

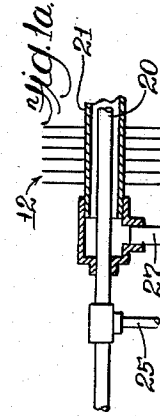
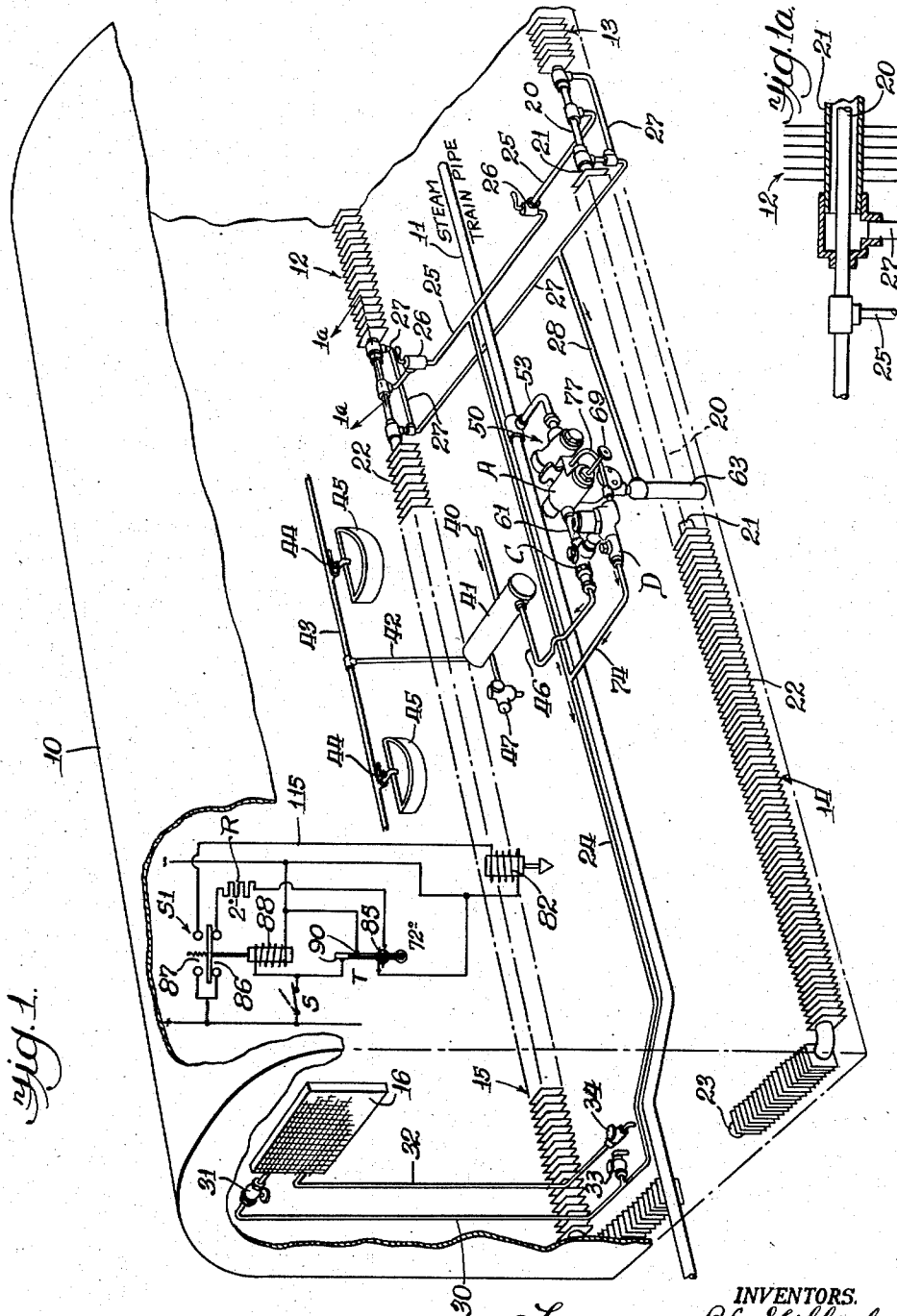
Aug. 6, 1957

