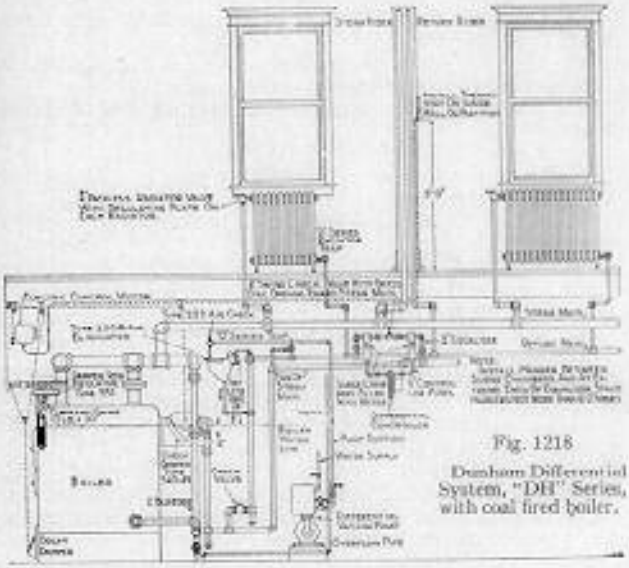


Fig. 1218

Dunham Differential System, "DH" Series, with coal fired boiler.

Installation and Operation

Before connecting pump to heating system thoroughly blow down and clean out the system under 5 pounds pressure with condensate wasted to sewer. Operate the entire system a week with temporary elbows installed on radiators, wasting condensate to sewer. After this period then surface blow-off the boiler, as directed on page 167.

After clean-out remove the Dunham Temporary Elbows and install in their place the Dunham Traps. Install the Dunham Regulating Plates in the radiator valves.

Operation

The vacuum created by the pump will be indicated by the gauge on the boiler. Air is exhausted through vent (E). (See Fig. 1117C.)

Description of Parts and Connections

A. "DH" Series Differential Vacuum Pump. (See Fig. 1117C.)

B. Differential Controller, furnished as an assembly, including Surge Chambers (J), Check Valve (K), Cock (L) and necessary fittings.

C. Connect pipe from vent of Air Eliminator to Pump Suction through ¾-inch brass disc Swing Check Valve.

D. Overflow to be piped to sewer, grading pipe downward toward sewer.

E. Air Vent from pump discharge to be run up 5 or 6 feet above tapping in tank.

F. "D" Series Dunham Trap for venting end of steam main.

G. Rubber Coupling, furnished with pump.

H. Unions which are furnished as part of Differential Controller assembly.

I. ¾-inch Equalizer Connection, preferable to connect near end of largest steam main, and to return main near Dunham Air Eliminator. Equalizer must be level, free from sags, and well supported by hangers spaced not more than six feet apart.

