United States Patent [19]

Bullock

[11] **3,869,815**

[45] **Mar. 11, 1975**

[54] **GARMENT FINISHING APPARATUS**

[75] Inventor: **Norman J. Bullock,** Prospect, Ky.

[73] Assignee: **W. M. Cissell Manufacturing Company,** Louisville, Ky.

[22] Filed: **Jan. 4, 1974**

[21] Appl. No.: **430,630**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 267,518, June 29, 1972, Pat. No. 3,085,561.

[52] **U.S. Cl.** **38/77.6,** 223/51

[51] **Int. Cl.** **D06f 75/06**

[58] **Field of Search** 38/77.5, 77.6; 223/51

[56] **References Cited**

UNITED STATES PATENTS

3,432,939	3/1969	Eichholz	223/51
3,508,354	4/1970	Stansbury et al.	38/77.6
3,601,292	8/1971	Bliss	223/51

Primary Examiner—Patrick D. Lawson

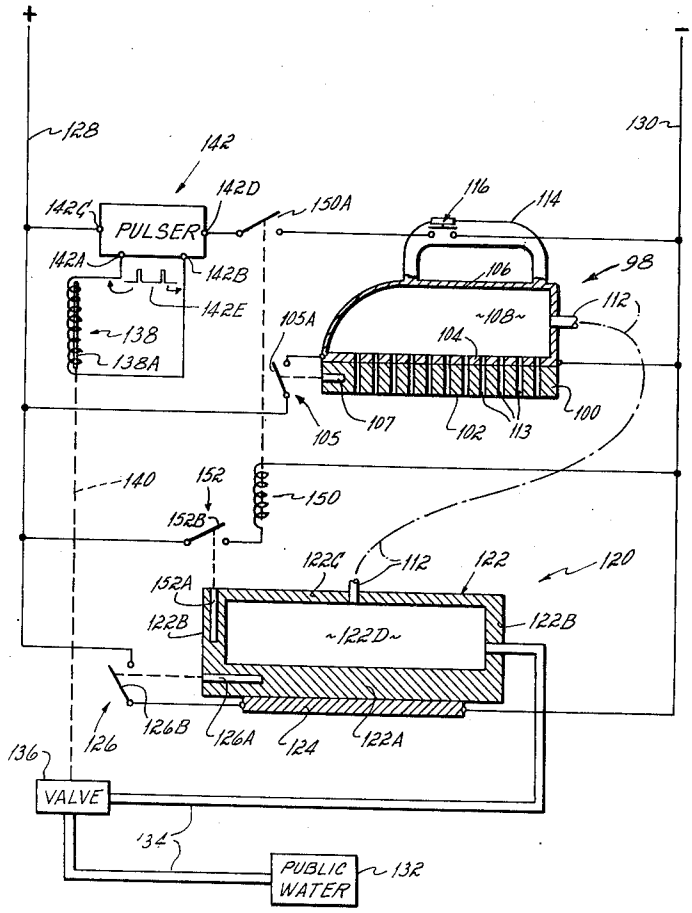
Attorney, Agent, or Firm—Wood, Herron & Evans

[57] **ABSTRACT**

A garment finishing apparatus for dewrinkling clothes including a cabinet into the interior of which clothes to be finished are placed via a door, a steam generator for converting water into steam which is then emitted into the interior of the cabinet for dewrinkling the clothes, the steam generator being characterized by instantaneously converting the water into steam and generating a predetermined quantity of steam per garment refinishing cycle irrespective of the pressure at which the water is supplied to the steam generator, and air circulating and heating means for recirculating hot air through the interior of the cabinet to dry the previously steamed clothes.

In a portable iron embodiment incorporating a remotely located steam generator connected to the iron via a flexible hose, a pulsing circuit interconnected between a manual electrical switch and the pressure-insensitive valve is provided to avoid flooding should the manual switch be actuated for an extended period of time.

