May 19, 1936. S. M. BROOKS 2,041,282

HEATING SYSTEM AND APPARATUS

Filed May 2, 1935

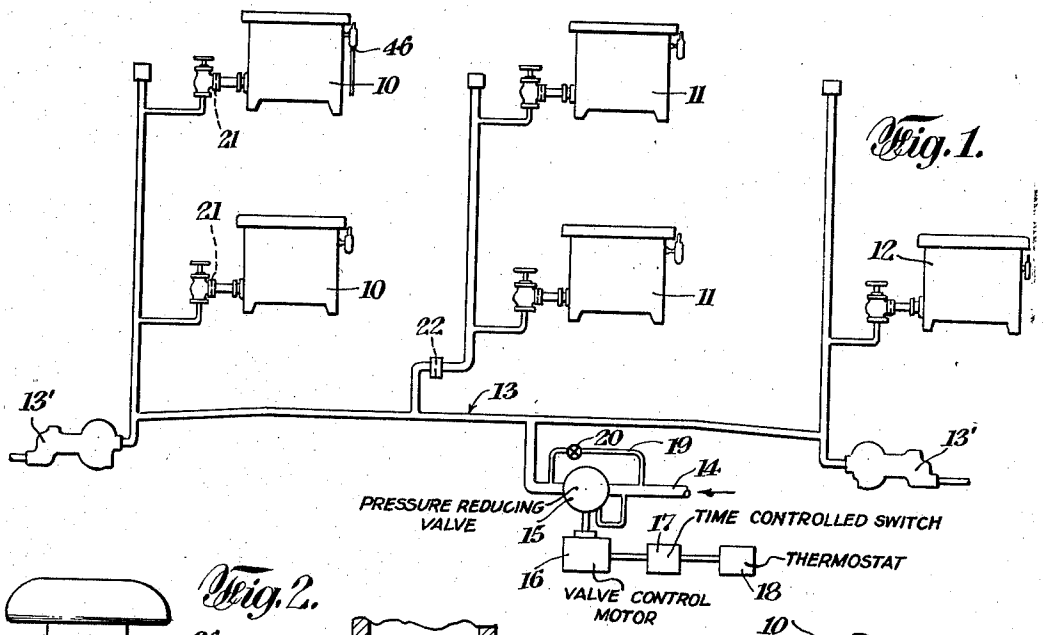


Fig. 1.

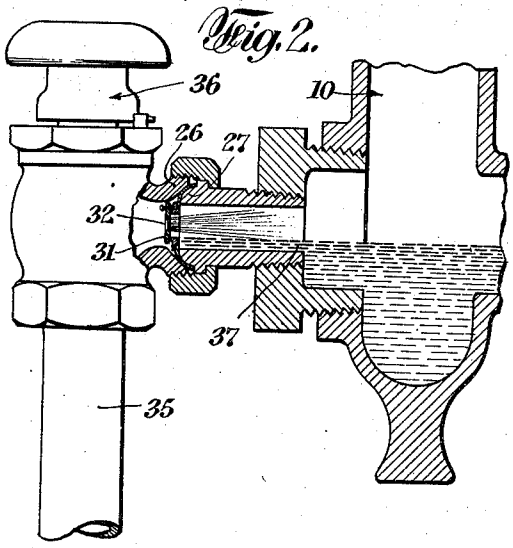


Fig. 2.

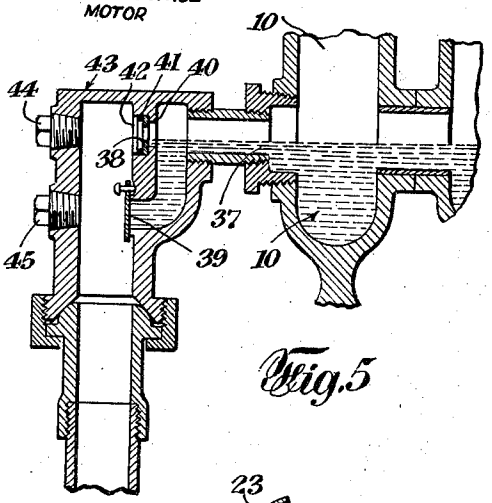


Fig. 5

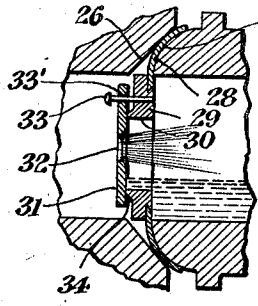


Fig. 3.

