Dec. 2, 1941. E. E. GRIFFITHS 2,264,793

HOT WATER SYSTEM

Filed Oct. 18, 1939 3 Sheets-Sheet 1

Fig. 3.

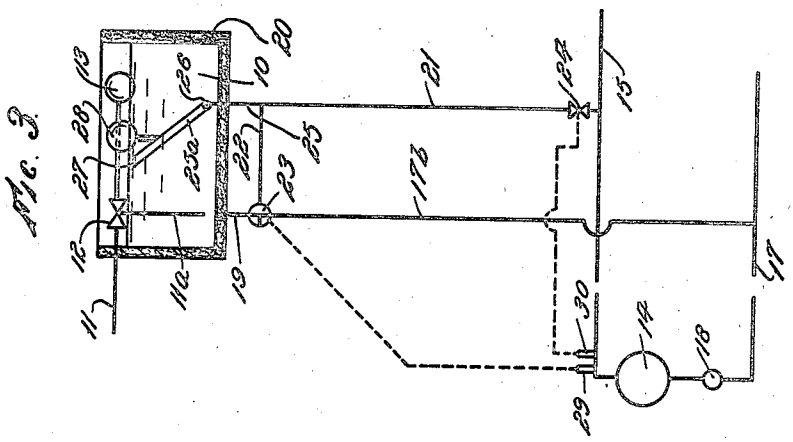


Fig. 2.

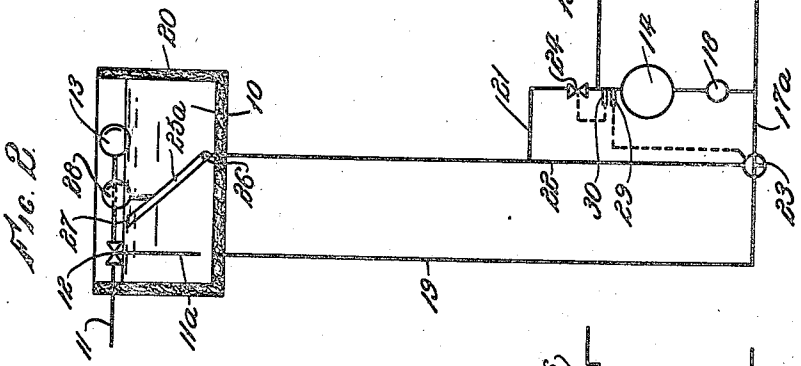
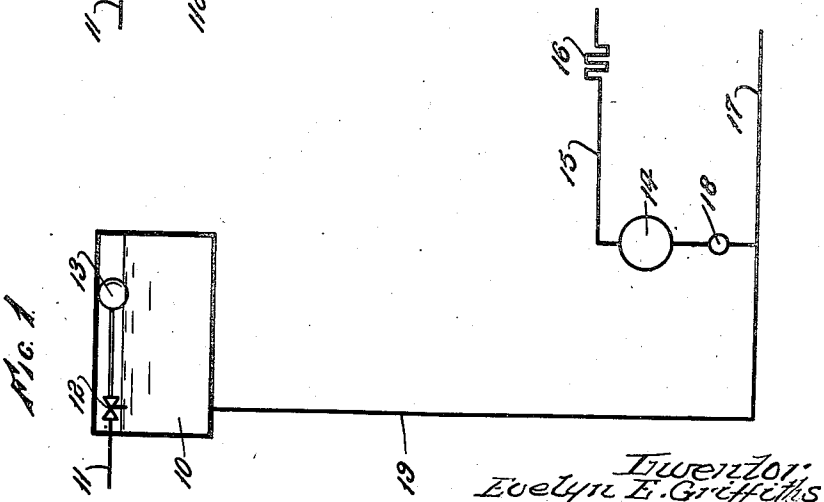


Fig. 1.