5 Claims, 3 Drawing Figures



PATENTED MAR 11 1975

3,869,815

SHEET 1 OF 3

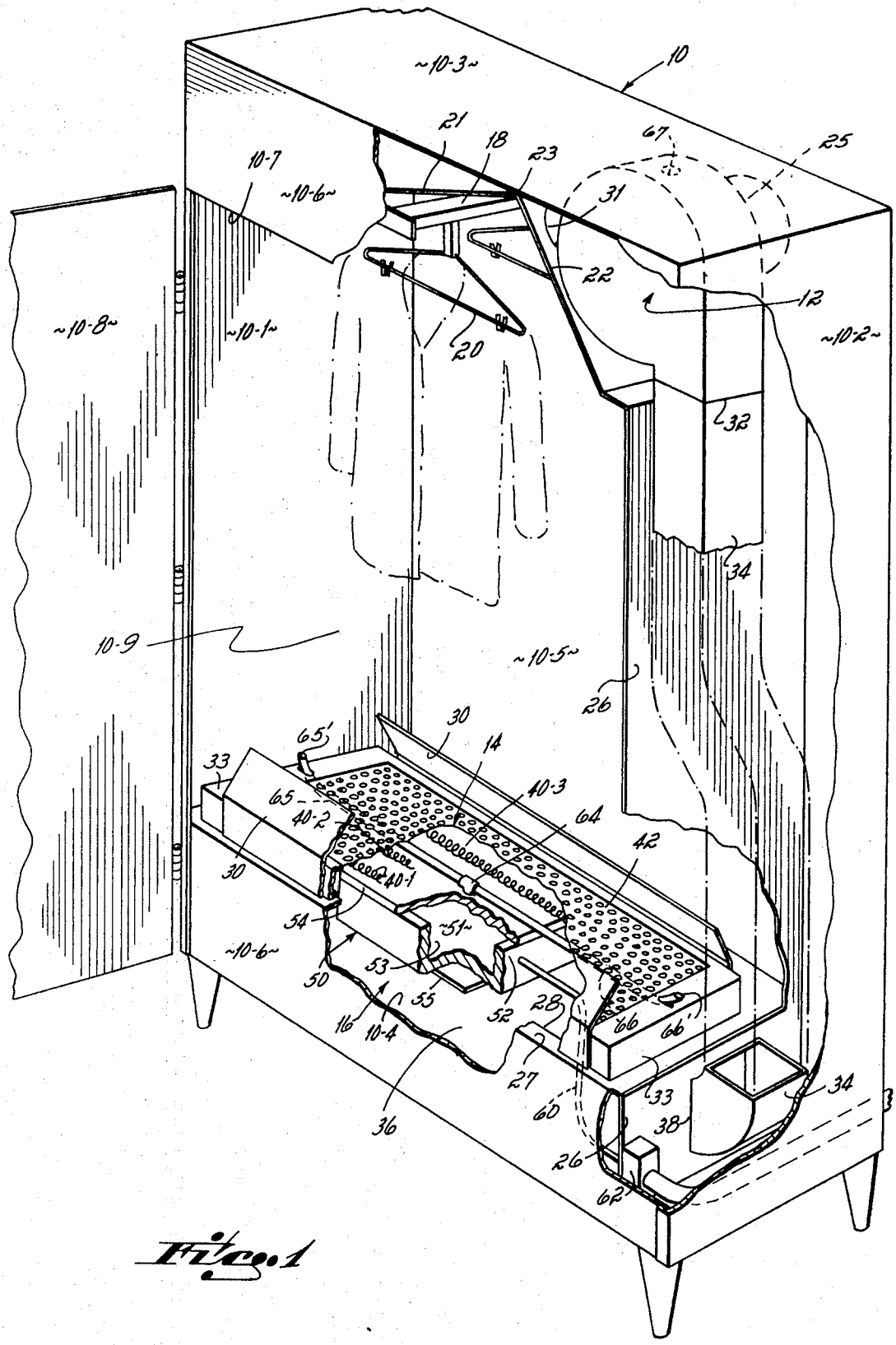


Fig. 1

