J. A. DONNELLY.

STEAM HEATING SYSTEM.

APPLICATION FILED MAR. 12, 1908.

974,246.

Patented Nov. 1, 1910.

2 SHEETS—SHEET 1.

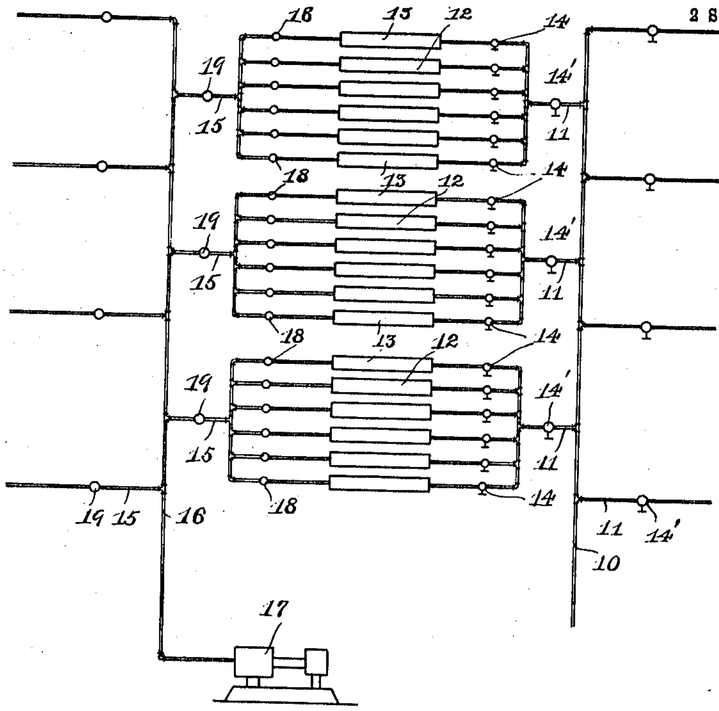

Fig I.

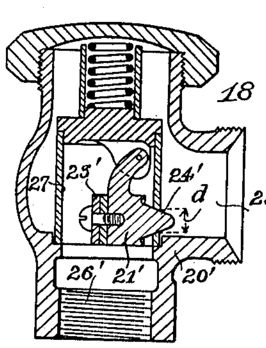

Fig. II.

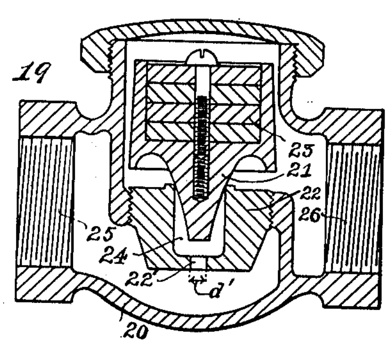

Fig. III

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By his Attorney Fred'k T. Schuetz

