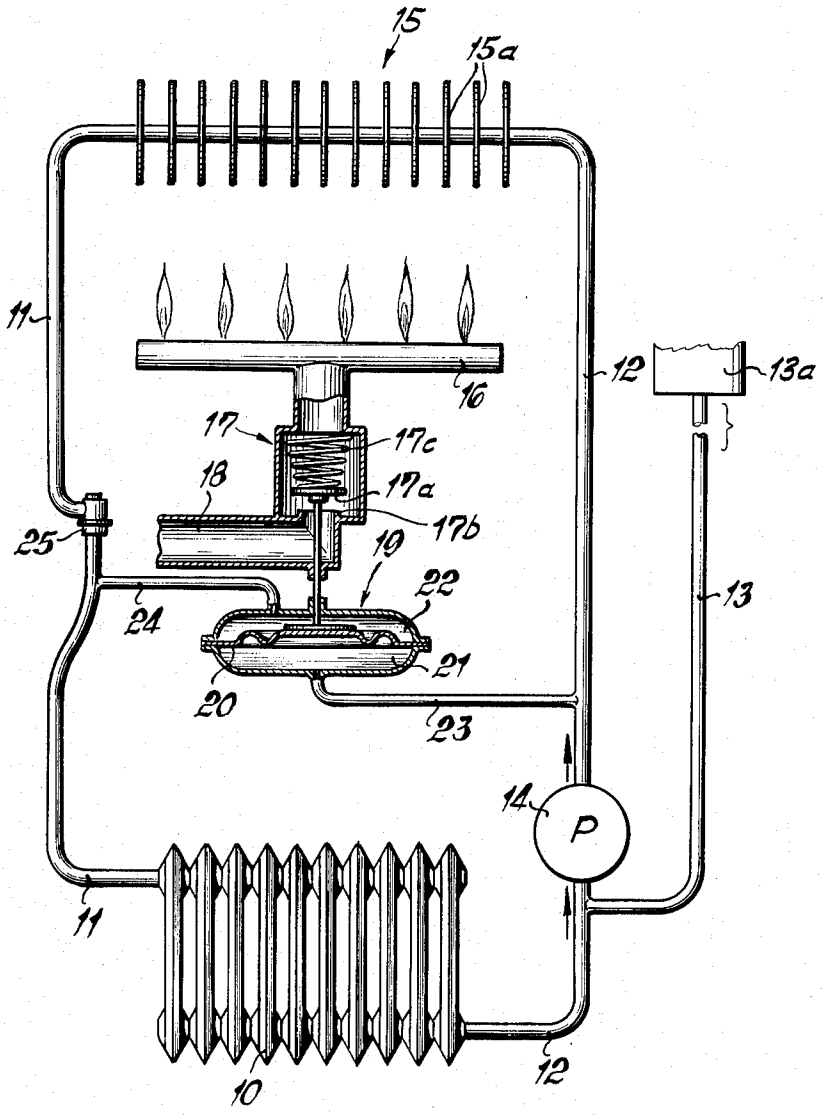
June 28, 1966 A. KURZ ETAL 3,258,203

HOT-WATER HEATING SYSTEM

Filed July 31, 1964 4 Sheets-Sheet 1

FIG. 1



INVENTORS:
ADOLF KURZ
HEINZ VAN LIER
by Michael S. Striker
Atty

June 28, 1966 A. KURZ ETAL 3,258,203

HOT-WATER HEATING SYSTEM

Filed July 31, 1964 4 Sheets-Sheet 2

FIG. 3

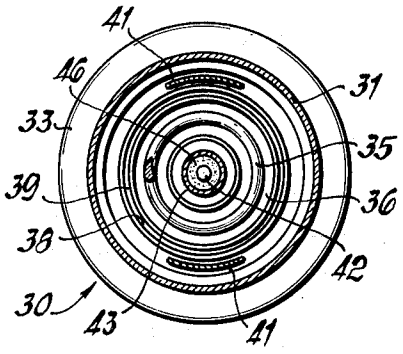


FIG. 2

FIG. 4

INVENTORS:
ADOLF KURZ
HEINZ VAN LIER

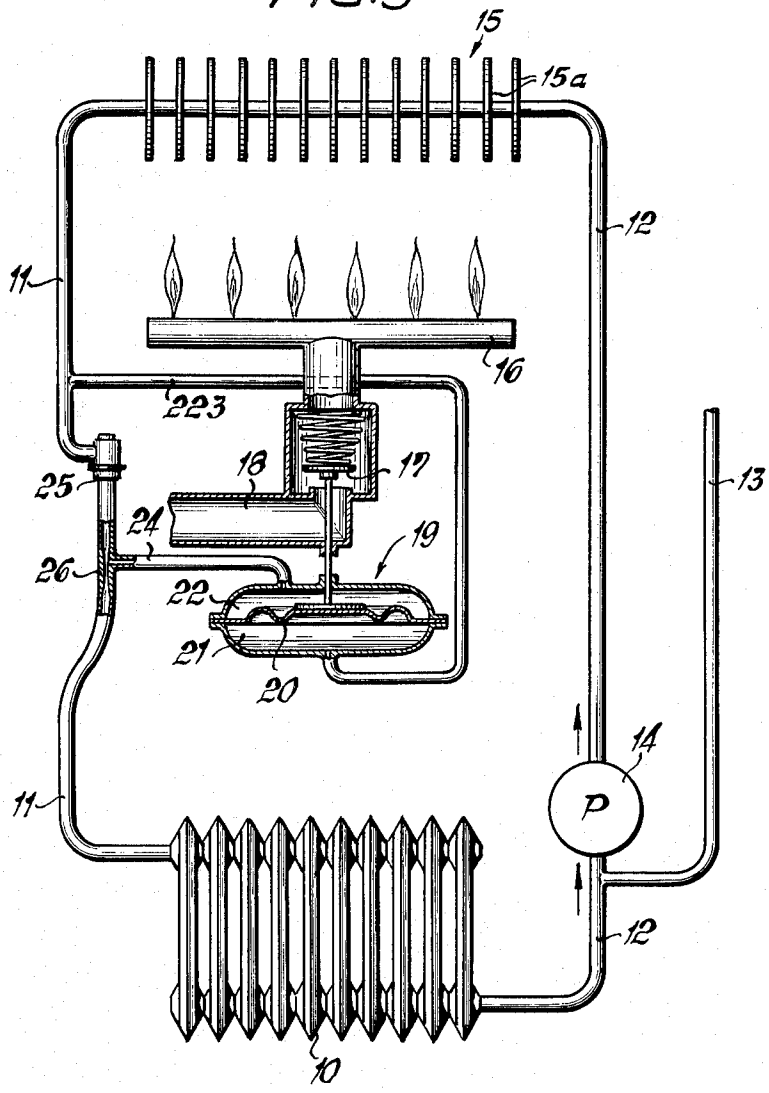
by Michael J. Striker

June 28, 1966 A. KURZ ETAL 3,258,203

HOT-WATER HEATING SYSTEM

Filed July 31, 1964 4 Sheets-Sheet 3

FIG. 5



INVENTORS:
ADOLF KURZ
HEINZ VAN LIER

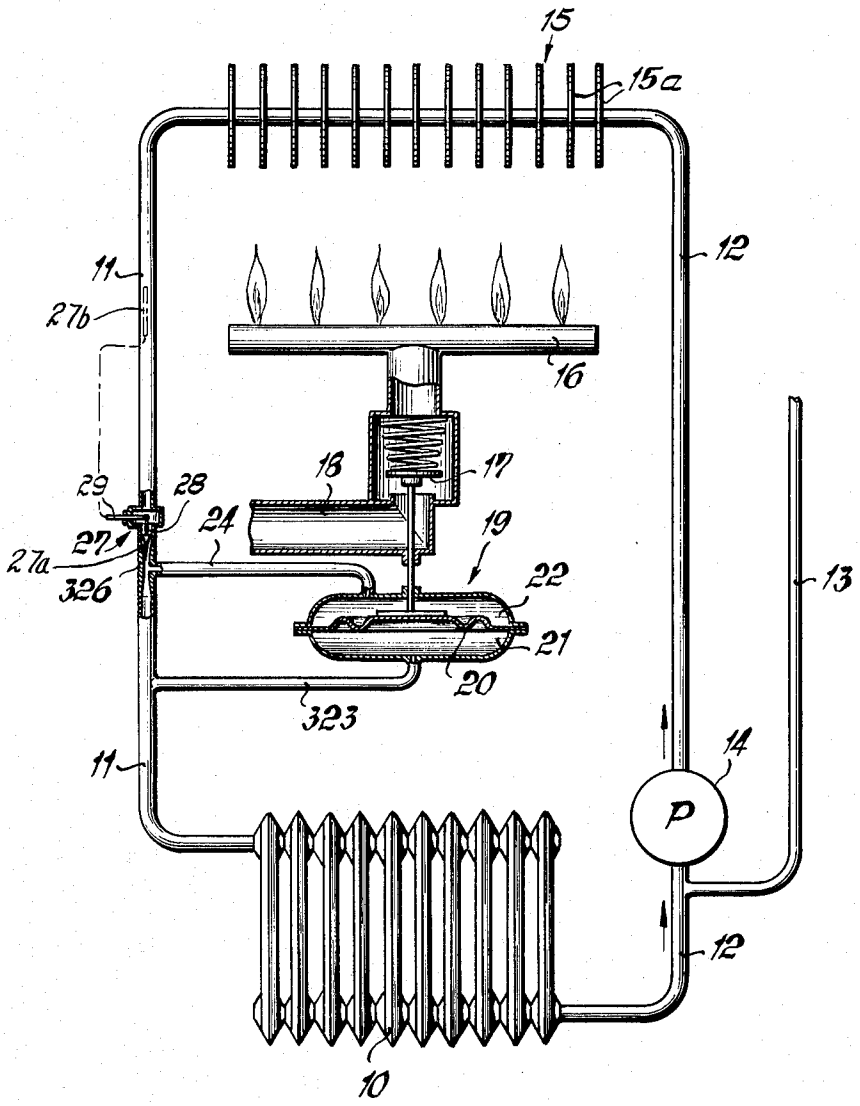
by Michael J. Striker
Atty

June 28, 1966 A. KURZ ETAL 3,258,203

HOT-WATER HEATING SYSTEM

Filed July 31, 1964 4 Sheets-Sheet 4

FIG. 6



INVENTORS:
ADOLF KURZ
HEINZ VAN LIER

By Michael J. Striker
Atty

United States Patent Office 3,258,203
Patented June 28, 1966

3,258,203

HOT-WATER HEATING SYSTEM

Adolf Kurz and Heinz van Lier, Wernau, Germany, assignors to Junkers & Co. G.m.b.H., Wernau, Germany

Filed July 31, 1964, Ser. No. 386,625
Claims priority, application Germany, Aug. 1, 1963, J 24,173
17 Claims. (Cl. 237—8)

The present invention relates to central heating systems in general, and more particularly to an improved hot-water heating system. Still more particularly, the invention relates to improvements in hot-water heating systems which operate on the principle of forced circulation created by a motor-driven circulating pump controlled by outside thermostats or room thermostats.

In many presently known hot-water heating systems wherein the source of heat comprises a gas-heated heat exchanger, the heat exchanger normally comprises one or more packages of laminations or fins which surround a length of the water containing coil and are heated by flames or gaseous products of combustion produced by a gas burner. A serious drawback of such hot-water heating systems is that the spaces between the fins of the heat exchanger become clogged after short periods of use to thereby reduce the efficiency of the heat exchanger. The reason for clogging of the heat exchanger is that such hot-water heating systems normally comprise