L. H. GILICK ET AL
COMBINED SPACE HEATING AND WATER HEATING
SYSTEM FOR A RAILWAY CAR

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4 Sheets-Sheet 1



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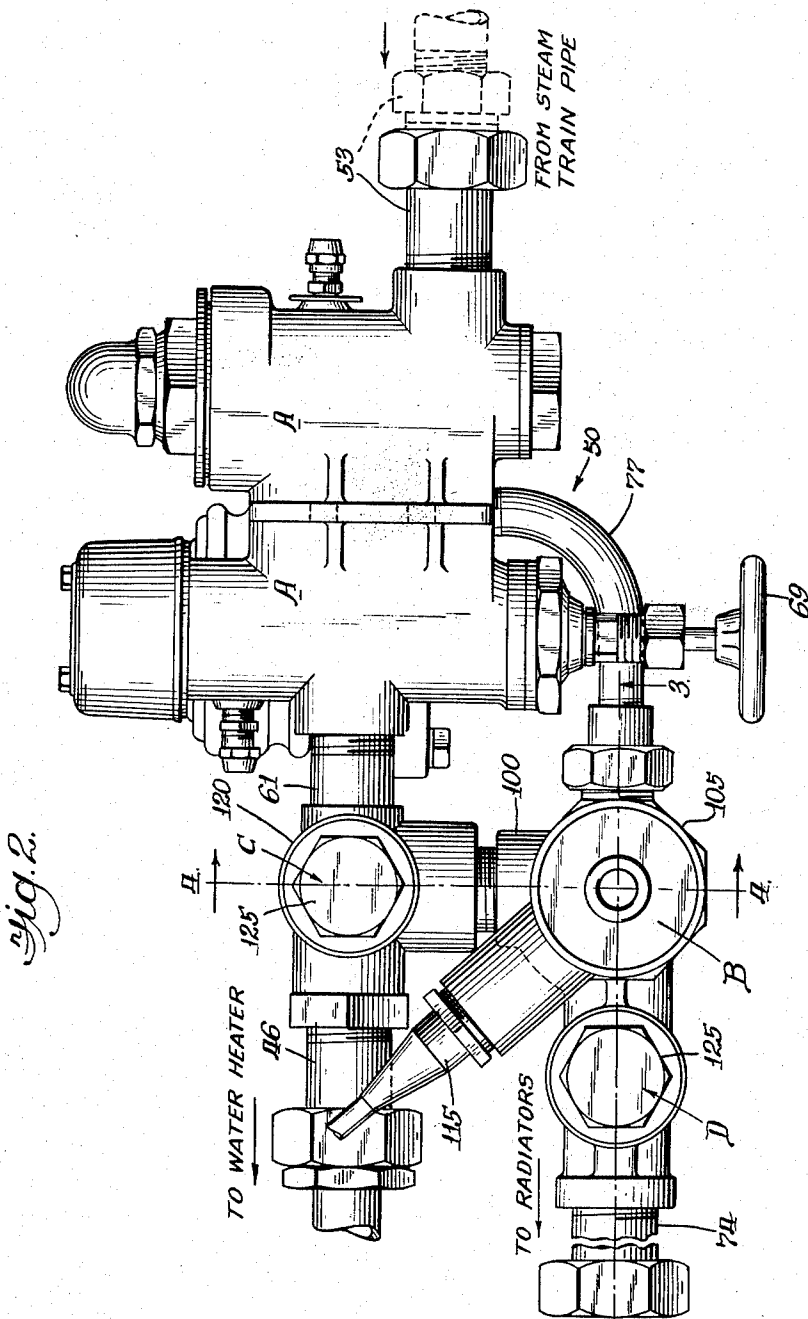
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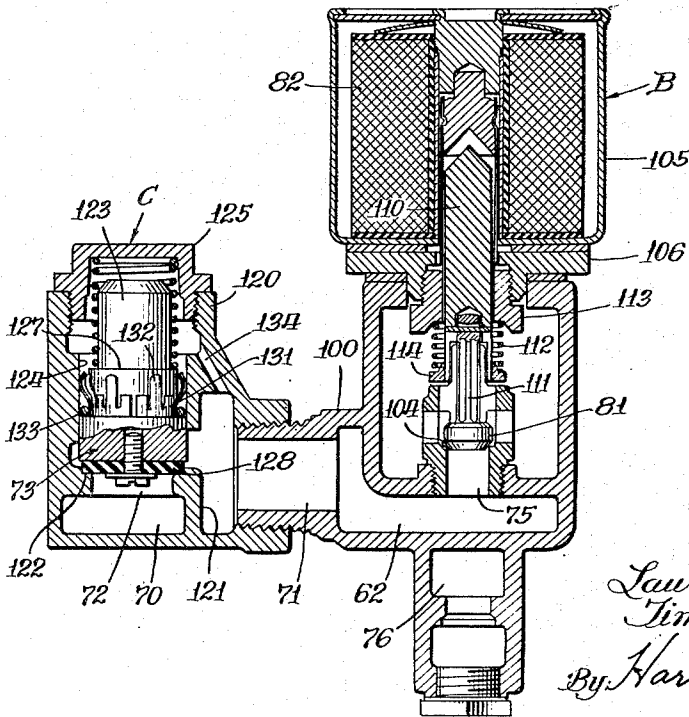
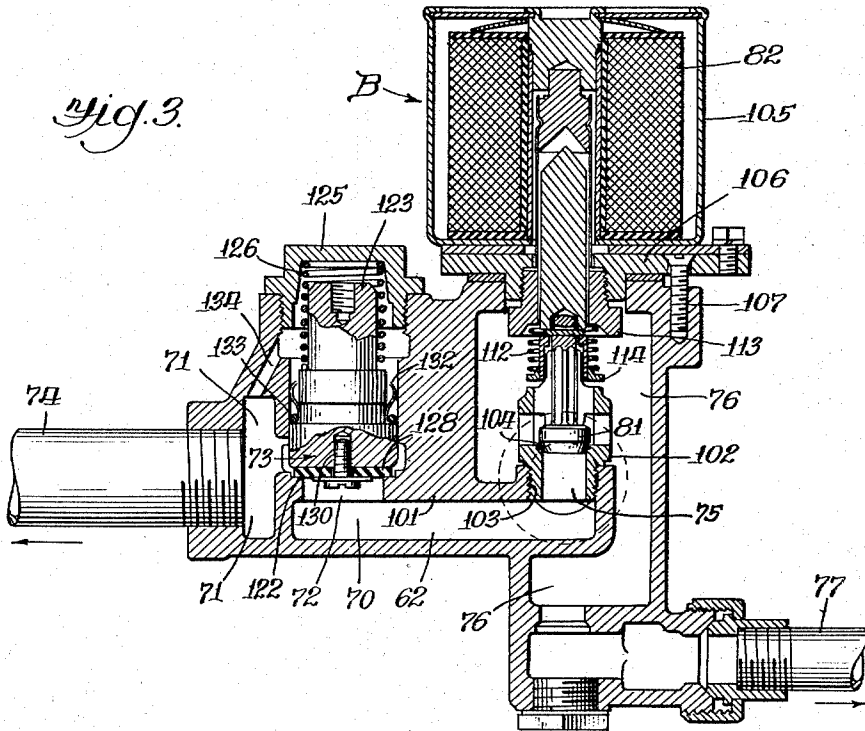
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4 Sheets-Sheet 3