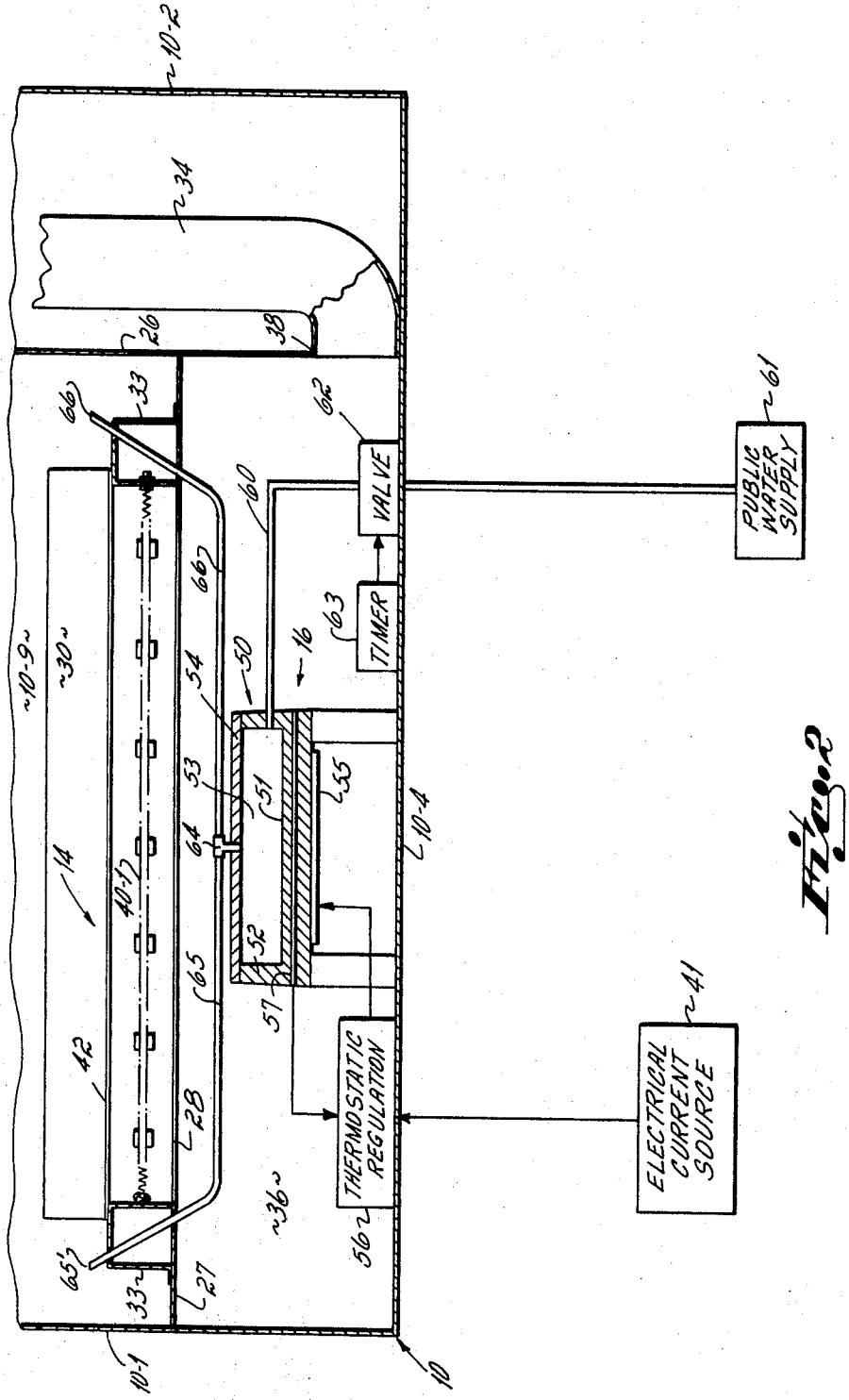
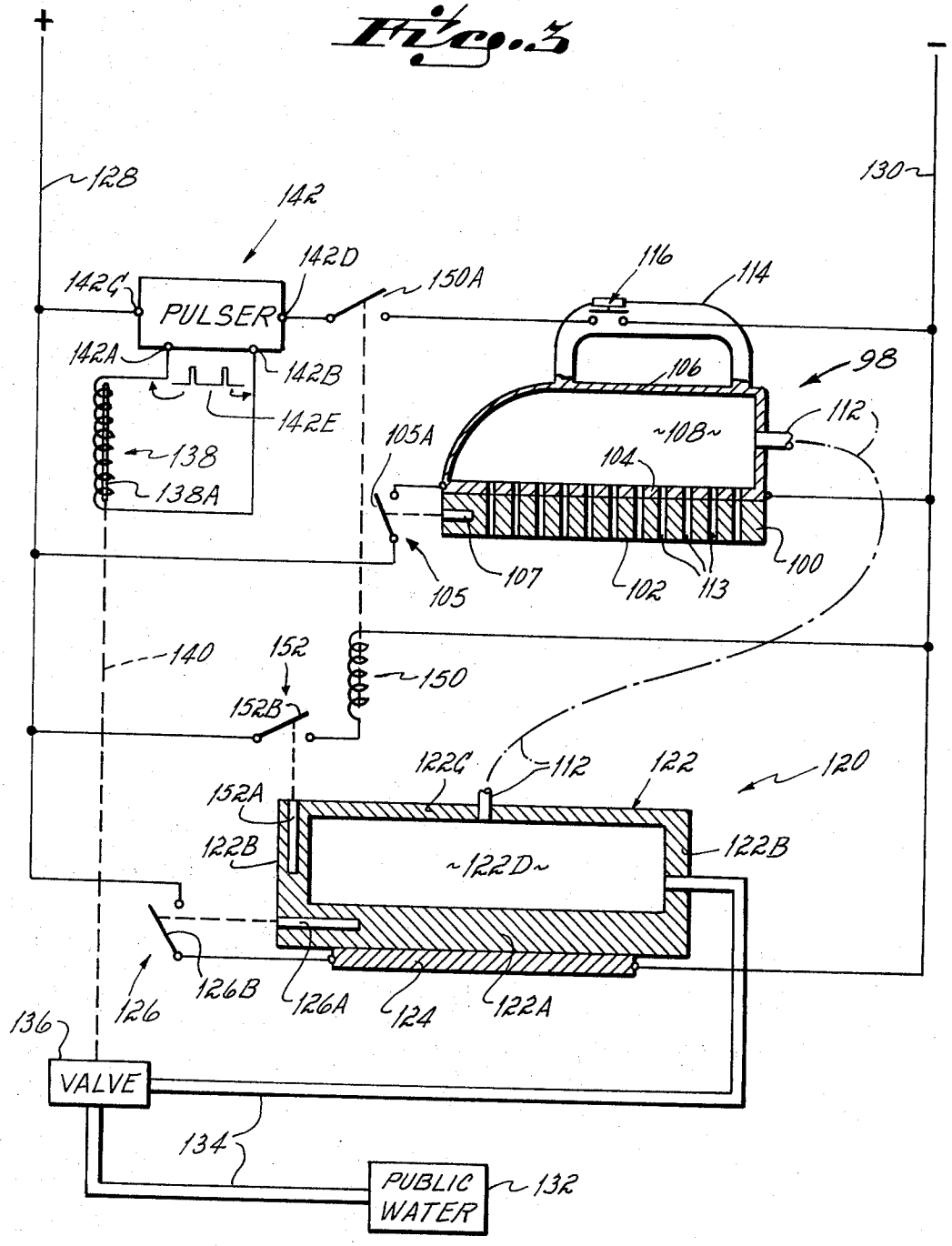