a motor-driven circulating pump which operates intermittently in response to impulses received from a room thermostat or from another starting device to cause circulation of water through the coil. When the pump is started, it begins to circulate a stream of cold water, or comparatively cold water, which flows through the heat exchanger. Since the rate at which the water is circulated in response to operation of the pump is determined in advance, the quantity of water flowing through the heat exchanger is constant and the latter transmits to such water a certain quantity of heat energy. Consequently, the heating effect is low when the circulating pump is started, which means that the exposed surfaces of the fins are coated with a layer of condensate which is drawn from the surrounding air and promotes the clogging of spaces between the adjoining fins.

In order to reduce such deposition of condensate, it was already proposed to return a certain quantity of freshly heated water into a portion of the coil immediately upstream of the heat exchanger so that hot water blends with colder water and the heat exchanger receives a preheated mixture rather than a stream of cold or comparatively cold liquid. Such blending is continued until the water temperature in the entire coil rises to a predetermined value at which no further precipitation of condensate takes place or at which the deposition of condensate is negligible. Of course, the apparatus for effecting such mixing of hot and cold water contributes greatly to the bulk, initial cost and maintenance cost of the hot-water heating system. In addition, such blending apparatus normally comprises complicated control devices which are prone to malfunction and must be serviced by highly skilled persons.

Therefore, it was already proposed to replace such blending apparatus by the provision of a main heater and an auxiliary heater which latter is used to prevent the water temperature from descending below a predetermined value, i.e., the auxiliary heater insures that the water temperature remains between a predetermined minimum value and a predetermined maximum value. Of course, this means that the hot-water heating system must comprise two heaters, two burners and a correspondingly