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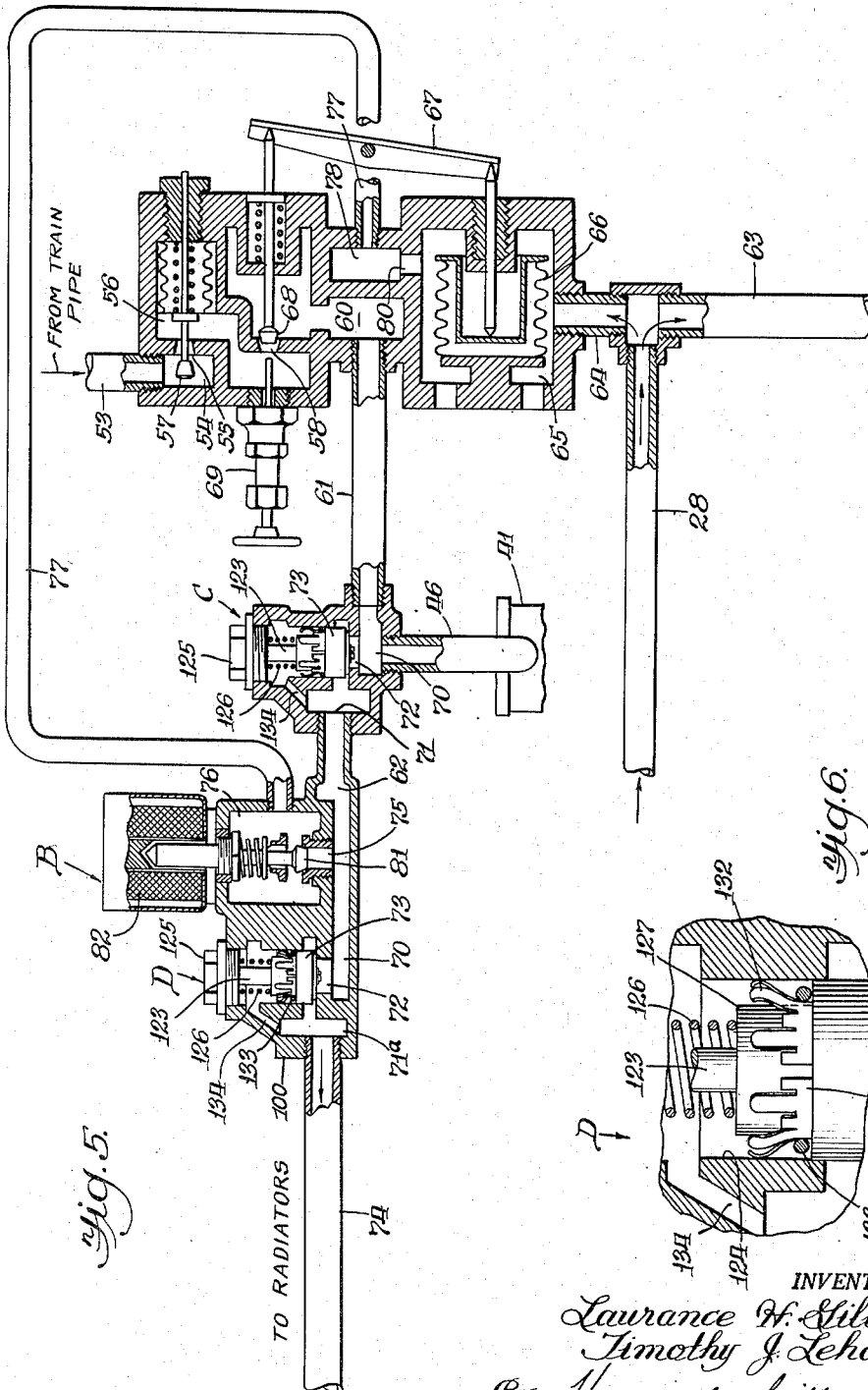
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COMBINED SPACE HEATING AND WATER HEATING SYSTEM FOR A RAILWAY CAR

