I. COWLES.

HEATING SYSTEM.

APPLICATION FILED OCT. 23, 1909.

987,861. Patented Mar. 28, 1911.

3 SHEETS—SHEET 1.

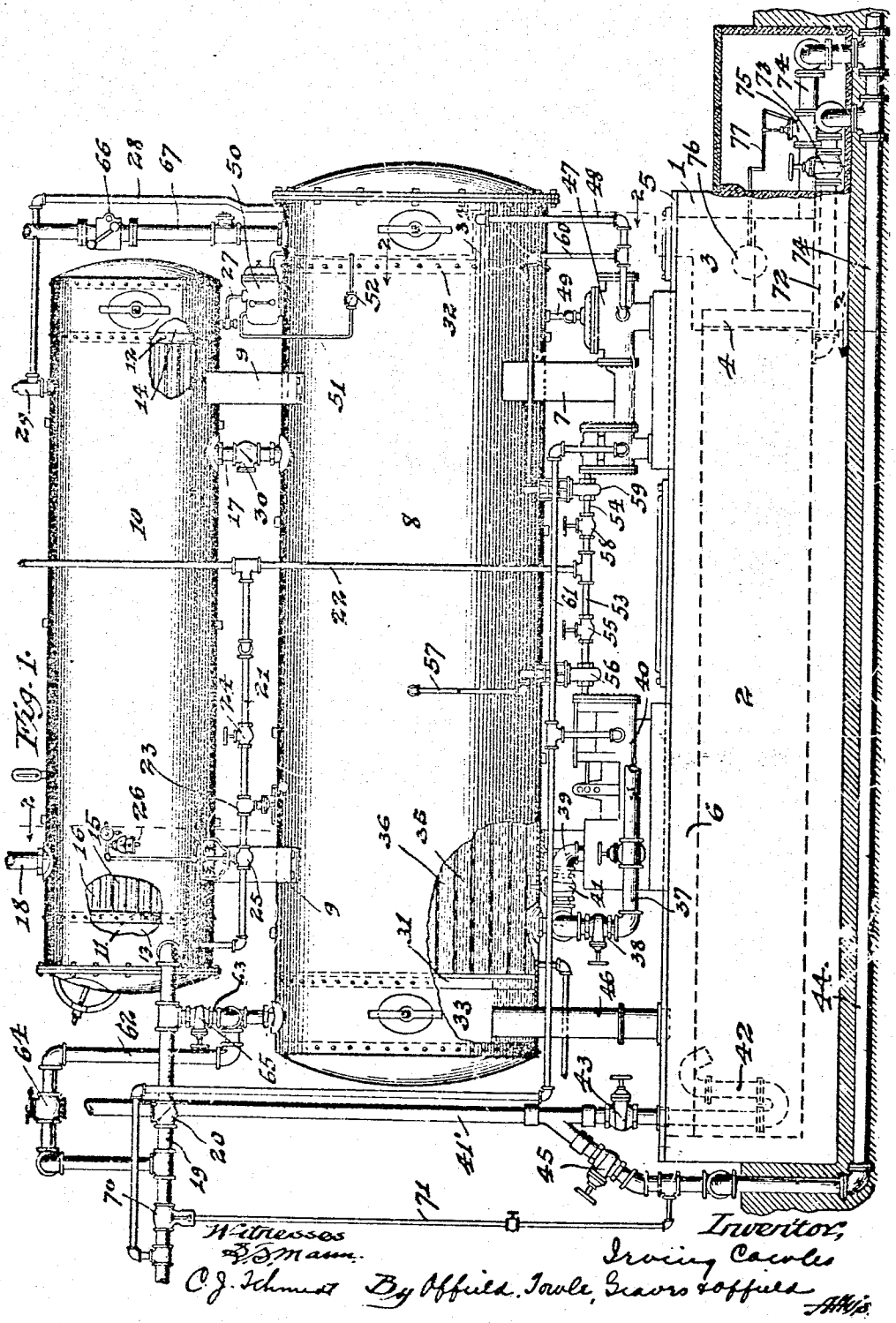

Fig. 1.

Witnesses
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3 SHEETS—SHEET 2.