10-2
34
26
38
66
33
62
VALVE
61
PUBLIC WATER SUPPLY
60
63
TIMER
16
10-9
30
66
50
54
53
51
55
10-4
14
40-1
64
52
65
57
42
28
41
ELECTRICAL CURRENT SOURCE
THERMOSTATIC REGULATION
36
56
65'
33
27
10-1
10

Fig. 2

Fig. 3


+
−
128
130
142
142D
142G
PULSER
150A
116
114
142A
142B
142E
106
98
112
138
138A
105A
108
104
100
105
107
102
113
140
152
150
152B
122G
112
122
120
152A
122B
122D
126
126B
126A
124
122A
136
VALVE
134
PUBLIC WATER
132

GARMENT FINISHING APPARATUS

This application is a continuation-in-part of application Ser. No. 267,518, filed June 29, 1972 entitled "Garment Finishing Apparatus", and now U.S. Pat. No. 3,085,561.

This invention relates to apparatus for dewrinkling clothes by subjecting them to a steaming and hot air drying operation and more particularly to garment dewrinkling apparatus and steam generator therefore which generates steam instantaneously and in a predetermined amount of irrespective of random fluctuations in pressure of the water supplied to the apparatus from which the steam is generated.

In recent years, particularly as a consequence of the rising popularity of garments made of synthetic fibers, it has been the practice to dewrinkle, and in effect, press synthetic fiber garments by subjecting them to high temperature moisture, preferably steam, followed by drying in which the garments are subjected to a continuous stream of hot air. Garment dewringkling apparatus of the type described typically includes a cabinet in which the garments are placed, suspended from hangers, during the moisturizing and drying cycles, a source of steam of subjecting the garments to a moisturizing environment, and a source of warm air for drying the garments after they have been steamed.

The dewrinkling cabinets which first appeared in use were designed for installation in commercial drycleaning establishments where the daily volume of garments is large. These machines were relatively elaborate and complex. Typically, such machines used a separate pressurized steam boiler and condensate return system which would generate steam on a more or less continuous basis throughout the day. An operator, desiring to subject garments in the cabinet to a specified amount of steam equivalent to, for example, 8 ounces of water, would merely leave the garments in the cabinet for a specified length of time. Since steam was being generated continuously and at some controlled, but substantial pressure and at a relatively constant rate, a garment, with relatively good accuracy, could be subjected to a given quantity of steam, which has been found to be desirable, by leaving it in the steam cabinet for a specified length of time.

With the increase in popularity of synthetic fiber garments which are efficiently dewrinkled by steam treatment, and with the trend toward coin-operated, self-service laundry and drycleaning establishments, there has arisen a need for a self-contained garment dewrinkling cabinet of the steam type which is suitable for installation in coin-operated, self-service drycleaning establishments and which can be operated with uniform and satisfactory results by unskilled customers rather than trained operator-employees of commercial drycleaning establishments of the non-self-service type. Unfortunately, and due to the differing circumstances existing in coin-operated, self-service drycleaning establishments vis-a-vis commercial drycleaning establishments, the steam cabinet heretofore satisfactory for large-scale commercial drycleaning establishments utilizing trained personnel to operate the equipment on a continuous basis has not proven satisfactory for the self-service, coin-operated drycleaning establishment having considerably smaller volume, intermittent operation, and customers untrained in the operation of the equipment.

