July 11, 1967 R. E. WARNER 3,330,332

DOMESTIC HOT WATER STORAGE SUPPLY SYSTEM

Filed Jan. 27, 1965 2 Sheets-Sheet 1

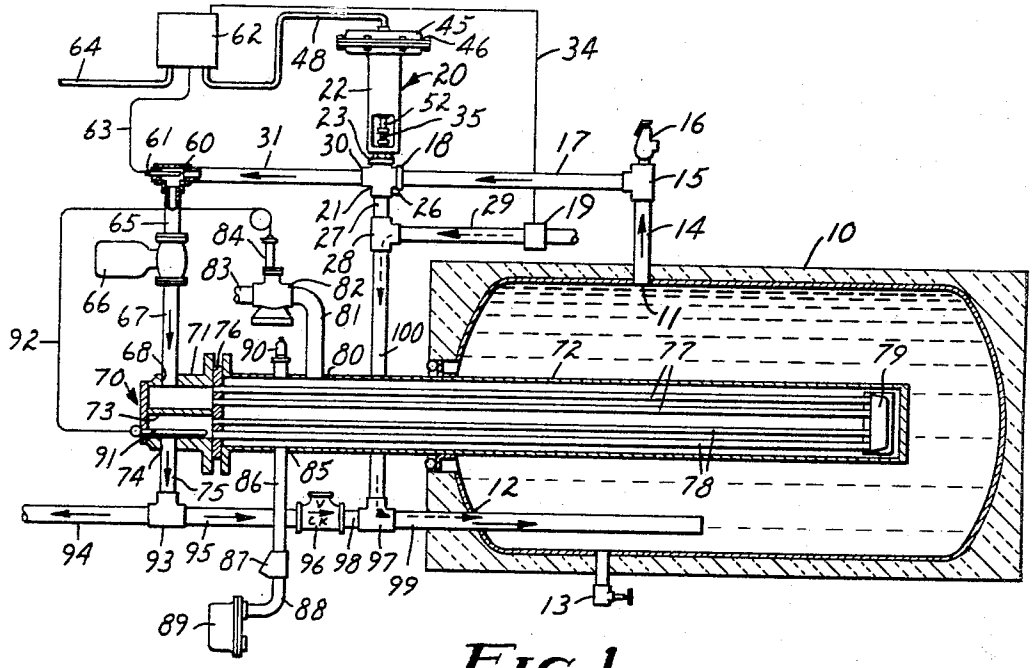


FIG. 1

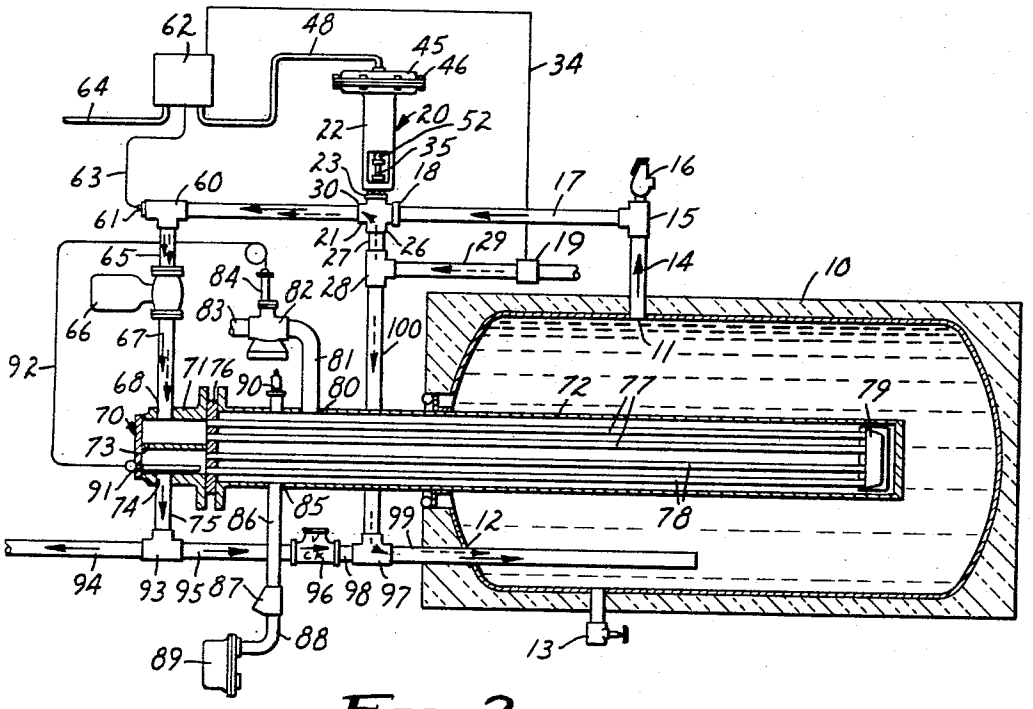


FIG. 2

INVENTOR.
ROBERT E. WARNER
BY
Merchant, Merchant & Gould
ATTORNEYS

July 11, 1967 R. E. WARNER 3,330,332

DOMESTIC HOT WATER STORAGE SUPPLY SYSTEM

Filed Jan. 27, 1965 2 Sheets-Sheet 2

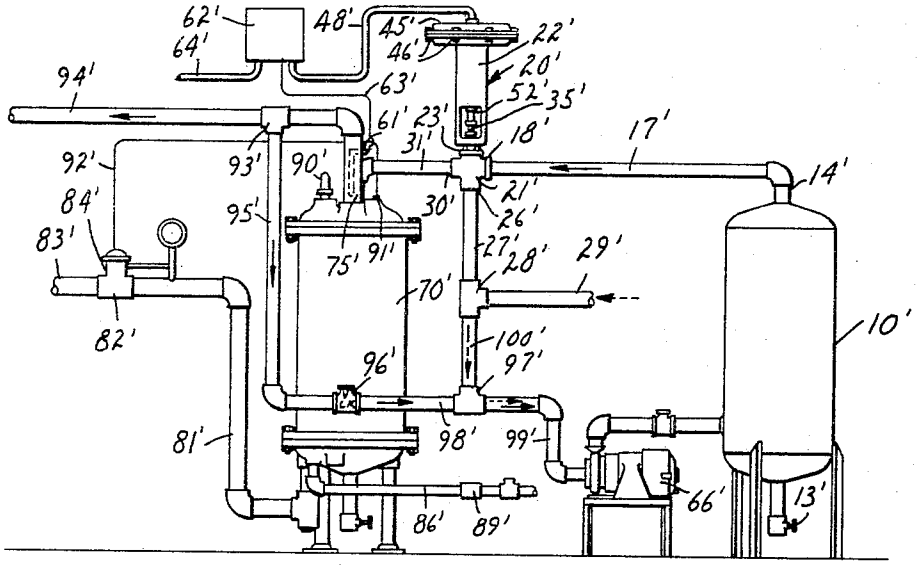


FIG. 5

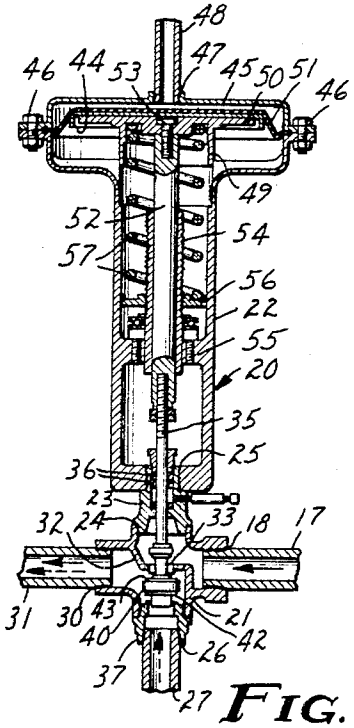


FIG. 4

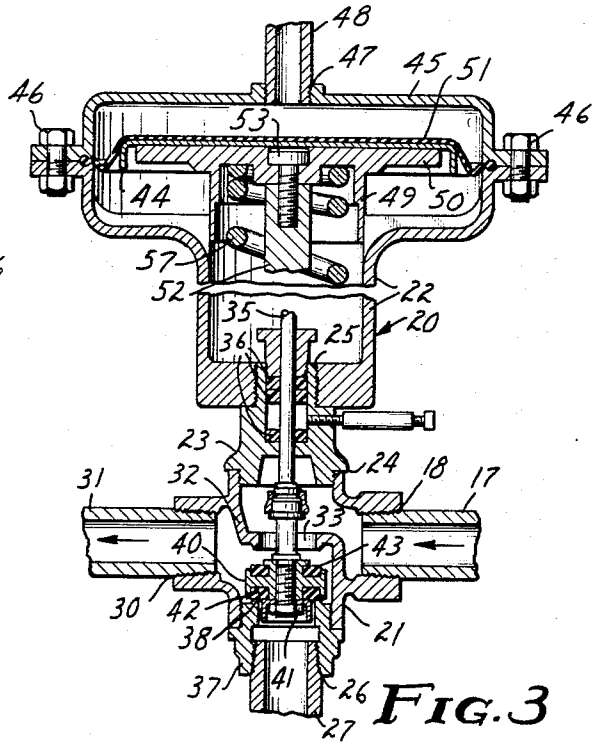


FIG. 3

INVENTOR.
ROBERT E. WARNER
BY
Merchant, Merchant & Gould
ATTORNEYS

United States Patent Office

3,330,332

Patented July 11, 1967

3,330,332

DOMESTIC HOT WATER STORAGE SUPPLY SYSTEM

Robert E. Warner, 4616 Lynwood Terrace, Minnetonka, Minn. 55345

Filed Jan. 27, 1965, Ser. No. 428,292

3 Claims. (Cl. 165—26)

The present invention pertains to a new and improved domestic hot water storage supply system and in particular to a hot water storage supply system in which the water passes from a storage tank through a heat exchanger and to a hot water supply outlet under normal draw conditions and the water from the hot water storage tank is mixed in a predetermined proportion with cold water during high draw conditions to extend the water supply in the hot water storage tank and cause the heat exchanger to operate at its full capacity.

In hot water supply systems for large domestic dwellings such as hotels and the like it is commonly the practice to have a large hot water storage tank which is connected to a heat exchanger through a circulating pump. The water in the tank is nearly at the desired temperature and any slight deficiencies in temperature are supplied as the water circulates through the heat exchanger on its way to the hot water supply outlet. As water is drawn from the hot water storage tank it is replaced by cold water or by hot water from the heat exchanger outlet. Thus, the water in the system is in general nearly at the desired temperature unless a large amount of hot water is drawn, in which case the cold water refilling the storage tank reduces the temperature of the water therein.