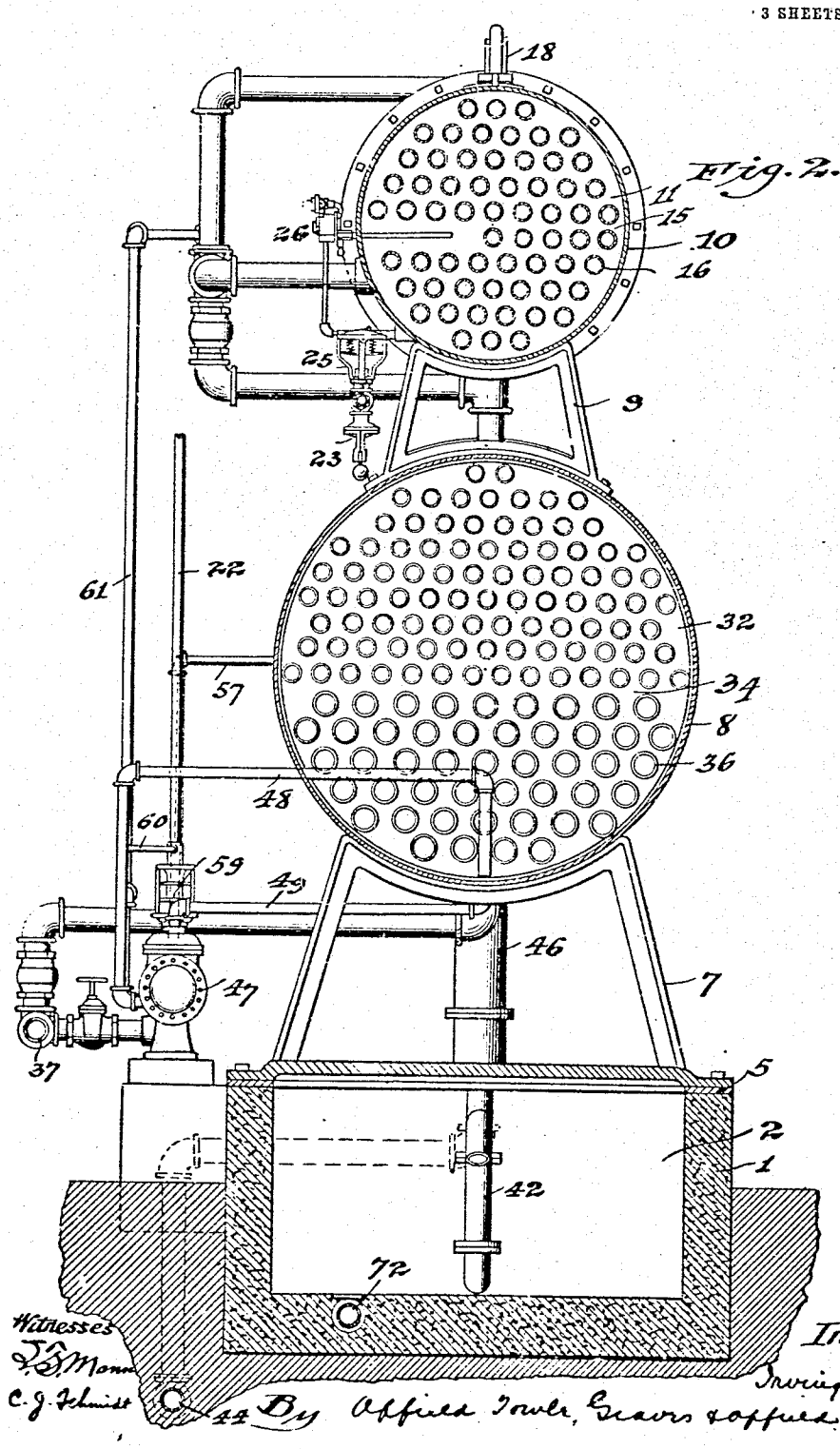

Fig. 2.

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3 SHEETS-SHEET 3.

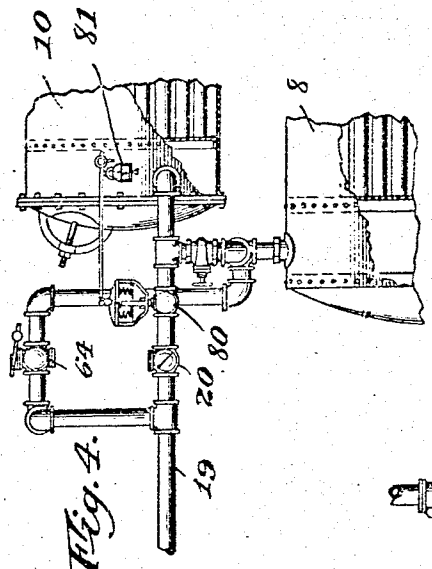

Fig. 4.