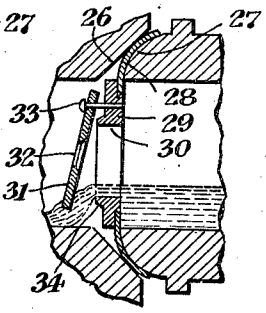


Fig. 4.

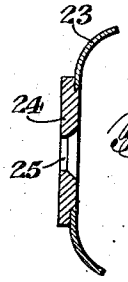


Fig. 6.

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Patented May 19, 1936

2,041,282

UNITED STATES PATENT OFFICE

2,041,282

HEATING SYSTEM AND APPARATUS

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Application May 2, 1935, Serial No. 19,357

9 Claims. (Cl. 237—67)

This invention relates to heating systems and valve means therefor, and the objects of the invention include the provision of improved heating systems of the type wherein steam is conveyed intermittently or at fluctuating pressures to radiators through conduits, the same conduits being utilized for the return of the condensate. With systems of this type embodying valve means and arrangements comprised in my invention hereinafter described, the condensate is returned with a minimum of interference with the efficient supplying of steam.

Various further and more specific objects, features and advantages will clearly appear from the detailed description given below, taken in connection with the accompanying drawing forming a part of this specification and illustrating merely by way of example the preferred embodiments of the invention.

The invention consists in such novel features, arrangements, combinations of parts and methods as described in connection with the apparatus herein disclosed by way of example only.

In the drawing, Fig. 1 comprises a schematic diagram of a heating system embodying my invention;

Fig. 2 is a vertical sectional view partly broken away, showing one form of valve and orifice means embodied in my invention;

Figs. 3 and 4 are enlarged vertical sectional views showing respectively parts of the structure of Fig. 2 in two different operative positions;

Fig. 5 is a view similar to Fig. 2 but illustrating a modification; and

Fig. 6 is a view of a fixed orifice member such as has heretofore been used in systems of this class.

Referring to Fig. 1, the system there schematically shown may comprise a plurality of radiators of conventional type as at 10, located in a building or other structure to be heated. Other radiators as at 11 and 12 are located in other buildings or other sections of the same building or structure. All of these radiators as shown are connected by a "one pipe" conduit system 13, to a steam main 14 which in turn may be connected to a boiler or a central heating plant for providing a source of steam supply.

Drip connections may be provided to suitable float traps of known construction as at 13' for discharging the water of condensation from the conduit system while retaining the steam. The water as discharged may be conveyed to boiler water feeding mechanism or to other points of disposal such as sewers, etc.

A pressure reducing valve 15 or other form of valve for controlling the steam supply is provided in the steam main 14. This valve is so arranged or operated as to control the steam supply at intermittent "on" and "off" periods. That is, during cycles preferably of predetermined length, a thermostatically regulated quantity of steam is admitted during one part of each cycle, and during another part of each cycle the flow of steam is either cut off or its pressure substantially reduced. For this purpose a valve control motor schematically indicated as at 16, may be provided and if the valve is to be operated according to predetermined cycles of operation, this motor may be controlled by a time controlled switch 17 and the percentage of each cycle during which the "on" period occurs may be determined by controlling a time clock and its associated mechanism with a thermostat 18 preferably located outside the structure heated. That is, the thermostat may thus be arranged to control the relative lengths of the "on" and "off" periods of the cycle, or it may be arranged to directly control the motor or other valve operating means to vary the pressure of the steam after passing through the pressure reducing valve, in accordance with temperature variations during fixed or predetermined "on" intervals. As indicated at 19, a bypass with a control valve 20 may be provided around the main steam valve for supplying, during the "off" intervals, sufficient steam to maintain the conduit system constantly heated, notwithstanding the intermittent or fluctuating character of the main supply, so that at the initiation of the "on" intervals, steam will be promptly supplied to the more remote radiators of the system.

Apparatus and systems for thus controlling a steam valve to provide intermittent "on" and "off" periods of steam supply of thermostatically regulated length or of fixed length with thermostatically controlled pressure variations, have been heretofore known and used. For example, one form of such apparatus is disclosed in German Patent No. 279,084, Ausgegeben October 9, 1914. Other and improved systems of this type are disclosed in the patents to Owens No. 1,812,897, granted July 7, 1931, and No. 1,962,999, granted June 12, 1934, and in the copending application of Karl W. Rohlin, Ser. No. 19,397, entitled "Heat controlling systems", filed of even date herewith. Accordingly the details of this part of the system per se need not here be further described.