Inventor:
Evelyn E. Griffiths
By J. M. Lawrence
Atty

Dec. 2, 1941. E. E. GRIFFITHS 2,264,793

HOT WATER SYSTEM

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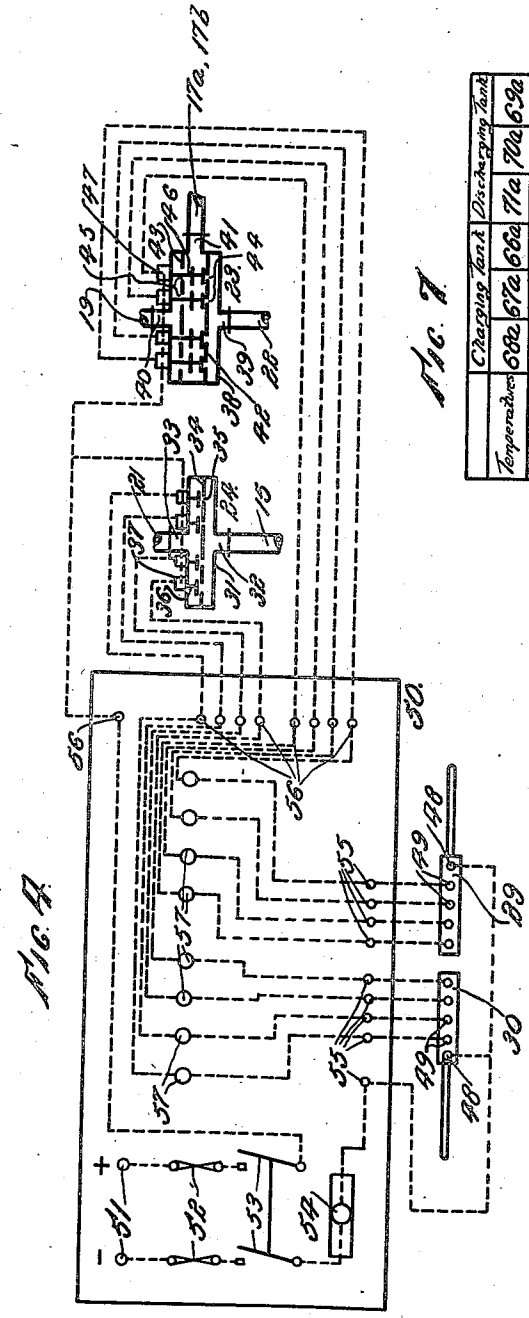


FIG. 4

Temperatures	Charging Tank 68a	67a	Discharging Tank 68a	71a	70a	69a
	Steam closed in Winter			C	C	C
168	○	○	○	C	C	C
165	○	○	○	C	C	C
164	○	○	●	C	C	C
163	○	●	●	C	C	C
160	●	●	●	C	C	C
158	●	●	●	C	C	W
156	●	●	●	C	W	W
154	●	●	●	W	W	W
150	●	●	●	W	W	W
	Line Steam opened in Summer					

FIG. 7

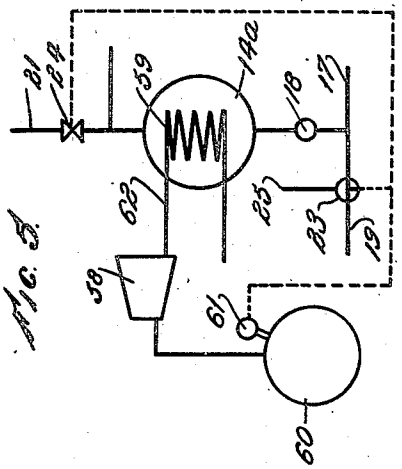


FIG. 5

Inventor
Evelyn E. Griffiths
By J. Shurie
Atty

Dec. 2, 1941. E. E. GRIFFITHS 2,264,793

HOT WATER SYSTEM

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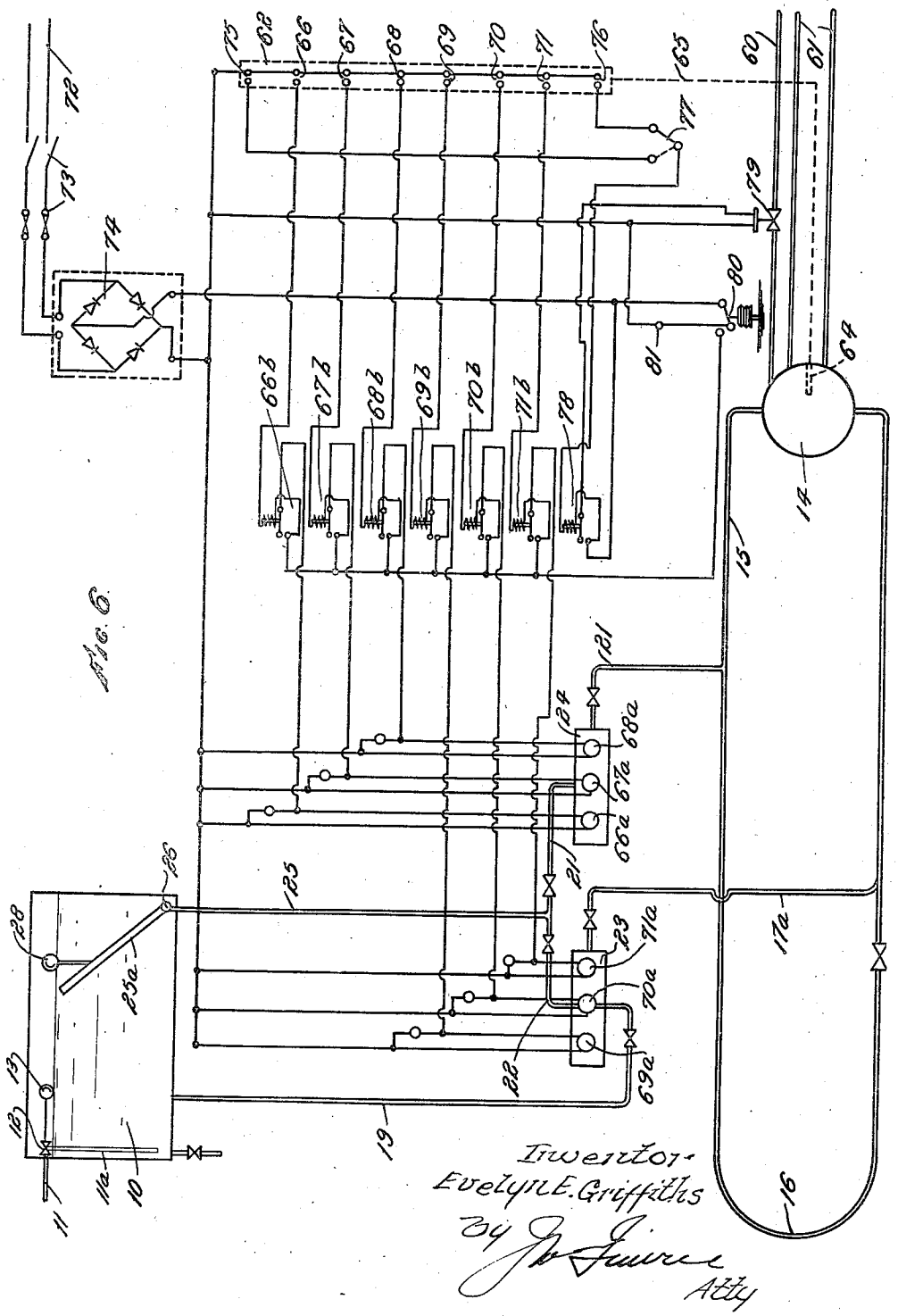