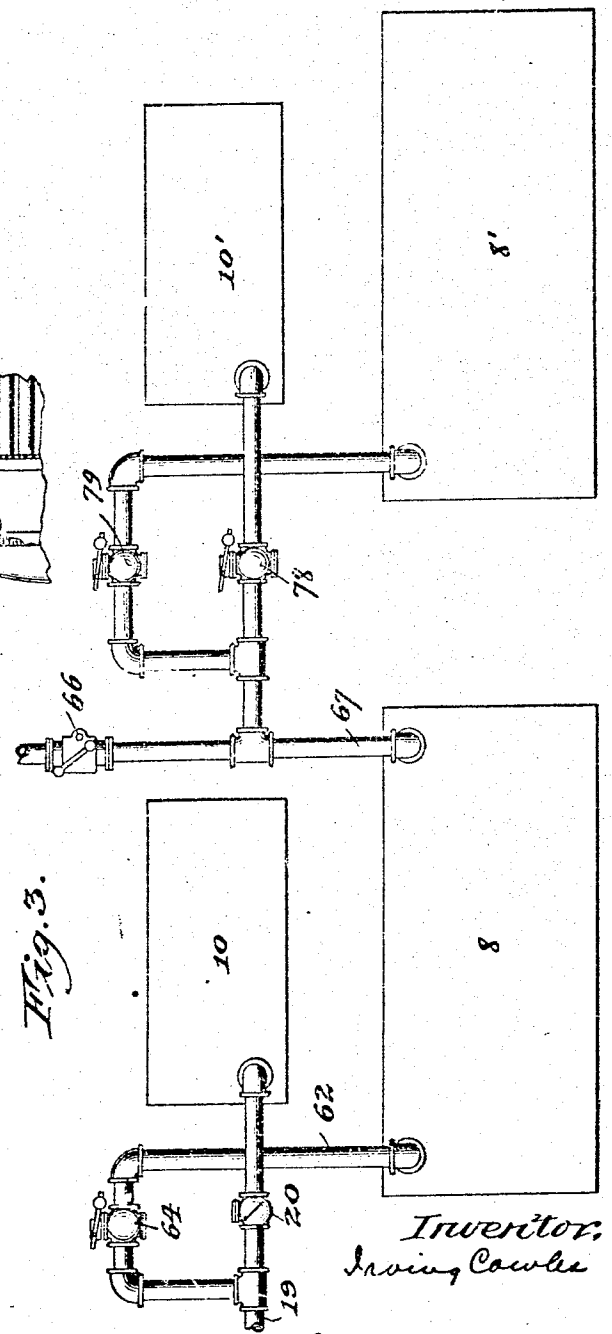

Fig. 3.

Witnesses,
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Inventor:
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UNITED STATES PATENT OFFICE.

IRVING COWLES, OF CHICAGO, ILLINOIS. ASSIGNOR OF ONE-HALF TO ROBERT L. GIFFORD, OF CHICAGO, ILLINOIS.

HEATING SYSTEM.

987,861. Specification of Letters Patent. Patented Mar. 28, 1911.

Application filed October 23, 1909. Serial No. 524,116.

To all whom it may concern:

Be it known that I, IRVING COWLES, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Heating Systems, of which the following is a complete, clear, full, and precise specification.

My invention relates to heating systems, particularly to heating systems for utilizing the heat in steam.

My invention is particularly adaptable for heating water to be used for various purposes, such as for washing and refilling locomotive boilers.

Among the salient objects of my invention are to provide a system comprising a plarality of heating mechanisms in each of which the heat from steam is utilized, these mechanisms being so interconnected that one mechanism has preference over the others with respect to the steam supply, the arrangement being such that when a certain temperature has been reached in one mechanism the steam supply is automatically diverted to other mechanisms; to provide interconnections whereby the heating mechanisms can be used alone or in various combinations; to provide attachments whereby heat from blown-off steam and water can be utilized in the mechanisms; and in general to provide a system which is very flexible and which can be used in a variety of ways for heating or other purposes.