During periods in which an excessive amount of hot water is drawn and the temperature of the water in the storage tank is reduced a temperature sensor at the output of the heat exchanger activates a control which increases the flow of steam to the heat exchanger thereby causing the heat exchanger to operate at a greater capacity. In general the heat exchanger does not operate at full capacity until the amount of hot water drawn reaches approximately one-half of the capacity of the storage tank.

It can be seen that the system described above requires an extremely large storage tank since, during periods of excessive drawing of hot water, after approximately one-half of the water has been drawn from the storage tank the water supplied to the heat exchanger will continue to decrease in temperature while the heat exchanger is already operating at maximum capacity. Therefore, as more water is drawn the heat exchanger will not be able to supply a sufficient amount of heat and the temperature of the water at the hot water outlet will be below the desired temperature. To insure a sufficient supply of hot water from these prior art systems it is necessary to either have a storage tank approximately twice as large as the maximum of hot water to be used or to in some manner increase the maximum capacity of the heat exchanger.

In the present invention a three-way valve is placed between the storage tank and the heat exchanger. The three-way valve has water from the storage tank flowing into one inlet and cold water from a cold water source flowing into the other inlet. The operation of the three way valve is such that the cold water inlet can be shut

off so that water flows to the heat exchanger only from the storage tank or the cold water inlet can be opened so that the water from the storage tank will be mixed with cold water. The three-way valve is operated in response to a temperature sensor which is placed in the water line between the three-way valve and the heat exchanger and, optionally, a flow switch placed in the cold water supply conduit. As the temperature at the sensor increases the valve gradually opens allowing cold water to flow therethrough and mix with the water from the storage tank.