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10 Claims. (Cl. 237—6)

This invention relates to a combined space heating and water heating system for a railway car and is characterized by its improvements whereby steam is supplied to the space heaters and to a water heater at the same pressure during the space heating season, but is supplied to the water heater at a lower pressure during the warmer weather when the space heaters are not being used.

According to the invention, the space heaters include a plurality of radiators which are continuously open at their outlets; the said outlets being connected through a common discharge pipe with a thermostatically operated steam delivery valve. During the space heating season, the steam delivery valve is responsive to the temperature at the outlet of the space heaters to deliver steam to the space heaters and to the water heater at a pressure (approximately eight pounds, depending upon the flow resistance through the space heaters) sufficient to maintain the space heaters filled with steam. When the space heaters are filled with steam, the surplus steam passes through the discharge pipe to the thermostat chamber of the steam delivery valve and thereby expands the thermostat to close the steam delivery valve. When the steam in the space heater condenses so that there is no surplus steam discharging therefrom, the thermostat of the steam delivery valve cools and thereby contracts sufficiently to open the steam delivery valve until the space heaters and the water heater are again filled with steam.

In addition to controlling the delivery of steam to the space heaters and to the water heater in response to the temperature at the outlet of the space heating system, provision is also made to by-pass steam directly from the steam delivery pipe to the thermostat chamber of the steam delivery valve and thereby shut off the delivery of steam. In this connection, an electrically operated by-pass valve is interposed in the steam delivery pipe intermediate the space heater and the steam delivery valve. An electrical circuit for energizing the by-pass valve to open position is controlled by a thermostat responsive to the ambient temperature within the car. Consequently when the temperature within the car rises to a predetermined value, the space thermostat functions to close an energizing circuit through the by-pass valve actuating means and thereby opens the by-pass valve to direct steam from the delivery pipe through a by-pass conduit into the thermostat chamber of the steam delivery valve, whereby the thermostat therein reacts to close the delivery valve.

The water heater is connected into the steam delivery pipe intermediate the by-pass valve and the steam delivery valve. Consequently, it is supplied with steam at a predetermined pressure whenever steam is supplied to the space heaters. It is also supplied with steam at a lower pressure when the by-pass valve, for any reason, remains open for a substantial period of time. Under such condition, for example during warm weather, the thermostat within the car remains closed or the by-pass valve energizing circuit may be otherwise energized to open the valve,

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A pressure relay valve adapted to open at a predetermined low pressure, for example three pounds per square inch, is interposed in the steam delivery pipe between the by-pass valve and connection leading to the water heater and a like pressure opened check valve is interposed in the steam delivery pipe between the by-pass valve and the space heaters.