increased number of valves, piping, control elements and other accessories which add to the bulk, cost and complicatedness of the assembly.

Accordingly, it is an important object of the present invention to provide a very simple, reliable and compact hot-water heating system which avoids the drawbacks of conventional heating systems and wherein the deposition of condensate on the fins of the heat exchanger is eliminated in a novel way.

Another object of the invention is to provide a hot-water heating system whose operation is automatic and wherein a small number of comparatively simple auxiliaries suffices to prevent clogging of spaces between the fins of the heat exchanger.

A further object of the invention is to provide a hot-water heating system wherein the heating of the heat exchanger produces little noise and wherein the admission of fuel to the burner or burners may take place in a fully automatic way and at low water pressure.

With the above objects in view, one feature of our present invention resides in the provision of a hot-water heating system which comprises a coil defining an endless path for a supply of water, a pump which circulates water in the coil, a burner for heating the water which circulates in the coil, a normally closed regulating valve provided in a conduit which supplies gas or another fuel to the burner, means for producing a pressure differential in two spaced portions of the coil when the pump operates to circulate the water, a safety device comprising a pair of water-filled chambers each communicating with one of the two spaced portions of the coil so that the water pressure in one of the chambers exceeds the water pressure in the other chamber, actuating means operatively connected with the regulating valve to initiate the admission of fuel to the burner in response to a predetermined pressure differential in the chambers, and a throttling device comprising a thermostat valve which is mounted in the coil upstream of the point where the other chamber communicates with the coil. This thermostat valve serves to throttle the flow of water at least at such times when the water temperature in the coil is below a predetermined value.