For economy, in many heating installations it

is desirable to use a "one pipe" system for conveying the steam to the radiators as well as for returning the condensate. To properly control the steam supply to the radiators, it has also in recent times often proved desirable to supply an intermittent or fluctuating source of steam supply such as above referred to. Furthermore, it has proven desirable in regulating the flow of steam throughout the system, to provide orifices of predetermined size at each radiator and/or at other points in the conduit system whereby during each "on" period, steam is supplied substantially concurrently to the various radiators in proportion to the predetermined steam requirements for each. However, under some conditions difficulties are encountered in applying these features to a "one pipe" type of system, in that if the "on" periods are made relatively long (as for example during cold weather), as compared with the "off" periods, there may be a tendency for the condensate to accumulate excessively in the radiators, thereby sometimes hindering the proper flow of steam into the radiators, or sometimes causing a flow of condensate out through the air exhaust valves of the radiators. Also, under such conditions the return flow of condensate through the inlets of the radiators, in interfering with the steam flow, may result in excessive agitation and splashing of the water, producing troublesome gurgling and water-hammer noises, as well as interrupting the desired distribution of the steam in the system. When these difficulties arise, they may be readily overcome by my invention.

Referring again to Fig. 1, orifice means as indicated at 21, each having apertures of predetermined size, may be provided at the inlets of each of the radiators for the purpose above stated of insuring that steam will be supplied substantially concurrently to the various radiators in proportion to the predetermined steam requirements for each. To this same end, or for aiding in the controlled flow of steam to the more remote parts of the system, as compared with the parts nearer the source of supply, similar orifices may be provided at other points in the conduit system as at 22. The details of one example of such an orifice member per se as heretofore used, are illustrated in Fig. 6. It may comprise a disc-like assembly having a relatively thin outer flange as at 23, properly shaped to be embraced between the engaging surfaces of two opposed union members. The inner portion of this disc-like assembly may comprise a reinforcing disc 24 sealed at its periphery into an aperture in the flange member 23. The steam controlling aperture 25 is formed at the center of the disc 24.

According to the preferred example of my present invention, however, these orifice members may be constructed in the manner shown in Figs. 3 and 4. Here opposed faces of union members are indicated at 26 and 27. The curved flange portion 28 of the orifice assembly is clamped in sealing relationship between these two faces. An inner reinforcing plate or disc is provided at 29 with its periphery swaged or otherwise sealed within an opening formed in the member 28. The central portion of the member 29 may be formed with an opening 30 arranged to be partially covered by a movable disc member 31, through which is formed the steam controlling orifice or aperture 32. That is, the aperture 32 is the one which is made of predetermined size, depending upon the position of the orifice in the system (for the proper control of the steam) for supplying steam at points beyond the orifice in proportion to the predetermined requirements. The disc 31 may be formed at its upper portion with a perforation or eyelet 33', through which a pin as at 33 freely passes. The pin 33 may be permanently or semi-permanently secured or retained in the member 29. The disc 31 is thereby normally suspended so that it covers the opening 30 in the member 29, or may swing to open position as shown in Fig. 4. The member 29 may be provided with a narrow raised seating area 34 surrounding the opening 30 to form a seat for the member 31 when in closed position.

The manner in which the device of Figs. 3 and 4 may be installed at the inlet of a radiator is indicated in Fig. 2 wherein a conduit of a "one pipe" steam heating system, as indicated at 35, is connected through a valve 36 of conventional form to a radiator inlet 37.

The operation of a heating system as embodying the above described example of my invention will now be explained. Let us assume that the main steam valve 15 is operating intermittently at relatively short intervals giving, for example, an "on" interval of steam supply to the radiators of from 5 to 20 minutes, alternating with an "off" interval of say one minute, during which only enough steam is being provided through the by-pass 19 to maintain the conduit system in warmed condition and with substantially no steam passing through the inlet orifices at the radiators. During the "on" intervals steam may for example be supplied to the valves at the intakes of the radiators at about one pound pressure and this will cause the swingable discs 31 to be retained in seating engagement with the seating areas as at 34, while steam is being delivered through the orifice apertures as at 32 into the radiators. As indicated in Figs. 2 and 3, the jets of steam at these orifices will be substantially above the surface of the condensate within the radiator inlets. Accordingly the incoming steam does not cause agitation and splashing of the water, and gurgling and water-hammer noises are obviated. As the steam condenses in the radiator during the continuance of the "on" interval, the water level rises slightly until the "on" interval is terminated. Thereupon the steam pressure on the discs 31 will be substantially diminished or removed and the jets of steam passing into the radiator inlets will be reduced or discontinued during the subsequent "off" interval. That is, in a relatively short time, say for example one-half minute, the gas and steam pressures on each side of the discs 31, will have become substantially equalized, so that these discs are free to swing outwardly under the pressure of the condensate within the radiator inlets, thus permitting the accumulated water to rapidly flow out through the openings 30 and be drained away through the supply pipe. Any subsequent tendency for alterations of the steam or gas pressures on opposite sides of the swingable discs during the continuance of the "off" interval, will be prevented from moving the discs 31 to closed position and from causing any chattering movement thereof because of the effective equalization of these pressures which takes place through the upper part of the openings 30. Accordingly during the "off" interval, the excess condensate in the radiators will be rapidly drained down to substantially the level of the lower limits of the openings 30 without interruption. Then when steam is again automatically turned on at the start of another "on" in-