Fig. 6.

Inventor:
Evelyn E. Griffiths
By J. Jaure
Atty

Patented Dec. 2, 1941 2,264,793

UNITED STATES PATENT OFFICE

2,264,793

HOT WATER SYSTEM

Evelyn Edwin Griffiths, Liverpool, England

Application October 18, 1939, Serial No. 300,085
In Great Britain June 2, 1938

8 Claims. (Cl. 237—8)

This invention is for improvements in or relating to hot water supply and/or heating systems. The usual form of hot water supply or heating system such as is installed in domestic dwellings, hospitals and like institutions generally comprises a hot water producer which may be for example a coal, oil or gas fired or electrically heated boiler, or a calorifier heated by exhaust steam, a delivery conduit from the hot water producer to the hot water consumers, a return pipe from the consumers to the hot water producer, and a feed tank connected to the producer and arranged to maintain a supply of feed water thereto. In some circumstances, particularly when the hot water producer comprises a calorifier heated by the exhaust steam from a steam operated power plant or a process utilizing steam, the rate of production of hot water varies with the amount of steam available so that at certain times the rate of production will be in excess of the demand, whereas at other times it may tend to fall below the demand. This variation in the rate of production of hot water is particularly apparent where the calorifier is fed by the exhaust steam from non-condensing engines used for the generation of electric power because the amount of steam available to the calorifier is dependent upon the load on the electric power plant and this may of course fluctuate to a substantial extent. Where the supply of exhaust steam is less than that required to meet the demand on the producer for hot water it is possible to operate an auxiliary heating means to augment the exhaust steam but where the supply exceeds that required, the excess has to be discharged to atmosphere. It is obvious therefore that the provision of some means for storing the heat available from said excess exhaust steam during times when the demand for hot water is low or when the rate of generation of hot water is high, so that said heat is available to assist in the production of hot water when the demand is great, would be of considerable advantage.

One object of the present invention is therefore to provide in a hot water supply or heating system a simple arrangement whereby hot water in excess of the demand on the hot water producer is passed to storage in the ordinary feed tank so that hot or warm feed water for the producer is available when there is a heavy demand on the hot water producer. A further object of the invention is to provide in a hot water supply or heating system a heat storage arrangement which is relatively cheap and simple to install, inasmuch as the actual storage of heat may be effected in the feed tank which constitutes an integral part of a hot water supply or heating system.

Accordingly the present invention provides in a hot water supply or heating system comprising a hot water producer having an outlet to the hot water consumers and a feed tank connected or adapted to be connected to a water main and arranged to maintain a supply of feed water to the hot water producer, the provision of a valve controlled conduit system for the interchange of hot water between the hot water producer and the feed tank.

The purpose of this arrangement is to enable hot water to be stored when desired in the feed tank so that hot feed water may be available for the producer when required. For example it would be convenient to store hot water when either the demand for hot water falls below or the production of hot water exceeds a predetermined limit so that hot feed water is available to the producer when the rate of production falls below or the demand exceeds a predetermined limit.

According to a further feature of the present invention there is provided in a hot water supply or heating system comprising a hot water producer having an outlet to the hot water consumers and a feed tank connected or adapted to be connected to a water main and arranged to maintain a supply of feed water to the hot water producer through a cold water feed pipe, the provision of a conduit system for the interchange of hot water between the hot water producer and the feed tank, valve means in said conduit system and in the cold water feed pipe for controlling the interchange of hot water between the hot water producer and the feed tank and for controlling the flow of cold feed water to the producer, an automatic operating means for said valve means and any one or the combination of the means herein specified for governing the operation of said valve means.