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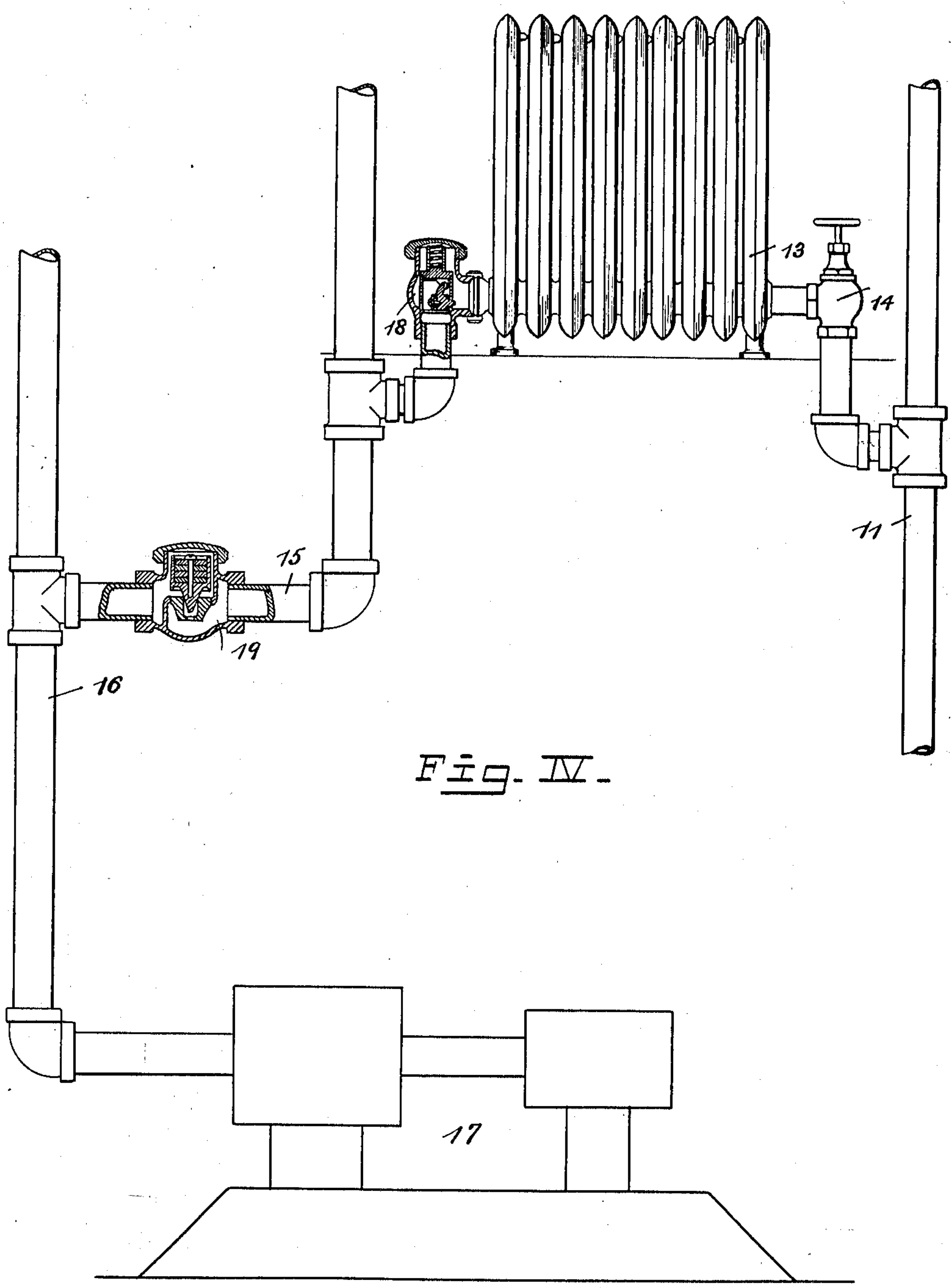

Fig. IV.

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UNITED STATES PATENT OFFICE.

JAMES A. DONNELLY, OF BROOKLYN, NEW YORK.

STEAM-HEATING SYSTEM.

974,246. Specification of Letters Patent. Patented Nov. 1, 1910.

Application filed March 12, 1908. Serial No. 420,622.

To all whom it may concern:

Be it known that I, JAMES A. DONNELLY, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Steam-Heating Systems, of which the following is a specification.

My invention relates to steam heating systems, and particularly to that class of steam heating systems in which a mechanical circulation of the steam is maintained by the application of a vacuum pump upon the return.

It has for its object a system of this character in which the use of all devices necessary for the control of the circulation of steam are of the simplest character.

In my prior application Serial No. 316,427, filed May 12, 1906, I have disclosed a method of control of the circulation by regulating the weight over a given area of the seat of the valve; whereas in the present application I control the flow by varying the area of the seat of the valve device, while the weight may or may not be constant, or may be entirely omitted.

The nature of my invention will be best understood in connection with the accompanying drawings in which—

Figure 1 is a diagrammatic view of an installation embodying my invention. Figs. 2 and 3 are sectional views of two forms of restricting means which may be used in connection with my invention. Fig. 4 is a view of a portion of an installation showing a radiator, pipe connections and restricting devices, the latter being in section.

Similar characters of reference designate corresponding parts throughout the several views.

In the earlier systems operating with a vacuum pump on the return it was customary to provide a restricting valve or a valve having a restricted opening of fixed dimension on the return of each radiating device and on each drip leading from the steam main to the return main. Thermostatic valves were afterward substituted for these, and later many other forms of automatic steam trap devices, such as float valves and pressure operated motor valves with piston or diaphragm to effect the operation of the valve piece. The thermostatic valves have not proved satisfactory, because of the insufficient motion of the valve piece to effect the desired removal of the water and air. They have also been found to clog very quickly owing to the rust, dirt and oil present; and have further proved defective, because of the gradual loss of the property of expansion due to the continued heating and cooling. The float devices, also, are not satisfactory, becoming inoperative by reason of the collapse or water logging of the float, or a destruction of the float due to the continued rattling or pounding of the same against the valve seat. The piston and diaphragm operated valves are likewise unsatisfactory because of the sticking of the piston in the former case, thereby holding the valve piece wide open or entirely shut; and in the latter case, because of the rupture of the diaphragm. All of these valves, with the exception of the thermostatic, are objectionable by reason of the noise produced when they are in action, as well as by reason of the many complications found necessary in their construction, in order to provide auxiliary means for the removal of the air.