My invention will be clearly understood by reference to the following specification and accompanying drawings, in which drawings,

Figure 1 is the side elevation showing the construction, relative positions and connections of a system comprising two tanks, Fig. 2 is a sectional view taken on plane 2—2, Fig. 1, Fig. 3 shows diagrammatically a modified arrangement and interconnection of heating mechanisms, and Fig. 4 shows the ends of the two tanks shown in Fig. 1 and a modified form of diversion controlling mechanism connected therewith.

The apparatus in Figs. 1 and 2 is supported on a concrete bed 1, forming the main vat 2, and an over-flow vat 3, separated from the main vat by a transverse wall 4. The vat is sealed by a cover 5 which engages the top of the structure 1, the top of wall 4 being below the cover so that the level of water in vat 2 is always below the cover to leave an air space 6 over the water. Saddle frames 7 mounted on the bed support a large condenser tank 8 and saddle frames 9 on this tank in turn support a smaller tank 10. The tank 10 is divided by partitions 11 and 12 into end compartments 13 and 14 and into a heating compartment 15. Flues 16 terminate in the partitions 11 and 12 so that steam flowing through the flues will heat water circulating through compartment 15. The water to be heated enters compartment 15 from piping 17 and the heated water is conveyed to the place of consumption through piping 18. Piping 19 connects with compartment 13 to convey thereto the exhaust steam from steam heating or power plants or from steam operated heating or power devices, the check valve 20 being interposed in this piping to prevent back flow from the heating tank. Piping 21 connects compartment 13 with a live steam delivery pipe 22, a reducing valve 23 being interposed in this piping together with a main controlling valve 24. This piping also includes a valve 25 which is controlled automatically by thermostatic mechanism 26 which communicates with the interior of compartment 15 to be influenced by the temperature of the water therein. The water of condensation can escape from the steam compartments of the tank through the piping 27. The piping 28 extends from the upper part of compartment 15 and contains a relief valve 29 which opens when the pressure in the water compartment becomes too great, as when the service piping 18 is suddenly closed, back flow of the water from compartment 15 being prevented by a check valve 30 interposed in piping 17.

The large heating tank is divided by partitions 31 and 32 into end compartments 33 and 34 and a water heating compartment 35, these partitions being connected by flues 36 which communicate with the end compartments 33 and 34 to receive steam flow whose heat serves to raise the temperature of water flowing through compartment 35 about the flues 36. The water to be heated may enter the compartment 35 directly through piping 37 controlled by the valve 38 or the water can be forced into the compartment through piping 39 by a force pump 40, a valve 41 being interposed in piping 39. Piping 41′ serves to transmit blow-off steam and water from a boiler to the vat 2, the end of this piping extending