First the separate steam boiler present in large-scale commercial steaming units requires substantial floor space. This problem is particularly acute in coin-operated, self-service installations where floor space is expensive. Second, large-scale commercial steaming units with their separate pressurized boilers and return system often conflict with local building code restrictions relating to pressure vessels and water discharge, with the result that installation is complicated, and in some cases prevented. Third, with commercial boiler installations the expense of boiling water treatment is substantial. Fourth, the pressurization of the boiler unit in a large-scale commercial unit poses a hazard from explosion. Fifth, the substantial cost of the large-scale commercial steam cabinet, a significant cost factor of which is the cost of the steam generator, while tolerable in a large volume operation, is intolerable in a small-scale, coin-operated, self-service establishment where the unit may be used only fiften minutes each hour. While attempts have been made to reduce the cost of commercial installation dewrinkling apparatus by substituting, for the large-scale steam generating boiler, a simplified steam generator of the immersion heater type wherein a specified amount of water, for example 8 ounces, is dumped into a pan containing a heat coil, the results have been generally unsatisfactory. The delay with an immersion heater between the time the water is inserted in the pan until steam begins to be generated is still significant, on the order of 30 seconds – 2 minutes. Additionally, there is no quarantee that all the water dumped into the pan will be converted into steam inasmuch as some of the water in the bottom of the pan may not come into contact with the immersion heater and, hence, may not become heated sufficiently to be converted into steam.

It has, therefore, been an objective of this invention to provide a steam cabinet operable by customers having no special machine-operating skills, which in small-scale, coin-operated, self-service drycleaning and laundering establishments or other likely locations, e.g., motel and hotel lobbies, vending areas, etc. having no special machine-operating skills. This objective has been accomplished in accordance with certain principles of this invention by providing a steam cabinet having a highly novel and unobvious steam generating unit utilizing the combination of a heat sink having a water-receiving cavity which is maintained at a temperature substantially above the boiling point of water to convert water input to it into very low pressure steam on an instantaneous basis, and a means for supplying to the heat sink cavity a predetermined quantity of water for steam generation which, in a preferred from, includes a timer-controlled valve connectable to an unregulated pressure city water main which provides a water flow output which is constant irrespective of fluctuations in the pressure of the water main. In operation, in this invention, the water valve under the control of the timer is opened for a specified time, for example, 10 seconds, during which a predetermined quantity of water, such as 8 ounces, is dumped into the heat sink cavity, and as a consequence of the elevated temperature of the heat sink and the fact that all the water is in contact with it, the water is converted into steam without any delay and continues until the entire amount of the water has been converted to steam, thereby producing a predetermined quantity of steam on an instantaneous basis.

The steam generator of this invention, particularly by virtue of the timer-controlled, pressure-insensitive valve, is particularly advantageous for use in commercial coin-operated, self-service drycleaning and laundry establishments. In such establishments, which typically have from 20 to 50 water-consuming washing machines, the pressure in the city water main at the installation varies considerably and in an unpredictable manner due to the unscheduled operation of the clothes washers, which is random both with respect to time of operation and number of machines operating at any given time. With this invention the timer-controlled valve is insensitive to pressure variations in the local supply main, and a constant charge of water, dependent only on the time duration of valve operation, is obtained. Thus, uniformity in quantity of steam generation per garment treating cycle is obtained.

The steam generator of this invention, which combines, inter alia, a pressure-insensitive valve with a heat sink, has also been found to possess an unusually high degree of utility in applications involving portable combination steam/electric irons. A conventional portable steam/electric iron of the type useful in commercial drycleaning and laundry operations typically includes an electrically heated sole plate, the bottom surface of which contacts the fabric being pressued, as well as means to apply steam to the fabric as it is being ironed. The portable steam/electric iron is also provided with a handle, enabling the operator to manipulate it.

The portable irons of the type used in commercial laundry and dry cleaning establishments, the steam applied to the fabric as it is being ironed is obtained from a remote steam generating unit and transported to the iron via a flexible hose. In view of the rather substantial steam required in portable irons used in commercial businesses, remotely located large capacity steam generators separate from the iron itself are necessary. This is in contrast to portable irons common for home use where the steam requirements are low and can be generated within the iron itself.

It has been found that the steam generator of this invention can be advantageously used as a remote source of steam for portable irons of the type used in commercial drycleaning and laundry establishments. When the steam generator of this invention, which combines a pressure-insensitive valve connected between an unregulated-pressure public water supply and a heat sink, is used to supply steam to a portable iron via a hose, it has been the practice for the operator to control the water valve from a manually-operable switch at the iron. When the operator desires steam, the manually-controlled switch, which may be mounted on the iron itself, is activated to open the pressure-insensitive valve and cause water to be supplied to the heat sink for conversion into steam and application to the fabric via the flexible hose connecting the remote steam generator with the iron.