When the by-pass valve is open, the first mentioned pressure relief valve will allow any steam issuing from the steam regulator at a pressure in excess of its relatively low setting to be by-passed through the by-pass valve to the thermal chamber of the steam pressure regulator but when the pressure of steam has dropped off, the supply of steam to the by-pass valve will be materially reduced, if not terminated altogether and a relatively small flow of steam at low pressure will continue to be conducted by this valve to the heat exchange device for heating the wash water. The function of the other pressure relief valve during the time that the by-pass valve remains open is to block the passage of steam to the radiators and enhance the flow of by-passed steam through the by-pass conduit to the thermal chamber of the steam regulator.

The invention includes a novel form of pressure relief and check valve which is capable of association with the by-pass valve employed in connection with the present system to provide an extremely compact valve assembly. These pressure operated valves, together with the by-pass valve and the steam delivery or pressure regulator valve, are nested together in a cluster of mechanism, so to speak, which results in an extremely compact assembly of elements that consumes but little space and which facilitates installation of the assembly as a unitary structure.

A preferred embodiment of the invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a fragmentary perspective view, schematic in its representation, of a railway car to which the improved heating system of the present invention has been applied and illustrating the location of the various heating elements and their associated control instrumentalities.

Fig. 1a is a fragmentary sectional view taken on line 1a—1a of Fig. 1.

Fig. 2 is an enlarged assembly view of a portion of the control mechanism showing a steam regulator assembly, a solenoid control valve and a pair of pressure regulating valves employed in connection with the invention, together with the operative connections therefor in the system.

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 2.

Fig. 5 is a fragmentary flow chart of a portion of the system showing the steam regulator assembly, solenoid control valve and pressure regulator valves in section and diagrammatically illustrating the hydraulic relation which these assemblies bear to one another; and

Fig. 6 is an enlarged fragmentary view of a portion of one of the pressure regulator valves of Fig. 2 with certain parts thereof in section.

Referring to the drawings: The improved heating system is shown in Fig. 1 applied to a railway passenger car, the outlines of which are indicated in broken lines at 10. The car 10 may, if desired, be compartmented although no division of the invention thereof has been illustrated and may be heated by a series of floor radiators of which four have been shown at 12, 13, 14 and 15 respectively and by an overhead radiator 16. The radiators 12, 13, 14 and 15 are preferably of the "inner feed" type comprising inner and outer coaxial pipes 20 and 21 respectively, the latter pipe being provided with a plurality

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of radiating fins 22 and being closed at its end by an end cap 23. Steam is supplied to the inner coaxial pipe 20 of the various radiators from a source of steam supply, for example a steam train pipe 24 and branch pipes 25 having shut-off valves 26 interposed therein. The condensate from the various radiators 12, 13, 14 and 15 passes from the outer coaxial pipes 21 through branch pipes 27 to a common discharge pipe 28. The steam train pipe 24 communicates through a vertical section 30, having a shut-off valve 31 interposed therein, with the overhead radiator 16. A drain pipe 32 returns the condensate to floor level and suitable steam traps 33 and 34 are disposed at the lowermost level of the pipe sections 30 and 32.

Still referring to Fig. 1, wash water is adapted to be supplied from a supply pipe 40 to the water side of a conventional heat exchanger 41 from whence the heated water is conducted through a header 42 to a common distribution pipe 43 provided with taps 44 at spaced points therealong for supplying water to the usual wash basins 45. The steam side of the heat exchanger 41 has its inlet end operatively connected to a steam conduit or pipe 46 and its outlet end communicates with a steam trap 47.

The improved heating system of the present invention includes a cluster of instrumentalities designated as a whole in Figs. 1 and 2 at 50. This cluster of instrumentalities comprises a steam delivery valve or regulator assembly A (see also Fig. 2) which operates thermostatically to regulate the delivery of steam, solenoid actuated by-pass valve B, and a pair of spring loaded pressure relief and check valves C and D respectively, these elements being operatively associated with one another and operatively connected to the steam line 11, steam supply lines 24 and 46 for the radiators 12, 13, 14 and 15 and water heater 41 respectively, and to the return line 28 in a manner that will be made clear presently. The solenoid valve B operates under the control of a thermostat T operatively associated with an electrical control mechanism schematically illustrated in Fig. 1 and designated in its entirety at 51.