J. Surge Chambers furnished as part of Differential Controller Assembly.

K. ¾-inch brass disc Check Valve opening toward steam main, furnished in Controller Assembly.

L. Cock placed between Surge Chambers to shut off steam connection whenever necessary.

M. ¾-inch Plugs for sealing Surge Chambers and Controller Balancing Pipes after filling with water.

N. Dunham Air Check furnished with Air Eliminator to be placed in tee on Eliminator.

O. Swing Check Valves furnished with Pump.

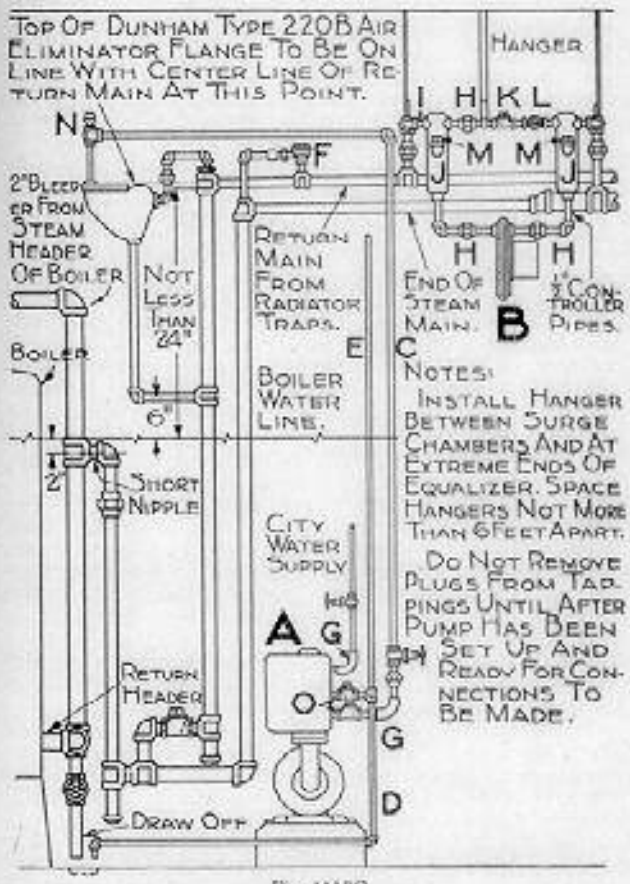


Fig. 1117C

Method of installing and connecting "DH" Series Pump

Operation

That the operation of the "DH" Series system may be understood, reference is made to Fig. 1059-D, page 34, which illustrates a typical gas fired boiler as a source of making and furnishing steam to the system (any fuel may be used).

With the temperature in the room below 70 deg. the thermostat will operate the fuel control, which in turn starts the flow and ignites the gas and simultaneously starts the differential vacuum pump.

As the water in the boiler absorbs heat the action of the pump rarefies the space above the water, inducing steam to form at very low temperatures and fill the radiators. As a result, substantially the entire radiator surface works at a temperature corresponding to the vacuum maintained in the system.

After every radiator is filled with steam the Differential Controller maintains a condition in the return at a pressure less, or a vacuum greater than, the pressure in the radiator. Circulation is thereby insured irrespective of supply pipe pressure or vacuum. The Dunham Differential Radiator Traps on the radiators function under wide ranges of pressure or vacuum. All air and water is released from the radiator by the trap and drawn out by the pump, but steam is not released.

In mild or even moderately cold weather, the gas should be regulated so as to supply the burner at a very low rate. This low heat input to the boiler gives off steam to the system at a high vacuum, but in severe weather the gas is regulated to supply steam at such a rate in the boiler, supply piping and radiators, that pressures at or even greater than atmosphere can be maintained.

During the Fall, mild Winter and Spring weather, the steam is circulated under the vacuum condition so as to provide the heat requirements *without overheating*.

When firing up the system initially cold, the thermostatic traps on the radiators are open. The pump will be started when the thermostat starts the fire going. The vacuum produced by the pump will carry through the returns, thermostatic traps, radiators, inlet valves and supply piping to the water surface of the boiler. As a result, the boiling of the water will commence at a temperature corresponding to the degree of vacuum produced by the pump. The boiler will quickly begin to supply steam to the radiators at lower temperatures than if the boiler operated at atmospheric pressure. The steam will be distributed evenly in the supply piping, and delivered to each radiator through the regulating plate in each Dunham Radiator Valve. The plate proportions the flow

of steam accurately to each radiator, so that all the radiators will heat evenly. The pump withdraws the air and condensation from the radiators, the air is discharged to the atmosphere and the condensate returns to the boiler by gravity.