It is the object of the present invention to dispense with the use of such valves entirely, and in fact, to dispense with the use of all valves of any complication whatsoever; substituting therefor devices providing restricting orifices of fixed dimensions insuring the ready and rapid removal of the water of condensation and the air, but preventing the passage of the steam in objectionable quantities.

Referring to the diagrammatic view, Fig. 1, 10 designates a steam supply main receiving exhaust steam from an engine (not shown) or other suitable source of supply. The main 10 feeds through branch supply pipes 11 and valves 14′, a plurality of heat distributing sections or systems 12, comprising one or more radiating devices 13 provided with the usual inlet valves 14. Branch returns 15 connect each section or system 12 with a return main 16, upon which acts the vacuum pump 17.

At the outlet of each radiating device is a restriction, as in the valve device 18 shown in Fig. 2, and hereinafter more fully described. This device 18 provides a restriction of fixed dimension as of the diameter d affording such area of opening as will be sufficient to allow of the removal of the initial water of condensation from the fixed amount of radiating surface controlled thereby, and under a given difference of pressure and substantially within a predetermined time.

Into each of the branch returns 15 is inserted a restricting device 19, shown in Fig. 3 and hereinafter more fully described, and providing a restriction of fixed dimension as of diameter d'. This restricting opening in the device 19 is of sufficient area to readily pass the total normal condensation from the corresponding section or system 12 under a predetermined difference of pressure and within a predetermined period of time. The said device 19 comprises essentially a body 20 forming a casing; a valve piece 21 seated upon the valve seat 22 which is provided with the restriction 22′ of diameter d', which restriction may be varied; suitable weights 23 affording a means of regulating the weight over the restriction if desired; a valve passage 24 adapted to be automatically sealed or opened by said valve piece 21; and an inlet 25 and an outlet 26 to said body 20.

I prefer to make the valve device 18 somewhat similar to the device 19. This valve device 18 comprises a body 20′ forming a casing provided with an inlet 25′ and outlet 26′ and a valve piece 21′ hinged to a separate inclosing casing 27 within the body 20′. The valve piece 21′ carries suitable weights 23′ and projects through the restricting opening or valve passage 24′ in casing 27 of a diameter d.

I may of course substitute one form of device for the other, or employ only one and the same device at the outlets of the radiating devices and in the branch returns; but prefer to use the form shown in Fig. 2 at the outlets of the radiating devices 13, and the form shown in Fig. 3 in the branch returns 15. These restricting devices as shown, are made in a convenient form for affording a restricted opening of fixed dimension (smaller than the pipe connection); and the valve piece is provided for the purpose of closing the restricting opening against flow in the reverse direction, and to provide such further control of the flow as may be desired by varying the weight of the said valve piece as set forth in my prior application #316,427, filed May 12, 1906.

In making the adjustment to pass the water of condensation and the air from radiators through devices having restricted openings of fixed dimensions, or static valve devices, it has been the usual practice to fill the system with steam and then by trial vary the area of the restricting openings until the required area to pass the air and the water of condensation as it accumulated was obtained. This was readily accomplished, and so long as the system remained in continuous operation, but little difficulty was experienced. When, however, any radiating device was turned off and on at frequent intervals it was found that the device did not clear itself of the air and the condensed water as quickly as it should, due to the fact that the initial condensation resulting from the absorption of heat by the iron of the radiating device is considerable. Thus, radiators of the ordinary type weighing as they do from 6 to 7 lbs. per sq. ft. of direct radiation, will condense about as much water in their initial heating as they would ordinarily condense in one-half hour under normal operation. For example, a radiator, containing 100 sq. ft. of exposed surface may be considered as ordinarily condensing about 30 lbs. of steam in one hour, and as condensing about 15 lbs. in the initial heating. Now, since it is desirable that a radiator when cold should heat up within five or six minutes after the heat is turned on, the area of the restricting opening in the valve would therefore have to be from 5 to 6 times as large as that required to pass the normal condensation; and as such, would be 5 to 6 times larger than would afterward be required for the normal operation of the radiating device. It can thus be readily seen that the result in this case would not be satisfactory. In the present invention these difficulties are overcome, the large restricting openings necessary to accommodate the initial condensation being retained, but the entire system so arranged that the disadvantages of the former systems are not present, whereby I obtain the great advantages resulting from the extreme simplicity of the devices employed.

In order to obtain the desired result, I ordinarily employ a method of collecting the water of condensation and the air from several radiators connected into the groups 12, the total condensation and air from each group passing through the corresponding branch returns 15 to the main return 16.