terval, the pressure of the steam quickly moves the discs 31 to closed position and the jets of steam occurring through the orifice apertures 32 will be well above the level of the remaining condensate and accordingly the jets will cause little or no disturbance of the water in the radiators and inlets.

In Fig. 2 the condition of the parts and the level of the condensate at the beginning of an "on" interval, is indicated. Fig. 3 indicates the level of the condensate after an "on" interval as continued for a short period and while steam is still being admitted through the orifice aperture. Fig. 4 shows the condition of the parts and of the condensate shortly after an "off" interval has been initiated.

Fig. 5 illustrates an alternative embodiment of the invention wherein the steam controlling orifice 38 may be formed as a member separate from the swingable condensate exit member at 39. That is, for example, the orifice 38 may be formed in a fixed assembly similar to that above described in connection with Fig. 6, or as shown, may comprise a flat perforated plate held between a flange 40 and an expansible ring 41, within a passageway 42, formed in a casting 43. The construction of the condensate exit member at 39 may be similar to that above described in connection with Figs. 3 and 4 except that the steam orifice may be omitted. Screw plugs as at 44 and 45 may be provided in a wall of the casting 43, to enable inspection, repair or replacement of the orifice and condensate exit members. The arrangement of the passages and the operation of the modification shown in Fig. 5 will be apparent from the drawing when taken in connection with the above description of the device of Fig. 2. Fig. 5 indicates the level of the condensate and the condition of the parts just prior to the beginning of an "off" interval.

The condensate outlet thus may be located within the same fixture and just below the steam orifice, or if desired, these two parts may be mounted within separate coupling members. In either event, the passage for the condensate, during the "off" intervals, forms in effect a by-pass for the steam orifice, permitting rapid withdrawal of the condensate during the "off" intervals and independently of the admission of steam during the "on" intervals.

With heating systems constructed in accordance with this invention, the radiators may be provided with air valves or air line valves as at 46, of standard size and form as now in general use, including also types of such valves having float elements. Yet due to the rapid drainage of the condensate during the "off" intervals, and despite the use of the restricted orifices for the steam control during the "on" intervals, all danger of leakage of water from the air valves may be practically eliminated. The equalization of the pressures between the radiator and the supply pipe at the beginning of the "off" intervals, takes place very promptly and is maintained during the remainder of the "off" interval, and as a consequence, air valves may be satisfactorily used even though having relatively small venting ports. Heretofore when steam control orifices have been used, it has in general been found desirable to use air valves with exceptionally large venting ports in order to prevent the development of a vacuum within the radiator during the periods when the steam supply is cut off.

This invention has the further advantage that in some cases, in the event the main stem valve or other intermittently operating means for controlling the steam supply is shut down for readjustment purposes or for repair, the operation of the system may be readily continued without providing duplicate "standby" equipment for accurately controlling the intermittent supply. That is, in such cases the steam may be normally supplied at suitable pressure and the supply interrupted by a manually controlled valve, say for five minute periods at intervals of one-half hour to provide the drainage intervals during such emergencies when the main steam control system is out of service.

This invention permits the use of abnormally short "off" intervals whenever such practice is desirable in avoiding pressure fluctuations in the boilers or in cold weather when it is necessary to maintain the steam supply during as large a portion of the time as possible. In other words, the "off" intervals may be reduced to a predetermined minimum, leaving available a substantially greater portion of each cycle of operation for "on" intervals regulated in length according to the temperature conditions. Furthermore, as compared with the practice possible with intermittently operated "one pipe" systems heretofore available, the "on" intervals may be greatly extended even with the air valves of standard types, without the possibility of water escaping from the air valves. This invention readily makes possible the reduction of the "off" period to as little as 10% of the total period of each cycle of operation, so that for example, if the operation of the system is divided into cycles of ten minutes in length, the minimum "off" period might be one minute and the remainder of the cycle devoted to delivering steam to the radiators.