The automatic operation of the valve means controlling the interchange of hot water between the hot water producer and the feed tank and also the flow of cold water to the producer, may be governed by any one or a combination of the following means:

(a) Temperature or pressure responsive means at the hot water producer.

(b) Means responsive to the temperature, pressure, rate of flow or velocity of the heating steam for the water in the calorifier.

(c) Temperature, pressure or velocity sensi-

tive means responsive to the total demand or individual demands on a steam generator a part of the steam from which is utilized to heat water in the calorifier; for instance if the generator supplies steam to an engine the interchange of heat between the hot water producer and the feed-tank may be governed by the demand of the engine for steam from the generator; by this arrangement it is possible when the demand by the engine is very heavy to cut off the flow of steam to the calorifier and depend as far as is possible on the hot water in the feed tank to meet the demands for hot water from the producer.

(*d*) A time switch arranged so that storage of hot water in the storage tank takes place automatically at certain times of the day and the supply of hot feed water to the producer takes place automatically at other times of the day. This arrangement is convenient where the hot water in the producer is heated electrically because hot water can be stored automatically during times of the day when the cost of electricity is less than at other times.

According to a still further feature of the present invention there is provided a hot water supply or heating system comprising a hot water producer having a hot water outlet and a feed water inlet, a feed-water tank for said producer, conduits and a two-way feed water control valve or equivalent for connecting the feed water inlet to either the upper or lower part of the feed tank for the supply of hot or cold feed water, a conduit connecting the hot water outlet of the producer to the upper part of the feed tank and valve means in said conduit for controlling the flow of hot water from the producer to the storage tank, wherein the two-way feed water control valve and the hot water control valve each comprises a series of valve units having separate automatic operating means and wherein any one or a combination of the means hereinbefore specified is provided for governing the operation of said valve units and wherein the valve units are operated progressively according to the amount of change to which the valve governing means herein specified is subjected. The equivalent of a two-way valve would be two separate valves.

The expression "water main" where used in this specification is to be construed as meaning any main supply pipe or tank for delivering water to the feed tank which maintains a supply of feed water to the hot water producer.

The invention will be further described with reference to the accompanying drawings, whereon—

Figure 1 is a diagrammatic view of an ordinary hot water supply or heating system which might be installed in, for example, a hospital,

Figure 2 is a diagrammatic view of the arrangement shown in Figure 1 but modified in accordance with the present invention so that at times of low demand for hot water, said hot water is stored to assist the hot water producer in meeting heavy demands,

Figure 3 is a diagram similar to Figure 2 but showing a slightly modified embodiment of the invention,

Figure 4 is a diagram of a control panel and multiple valve and thermostatic control arrangement which may form part of a system according to the invention,

Figure 5 is a diagram of an embodiment of the invention in which the hot water producer comprises a calorifier heated by exhaust or live steam and in which control of the storage of hot water is governed by the temperature or pressure of the steam in the steam generator.

Figure 6 is a diagram of a further embodiment of the invention, and

Figure 7 is a chart which illustrates the operating sequence of the valves used in the arrangement shown in Figure 6.

The system shown in Figure 1 comprises an elevated feed tank **10** which is supplied with cold feed water from a water main **11** by way of a cock **12** controlled by a float **13**. The hot water producer which may be a calorifier heated by exhaust or live steam or a self-contained hot water producer, such as a coke, coal, or gas fired or electrically heated boiler, is indicated at **14**. The hot water producer is connected to a delivery pipe **15** by which hot water is supplied to hot water consumers **16**. The hot water consumers **16** may constitute hot water heating radiators and/or draw-off taps for a supply of hot water. A return pipe from the consumers to the hot water generator is indicated at **17** and circulation of the water may be maintained by a circulating pump **18**. The feed tank **10** is connected to the hot water producer on the inlet side of the pump **18** by a cold water feed pipe **19**.

For the purpose of the present invention, the system shown in Figure 1 is modified as shown in Figure 2. In this example of the invention, the tank **10** is lagged with heat insulating material **20** so as to conserve the heat of the water in the tank and a by-pass or hot water delivery **21** is connected to the delivery pipe **15** from the hot water producer. A hot water feed pipe **22** is connected to the cold water feed pipe **19** through a two-way valve **23** which can be turned so as to connect either the cold water feed pipe **19** or the hot water feed pipe **22** to the hot water producer by way of the section **17***a* of the return pipe **17**. A valve **24** is located in the hot water delivery pipe **21** and the hot water feed pipe and the hot water delivery pipe are connected to the feed tank **10** by a common hot water pipe **25**. The hot water pipe **25** has a movable section within the tank in the form of a hollow arm **25***a* hinged at **26** and the open free end **27** of which is maintained near the surface of the water in the tank by a float **28**. The valve **23** and the valve **24** are controlled respectively by thermostats **29** and **30** located in the delivery conduit **15** adjacent the outlet from the hot water producer so as to be responsive to the temperature of the water flowing from the producer. The cold water feed pipe to the tank **10** is extended as indicated at **11***a* so that the cold water is discharged into the bottom of the tank. The valves **23** and **24** may be electro-magnetically operated, the electro-magnets being controlled by switches actuated by the thermostats **29** and **30** and the arrangement is such that when the rate of production of hot water exceeds the demand and the temperature of the water at the delivery side of the producer is relatively high, the valve **24** is opened, whilst the valve **23** puts the cold water pipe into communication with the inlet side of the producer. Under these conditions hot water is by-passed to the upper part of the feed tank **10** by way of the pipes **21** and **25** and the floating arm **25***a*, whilst cold water is fed to the producer by way of the pipe **19**, so as to take the place of the hot water passed to storage in the tank **10**. Excessive production of hot water may of course be due to a low demand or in cases where the hot water producer