In the operation of the present device during periods when the hot water supply is being used at a normal rate or less the three-way valve allows water to flow to the heat exchanger only from the storage tank. Since the hot water is being used at a relatively low rate the cold water refilling the storage tank does not lower the temperature therein sufficiently to warrant increasing the capacity of the heat exchanger and therefore the flow switch remains open. Therefore, the heat exchanger continues to operate at a low capacity. During periods when a large quantity of hot water is being used from the supply system the flow switch is activated. The water flowing from the storage tank is initially at approximately the desired temperature of the water at the hot waer oulet. The temperature sensor is set to operate the three-way valve at some predetermined water temperature, which is near the minimum water temperature the heat exchanger can raise to the desired water temperature. Thus, the water initially flowing from the tank activates the three-way valve and cold water is mixed therewith to lower the temperature of the mixture to the predetermined temperature. As large quantities of water are used from the storage tank and replaced by cold water the temperature of the water in the tank is lowered. The lower temperature of the water flowing from the tank lowers the temperature of the mixture of water, which is sensed by the temperature sensor and the three-way valve allows less water to mix therewith. The temperature of the water flowing into the heat exchanger is thus maintained at some value below the desired temperature at the hot water outlet. Since this water is at a much lower temperature the heat exchanger immediately begins to operate at a higher capacity to heat the water to the desired temperature.