However, in using the steam generator of this invention with portable irons in the manner indicated, a problem has arisen. Specifically, the problem involves the tendency of an operator manually controlling the water valve to supply water to the steam generator by excessively prolonged actuation of the manually-controlled switch, such that water is supplied at a rate for greater than can be formed into steam for transport to the portable iron, with the result that the steam generator becomes flooded, deleteriously affecting its operation. As noted, the flooding is produced due to the fact that the employee/operator of the commercial laundry and drycleaning establishment typically activates the pressure-insensitive flow valve, which controls the supply of water to the steam generator from a city water supply, for periods of time far in excess of that required.

Accordingly, it has been an objective of this invention to provide a portable iron with a steam generator having a heat sink and pressure-insensitive valve, in which the generation of steam is under control of the operator, and which is free of any tendency to flood the heat sink with water should the operator activate the manually-controlled pressure-insensitive valve for extended periods of time. This objective has been accomplished in accordance with further principles of this invention by interconnecting, between a pressure-insensitive valve of the solenoid type and a manually-controlled valve-actuating electrical switch, a low-duty cycle electrical pulser which intermittently energizes the solenoid, effectively opening the valve on an intermittent basis for only a small fraction of the time the manually-controlled switch is actually actuated by the operator. In a preferred form the pulser generates, in response to continuous actuation of the manually-controlled switch, electrical pulses having a duty cycle of approximately 5 percent, with the result that the solenoid-operated pressure-insensitive valve is actually only placed in an open condition 5 percent of the time interval the manual control is operated.

With this invention, the quantity of steam generated is directly correlated to the duration the manually-controlled switch is actuated by the operator and independent of any pressure fluctuations in the public water supply to which the steam generator is connected. Further, since the steam generator is input via the pressure-insensitive valve with water from the public water supply for only a small fraction, e.g., 5percent, of the interval during which the manually controlled switch is operated, flooding of the steam generator is eliminated should the manually-controlled switch be operated by the user of the portable steam iron for an extended or excessive period.

These and other advantages and objectives of the invention will be more readily apparent from a detailed description of the drawings in which:

FIG. **1** is a perspective view, partially cut-away, of the steam cabinet of this invention;

FIG. **2** is a vertical cross-sectional view through the lower portion of the steam cabinet showing the relationship of the air circulating passages, steam generator, and air heater; and

FIG. **3** is a schematic diagram of another embodiment of the steam generator of this invention, and associated electrical control circuitry, for use with a portable steam iron having a manually-operated steam control actuator.

The preferred embodiment of the garment conditioner depicted in FIGS. **1** and **2** includes as its principal components a cabinet **10** in which the garments to be conditioned or dewrinkled are placed, a steam generator **16** for introducing into the cabinet interior to dewrinkle the garments a predetermined quantity of steam each operating cycle, an air circulating system **12** for recirculating air within the cabinet, and an air heating unit **14** which heats the circulating air to facilitate drying the garments which have been steamed.