comprises a calorifier heated by exhaust steam, to the production of a large quantity of such steam. When the temperature of the hot water in the hot water producer falls, due to say a heavy demand or a shortage of exhaust steam the thermostat **30** causes the valve **24** to close and the thermostat **29** causes the valve **23** to move so as to close the pipe **19** and put the hot water feed pipe **22** into communication with the inlet side of the hot water producer. Under these conditions the hot water previously stored in the tank is fed to the hot water producer so as to assist said producer in providing the required amount of hot water at the desired temperature

In the modification shown in Figure 3 the general arrangement of the parts is similar to that described with reference to Figure 2, and like reference numerals have been used to indicate like parts. In this modification however the valve **23** is located close to the tank **10** and is adapted to connect either the cold water feed pipe or the hot water feed pipe **22** to the hot water producer by way of a common feed pipe **17***b* and the return pipe **17**. Also in this example, the hot water producer is presumed to be located some distance from the feed tank and for this reason it is convenient to utilize a substantial part of the return pipe **17** for feeding the water from the tank **10** to the hot water producer.

In some circumstances it is desirable to vary the amount of opening of the valve **24** and the relative opening of the ports in the valve **23** according to the amount by which the rate of production of hot water exceeds or falls below the demand. Thermostatic devices and valves are available for this purpose which are particularly suitable for the purpose of the present invention. In one device of this character the thermostat devices comprise a series of switches which are set to close at different temperatures, and the valves having a series of ports each governed by an electro-magnetically operated valve member, the operating solenoid of each valve member being connected to a particular switch in the thermostat so that the number of ports opened depends on the number of switches closed, which of course depends on the temperature to which the thermostat is subjected. An embodiment of the invention incorporating valves and thermostats having this characteristic is shown in Figure 4.

In the modification shown in Figure 4 it may be assumed that the general arrangement of the system is similar to that described with reference to Figures 2 and 3, the principal modification residing in the construction of the valves **23** and **24** and in their control thermostats **29** and **30**. The valve **24** comprises a casing **31** having an inlet **32** to which the pipe **15** is connected and an outlet **33** to which the pipe **21** is connected. The inlet **32** is separated from the outlet **33** by a partition **34** having a series of ports **35**, each of which is controlled by an independent valve member **36** adapted to be actuated by an electro-magnetic device **37**. The valve **23** comprises a casing **38** having an inlet **39** connected to the pipe **22**, an inlet **40** connected to the pipe **19**, and a common outlet **41** connected to the pipe **17***a* or the pipe **17***b*. The inlets **39** and **40** are separated from the outlet **41** by partitions **42** and **43** respectively, having ports **44** and **45** respectively, which are controlled by independent members **46** adapted to be actuated by electro-magnets **47**. The thermostats **29** and **30** controlling the valves **23** and **24** are similar in construction and each comprises a series of switches having a common terminal connection **48** and independent terminal connections **49**. A control panel **50** is provided, which serves to facilitate connecting up of the thermostats **29** and **30** and the valves **23** and **24**. The control panel is provided with terminals **51** for the connection of the installation to the electricity supply mains, fuses **52**, and a double pole switch **53**. A panel light **54** is connected in circuit with the switch **53** so as to indicate when the installation is switched on. The panel also carries nine terminals **55** adapted to receive the connections from the thermostats **29** and **30** and nine terminals **56** for the connections from the electromagnets **37** and **47** of the valves **24** and **23**. The terminals **55** and **56** are connected together and in series with indicator lamps **57**. After the wiring of the control panel has been effected it is a relatively simple matter to connect up the thermostats **29** and **30** and the valves **23** and **24**, it only being required to run a nine cored cable from the thermostats to the board and from the board to the valves. The electrical connections are shown on the drawings in dotted lines to distinguish them from the water pipes which are shown in heavy full lines. It will be appreciated that in the case of the thermostat **30**, as the temperature of the water at the delivery side of the producer rises, the switches in the thermostat will close or open one after the other, and the corresponding valve members **36** will uncover the ports **35** so as to permit an increased amount of hot water to be by-passed to storage in the feed tank **10**. Similarly as the temperature to which the thermostat **29** is subjected, rises, an increasing number of the electromagnets **47** will be operated to move the valve members so as to uncover the ports **45** and cover the ports **44**. This operation will of course be reversed when the temperature of the water at the delivery side of the producer, falls. The indicator lamps **57** will be eliminated in accordance with the opening or closing of the various valve members and will therefore serve to indicate the rate at which hot water is being passed to storage or is being drawn from storage. For instance in the example shown each set of four lamps could be marked respectively to indicate, ¼, ½, ¾ and full charging rate and discharging rate.