Since the heat exchanger is operating at or near maximum capacity very soon after the start of the period during which a relatively large supply of hot water is being used and since the water being supplied to the heat exchanger is only partially supplied by the storage tank the present device can supply a very much larger quantity of hot water with the same size tank and heat exchanger as the previous systems. Thus, the present device is a great improvement over the prior art since it is more efficient and a smaller storage tank and/or a smaller heat exchanger can be utilized to supply the same quantity of hot water.

It is an object of the present invention to provide an improved domestic hot water storage supply system.

It is a further object of the present invention to provide a domestic hot water storage supply system which is more efficient and utilizes a smaller storage tank and/or a smaller heat exchanger.

These and other objects of this invention will become apparent to those skilled in the art upon consideration of the accompanying specification, claims, and drawings.

Referring to the drawings, wherein like characters indicate like parts throughout the figures:

FIG. 1 is an elevational view of one embodiment of the present invention, portions thereof shown in section, illustrating the normal flow pattern;

FIG. 2 is a view similar to FIG. 1 but illustrating a high draw flow pattern;

FIG. 3 is a greatly enlarged axial sectional view of the three-way valve, portions thereof shown in elevation and portions thereof broken away;

FIG. 4 is an enlarged axial sectional view of the three-way valve, portions thereof shown in elevation showing a different mode of operation than FIG. 3; and

FIG. 5 is an elevational view of a modified form of the present invention.

In FIG. 1 an insulated storage tank **10** has an outlet **11** for heated water and an inlet **12** for cold water. A pipe and valve **13** in the bottom of the tank are for draining of the tank during cleaning, etc. A vertical pipe **14** extending from the outlet **11** of tank **10** is connected to a T-coupling **15** one opening of which has a relief valve **16** therein. The other opening of the T-coupling **15** has a pipe **17** therein which is connected to one inlet **18** of a three-way valve generally designated **20**. Valve **20** can be seen more clearly by referring to FIGS. 3 and 4.

Referring to FIGS. 3 and 4 the numeral **21** indicates the body of the three-way valve, the numeral **22** indicates a housing which contains the actuating mechanism and the numeral **23** indicates a coupler which threads into an opening **24** in the top of the body **21** and into an opening **25** in the bottom of housing **22**. Body **21** has the first inlet **18**, which in the present embodiment is connected to the outlet of the storage tank **10** by means of conduits **14** and **17**. Body **21** has a second inlet **26** having a conduit **27** therein which is connected to a T-coupling **28**. T-coupling **28** has a conduit **29** connected thereto which is attached to a cold water supply, not shown, through a flow switch **19**, which will be explained in more detail later. Body **21** of three-way valve **20** has an outlet **30** with a conduit **31** threaded therein.

As can be seen from FIGS. 3 and 4, body **21** is construced so that inlet **18** and outlet **30** are coaxial while inlet **26** is perpendicular thereto and enters from the bottom. A partition **32** having a somewhat S-shaped cross section extends across the cavity in the body **21** from a point between the inlets **18** and **26** to a point between the opening **24** and the outlet **30**. The partition **32** has a hole **33** therein which is approximately horizontal and coaxial with inlet **26**. Water entering inlet **18** must flow through hole **33** in the partition **32** to reach the outlet **30**, while water flowing in the inlet **26** flows directly to the outlet **30**.

A vertical valve stem **35** is mounted for vertical movement in the coupler **23** by means of a plurality of Teflon-coated packing rings **36**. Stem **35** is mounted coaxial with inlet **26** and extends through the openings **33** in the partition **32** and slightly into an insert **37** having an inwardly projecting shoulder **38** thereon. Insert **37** is threaded into the body **21** and forms the inlet **26**. A double-faced valve element **40** is fixedly attached to the lower end of the stem **35** by means of a nut **41** threaded onto the lower end of stem **35**. Valve element **40** has a composition disc **42** firmly imbedded in the lower face thereof and a composition disc **43** imbedded in the upper face thereof. Discs **42** and **43** are coaxial with the stem **35** as well as the insert **37** and hole **33** in the partition **32**.