into the tank and being reversely curved as shown to form a trap 42, the pipe including also a controlling valve 43. By-pass pipe 44 connects with piping 41′ in advance of valve 43 and leads to a waste receiving source such as a sewer, this piping including a controlling valve 45. The air space 6 of the vat 2 communicates with compartment 33 through a connecting pipe 46 so that blow-off steam can flow directly from the space 6 into compartment 33 and from thence through the heating pipes 36 and into compartment 34. Blow-off water cannot flow to the heating tank but remains in the vat. The temperature and pressure of the blow-off water are usually above the natural boiling temperature and atmospheric pressure respectively and when this blow-off water flows into the vat its pressure will be greatly relieved, the result being that the water boils to generate steam and this steam will flow through connection 46 into the heating compartments of the tank 8. To increase the tendency of the blow-off water to boil additional means are provided for creating vacuum effect in the steam compartments of the tank and in the space 6 of the vat. This vacuum effect can be produced by a pump 47 connected with the steam compartments of the tank, piping 48 being shown for connecting the pump with the compartment 34, the pipe extending to the bottom of this compartment as shown. As soon as steam flows into the steam compartments of the tank it is cooled by the water about the flues 35 and is condensed, the water of condensation being taken up by the vacuum pump through pipe 48, this causing the creation of vacuum effect in the steam compartments and also in the space 6 of the vat, the result being that the pressure is further reduced in the vat and further boiling of the blow-off water is caused. The vacuum effect can be adjusted so that the water will boil until all its useful heat is extracted in the form of vapor and steam which flow through the steam compartments of the tank 8 to heat the water circulating about the flues. The water of condensation taken up by pump 47 is preferably delivered through pipe 49 into compartment 35 to there mingle with the water and to add its heat units thereto. The condensation water outlet piping 27 from the steam compartments of tank 10 is connected with compartment 34 so that the condensation water from tank 10 is also delivered to the water to be heated, a trap valve 50 being interposed in pipe 27 so that the condensation water will flow from tank 10 to tank 8 but steam flow between the tanks prevented. A pipe 51 also connects compartment 34 with the upper part of trap 50 and thence with the compartment 14 of tank 10 so that the vacuum effect is also extended to the steam compartments of tank 10 and thus to the exhaust supply delivered through piping 19. A check valve 52 interposed in piping 51 would prevent back flow from the steam compartments of tank 8 to those of tank 10. The relief outlet 28 from tank 10 also communicates with compartment 34 so that any over-flow water from tank 10 is caught and delivered by pump 47 to compartment 35 of tank 8. The piping 17 connects at the top of tank 8 with compartment 35 so that the water delivered from the main 37 will flow serially through the tanks, back-flow from tank 10 to tank 8 being prevented by the check valve 30 already referred to. No condensation water or over-flow water is wasted as it is all delivered back to the water in the tank 8 and no heat units are therefore lost. Pumps 40 and 47 receive their steam supply from branch pipes 53 and 54 connected with the main supply pipe 22. Pipe 53 includes a hand valve 55 and a governor valve 56 which connects through pipe 57 with the compartment 35, this valve being controlled by the pressure of the water in the tanks to automatically adjust the steam supply to pump 40. In pipe 54 is included a hand valve 58 and a governor valve 59 which connects through a pipe 60 with the pipe 48, this governor valve being controlled by the vacuum degree in the tank to automatically adjust the steam supply to pump 47. If the pressure of the water in the tanks exceeds a predetermined value valve 56 will be automatically closed and delivery pump 40 stopped. Likewise if the vacuum effect exceeds a certain predetermined value valve 59 will shut off the steam supply from pump 47, the operation of these valves being well understood in the art. The exhaust steam from these pumps is delivered through piping 61 to the piping 19 so that the heat units from the exhaust steam can assist in heating water in tank 10.

Piping 62 connects with piping 19 outside of the check valve 20 and leads to compartment 33 of tank 8. Piping 63 connects with piping 19 inside of the check valve 20 and also leads to compartment 33. Piping 62 includes a back pressure valve 64 which prevents steam flow from tank 8 to tank 10 and which allows steam flow from piping 19 to tank 8 only when the pressure inside the piping exceeds the pressure for which valve 64 has been adjusted. The steam pressure in tank 8 is limited by a back pressure valve 66 included in outlet piping 67 extending from compartment 34.

The operation of the system can now be followed. Valve 65 is normally closed and the exhaust steam supply through piping 19 flows into the steam compartments of tank 10, and if the pressure of the exhaust steam exceeds the pressure for which valve 64 is