Figure 5 shows an arrangement of the invention in which the hot water producer comprises a calorifier **14***a* which is heated by the exhaust steam from a turbine **58**, the steam being passed through a coil **59**. A steam generator for the supply of steam to the turbine is indicated at **60** and the vlaves **23** and **24** are operated automatically by a pressure sensitive device **61** responsive to the steam pressure in the generator. Alternatively, the pressure sensitive device could be located in the conduit **62** or in the connection from the generator to the turbine so as to be responsive to the pressure or velocity (i. e. rate of flow) of the exhaust or live steam. Where variations in velocity are utilized to operate the valves **23** and **24** a Venturi tube or like throttling device could be used so as to convert variations in velocity into pressure variations capable of operating the valves. Although in the examples above described separate thermostats have been provided for the valves **23** and **24** it will be appreciated that these valves could be controlled by a single thermostat having a high temperature limit at which it opens the valve **24** and

adjusts the valve 23 to feed cold water into the producer and a lower temperature limit at which it closes the valve 24 and adjusts the valve 23 to feed hot or warm water into the hot water producer.

In some cases it may be necessary to control the valves 23 and 24 through relays, i. e. relays operated by the thermostatic or pressure sensitive devices and controlling the supply of electricity from the mains to the electro-magnetic devices of the valves. Such relay devices may be mounted on the control panel 50.

The modification of the invention shown in Figure 6 comprises a calorifier 14 which is connected by a pipe 15 to the consumers indicated at 16. The water in the calorifier is heated by live steam supplied through a pipe 60, and by exhaust steam through pipes 61. The flow of water to storage in the tank 10 is controlled by a valve 24 in the pipe 21, which may be similar in construction to that described with reference to Figure 4. Delivery of hot or cold water from the storage tank 10 by way of either the pipe 22 or the pipe 19 and the common pipe 17*a* is controlled by the valve 23 and this valve also may be similar in construction to the corresponding valve described with reference to Figure 4. The valves 23 and 24 differ in one respect however from the corresponding valves shown in Figure 4 in that the valves shown in Figure 6 comprise three valve units instead of four so that the flow of water is adjusted in three stages. The valve members of the valves 23 and 24 are governed by electro-magnetic devices the valve members of the valve 24 being opened electrically and those of the valve 23 being closed electrically. Opening and closing of the valve members in the valves 23 and 24 through their electro-magnetic controlling devices is governed by an eight-point thermostatic switch 62 mounted on a control panel for the installation. The thermostatic switch is responsive to conditions at the calorifier so that if the rate of production of hot water exceeds the demand, a part of the hot water will be passed to storage in the tank 10, whereas if the rate of production tends to fall below the demand, hot feed water will be passed from the storage tank to the calorifier. For this purpose the thermostatic switch 62 is connected to a temperature responsive device 64 at the calorifier, by a capillary tube 65. The thermostatic switch has pairs of contacts 66, 67 and 68 which correspond to and control the valve members 66*a*, 67*a* and 68*a* of the valve 24 and as each of said pairs of contacts is closed, its associated valve member is opened to pass hot water to storage in the tank 10, the valve elements in the valve 23 being in a position in which they pass a maximum amount of cold water from the bottom of the feed tank to the calorifier. The thermostatic switch also has pairs of contacts 69, 70 and 71 which correspond to and control the valve members 69*a*, 70*a* and 71*a* of the valve 23 and as each of said pairs of contacts is opened, its corresponding valve member is operated to cut off the flow of cold water from the tank 10 and permit warm feed water to flow from said tank to the calorifier. The electro-magnetic devices operating the valve members of the valves 23 and 24 are controlled from the contacts 66 to 71 inclusive through relay devices 66*b* to 71*b* mounted on the control panel. The supply of electricity for the operation of the electrical portion of the installation may be taken from the supply mains 72 and controlled by the usual switches and fuses 73 which may be mounted on the control panel. If an alternating current supply is used a rectifier 74 may be provided for rectifying the supply for the operation of the relays and the electro-magnetic valve operating devices.

The thermostatic switch 62 also comprises a pair of "winter" contacts 75 and a pair of "summer" contacts 76. One of each pair of contacts 75 and 76 is connected to a change-over switch 77 which serves to connect either the contacts 75 or contacts 76 to a relay 78 in the control circuit of an electrically operating steam control valve 79 in the live steam pipe 60. During the summer the switch 77 is moved into the position indicated in full lines whereas during the winter the switch is changed over to the dotted position.