The shoulder **38** on the upper edge of the insert **37** engages with the composition disc **42** in the lower face of the valve element **40** when the stem **35** is in its extreme downward position, thereby closing inlet **26** and preventing any water from flowing therein. Composition disc **43** engages with a shoulder in the partition **32** surrounding the hole **33** when the stem **35** is in its extreme upward position, thereby, closing the hole **33** and preventing any water from flowing into the inlet **18**. It should be noted that the amounts of water flowing into the inlet **18** and the inlet **26** will be determined by the position of the valve element **40** and can be varied by moving the valve element between the upper and lower extremes.

The housing **22** has a hollow cylindrical shape with the upper portion thereof having a substantially increased radius. The lower end of the cylindrical housing **22** is closed except for the hole **25** which has the coupler **23** threaded therein. The upper end of the cylindrical housing **22** is open and has a matching cap **45** fitted thereover and fixedly attached by means of bolts **46**. Cap **45** is closed except for an axial opening **47** therein which has threaded into it a conduit **48**. Conduit **48**, as will be explained in more detail later, is attached to some source of pressure such as pneumatic pressure.

A piston **49** is coaxially mounted for limited axial movement in cylindrical housing **22**. The upper end of piston **49** has a radially, outwardly extended flange **50** over which is secured a cup shaped housing **44** which provides a relatively large flat surface over which a diaphragm **51** is stretched. Diaphragm **51** is circular in shape and is fixedly held in place by placing the edges thereof between the upper surface of the cylindrical housing **22** and the lower surface of the cap **45** before bolting them together. The outer edge of the diaphragm **51** is slightly thicker than the remainder of the diaphragm and consequently serves as a gasket to make the junction between the cap **45** and the housing **22** airtight.

A rod **52** is fixedly attached at the upper end to the underside of piston **49** by a screw **53**. Rod **53** is coaxial with piston **49** and stem **35** and the lower end of rod **52** is threaded onto the upper end of stem **35**. Thus, stem **35** is fixedly attached to piston **49** and moves axially therewith.

Rod **52** is slidably mounted within a cylinder **54** which is in turn fixedly mounted coaxial with the cylindrical body **22** by means of a collar **55** on the inner periphery of the housing **22**. The inner diameter of the cylinder **54** is slightly larger than the outer diameter of the rod **52** so that the rod **52** is maintained coaxial with the housing **22**. The outer periphery of the cylinder **54** is threaded and has engaged thereon a nut **56** which has an outside diameter slightly smaller than the inside diameter of the housing **22**. Mounted between the upper surface of nut **56** and the lower surface of piston **49** is a compression spring **57** which biases the piston **49** upwardly. The amount of bias which the compression spring **57** applies to the piston **49** is dictated by the axial position of the nut **56** on the periphery of the cylinder **54**. In the present embodiment the nut **56** is generally near its lower extreme on the periphery of the cylinder **54** so that the spring **57** biases the piston **49** to a position in which the valve element **40** is approximately midway between the hole **33** in partition **32** and the shoulder **38** on insert **37**. Thus, in its normally biased position the valve **20** allows approximately one-half of the water flowing in the outlet **30** to flow from the inlet **18** and the other one-half of the water flowing in the outlet **30** to flow from the inlet **26**.

In the operation of the valve **20** as pressure is applied through conduit **48** to the upper surface of the diaphragm **51** the piston **49** is forced downwardly against the bias of the compression spring **57**. As the piston **49** moves downwardly the hole **33** in the partition **32** is obstructed less by the disc **43** in the valve element **40** and the inlet **26** is obstructed more by the disc **42** in the valve element **40**. Thus, by varying the pressure in the conduit **48** the mixture of water from inlet **18** and from inlet **26** in outlet **30** can be varied. In general, the greater the pressure in conduit **48** the greater the amount of water flow from inlet **18** to inlet **30**.

It should be noted that while the present embodiment discloses apparatus for varying the mixture of hot water from the storage tank **10** with cold water, which is operated by a pressure source such as fluid, the present invention is not limited to this form. In fact the present invention will operate with any apparatus that varies the proportions of hot water and cold water flowing therein. For example the apparatus disclosed can be operated by pneumatic pressure, water pressure, or steam pressure (with slight modifications) or the pressure apparatus can be changed and the valve stem **35** can be moved by electrical means.