adjusted exhaust steam will also flow to tank 8. Primarily, however, all the steam flows into tank 10 on account of the vacuum effect created in said tank by the rapid condensation of the steam as it comes in contact with the cold surfaces in the water compartment 15. As soon as the water has absorbed sufficient heat units to give it a temperature corresponding to the pressure of the exhaust steam, and if this pressure exceeds the pressure for which valve 64 has been adjusted the exhaust steam flow will be diverted through pipe 62 to tank 8 and the heat units of the exhaust steam taken up by the water in tank 8. As the temperature in tank 10 falls steam will again flow and the water will be quickly brought up to its desired temperature. Thus all the heat of the exhaust steam is primarily available for heating a small volume of water in tank 10 and as soon as this small volume of water has been sufficiently heated the exhaust steam is diverted to tank 8 to heat a larger volume of water in this tank. Tank 10 has always direct connection with the piping 19 but takes on exhaust steam flow only in sufficient quantities to maintain its water at a certain temperature, all excess steam flowing to tank 8. Reducing valve 23 should be set for a pressure somewhat less than the pressure for which valve 64 is adjusted and therefore although valve 25 is opened by the thermostatic mechanism, live steam will not flow into tank 10 unless the exhaust steam has a pressure below that for which the reducing valve is set, that is, live steam will not flow until the exhaust steam falls in pressure and is unable to sufficiently heat the water. For illustration, suppose that valve 64 is set for two pounds and the reducing valve 23 for one and one half pounds. When, now, the system is started and the water in tank 10 is cold the incoming exhaust steam will be immediately condensed and considerable vacuum effect created in the tank so that live steam at a pressure of one and one half pounds will flow into the tank to assist the exhaust steam to rapidly bring the water up to temperature. As soon as the vacuum effect diminishes and the pressure rises above one and one half pounds the live steam flow will stop but if during the course of operation the exhaust steam pressure falls below one and one half pounds, live steam immediately enters and assists until the exhaust steam again recovers its normal pressure. Also, as soon as the water in tank 10 has been brought to temperature and the pressure in the tank has come to the pressure of the exhaust steam, and if this pressure is over two pounds, the exhaust steam flow will be diverted through valve 64 to tank 8. Thus tank 8 automatically receives exhaust steam supply as soon as the water in tank 10 has been brought to the desired temperature. Both tanks can, however, be directly connected with the exhaust steam source by opening valve 65, whereupon the heating surfaces of the two tanks will be combined. If the pressure in the tanks is below one and one half pounds live steam will flow to both tanks to assist the exhaust steam in rapidly bringing the water to temperature. If it is desired to utilize the heat from blow-off steam and water, valve 43 is opened, valve 45 remaining closed. If valve 65 is closed, the blow-off steam and the steam generated by the boiling water in vat 2 will flow through the steam compartments of tank 8 only, while if valve 65 is open blow-off steam will also enter tank 10, but this valve is preferably closed so that back pressure valve 64 is effective to automatically control the exhaust steam to tank 8, back flow of blow-off steam to the exhaust steam system being prevented by valves 20 and 64. With the arrangement thus far described, the tanks can each be used alone for heating water or can be used together in various combinations. The heat producing medium can be entirely live steam, or exhaust steam, or blow-off steam, or different combinations thereof.

The exhaust steam flowing through pipe 19 can be cleaned by means of a separator mechanism 70 which discharges through piping 71 into piping 44 leading to the sewer. The blow-off water after being deprived of its heat units in vat 2 is discharged to the sewer through piping 72 connecting with piping 44 and controlled by valve 73. The vat 2 is sufficiently large to receive and to hold one or more blow-off discharges, but if the water in the vat should rise above the level of wall 4 the flow-over water will enter compartment 3 and will discharge through piping 74 to the sewer, this piping having a valve 75 automatically controlled by the level of the water in compartment 3 by means of a float having connection through lever mechanism 77 with valve 75.

In my system, therefore, one heating mechanism has preference in a plurality of heating mechanisms as regards a steam supply, the steam flow to the said heating mechanism being unrestricted and being diverted only when a certain temperature has been reached in the heating mechanism. This steam supply to the heating mechanism remains unrestricted so that if the temperature falls it can immediately be brought back to the proper value. The diverted steam can be utilized in any number of other heating mechanisms. The diversion feature can be continued progressively to a number of heating mechanisms. For example, in Fig. 3 I have shown diagrammatically tanks 10 and 8 connected together by a diversion path, and with the relief pipe 67 I have connected a second heating mechanism compris-

ing tanks 10′ and 8′. The exhaust steam supply piping 19 has unrestricted connection with the tank 10 and has connection with tank 8 through pipe 62, the flow, however, from tank 8 being restricted by the back pressure valve 64. After tank 10 has been sufficiently heated by the exhaust steam the exhaust steam will be diverted to tank 8. If valve 64 is adjusted for two pounds then if the exhaust steam pressure is greater than two pounds the exhaust steam will flow to tank 8. The water in tank 8 is soon sufficiently heated and requires no more steam. In the connection between pipe 67 and tank 10′ is a back pressure valve 78 which, for example, may be adjusted for three pounds pressure, and in the connection from pipe 67 to tank 8′ is included a back pressure valve 79 which, for example, may be adjusted for four pounds, and the back pressure valve 66 included in pipe 67 may, for example, be adjusted to five pounds. As soon as no more exhaust steam is required in tank 8 and the steam pressure is greater than four pounds, exhaust steam will flow from tank 8 through valves 78 and 79 to tanks 8′ and 10′ to heat the water in these tanks. If the pressure is less than four pounds steam will flow through only valve 78 and only tank 10′ will be heated. If there is any heat left in the steam after heating tanks 8′ and 10′ the surplus can be diverted to other heating mechanisms, and so on, until all available heat has been extracted. The heating mechanism could also be connected with the pipe 67 beyond the valve 66 so that surplus steam over five pounds pressure will not be wasted but can be utilized. Thus a plurality of heating mechanisms can be adapted for successive connection with a steam supply source, each mechanism having preference over the succeeding mechanism with respect to the steam supply. If, after the steam flow has been diverted from one mechanism this mechanism should again require steam flow, the steam flow will automatically be diverted back to the mechanism from the succeeding mechanisms until the proper temperature has again been restored. For example, if tank 10′ should become suddenly cool, the pressure therein would immediately fall and the steam flow from pipe 67 will flow in greater part to tank 10′ until the temperature is restored. Likewise, should tank 10 become suddenly cool, this tank will have the preference and will divert the steam flow to itself until its temperature is again restored.