The function of the heating system including the cluster of instrumentalities 50 (Figs. 1 and 2) is to deliver steam to the various radiators at a predetermined low pressure and to simultaneously supply steam to the heat exchange device 41 to heat the wash water supplied to the wash basins 45 through the pipes 42 and 43. Means are provided whereby the system may be conditioned for use during the heating season so that when a temperature below a predetermined maximum is maintained within the car steam will be supplied to the inlet ends of various radiators at a pressure (approximately eight pounds per square inch) which will overcome the flow resistance therein and maintain the radiator filled with steam at approximately atmospheric pressure, and will deliver steam to the heat exchange device 41 to heat the wash water. When a predetermined maximum temperature is attained within the car the system will function automatically to supply only sufficient steam to the radiators to maintain the desired temperature within the car. When steam is not delivered to the radiators, for example during warm weather, the system may be conditioned so that the thermostatic control mechanism is disabled and the steam that ordinarily is available for the radiators is by-passed to the thermal chamber of the steam regulator A so that the latter will shut off the supply of high pressure steam from the steam train line, but allowing steam at a lower pressure to pass to the water heating device 41.

The pressure regulator assembly A is in the form of a pressure reducing and steam delivery valve assembly. This assembly is illustrated in somewhat diagrammatic form in Fig. 5 and may be described briefly as follows: Steam existing at train steam line pressure is admitted from a conduit 53 (Figs. 1 and 5) to a chamber 54 of the valve assembly and passes through a valved port 55 to a chamber 56. When the pressure in the chamber 56 attains a predetermined point, a pressure sensitive valve 57 moves

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to a position to maintain the desired pressure in the chamber 56. From the chamber 56, the steam passes through a port 58 to the supply chamber 60 from whence it is available in a conduit 61 for transmission through the supply conduit 46 to the heat exchange device 41. Steam from the chamber 60 is also available for conduction to the various radiators 12, 13, 14 and 15 as well as to the overhead radiator 16 through the relief valves C and D, as well as through an unrestricted passage 62 provided in the casing of the solenoid actuated valve B and which communicates with both valves B and C.

During normal operation of the radiators 12, 13, 14 and 15, when one or more of these radiators become filled with steam, the steam, together with its condensate, is discharged through the return conduit 28. The steam is separated from its condensate and the latter is discharged through the drain pipe 63 (Figs. 1 and 5) while the steam is introduced through a pipe section 64 to the thermal chamber 65. The steam functions to expand a bellows thermostat 66 and thereby rocks a lever 67 to move a normally open spring pressed valve 68 in a direction to shut off the delivery of steam to the supply chamber 60. The valve 68 has associated therewith an emergency control mechanism designated in its entirety at 69 and which is capable of manual operation to dislodge the valve 68 from its seat and to maintain the same open in any desired degree of adjustment.

The two valves C and D are in the form of combined pressure relief and check valves, the details of which will be set forth subsequently. Suffice it to say for the present that the casing of valve D is, in the embodiment shown, integrally formed with the casing of the solenoid valve B while the valve C is a separate entity. Each valve C and D is provided with an inlet chamber 70 and an outlet chamber 71 separated by a port 72 which is normally closed by a spring pressed valve member 73. The outlet port 71 of the valve C communicates through the previously mentioned passage 62 with the inlet port 72 of the valve D and the outlet port 71^a of this latter valve is connected to the steam train pipe 24 through a conduit 74 (Figs. 1 and 5). The spring pressure setting of the valves C and D may arbitrarily be set at three pounds.

The solenoid actuated valve B will likewise be described in detail subsequently but for an understanding of its function in the system it is sufficient to state that it constitutes a by-pass valve having a by-pass port 75 communicating with passage 62 and a valve chamber 76 which communicates through a by-pass conduit 77 with a chamber 78 associated with the steam delivery valve assembly A. The chamber 78 communicates through a port 80 with the thermal chamber 65 of the assembly A. A spring loaded valve element 81 normally maintains the by-pass port 75 closed but, upon energization of a solenoid winding 82 associated with the valve under the influence of the thermostat control mechanism 51 (see also Fig. 1), the valve port 75 becomes open and steam may be by-passed around the radiator system, i. e. from the chamber 60 through conduit 61, valve C, passage 62, valve B and by-pass conduit 77 directly to the thermal chamber 65 where it operates to move the valve 68 toward its port closing position.

The above described function of the by-pass valve B under the influence of the thermostatic control mechanism 51 may best be understood by reference to Fig. 1 taken in conjunction with Fig. 5. The thermostat T may have any suitable temperature setting, for example 72° F., without the influence of electrical heat. However, this thermostat is provided with an electrical heater 85 which when fully energized will supply an additional amount of heat, for example 2° F., to the thermostat. The circuit for the heater 85 extends from the positive side of a current supply line through the normally open contacts 86 of a relay actuated switch S-1, current limiting resistor R and heater 85 to the negative side of the

line. The switch S-1 has associated therewith a second pair of contacts 87 which are normally closed and these latter contacts are disposed in an electrical circuit extending from the positive side of the line through the contacts 87, and the winding 82 of the by-pass valve B to the negative side of the line.