The conduit **31** threaded into the outlet **30** of three-way valve **20** is threaded into one opening of a T-coupling **60** at the other end. One of the other openings in T-coupling **60** has a plug containing a temperature bulb **61** threaded therein. The temperature bulb **61** is connected to a pneumatic flow regulator **62** by any convenient means such as electricity, etc. illustrated by the line **63**. A conduit **64** connects the pneumatic flow regulator **62** to a source of pneumatic pressure and the conduit **48** attached to the three-way valve **20** is connected to the output of the pneumatic flow regulator **62**. The pneumatic flow regulator **62** and the temperature bulb **61** operate in the following manner. If the temperature of the water in the T-coupling **60** is above a predetermined value this temperature is sensed by the temperature bulb **61** which sends a signal by way of line **63** to the pneumatic flow regulator **62**. The signal at the pneumatic flow regulator **62** reduces the pneumatic pressure in the conduit **48** thereby allowing the three-way valve **20** to open the inlet valve **26** a predetermined amount allowing cold water from conduit **29** to flow therethrough.

The third opening in the T-coupling **60** has one end of a conduit **65** threaded therein. The other end of the coupling **65** is threaded into the inlet of a circulating pump **66**. The outlet of the circulating pump **66** has one end of a conduit **67** threaded therein the other end of which is threaded into an inlet **68** of a heat exchanger generally designated by numeral **70**.

The heat exchanger **70** has two main body portions, a bell shaped portion **71** and an elongated cylindrical portion **72**. The bell shaped portion **71** and the cylindrical portion **72** each have a closed end and an open end. The open ends of portions **71** and **72** are joined together to form a completely enclosed container. The bell shaped portion **71** is divided approximately into two halves by a partition **73** therein. The inlet **68** connects conduit **67** with one-half of the bell shaped portion **71**. An outlet **74** connects the other half of the bell shaped portion **71** with a conduit **75**. A partition **76** fixedly connected at the junction of the bell shaped portion **71** and the cylindrical portion **72** provides a water and steam tight partition between the two portions **71** and **72**.

A plurality of rigid elongated conduits **77** and **78** are embedded fixedly horizontal in the partition **76** and extend from the partition **76** approximately the length of the cylindrical portion **72**. All of the conduits **77** and **78** are joined together at their other end by a small tank-like structure **79**. The end of the conduits **77** embedded in partition **76** open into the inlet half of the bell shaped portion **71** while the other ends open into the tank-like structure **79**. The ends of the conduits **78** embedded in the partition **76** open into the outlet half of the bell shaped portion **71** while the other ends open into the tank-like structure **79**. Thus, water entering the inlet **68** from conduit **67** is free to circulate through conduit **77**, tank **79**, conduit **78** to the outlet **74**.

The cylindrical portion **72** of heat exchanger **70** has a steam inlet **80** therein with one end of a steam conduit **81** fixedly attached thereto. The other end of steam conduit **81** is threaded into a steam flow regulator **82** which controls the amount of steam supplied to conduit **81**. Steam flow regulator **82** is connected to a source of steam, not shown, by means of a conduit **83**. The steam flow regulator **82** is operated by some convenient means such as the mechanism **84**, which may be for example electrical. The cylindrical portion **72** of heat exchanger **70** also has an outlet **85** having one end of a conduit **86** fixedly attached therein. The other end of the conduit **86** is attached to a condensate strainer **87**. The condensate strainer has one end of a conduit **88** attached thereto the other end of which is attached to a steam trap **89**. The cylindrical portion **72** of heat exchanger **70** also has a vent **90** attached thereto to eliminate the air in tank **10** to prevent air binding and the like.

It should be noted that while the present embodiment utilizes a steam energized heat exchanger **70** any method of heating the exchanger **70** would be within the scope of this invention. The present invention would operate with any of a variety of heat exchangers in place of heat exchanger **70** some examples of which are hot air, electrical, etc.

A temperature sensing element **91** is mounted in the bell shaped portion **71** of the heat exchanger **70** near the outlet **74**. The temperature sensing element **91** is connected to the steam valve operating mechanism **84** by some means, such as electrical, denoted by the line **92**. The steam flow regulator operating mechanism **84** operates in a fashion such that when the temperature sensing element **91** senses a reduction in temperature of the water passing out of the outlet **74** the mechanism **84** increases the flow of steam through the steam flow regulator **82** thereby increasing the capacity of the heat exchanger **70**.