In Fig. 4 is shown a somewhat modified arrangement for controlling the diversion of steam flow from one heating mechanism to another. In this arrangement a valve 80 included in piping 19 inside the check valve 20 is thermostatically controlled by thermostatic mechanism 81 influenced by the steam within the steam compartment of tank 10. As soon as the temperature of the steam, and therefore, of the water reaches a certain predetermined value, valve 80 is closed and the steam flow diverted to other heating mechanism, in this case to the tank 8. This thermostatic control could be applied to both the arrangements shown in Figs. 1 and 3. The various mechanisms could also be adapted for controlling the flow of fluid in fluid pressure systems. In this case the valve mechanisms for controlling the flow to the various tanks would be pressure controlled so that when the pressure in a tank reaches a certain value flow to that tank will automatically be closed and the flow diverted to other tanks or mechanisms. For example, valve 80 would be a pressure controlled valve so that as soon as the pressure of the fluid in tank 10 reaches a certain value further flow would stop and the fluid would be diverted to tank 8. In accordance with my invention, therefore, a plurality of mechanisms are each adapted for connection with a fluid supply, from which mechanisms the flow is automatically diverted as soon as the pressure or temperature in the mechanism reaches a predetermined value, and the mechanisms are progressively so inter-connected that each mechanism has preference over the succeeding mechanism in the progression with reference to the fluid supply.

I do not wish to be limited to the precise arrangement which I have shown, as modifications are possible which still come within the scope of my invention, and

I therefore desire to secure the following claims by Letters Patent:

1. In a heating system, the combination of a source of steam, a plurality of heat utilizing units one at least being a water heater of the closed condenser type, suitable valve controlled connections connecting the several heat utilizing units with said source of steam, whereby the steam may be diverted from the said water heater to another of said units, and automatic valve actuating mechanism operatively associated with said water heater, actuated by the changes of conditions in said water heater due to temperature and operating to automatically divert the steam supply away from the water heater to another unit and to switch it back to the water heater.

2. In a steam heating system, the combination with a source of steam, of a plurality of water heaters of the closed condenser type, one of said heaters being of relatively small size as compared with the other or others, suitable valve controlled connections connecting the several water heaters with said source of steam, whereby the steam may be diverted from the smaller water heater to the other or others, and automatic valve actuating mechanism operatively associated

with said relatively small water heater, actuated by the changes of conditions in the latter due to temperature, and operating to automatically direct the steam supply to the relatively small water heater until the water therein arrives at a predetermined temperature, to automatically divert the steam supply from said small water heater to the other or others when the temperature reaches said predetermined point and to automatically switch the steam supply back to the small water heater whenever the temperature in the latter falls below said predetermined point.

3. In a water heating system, the combination of a heating tank having a steam compartment and a water compartment, a second tank having a steam compartment and a water compartment, piping connecting with the steam compartment of the first tank and adapted for connection with a source of exhaust steam, a check-valve in said piping, branch piping connecting with said first mentioned piping at a point outside of the check valve and having connection with the steam compartment of the second tank, and valve mechanism included in said branch piping for preventing back flow from the second tank to the exhaust steam source and for allowing flow from the exhaust steam source to the second tank only when the pressure of the exhaust steam reaches a certain value.

In witness whereof, I hereunto subscribe my name, this 20th day of October, A. D. 1909.

IRVING COWLES.

Witnesses:
ALBERT H. GRAVES,
CHARLES J. SCHMIDT.