The sequence in which the contacts of the thermostatic switch 62 are closed and the corresponding positions of their associated valves are indicated in the chart shown in Figure 7. In this chart, valves which are open are indicated by a plain circle and valves which are closed are indicated by a cross-hatched circle. The letter C indicates that cold feed water is being fed from the storage tank to the calorifier whilst the letter W indicates that warm feed water is being supplied from the storage tank to the calorifier. It will be seen that in winter at a temperature of or above 168° F. the contacts 75 are closed and the live steam supply to the calorifier is cut off by the valve 79, so that the heating of the water in the calorifier is effected entirely by the exhaust steam, this condition being due for example to a small demand for hot water. At a temperature of 165° F. the live steam valve 79 is opened but a substantial portion of the hot water produced in the calorifier is still passed to storage in the tank 10. As the temperature at the calorifier falls a decreasing amount of water is passed to storage and at a temperature of 160°, the flow of hot water to storage ceases. At a temperature of 158° F. withdrawal of warm feed water from the storage tank commences to take place and the supply of hot feed water increases progressively until all three valve members in the valve 23 have been actuated for the supply of warm feed water. During the summer the valve 79 is closed to shut off the flow of heating steam to the calorifier, when the temperature at the calorifier exceeds 150° F.

A switch 80 governed by the pressure in the main steam drum of the steam generator is connected in the circuit of the relays 66*b* to 71*b* inclusive and unless the steam pressure in the generator is above a predetermined minimum the switch 80 opens the circuit of the relays and thereby renders them inoperative to actuate the valve members of the valves 23 and 24 so that thermostatic controls of the water storage system are put out of action and any hot water in tank 10 is available as feed water to the producer. A signal lamp 81 mounted on the panel is connected in circuit with the switch 80 to indicate when this switch is closed and the installation is operating normally.

The terms "summer" and "winter" where used above do not necessarily refer to the particular seasons but to particular conditions of supply of and demand for heating medium throughout the whole thermal and thermo-dynamic system.

The valves 23 and 24 may be motor operated and control of the operating motor or motors may be effected by a time switch adapted to close

the motor circuit at short intervals and a thermostatic reversing switch in series with the time switch. The arrangement is such that when the thermostatic switch closes the motor circuit say on a rise in temperature at the outlet from the hot water producer, the valves 23 and 24 are adjusted stage by stage each time the time switch closes the motor circuit so as to permit an increasing amount of water to pass to storage in the tank 10 until either the valves are fully adjusted for storage conditions or the temperature at the hot water producer falls and the thermostatic switch opens the motor circuit. When the thermostatic switch opens the motor circuit at the outlet from the hot water producer, the reverse operation takes place, the valve 24 being closed and the valve 23 adjusted so that hot or warm feed water is supplied to the producer. In the case of the valve 23, gradual opening of one port may of course result in a gradual closing of the other. In the simplest form of the apparatus only two indicator lamps 57 may be provided, one to indicate that the tank is being charged with hot water and one to indicate that hot water is being discharged from the tank.

As described above the valves 23 and 24 may be governed by temperature, pressure, or velocity sensitive means, and the system may incorporate one or more of these arrangements which may be operated independently or in conjunction with one another. When a plant is fitted with two or more systems of control (e. g. temperature and pressure) it is possible to switch from one system to the other to suit the conditions under which the plant is operating. The storage system described has the advantage however, that a reduction in the size of the boiler may be effected. Any deficiency of boiler capacity at times of peak load is met by the withdrawal of hot water from storage and at times of low load any surplus boiler capacity is utilized to refill the hot water storage.

The systems according to my invention enable the boilers to be operated at a more even rate of loading than is possible without a thermal storage system and this evenness of loading assists in obtaining a high efficiency and consequently a low fuel consumption for the boiler. Furthermore, although the temperature or pressure systems described above, constitute particularly convenient systems of control for the purpose of the invention other systems comprising a known metering device responsive to certain predetermined conditions may be used.

The system may, of course, include more than one hot water producer or calorifier. For instance separate calorifiers or banks of calorifiers may be provided for the hot water supply and heating circuits, although the invention is particularly applicable to calorifier systems heated by exhaust steam it can also be used with advantage in systems in which the water is heated in low pressure boilers having mechanical stokers. The invention enables heat to be stored in the feed tank in accordance with the demand on the system and may thereby eliminate the necessity for altering the feeding rate of the automatic stokers.

Whilst the interchange of hot water between the hot water producer and the feed tank has been described more particularly as being controlled by the rate of production of hot water through temperature responsive means at the producer, it is to be understood that various other arrangements can be used for this purpose. In some installations the interchange of hot water may with advantage be made dependent on conditions at some remote part of the system or installation such as the pressure of the steam in a steam generator adapted under certain conditions to provide live steam for heating the water in the producer and also steam for the operation of an engine or engines. The supply of live steam to the producer may be controlled by the demand made on the boiler by the engines so that the live steam supply to the producer is shut down when the demand made by the engines is particularly heavy. Control of the flow of live steam to the producer in this arrangement could be effected by a device responsive to the velocity of the steam in the steam pipe from the generator to the engines. Control from a remote part of the system is of advantage where a change of conditions in the system does not produce an immediate effect at the producer.