In FIGS. 1 and 2 a substantial amount of the elongated cylindrical portion **72** of the heat exchanger **70** is mounted within the storage tank **10**. Thus, the heat exchanger **70** serves a dual function. While the heat exchanger **70** is heating water passing from the inlet **68** through the conduits **77** and **78** to the outlet **74**, heat lost through the side of the cylindrical portion **72** will be absorbed by the water in the storage tank **10**. However, this is simply one possible embodiment of the present invention and by referring to FIG. 5 a second embodiment can be seen in which the storage tank **10'** and the heat exchanger **70'** are separate and independent. It should be noted that everything else in FIG. 5 is connected and operates similar to the structure in FIGS. 1 and 2. The apparatus in FIG. 5 similar to the apparatus in FIG. 1 has been given similar numbers with a prime added to denote an alternate embodiment.

The open end of the conduit **75** is threaded into a T-coupling **93**. One of the openings in the T-coupling **93** has a conduit **94** threaded therein. The conduit **94** is a hot water supply outlet. The other opening in the T-coupling **93** has one end of a coupling **95** threaded therein the other end of which is threaded into a check valve **96**. Check valve **96** is connected to a T-coupling **97** by means of a short conduit **98**. One of the openings in the T-coupling **97** is connected to the inlet **12** of the storage tank **10** by means of a conduit **99**. The other opening in the T-coupling **97** is connected to the T-coupling **28** by means of a conduit **100**. Conduit **100** carries cold water from the conduit **29** to the inlet **12** of storage tank **10**. Check valve **96** prevents cold water from flowing through conduit **95** to conduit **94**.

Flow switch **19** in the cold water supply conduit **29** is any water flow sensor which can be set to operate when the flow reaches a predetermined value and it can operate by any of the well-known methods except that it should be compatible with the temperature sensor **61** and the flow regulator **62**. The flow switch **19** is connected to the flow regulator **62** by any means also compatible with the operation and such connection is indicated by the line **34**. The operation of the flow switch **19** is such that when the hot water being used at outlet **94** is normal or below the flow switch **19** is open and the flow regulator **62** applies maximum pressure to the three-way valve **20**, closing off the inlet **26**. When the flow of water through the flow

switch 19 reaches a predetermined value the flow switch 19 closes and the pressure allowed in line 48 by the flow regulator 62 is determined by the temperature sensor 61. It should be noted that the flow switch 19 is optional and the present system will operate without it but the circuit containing the three-way valve 20 and the sensor 61 has a tendency to oscillate slightly during periods when small amounts of hot water are being used.

In the operation of the present device refer first to FIG. 1. The water in the storage tank 10 is maintained near the desired heat by the action of the heat exchanger 70 therein. When normal quantities of hot water are drawn from the conduit 94 the three-way valve 20 is in the position shown in FIG. 3. That is, water is flowing from conduit 17 to conduit 31 and conduit 27 is closed. Since the circulating pump 66 is operating continuously, water is drawn from the storage tank 10 through conduits 14 and 17 to the three-way valve 20 where it passes to conduit 31 and then past the temperature sensing element 61 to conduit 65 and into the circulating pump 66. Water is forced out of the circulating pump 66 through conduit 67 and into the heat exchanger 70 where it passes through the conduits 77 and 78, over the temperature sensing element 71 and out into conduit 75. Since the water entering the heat exchanger 70 is nearly at the desired temperature, sensing element 91 causes steam flow valve 82 to pass only a small amount of steam to heat the water in the conduits 77 and 78. Thus, the heat exchanger 70 is operating at a very low capacity. As water is drawn from the storage tank 10 cold water enters conduit 29 from the source and passes through conduit 100 and conduit 99 to the inlet 12 in storage tank 10 where it mixes with the hot water already there to cool that water slightly.

Referring to FIG. 2 assume that a large quantity of water is being drawn from the conduit 94 and, therefore, flow switch 19 has operated. Initially only hot water from tank 10 passes through the valve 20. This hot water is sensed by the temperature sensor 61 which applies a signal to the pneumatic flow regulator 62. The flow regulator 62 decreases the pressure applied to the valve 20 whereby inlet 26 is opened allowing cold water to flow therein and mix with the hot water from tank 10. The flow regulator 62 decreases the pneumatic pressure on valve 20 until the temperature of the water at sensor 61 has dropped to a predetermined value. This predetermined value will be in general approximately the minimum water temperature the heat exchanger 70 can raise to the water temperature desired at the hot water outlet 94.

As water is drawn from outlet 11 in the storage tank 10 it is replaced by cold water at inlet 12. Cold water entering the storage tank 10 gradually reduces the overall temperature of the water therein. The valve 20 operates in a somewhat linear fashion so that as the temperature of the water in the tank 10 cools and the temperature of the blended water leaving the valve 20 cools, sensor 61 causes flow regulator 62 to increase the pneumatic pressure which in turn causes the valve 20 to allow less cold water to flow through inlet 26. Thus, the temperature of the water at sensor 61 remains at approximately the predetermined value.