At the outlet of each radiating device 13 is one or the other of the devices 18 or 19, provided with a restricting opening of diameter d affording an area of opening sufficient to accommodate, within the desired time, the initial condensation and the air from said radiating device. Into each of the branch returns 15 is inserted one or the other of the valves 18 or 19 providing a restricting opening of diameter d' affording an area sufficiently large to pass the total normal condensation and the air from all of the radiators of the corresponding group. The proper proportioning of these restricting openings is a very simple problem for any one of ordinary skill; and familiar with the art and with the laws governing the flow of fluids through orifices. Thus, a hole 1/16 inch in diameter, equal to .003 sq. inch, will pass the air and the water of condensation from a radiator having 100 sq. ft. of radiating surface with one pound difference in pressure; and consequently one having a diameter of 5/32 inch, equal to .019 would be sufficiently large to pass the condensation due to the initial heating within the required time with the same difference in pressure. Or, one of about 1/4 inch in diameter would be sufficient for 1/4 pound difference in pressure.

As it is generally desirable to carry 8 to 10 inches of vacuum in the main return in order that the friction of the steam main and return main may be provided for, and a sufficient difference in pressure still be left for operation at some distance from the source of supply, the opening in the branch may be figured as about .02 square inch in area, or a 5/32 inch, round hole for the normal condensation from 1000 sq. ft. of radiation with 4 pounds difference in pressure.

Where a single radiator is connected to the main return the same method may be used if the cubical contents of the pipe between the two openings is sufficient to temporarily hold the water of initial condensation. Thus the space required for the initial condensation from a radiator of 100 sq. ft., would be that occupied by 15 pounds of water, or about 1/4 of a cubic foot.

No exact method is needed for the proportioning of these openings if the same ratio of opening in proportion to radiating surface is used, as the required difference in pressure will automatically adjust itself to that required for the withdrawal of the air and water from the opening which is provided.

In practice the restricting openings in the branch returns are proportioned to an area of from 15 to 20% in excess of that necessary to pass the normal condensation, in order to provide for the temporary increased condensation caused by the turning on of a cold radiator. The returns being as a rule of considerable capacity, they will also tend to accommodate the temporary increased condensation. After the entire plant is in operation any errors apparent, that have been made in the areas of the restrictions, are corrected by increasing or decreasing the restricting openings as the occasion may require.

The radiating effect of the return main will also tend to compensate for irregularities in the proportion of these openings by condensing the steam passed from the openings which may be slightly larger than that necessary for proper air and water removal. As a rule, the radiating surface of the branch returns is ample to accomplish this. The reëvaporation of the condensed water from the radiators, due to the same entering a space of lower pressure, will likewise be condensed by the radiating surface of the return.

Although I have shown the restricting devices in the preferable form of check valves to prevent backing and to aid in the control of the circulation, yet I do not wish thereby to restrict myself to the use of such valves, as I may employ simple restrictions to effect the desired result.

I claim:—

1. In a steam heating system, the combination of a steam supply main, a return main, a plurality of heat distributing sections or systems each comprising one or more radiating devices, a branch supply and a branch return pipe affording independent communication for each section or system with said supply and return mains, a fitting, having a restricting orifice of fixed dimension, at the outlet of each radiating device, and a fitting, having a restricting orifice of fixed dimension, in each branch return, the area of said restricting orifices of the radiating devices of each section or system bearing a definite and predetermined relation to the area of the restricting orifice of the corresponding branch return.

2. In a steam heating system, the combination of a steam supply main, a return main, a plurality of heat distributing sections or systems each comprising one or more radiating devices, a branch supply and a branch return pipe affording independent communication for each section or system with said supply and return mains, a fitting, having a restricting orifice, at the outlet of each radiating device, the area of same being proportioned to the initial condensation of the radiating device, and a fitting, having a restricting orifice, in each of the branch returns, the area of same being proportioned to the normal condensation of the corresponding section or system.

3. In a steam heating system, the combination of a steam supply main, a return main, a plurality of heat distributing sections or systems each comprising one or more radiating devices, a branch supply and a branch return pipe affording independent communication for each section or system with said supply and return mains, a check valve, having a restricted orifice of fixed dimension, at the outlet of each radiating device, and a check valve, having a restricting orifice of fixed dimension, in each of the branch returns.

4. In a steam heating system, the combination of a steam supply main, a return main, a plurality of heat distributing sections or systems each comprising one or more radiating devices, a branch supply and a branch return pipe affording independent communication for each section or

system with said supply and return mains, a weighted check valve, having a restricting orifice of fixed dimension, at the outlet of each radiating device, and a weighted check valve, having a restricting orifice of fixed dimension, in each of the branch returns.

Signed at New York, in the county of New York, and State of New York, this 10th day of March A. D. 1908.

JAMES A. DONNELLY.

Witnesses:
FREDK. F. SCHUETZ,
SALLY O. YUDIZKY.