What is claimed is:

1. The combination in a hot water system having hot water utilizers, of a hot water producer having outlet means connecting with hot water utilizers, a water main, a feed tank, a connection between the feed tank and the water main, a cold water feed pipe from the feed tank to the hot water producer, a hot-water-exchange pipe system between the feed tank and the hot water producer and including a movable pipe section within the tank, a float within the tank, an operative connection between said movable section and the float whereby the inlet end of said section is maintained in the upper zone of water in the tank, valve means in the cold water feed pipe for controlling the flow of cold feed water to the hot water producer, valve means in the hot-water-exchange system for controlling the interchange of hot water between the hot water producer and the feed tank, operating means for said valve means, and means responsive to conditions in the hot water system for governing the operation of said last valve means.

2. The combination in a hot water system having hot water utilizers, of a hot water producer having outlet means leading to the hot water utilizers, a water main, a feed tank, a connection between the feed tank and the water main, a cold water feed pipe from the feed tank, a three-way valve connected to said cold water feed pipe, a feed pipe from said valve to the hot water producer, a hot water pipe connected to the feed tank, a hot water branch pipe from said hot water pipe to the outlet of the producer, a branch feed pipe connecting the hot water pipe to said three-way valve, a valve in the hot water branch pipe for controlling the flow of hot water to storage in the feed tank, the three-way valve controlling the flow selectively of either hot or cold feed water from the feed tank to the hot water producer, a movable pipe section open at one end and having its opposite end movably connected to the hot water pipe, said movable section being located within the feed tank, a float within the feed tank, an operative connection between said movable section and the float whereby the open end of said section is maintained in the upper zone of water in the tank, operating means for the said valves, and means responsive to conditions in the hot water system for governing the operation of said last valve operating means.

3. In a hot water system, a feed tank, means for supplying the feed tank with water from an external source, a hot water producer, a hot water outlet from the hot water producer in communi-

cation with the tank, a cold water pipe leading from the tank and in communication with the inlet of the hot water producer, a conduit communicating with the hot water outlet from the producer and the cold water inlet to the producer, a two-way valve at the junction of the cold water pipe, hot water pipe, and conduit whereby water may be delivered from the tank directly through the cold water pipe to the producer inlet, or from the hot water pipe between the producer outlet and the tank to the inlet of the producer, a valve in the conduit controlling the communication of the conduit between the producer outlet and tank, and means controlled by the heat of the water from the producer outlet for simultaneously controlling said valves to simultaneously deliver cold water from the tank to the producer inlet and hot water from the producer outlet to the tank in one position of said valves, and to prevent cold water delivery to the producer inlet from the tank and hot water delivery from the producer outlet to the tank, and admit hot water delivery from the tank through the bypass to the inlet of the producer.

4. A construction as defined in claim 3 wherein the conduit between the outlet of the hot water producer and the tank extends within the tank as a movable pipe section, provided with a float to maintain the outlet of the movable pipe section at the level of the water within the tank.

5. A construction as defined in claim 3 wherein the means for delivering water from an outlet source to the tank opens into the tank near the bottom thereof.

6. The combination in a hot water system having hot water utilizers, of a hot water producer having outlet means for connecting the producers to hot water utilizers, a water main, a feed tank, a connection between the feed tank and the water main, a cold water pipe connected to the feed tank, a hot water pipe leading to the tank, a branch pipe from the hot water producer communicating with the hot water pipe for the supply of hot water from the producer to the feed tank, a valve in said branch pipe for controlling the flow of said hot water to storage in the feed tank, a three-way valve connected to the cold water feed pipe, a hot water branch pipe from the hot water pipe to said valve, a feed pipe connecting said valve to the hot water producer, said three-way valve being adapted for selective connection of the hot water producer to the hot water branch pipe and the cold water feed pipe, operating means for said valve means, and means responsive to conditions in the hot water system for governing the operation of the operating means.

7. A construction as defined in claim 3 wherein the valves are of the variable flow type and wherein the governing means for the valves is of the thermostatic type, the thermostatic control varying the valve movement as to flow quantity in accordance with the variation in heat of the fluid delivered from the hot water producer.

8. In a hot water system including a hot water utilizer, a hot water producer having an outlet to said utilizer, a feed tank, a water main leading to the feed tank, a cold-water feed pipe from the feed tank to the hot water producer, a conduit between the hot water producer and the feed tank, a first valve means in said conduit for controlling interchange of hot water between the hot water producer and feed tank, a hot water feed pipe leading from said conduit to the cold water pipe between the tank and the hot water producer, a second valve between the junction of the hot water feed pipe and cold water pipe, a steam generator for supplying heating steam to the hot water generator, independent operating means for each said first and second valve means, and a master control governed by the pressure of the steam in the steam generator for actuating the respective valve operating means, whereby to selectively shut off the flow of hot water from the hot water producer to the feed tank and the flow of cold water to the hot water producer and to permit the flow of hot water from the feed tank when the steam generator pressure falls to a predetermined limit.

E. EDWIN GRIFFITHS