Because the temperature of the water flowing through conduit 67 to inlet 68 of the heat exchanger 70 is at a much lower temperature after the valve 20 operates, the temperature sensing element 91 at the outlet 74 transmits a signal to the mechanism 84 and the steam flow regulator 82 opens to allow more steam to enter the heat exchanger 70. Thus, the heat exchanger 70 is operating at or near maximum capacity even though the water in the storage tank 10 is still relatively near the desired value. Since the hot water from the storage tank 10 is being blended with cold water from the conduit 29 in the three-way valve 20 the hot water will not be depleted as quickly as it would be if only hot water were being used. Also, since the heat exchanger 70 is operating at or near maximum capacity more heat is escaping to the water in the storage tank 10 and, therefore, the cold water entering the inlet 12 does not reduce the temperature of the entire supply of water in the storage tank 10 as far as it would if the heat exchanger 70 were operating at some lesser capacity. When the amount of hot water being drawn from the conduit 94 returns to a normal value or less, the flow switch 19 opens and hot water is circulated through conduit 95, check valve 96 and conduit 99 to inlet 12 of tank 10 so that the temperature of the water within the storage tank 10 quickly rises to nearly the desired value.

Thus, the present device can provide the required amount of hot water during large draw periods or normal draw periods and utilizes a much smaller storage tank 10 and/or a smaller heat exchanger 70. Also, the present device is much more efficient because hot water is always available whereas in the prior art systems the storage tank could be depleted of hot water and the heat exchanger is not capable of heating cold water to the desired value, so that in the prior art systems once they are depleted of hot water, that is the temperature of the water in the storage tank is reduced to a predetermined value, no more hot water is available for a long period of time.

While I have shown and described a specific embodiment of this invention, further modifications and improvements will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not limited to the particular form shown and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

I claim:

1. A domestic hot water storage supply system comprising:

(a) a hot water storage tank having a water outlet and inlet;

(b) cold water supply conduit adapted to be attached to a source of cold water;

(c) a three-way water valve having a first inlet connected to said storage tank outlet, a second inlet connected to said cold water supply conduit, and an outlet, said valve allowing quantities of water from both of said valve inlets to pass to said valve outlet and operating to decrease the flow of water from said second valve inlet;

(d) a circulating pump having an inlet and an outlet;

(e) a heat exchanger having a water inlet and outlet and a first temperature sensor at said outlet;

(f) energizing means operatively connected to said heat exchanger for supplying energy thereto up to a maximum amount which defines the maximum capacity of said heat exchanger and said heat exchanger being controlled by said first temperature sensor at said outlet for varying the enregy supplied to said heat exchanger to maintain the temperature of the water at the outlet substantially constant;

(g) conduit means including a second temperature sensor connecting said three-way valve outlet to said pump inlet and further conduit means connecting said pump outlet to said heat exchanger inlet;

(h) control means operatively connected to said second temperature sensor and to said three-way valve for operating said three-way valve to adjust the flow of cold water through said second valve inlet and hot water through said first valve inlet to provide water to the inlet of said heat exchanger having a temperature such that said heat exchanger operates at approximately its maximum capacity during periods of relatively high water usage and to substantially close said second valve inlet during periods of relatively low water usage;

(i) conduit means connecting said heat exchanger outlet to a hot water supply outlet and further connecting said heat exchanger outlet to said storage tank inlet through a check valve, for allowing water to

flow from said heat exchanger outlet to said storage tank inlet; and

(j) additional conduit means connecting said cold water supply conduit to said storage tank inlet for supplying cold water to replenish said storage tank.

2. The domestic hot water storage supply system of claim 1 wherein at least a portion of the steam operated heat exchanger is positioned within the storage tank for supplying heat to water within said tank as well as water within said heat exchanger.

3. The domestic hot water storage supply system of claim 1 wherein the control means includes flow switch means mounted in said cold water supply means and operatively connected to said control means for causing said

control means to operate said three-way valve to close said second valve inlet when the flow of water through said switch is below a predetermined value.

References Cited

UNITED STATES PATENTS

2,236,087	3/1941	Detwiler	236—18
2,756,739	7/1956	Schaub	126—362
3,053,516	9/1962	Killebrew	165—39

FREDERICK L. MATTESON, JR., *Primary Examiner.*

ROBERT A. DUA, *Examiner.*