The burner heats the fins of a heat exchanger which is provided along a length of the coil, and the throttling action of the thermostat valve is such that the spaces between the fins cannot accumulate condensate from surrounding air because the flow of water is throttled sufficiently to insure rapid heating of water in the heat exchanger to a temperature which is so high that the exchange of heat between the fins and water does not result in cooling of fins to a temperature at which the deposition of condensate can take place.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved heating system itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a somewhat schematic view of a forced-circulation hot-water heating system which is constructed in accordance with a first embodiment of the present invention, certain portions of the heating system being shown in section;

FIG. 2 is a central vertical section through a throttling device which is utilized in the heating system of FIG. 1;

FIG. 3 is a horizontal section as seen in the direction of arrows from the line IV—IV of FIG. 2;

FIG. 4 is a vertical section through the thermostat valve of the throttling device as seen in the direction of arrows from line IV—IV of FIG. 2;

FIG. 5 is a schematic view of a modified hot-water-heating system; and

FIG. 6 is a similar schematic view of a third hot-water heating system.

Referring to FIG. 1, there is shown a hot-water heating system including a coil **11**, **12** which defines a closed path for a supply of water, a circulating pump **14**, a heat exchanger **15** having fins **15***a* surrounding a length of the coil, a gas burner **16** which is located beneath and heats the fins **15***a*, and heat dissipating elements in the form of radiators **10**, only one such radiator being actually shown in the drawing. The radiator **10** is installed downstream of the heat exchanger **15** but upstream of the pump **14**. The flow of fuel to the burner **16** is controlled by a safety device **19** which is responsive to a pressure differential between the interior of the clod-water (return) section **12** and the hot-water section **11** of the coil. Upstream of the pump **14**, the return section **12** communicates with an expansion line **13** leading to an expansion tank **13***a*.

The flow of fuel to the burner **16** is controlled by a normally closed regulating valve **17** which is mounted in a supply conduit **18**. This regulating valve **17** is a gas valve of known design and is operated by the safety device **19** which comprises a casing accommodating an actuating element here shown as a deformable diaphragm **20** so as to divide its interior into chambers **21**, **22**. The diaphragm **20** is connected with and serves as a means for moving the valve member **17***a* of the valve **17** away from its seat **17***b*. The valve member **17***a* is biased by a spring **17***c*. The chamber **21** is connected with the return section **12** by a high-pressure pipe **23** which communicates with the section **12** at the downstream side of the pump **14**, and the chamber **22** is connected with a low-pressure pipe **24** leading to the hot-water section **11**. The chamber **21** is the high-pressure chamber and the chamber **22** is the low-pressure chamber. When the pump **14** is started, the heat exchanger **15** offers a certain resistance to the flow of water through the coil so that pressure prevailing in the chamber **21** exceeds the pressure in the chamber **22**. The pressure differential causes the diaphragm **20** to move the valve member **17***a* away from the seat **17***b* and to admit gaseous fuel from the supply conduit **18** into the burner **16**. Such fuel is ignited by an automatic igniter device of any known design, not shown in the drawings.

In accordance with the present invention, the rate at which water may circulate through the coil is controlled by a throttling device **25** which is installed in the hot-water section close to and upstream of the point where this section communicates with the low-pressure pipe **24**. The throttling device **25** is operative when the valve **17** admits fuel to the burner **16** and when the water temperature in the coil is below a predetermined value. The device **25** then insures that the flow of water through the hot-water section **11** is throttled whereby the burner **16** heats a small quantity of water per unit of time. The throttling action of the device **25** is proportional to the temperature of water and decreases in response to rising water temperature. When the entire supply of water in the coil **11**, **12** is heated to a predetermined temperature, the throttling device **25** is fully opened and allows for maximum (normal) circulation of water. In accordance with a preferred embodiment of our invention, the throttling device **25** comprises a thermostat valve which regulates the cross-sectional area of the passage in the hot-water section **11**. It will be noted that the device **25** is installed upstream of the point where the chamber **22** communicates with the section **11** of the coil and upstream of the point where the chamber **22** communicates with the pipe **24**.