The contacts 86 and 87 are operable under the control of a solenoid 88 the winding of which is disposed in a circuit extending from the positive side of the line through a main switch S and the winding 88 to the other side of the line. Normally, when a low ambient temperature prevails, closure of the switch S will serve to energize the winding of the solenoid 88, thus causing the contacts 86 to become closed and the contacts 87 to become open. The thermostat T is provided with a pair of spaced contacts 90 adapted to become bridged by the mercury column of the thermostat when the ambient temperature comes within 2° of its setting and when these contacts 90 are bridged a shunt circuit around the winding 88 will exist through the switch S and contacts 90 so as to reduce the current flow through the solenoid winding 88 and cause reversal of the switch S-1. Such reversal of the switch will cause opening of the contacts 86 and closure of the contacts 87. Closure of these latter contacts will cause energization of the winding 82 of the by-pass valve B and opening of the port 75 to allow steam from the passage 62 to be passed directly to the thermal chamber 65 of the steam delivery valve A. Such admission of steam to the chamber 65 will affect the expansion bellows 66 and cause at least partial closure of the steam admission port 58. When steam pressure in the passage 61 drops off below the setting of the valve C, which, as previously stated may be three pounds, the valve element 73 thereof closes upon the port 72 and steam at this pressure is available in the conduit 46 for supply to the water heater 41.

When the ambient temperature again falls below the functional setting of the thermostat T, the mercury recedes from the top contact of the thermostat T and the shunt circuit for the solenoid 88 is opened and the solenoid again becomes energized to close the contacts 86 to re-establish the cycling circuit for the thermostat through the electrical heater 85 and to open the contacts 87 and de-energize the by-pass valve B. Such de-energization of the valve B causes closure of the port 75 so that no further steam will flow through the by-pass conduit to the thermal chamber 65 of the steam regulator A. As a consequence, contraction of the thermally responsive element 66 will cause gradual opening of the port 58 and, when the pressure of steam in the passage 61 rises above the three pound setting of the valve C, this latter valve becomes open so that steam in excess of this amount may be available for distribution to the various radiators as previously described. The system may be designed so that at the commencement of heating operations steam at approximately eight pounds will pass through the valves C and D.

During the warm season, the switch S will be opened to disable the operation of the switch S-1 and cause the contacts 87 to remain permanently closed, thus energizing the winding 82 of the by-pass solenoid valve B and causing the same to remain energized at all times. As previously set forth, when the valve B is energized, the by-pass conduit 77 is effective to conduct steam to the thermal chamber 65 of the steam delivery valve to effect expansion of the heat responsive bellows element 66. Initial full or partial closure of the port 58 as a result of expansion of the heat sensitive member 66 will restrict the admission of steam to the passage 61 and when the pressure of steam in this passage approximates the three pound setting of the valve C the valve element 73 will close upon the port 72 but before the port becomes completely closed the volume or rate of flow of steam through the by-pass conduit will have been so reduced that a state of equilibrium will exist which will create a "cycling" con-

dition or a condition of equilibrium wherein the supply port 58 remains slightly open and the valve member 73 of the valve C remains slightly elevated from its seat so that the pressure of steam in the passage 61 assumes a substantially static pressure in the neighborhood of three pounds which is supplied to the heat exchange device 41 at that pressure. When this static condition of equilibrium exists, the pressure drop of steam across the port 72 of the valve C is sufficiently great that the valve member 73 of the valve D remains seated so that no steam can flow to the radiators 12, 13, 14, 15 and 16.

In Fig. 3 the by-pass valve B has been shown together with the pressure relief valve D which is intimately associated therewith and which is of built-in construction, so to speak. The valves B and D share a common housing or casing 100 formed with an internal partition wall 101 separating the chamber 76 from the passage 62. The by-pass port 75 exists by virtue of a nipple 102 threadedly received in an opening 103 provided in the wall 101 and providing a seat 104 for the valve member 81. The solenoid winding 82 is disposed in a housing 105 carried on an adapter plate 106 secured by countersunk screws 107 to the casing 100. A movable cone assembly including a core proper 110 operatively connected to a valve stem 111 formed on the valve member 81 is slidably disposed within the winding 82, the connection between the stem 111 and core proper 110 being a floating one so that the valve element 81 may seek a snug fit against its seat 104. A spring 112 bears at one end against a retaining nut 113 threadedly received in the adapter plate 106 and at its other end against a collar 114 mounted on the valve stem 111 and serves to move the valve core assembly to its valve-closing position. The electrical lead-in connections for the solenoid winding 82 is designated in its entirety at 115 and is of the sealed type.