While the invention has been described with respect to certain particular preferred examples which give satisfactory results, it will be understood by those skilled in the art, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a heating system, a source of fluctuating steam supply, a plurality of radiators located at different distances from said source and having different steam requirements, conduit means for connecting said radiators to said source, orifice members within the conduits to said radiators respectively, said members being provided with apertures of various predetermined sizes whereby substantial quantities of steam are supplied substantially concurrently to the various radiators in proportion to the steam requirements for each, said orifice members being movable to provide a larger aperture to permit rapid exit of condensate from the radiators during intervals when the steam supply is cut off or is relatively low.

2. In a heating system, a source of fluctuating steam supply, a plurality of radiators located at different distances from said source and having different steam requirements, conduit means for connecting said radiators to said source, orifice members within the conduits to said radiators respectively, said members being provided with apertures of various predetermined sizes whereby substantial quantities of steam are supplied substantially concurrently to the various radiators in proportion to the steam requirements

for each, said orifice members being movable to provide apertures lower than the steam admission apertures for permitting the exit of condensate from the radiators during intervals when the steam supply is cut off or is relatively low.

3. In a heating system, a plurality of radiators, a common source of fluctuating supply of fluid heating medium therefor, a conduit system for connecting said source with the inlets of each of said radiators, said radiators being provided with air exhaust valves, orifice members provided at various points in said conduit system, said members being provided with apertures of predetermined size to control the flow of heating medium therethrough whereby the amount of heating medium flowing to the various parts of the system will be substantially proportional to the requirements in each of said parts, and said orifice members being movable to positions permitting the rapid return of the cooled heating medium through the conduit system during intervals when the supply of heating medium is cut off or is at a relatively low pressure.

4. In a heating system, a plurality of radiators, a common source of fluctuating supply of fluid heating medium therefor, a conduit system for connecting said source with the inlets of each of said radiators, orifice members provided adjacent the inlets of the radiators respectively, each of said members being provided with apertures of predetermined size to control the flow of heating medium therethrough whereby the amount of heating medium flowing to each radiator will be substantially proportional to its requirements, said apertures being located at points substantially at or above the normal level of the cooled heating medium in the adjacent radiator, and said members being movable to provide lower openings permitting the rapid return of the cooled heating medium through the conduit system during periods when the supply of heating medium is cut off or is at a relatively low pressure.

5. In a heating system, a plurality of radiators, a common source of fluctuating supply of steam therefor, a conduit system for connecting said source with the inlets of said radiators, orifice members provided at various points in said conduit system, said members comprising suspended swinging disc-like elements provided with apertures of predetermined size to control the flow of steam therethrough and swinging to open a larger aperture for the return flow of condensate when the steam supply is cut off or reduced in pressure.

6. In a heating system, a radiating unit, a source of fluctuating supply of fluid heating medium therefor, a conduit for connecting said source with said unit, a movable orifice member provided in said conduit and having an aperture of predetermined size to control the flow of heating medium to said unit, said orifice member being movable to a position providing a larger aperture extending to a lower elevation than said first named aperture when the supply of heating medium is cut off or diminished.

7. In a steam heating system, a radiator, a conduit for supplying steam thereto through an inlet in the lower portion of said radiator, and movable means in said conduit adjacent said inlet and having a steam admitting aperture and movable to provide a lower condensate aperture when the steam pressure is diminished.

8. The method of supplying steam to a group of radiators connected by a conduit system, to a common source of steam supply, and of returning the condensate from the radiators, which comprises supplying steam from said source intermittently, restricting the flow of steam through the conduits to each of the radiators whereby substantial quantities of steam are supplied substantially concurrently to the various radiators in proportion to the predetermined steam requirements for each, and rapidly withdrawing at least the larger portion of the condensate from the radiators through said conduit system during intervals when the intermittent supply of steam is cut off or diminished, by utilizing the variations in the steam pressure to open and close exit openings for the condensate at or adjacent the radiators.

9. A method for supplying steam to a radiator system from a common source of supply through a conduit system and for withdrawing the condensate from the radiators through said conduit system, which comprises supplying steam to the conduit system intermittently with cycles comprising at least a minimum interval during which substantially no steam is supplied to the radiating units and another interval during which a quantity of steam is supplied depending upon prevailing heating requirements, restricting the flow of steam to each radiating unit whereby substantial quantities of steam are supplied substantially concurrently to the various units in proportion to the steam requirements of each, and rapidly withdrawing at least a greater part of the condensate from the radiators through said conduit system during the occurrence of said minimum time intervals, by utilizing the variations in the steam supply to control exit openings for the condensate from the radiators.

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