FIGS. 2 to 4 illustrate the construction of throttling device **25**. This device comprises a housing **30** including two open-ended tubular portions **31**, **32**. The open lower end of the upper portion **31** is connected to the open upper end of the lower portion **32** by a joint **33** which is located in a horizontal plane and supports a thermostat valve **34**. The valve **34** comprises an annular valve member **36** which is biased by a resilient element here shown as a helical spring **35**. The periphery of the valve member **36** is adjacent to an annular valve seat **38** having an annular flange **37** which is clamped between the tubular portions **31**, **32**. When the water temperature in the hot-water section **11** of the coil descends to or below a predetermined minimum value, the spring **35** maintains the valve member **36** in the axial position of FIG. 4 so that the valve member **36** and the seat **38** define between themselves an annular gap **39** which allows a minimum quantity of water to flow from the heat exchanger **15** to the radiator **10**. The flange **37** is connected with a lower carrier or yoke **40** and with an upper carrier or yoke **41**. These yokes partially enclose the valve member **36** and the yoke **40** carries an upwardly extending projection or pin **42** secured thereto by a nut **42***a*. The pin **42** is slidable in an aperture provided in the bottom wall of a jacket here shown as a cylinder **43**, and this cylinder is formed with a circumferential shoulder **44** for the valve member **36**. The upper end portion of the cylinder **43** extends through and beyond an aperture provided in the median portion of the yoke **41**, and the internal space of the cylinder accommodates an annular sealing member **45** which is adjacent to the apertured bottom wall and forms a fluid-tight seal around the pin **42**. The upper portion of the internal space in the cylinder **43** is filled with a material **46** which expands in response to a rise in temperature of the cylinder such as is brought about by changes in the temperature of water which flows in the hot-water section **11**. The upper leg **11***a* of this hot-water section is connected to the cylindrical wall of the upper tubular portion **31** and the lower leg of the section **11** comprises a nipple **11***b* which is secured to the bottom wall of the lower tubular portion **32** so that water flowing through and beyond the heat exchanger **15** may enter the upper portion **31** to flow around the cylinder **43**, through the gap **39**, through the lower portion **32** and into the nipple **11***b*.

The material **46** has a predetermined coefficient of expansion and allows the valve member **36** to remain in the lower end position of FIG. 4 when the water temperature in the section **11** reaches or descends below a predetermined minimum value. The valve member **36** is then held in such lower end position by the spring **35** which forces the pin **42** to penetrate into the material **46** by operating between the upper yoke **41** and the valve member, i.e., between the yoke **41** and the shoulder **44** of the cylinder **43**. The latter is slidable in the centrally located aperture of the yoke **41**.

When the temperature of water flowing through the section **11** begins to rise, the material **46** expands gradually and expels a portion of the pin **42** from the internal space of the cylinder **43** whereby the cylinder begins to move upwardly, as viewed in FIG. 4, and the cross-sectional area of the gap **39** between the valve member **36** and valve seat **38** increases proportionally so that the water may circulate at a higher rate. The expansion coefficient of the material **46** is such that the bias of the spring **35** is overcome only at the time the temperature of water flowing in the section **11** rises above a predetermined minimum value. Also, in the initial stage of expansion of the material **46**, the cross-sectional area of the gap **39** preferably remains unchanged or increases very little (see FIG. 6 which shows that the peripheral portion of the valve member consists of a short cylinder which is surrounded by a concentric cylindrical portion of the valve seat **38** so that the cross-sectional area of the gap **39** remains unchanged as long as the cylindrical

portion of the valve member **36** is actually surrounded by the cylindrical portion of the valve seat). In other words, the cross-sectional area of the gap **39** begins to increase gradually when the temperature of water in the section **11** rises to a value which is necessary to bring about a predetermined compression (shortening) of the spring **35** so that the cylindrical portion of the valve member **36** rises to a level above the cylindrical portion of the valve seat **38**.

It will be seen that the throttling device **25** allows for circulation of a smaller quantity of water when the water temperature is below a preselected value whereby the water filling that length of the coil which is surrounded by the fins **15***a* of the heat exchanger **15** remains in longer-lasting heat-exchanging contact with the fins **15***a* and is rapidly heated to a temperature at which the device **25** responds to allow for increased circulation of water through the coil. The thermostat valve **34** causes the throttling device **25** to open fully at the time the water temperature reaches or rises above a predetermined maximum value.

It is a rather simple procedure to select the minimum cross-sectional area of the gap **39** and the material **46** in such a way that water circulating in the coil **11**, **12** may be heated without causing any (or by causing negligible) deposition of condensate on the fins **15***a*. As a rule, the valve member **36** will be biased to the position of FIG. 6 whenever the flow of gaseous fuel to the burner **16** is shut off and whenever the water temperature drops below a predetermined minimum value so that the above-described operation begins as soon as the valve **17** admits fuel to the burner **16** and the latter begins to heat the fins **15***a*.

FIG. 5 illustrates a somewhat modified hot-water heating system wherein the high-pressure chamber **21** of the control device **19** is connected to a high-pressure pipe **223** leading to the hot-water section **11** at a point upstream of the throttling device **25**. The low-pressure pipe **24** communicates with the throat portion of a Venturi **26** which is provided in the section **11** downstream of the throttling device **25**, i.e., the inlet of the Venturi receives water which has passed through the gap **39** of the thermostat valve **34** in the housing **30** of the device **25**. In FIG. 5 the Venturi **26** produces the pressure differential which is necessary to keep the gas valve **17** in open position.