The thermostat in the room is set to maintain the desired temperature by governing the source of heat. The system will fill with low temperature steam and the radiator traps close, exactly as they do when the system is operating at a pressure equal to or greater than atmosphere. If the severity of the weather requires more heat, the thermostat will keep the gas on longer and the fire will increase the boiler pressure and steam temperature correspondingly. The pump will insure circulation at the steam pressures (and the corresponding steam temperatures) which give the desired room temperature. Steam at 20 inches of vacuum is possibly all that will be required in mild weather, while a pressure of a few ounces by the gauge will suffice in severe weather. If, in response to this temperature the pressure becomes greater than the

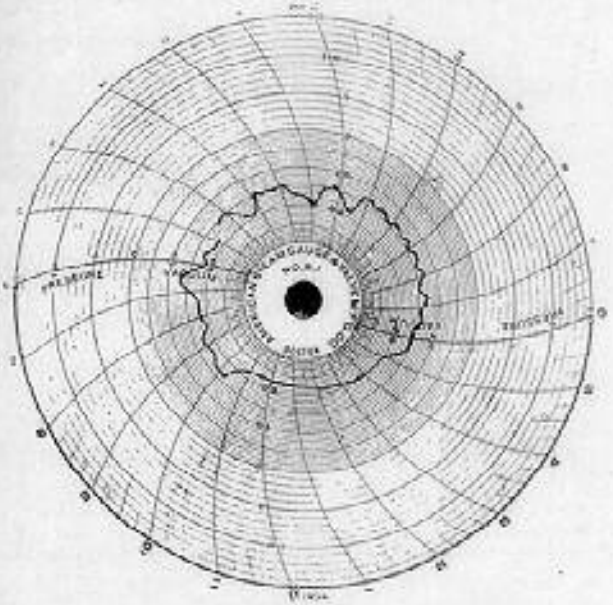


Fig. 1051

atmospheric pressure, the pump goes out of operation since it will not be needed to produce circulation. The Differential Controller of the Pump will keep the vacuum in returns substantially higher than that carried in the radiators when the system is operating under vacuum conditions. As a result the circulation of steam becomes positive and makes it possible to utilize this vacuum.

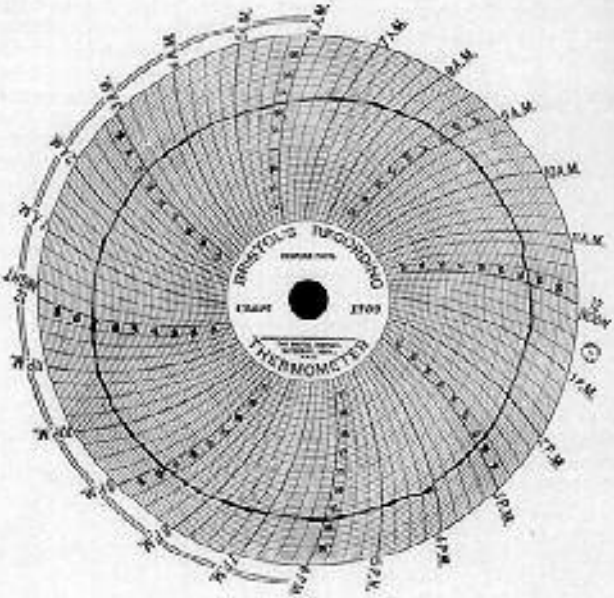


Fig. 1052

Figs. 1051 and 1052 are charts taken in a Chicago suburban residence. Fourteen rooms, with three bathrooms, and four rooms in basement. The "Service" building (6 rooms and 3 baths) and a three-car garage, 182 feet from house, are heated at same temperature, from the same boiler.

Fig. 1051 shows the vacuum on the boiler. The outside temperatures were:

4 P. M.	24° Fahr.	8 A. M.	20° Fahr.
8 P. M.	22° Fahr.	12 Noon	26° Fahr.
12 Midnight	24° Fahr.	4 P. M.	21° Fahr.
4 A. M.	25° Fahr.		

The highest wind velocity was 34 miles an hour.

Fig. 1052 shows an average temperature of 75° during the day, the lowest temperature during the night was 62°.

At no time was there atmospheric pressure on the system.