The valves C and D are of similar construction, the latter valve being of built-in construction with the by-pass valve B and the former being a separate entity. Despite this diversity in construction, it is thought that a description of one of these valves will suffice for the other. The valve C includes a casing 120 formed with an internal partition wall 121 having a central opening 122 providing the valve port 72. The port 72 is formed with a seat 122 and the previously mentioned valve element 73 is in the form of a piston element 123 which is slidable in a bore 124 formed in the casing 120. The upper end of the bore 124 is closed by means of a threaded closure cap 125 and a spring 126 bears at one end against the cap 125 and at its other end against a shoulder 127 formed on the piston member 123 to normally urge the valve element 73 to closed position on the seat 122. A valve face in the form of a sealing washer 128 is removably secured to the end of the piston member 123 by a stud 130 and cooperates with the valve seat 122. A snubber spring or ring 131 having friction fingers 132 formed thereon surrounds the piston member 123 within the bore 124. A contraction spring 133 holds the snubber spring 132 in position. The pressure relief characteristics of the valves C and D are dependent upon the rate of the spring 126 and, as previously described, the valves are each adapted to become opened to admit steam from the inlet to the outlet sides thereof at a pressure of approximately three pounds. To permit the valves C and D to function in the manner of one-way check valves, a bleeder passage 133 is formed in the casing 120 so as to establish communication between the valve outlet chamber 71 and the space within the bore 124 existing above the shoulder 127 formed on the piston member 123. Thus, if at any time the pressure of steam existing at the radiator side of the pressure relief valve D or the pressure existing at the by-pass valve side of the pressure relief valve C exceed the steam pressure existing at the inlet sides of these valves, or should the outlet pressures come within approximately three pounds of the pressure developed on the inlet sides thereof the valves will become closed and remain closed

until there is a pressure differential of at least three pounds acting against the springs 126.

We claim:

1. In a combined space heating and water heating system the combination with a steam activated space heater, a source of pressure steam, a supply pipe for conducting steam from said source to said space heater a steam pressure regulating valve for delivering steam to said supply pipe and including an actuating thermostat communicating with the outlet of said space heater and responsive to the temperature thereof to control the delivery of steam at a predetermined pressure during the activation of the space heater, of a by-pass valve interposed in said supply pipe and a conduit cooperating with the valve to pass steam directly from said supply pipe to said thermostat to effect closing of the pressure control valve, a steam activated water heater connected into said supply pipe intermediate the by-pass valve and the pressure regulator valve, and a pressure relief valve interposed in said supply pipe intermediate the by-pass valve and said water heater and adapted to close at a predetermined lower pressure to direct lower pressure steam to the water heater when the said by-pass is open.

2. A combination structure according to claim 1 characterized by the provision of a valve associated with said by-pass valve and positioned in said supply pipe intermediate said by-pass valve and said space heater for shutting off steam delivery to the space heater when said by-pass valve is open.

3. A combination structure according to claim 2 characterized in that the by-pass valve is normally closed and is provided with electrically energized means for opening the same.

4. A combination structure according to claim 3 characterized in that said electrical circuit means includes a thermostat responsive to a predetermined temperature within the enclosure for energizing said by-pass valve opening means a manually operable switch connected in parallel with said thermostat and adapted in one position to effect energization of said means and to render the thermostat ineffective.

5. A combination structure according to claim 4 characterized in that the valve for shutting off delivery of

steam to the space heater when the by-pass valve is open is a pressure relief valve.

6. A combination structure according to claim 5 in which both pressure relief valves are each provided with a casing having inlet and outlet chambers and in that the steam inlet chamber of the second pressure operated valve is in communication with the steam outlet of said other pressure relief valve, the by-pass conduit is in communication at one end with the steam inlet of said second pressure relief valve and with the steam outlet of the first mentioned pressure relief valve.

7. A combination structure according to claim 6 characterized in that both said pressure relief valves are spring loaded.

8. A combination structure according to claim 7 characterized in that said by-pass valve and second pressure relief valve are formed with a common valve casing having a passage therein extending between the respective valve inlets.

9. In a steam heating system of the character described, the combination set forth in claim 8 wherein said passage in the common valve casing forms the sole communication between the by-pass conduit and the outlet for the first mentioned pressure relief valve.

10. In a combined space heating and water heating system including a source of pressure steam, a space heater, and a water heater, a unitary connection leading from said steam source to said space heater and to said water heater, respectively, including a pressure regulator valve for controlling the pressure of the steam delivered to said space heater and to said water heater, a by-pass valve for diverting pressure steam away from the space heater and a pressure relief valve located at either side of the by-pass valve; all of said valves being preassembled in said unitary connection to facilitate installation thereof as a unit in the heating system.

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