It will be seen that the throttling device is again located upstream of the point where the chamber **22** communicates with the pipe **24**.

FIG. 6 illustrates a third hot-water heating system which differentiates from the systems of FIGS. 4 and 5 in that the high-pressure pipe **323** connects the chamber **21** with the section **11** at a point downstream of the point where the pipe **24** communicates with this section **11**. The pressure differential necessary to operate the control device **19** is produced mainly by a Venturi **326** which is provided in the section **11** and whose throat portion communicates with the intake end of the pipe **24**. A modified throttling device **27** is located upstream of the Venturi **326** and cooperates therewith to regulate the flow of water through the section **11**. This throttling device **27** comprises a thermostat which controls the axial position of a needle-shaped valve member **27***a* extending into and beyond the inlet of the Venturi **326**. Changes in axial position of the valve member **27***a* will bring about changes in the cross-sectional area of the annular orifice in the Venturi **326** so that the rate of water flow may be regulated in a manner analogous to that described in connection with FIGS. 1 to 4. The thermostat which regulates the axial position of the valve member **27***a* comprises a sensing element **27***b* which is in contact with water flowing toward the Venturi **326**.

Otherwise, the construction of the systems shown in FIGS. 5 and 6 corresponds exactly to that of the system shown in FIG. 1.

It will be readily understood that, even though the drawings illustrate hot-water heating systems whose burners operate with gaseous fuel, such burners may be replaced by other types of burners which utilize liquid or solid fuel. Also, while the drawings show heating systems wherein the regulating valve **17** is controlled by a safety device **19** which opens the valve **17** in response to a differential in water pressure, this safety device **19** may be replaced by other types of safety devices, for example, by a magnetic valve which regulates the admission of fuel in response to impulses furnished by a thermostat or in response to operation of the circulating pump **14**. All that counts is to provide a thermostatically regulated throttling device which controls the rate of water circulation in such a way that the rate of flow depends on the temperature of water so as to prevent the deposition of condensate on the heat exchanger whereby the spaces between the fins **15** remain free and allow for efficient exchange of heat between the fins and the products of combustion or flames of the burner **16**. This is due to the fact that small quantities of water which circulate through the heat exchanger **15** when the throttling device reduces the rate of flow undergo a very intensive heating action and the water temperature rises rapidly. Consequently, the fins **15***a* are maintained at a temperature which is high enough to prevent deposition of condensate. As soon as the deposition of condensate is prevented, there is no danger that the spaces between the fins **15***a* would become clogged.

FIGS. 1, 5 and 6 show that, when the hot-water heating system comprises a safety device **19**, the throttling device **25** or **27** is preferably positioned in that section of the coil in which the pressure differential exists, i.e., in the hot-water section **11**, whereby the throttling device may be installed upstream of the low-pressure pipe **24** but downstream of the high-pressure pipe **23** or **223** (FIGS. 1 and 5) or upstream of the pipes **24**, **323** (FIG. 6). In FIG. 1, the pressure differential is produced solely by the resistance to water flow which is offered by the heat exchanger **15**. In FIG. 5, such pressure differential is produced mainly by the Venturi **26**, and in FIG. 6 the pressure differential is produced mainly by the Venturi **326**.

Another very important advantage of our hot-water heating system is that the system is practically noiseless which is attributable to the fact that the throttling device **25** or **27** allows water to circulate at a rate which increases in proportion to rising water temperature. In many conventional hot-water heating systems, water which is overheated in the heat exchanger will produce a hissing sound which is unpleasant to human ears.

Furthermore, the throttling device **25** or **27** insures that the resistance to flow is rather high when the water temperature is low whereby the gas valve **17** may open in response to low water pressure and remains open when the resistance which the throttling device offers to flow of water decreases at elevated temperatures. The throttling device is reliable in operation and requires little attention. Also, by effecting certain minor adjustments a system utilizing our improved throttling device may be used with advantage in heating systems which operate with boiling water.

The material **46** used in the cylinder **43** of the throttling device **25** may be a wax like product.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a burner arranged to heat the water in said coil; a conduit for suppling fuel to said burner; a normally closed regulating valve provided in said conduit; means for producing a pressure differential in two spaced portions of said coil when the water is circulated by said pump means; a safety device comprising a pair of water-filled chambers each communicating with one of said spaced portions of the coil so that the water pressure in one of said chambers exceeds the water pressure in the other chamber, and actuating means operatively connected with and arranged to open said regulating valve in response to such pressure differential in said chambers; and a throttling device comprising a thermostat valve mounted in said coil upstream of the point where said other chamber communicates with the corresponding portion of said coil and arranged to throttle the flow of water at least when the water temperature in said coil is below a predetermined value.

2. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a burner arranged to heat the water in said coil; a conduit for supplying fuel to said burner; a normally closed regulating valve provided in said conduit; means for producing a pressure differential in two spaced portions of said coil when the water is circulated by said pump means; a safety device comprising a pair of water-filled chambers each communicating with one of said spaced portions of the coil so that the water pressure in one of said chambers exceeds the water pressure in the other chamber, and actuating means operatively connected with and arranged to open said regulating valve in response to such pressure differential in said chambers; and a throttling device comprising a thermostat valve mounted in said coil between said spaced portions thereof and arranged to throttle the flow of water at least when the water temperature in said coil is below a predetermined value.

3. A structure as set forth in claim 2, wherein that one of said spaced portions which communicates with said other chamber is located downstream of the other spaced portion.

4. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a burner arranged to heat the water in said coil; a conduit for supplying fuel to said burner; a normally closed regulating valve provided in said conduit; means including a Venturi for producing a pressure differential in two spaced portions of said coil when the water is circulated by said pump means whereby the portion containing water whose pressure is higher is located upstream of said Venturi; a safety device comprising a pair of water-filled chambers each communicating with one of said spaced portions of the coil so that the water pressure in that one of said chambers which is connected with the portion located upstream of said Venturi exceeds the water pressure in the other chamber, and actuating means operatively connected with and arranged to open said regulating valve in response to such pressure differential in said chambers; and a throttling device comprising a thermostat valve mounted in said coil upstream of said Venturi and downstream of the portion containing water whose pressure is higher, said thermostat valve being arranged to throttle the flow of water at least when the water temperature in said coil is below a predetermined value.

5. A structure as set forth in claim 4, wherein said Venturi comprises a throat portion and wherein said other chamber communicates with said throat portion.

6. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a burner arranged to heat the water in said coil; a conduit for supplying fuel to said burner; a normally closed regulating valve provided in said conduit; means including a Venturi for producing a pressure differential in two spaced portions of said coil when the water is circulated by said pump means whereby the portion containing water whose pressure is higher is located downstream of the other portion and downstream of said Venturi; a safety device comprising a pair of water-filled chambers each communicating with one of said spaced portions of the coil whereby the water pressure in that one of said chambers which is connected with the portion containing water whose pressure is higher exceeds the water pressure in the other chamber, and actuating means operatively connected with and arranged to open said regulating valve in response to such pressure differential in said chambers; and a throttling device comprising a thermostat valve mounted in said coil upstream of said Venturi, said thermostat valve having a reciprocable valve member adjacent to said Venturi and a temperature-responsive sensing element provided in said coil and operatively connected with said valve member to reciprocate the latter in response to changes in water temperature so that said valve member throttles the flow of water through said Venturi at least when the water temperature in said coil is below a predetermined value.

7. A structure as set forth in claim 6, wherein said valve member is a needle which extends through the inlet of said Venturi.

8. A structure as set forth in claim 6, wherein said Venturi comprises a throat portion and the other chamber communicates with said throat portion.

9. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a burner arranged to heat the water in said coil; a conduit for supplying fuel to said burner; a normally closed regulating valve provided in said conduit; means for producing a pressure differential in two spaced portions of said coil when the water is circulated by said pump means; a safety device comprising a pair of water-filled chambers each communicating with one of said spaced portions of the coil so that the water pressure in one of said chambers exceeds the water pressure in the other chamber, and actuating means operatively connected with and arranged to open said regulating valve in response to such pressure differential in said chambers; and a throttling device comprising a housing having two tubular housing portions connected in said coil upstream of the point where said other chamber communicates with the corresponding portion of said coil so that the circulating water flows through said housing portions, said housing portions having open ends adjacent to each other, a joint sealingly connecting said open ends with each other, and a thermostat valve provided in said housing and including an annular seat secured to said joint, a valve member reciprocable in and defining with said seat an annular gap of variable cross-sectional area, and means responsive to water temperature in said housing and operatively connected with said valve member to reciprocate the valve member with reference to said seat and to increase the cross-sectional area of said gap when the water temperature in said housing rises above a predetermined value.

10. A structure as set forth in claim 9, wherein said thermostat valve further comprises resilient means for biasing said valve member to a position in which the cross-sectional area of said gap is reduced to a minimum when the water temperature drops to said predetermined value.

11. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a heat exchanger having fins exposed to a humidity containing at-

mosphere, said fins surrounding a length of the coil downstream of said pump means; a burner arranged to heat said fins whereby the heat exchanger heats the water in said coil and said fins exhibit a tendency to collect condensate from the surrounding humidity containing atmosphere when the water temperature in said length of coil is below a predetermined value; heat-dissipating means provided in said coil downstream of said heat exchanger but upstream of said pump means; a throttling valve for regulating the rate of water flow through said coil, said throttling valve provided in said coil adjacent to and downstream of said heat exchanger but upstream of said heat dissipating means; and thermostatic actuating means dependent upon the water temperature in the region of said throttling valve adjacent to and downstream of said heat exchanger for reducing the rate of water flow, when the water temperature in the region of said length of the coil drops below said predetermined value below which condensate would tend to collect on said fins, so that the flow of water through said length of coil is slowed down whereby the water temperature in said length of coil rapidly rises above said predetermined value to at least reduce the accumulation of condensate on said fins.

12. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a heat exchanger having fins exposed to a humidity containing atmosphere, said fins surrounding a length of the coil downstream of said pump means; a burner arranged to heat said fins whereby the heat exchanger heats the water in said coil and said fins exhibit a tendency to collect condensate from the surrounding humidity containing atmosphere when the water temperature in said length of coil is below a predetermined value; a throttling valve for regulating the rate of water flow through said coil, said throttling valve provided in said coil adjacent to and downstream of said heat exchanger but upstream of said pump means; and thermostatic actuating means dependent upon the water temperature in the region of said throttling valve adjacent to and downstream of said heat exchanger for reducing the rate of fluid flow when the water temperature in the region of said length of the coil drops below said predetermined value below which condensate would tend to collect on said fins, so that the flow of water through said length of coil is slowed down whereby the water temperature in said length of coil rapidly rises above said predetermined value to at least reduce the accumulation of condensate on said fins.

13. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a heat exchanger having fins surrounding a length of the coil downstream of said pump means; a burner arranged to heat said fins whereby the heat exchanger heats the water in said coil and said fins exhibit a tendency to collect condensate from the surrounding air when the water temperature in said coil is below a predetermined value; a supply conduit arranged to supply fuel to said burner; a normally closed regulating valve provided in said supply conduit; a safety device for opening said regulating valve in response to circulation of water in said coil; and a throttling device for regulating the rate of water flow through said coil, said throttling device comprising a thermostat valve provided in said coil downstream of said heat exchanger but upstream of said pump means and arranged to reduce the rate of fluid flow, at least when the water temperature is below said predetermined value, so that the water temperature in said length of coil rapidly rises above said predetermined value to at least reduce the accumulation of condensate on said fins.

14. A structure as set forth in claim **13**, wherein said safety device is responsive to a pressure differential in two spaced portions of said coil and wherein such pressure differential is produced at least in part by the resistance offered by said heat exchanger to the circulation of water through said length of coil.

15. In a hot-water heating system, in combination, a coil defining an endless path for a supply of water; pump means for circulating the water in said coil; a heat exchanger having fins surrounding a length of the coil downstream of said pump means; a burner arranged to heat said fins whereby the heat exchanger heats the water in said coil and said fins exhibit a tendency to collect condensate from the surrounding air when the water temperature in said coil is below a predetermined value; heat-dissipating means provided in said coil downstream of said heat exchanger but upstream of said pump means; and a throttling device for regulating the rate of water flow through said coil, said throttling device comprising a thermostat valve provided in said coil downstream of said heat exchanger but upstream of said heat-dissipating means and arranged to reduce the rate of fluid flow, at least when the water temperature is below said predetermined value, so that the water temperature in said length of coil rapidly rises above said predetermined value to at least reduce the accumulation of condensate on said fins, said thermostat valve comprising a Venturi provided in said coil and having an inlet, a valve member reciprocably extending through the inlet of said Venturi to thereby regulate the rate of water flow through the Venturi, and a temperature-responsive sensing element provided in said coil and operatively connected to said valve member to reduce the rate of water flow through said Venturi when the water temperature descends to said predetermined value.

16. In a heating system, in combination, a coil defining an endless path for a supply of fluid, a heat exchanger and at least one heat dissipating element provided in said coil; burner means arranged to heat said heat exchanger whereby the latter heats the fluid; means for circulating the fluid in said coil; conduit means connected with and arranged to supply fuel to said burner means; a normally closed regulating valve provided in said conduit means; a safety device for opening said regulating valve in response to a pressure differential in two spaced portions of said coil; and an adjustable throttling device for regulating the rate at which the fluid may circulate in said coil, said throttling device comprising a thermostat valve mounted in said coil and arranged to throttle the flow of fluid at least when the fluid temperature in said coil remains below a predetermined value.

17. A structure as set forth in claim **16**, wherein said heat exchanger comprises at least one package of fins defining between themselves spaces which collect condensate from the surrounding air when the temperature of fluid in said coil drops to said predetermined value, said throttling device being arranged to prevent such accumulations of condensate in said spaces by throttling the flow of fluid sufficiently to insure that fluid contained in said heat exchanger is rapidly heated to above said predetermined temperature.

References Cited by the Examiner

UNITED STATES PATENTS

1,061,635	5/1913	Ross	237—8
2,194,805	3/1940	Moore	237—8
2,340,844	2/1944	Dillman	237—8
2,981,477	4/1961	Salmon	236—34
3,201,045	8/1965	Davidson et al.	237—8

FOREIGN PATENTS

1,201,596	7/1959	France.

EDWARD J. MICHAEL, *Primary Examiner.*