The cabinet **10** is generally box-like and includes opposite side walls **10-1** and **10-2**, a top **10-3**, a bottom **10-4**, and a back **10-5** and front **10-6** having an opening **10-7** provided with a hinged door **10-8** for selective placement and removal of garments in the cabinet interior **10-9**. A stationary support bracket **18** spannning the back and front walls **10-5** and **10-6** has hangers **20** suspended from it for supporting garments in vertical disposition within the cabinet interior **10-9**. A false ceiling is provided having planar sections **21** and **22** which slope downwardly and outwardly from a common junction line **23** extending from front to back along the interior of the cabinet top **10-3**. The downwardly and laterally extending slope of false ceiling sections **21** and **22** reduces the likelihood that steam condensing on the false ceiling will drip onto garments suspended from hangers **20**. Condensed steam will have a tendency to roll down the sloping false ceiling sections onto the interior of side walls **10-1** and false side wall **26** and thence to the bottom of the cabinet where it is removed via evaporation. The cabinet **10** as noted is provided with the false side wall **26** which runs from the lower edge of the false ceiling section **22** to the bottom panel **10-4**. The false side panel **26** and false ceiling panel **22** enclose components of the air circulating system **12** to be described in more detail hereafter. A false bottom **27** having a rectangular opening **28** is also included in the cabinet **10**. The false bottom functions to enclose the steam generator **16** and in combination with the lower portions of the front wall **10-6**, rear wall **10-5**, and side walls **10-1** and **26**, and bottom panel **10-4**, forms a duct, passage or cavity **36** for distributing air from the air circulating system **12** to the cabinet interior **10-9** via the opening **28**. Located over the opening **28** is the air-pervious heater **14** for heating air entering the cabinet interior **10-9** via opening **28**. The cabinet **10**, including its various walls, panels and the like, are preferably fabricated of sheet metal.

The air circulating system, considered in more detail, includes a blower motor unit **25** located in the space between false ceiling panel section **22** and cabinet top **10-3**. The blower unit **25** has an inlet port or duct **31** which communicates with the interior of the cabinet **10-9** via an opening in the false ceiling panel section **22** and an outlet **32**. A duct **34** located in the space between false side wall **26** and side panel **10-2** connects the outlet **32** of the blower **25** to the cavity **36** lying between the false bottom **27** and the bottom panel **10-4**. The lower end **38** of the duct **34** communicates with the cavity **36** via a suitable opening in the lower portion of false side wall **26**, which lower side wall portion forms one side of the structure defining cavity **36**. When the blower motor unit **25** is energized, air from the cabinet interior **10-9** enters the motor inlet duct **31** at the top of the cabinet interior and exits under pressure from the motor outlet **32** where it is transported downwardly by the duct **34** to the cavity **36** underlying the false bottom **27**. The air in the cavity **36** is then distributed upwardly through the false bottom opening **28**, passing through the heater **14**, wherein it becomes heated, to the interior of the cabinet **10-9**, drying garments on hangers **20** previously subjected to a steam cycle to be described. Eventually the air again enters the blower motor inlet **31** and the recirculation process is repeated. A portion, e.g., 10 percent, of the air entering the blower inlet **31** exhausts to the atmosphere via a vent hole **67** provided in the blower outlet side of the motor **32**, to facilitate removal of moisture from the cabinet interior **10-5**. By design, cracks exist in the cabinet **10** by virtue of imperfect sealing of the door **10-8** with cabinet opening **10-7** to permit make-up air to enter the cabinet interior **10-9** and avoid creation of a significant vacuum in the cabinet interior as a controlled quantity of air is exhausted at opening **67** to remove moisture when the blower motor unit **25** is energized.

The air heater which overlies the opening **28** in false bottom **27** may take a variety of forms. Preferably the heater is a resistance heating coil having a number of strands **40-1, 40-2, 40-3** spanning the opening **28** in a horizontal plane. Strands **40-1, 40-2** and **40-3** are anchored at each end to square cross-section transverse channel members **33, 33** mounted to the upper surface of false bottom **27** adjacent the opposite sides of opening **28**. The resistance heating strands **40-1, 40-2** and **40-3** are connected to a suitable source of electrical current (not shown) and when energized from such current source becomes sufficiently elevated in temperature to heat the recirculating air as it passes upwardly into the cabinet interior **10-9** via opening **28** in the false bottom **27**.

The air heater **14** also preferably includes an air pervious, perforated cover plate **42** disposed in a horizontal plane to the opening **28** and overlying the heating strands **40-1, 40-2, 40-3**. The perforated plate **42** protects garments, which inadvertently may fall from the hangers **20** to the bottom of the cabinet—from being burned which would otherwise result where the plate omitted and the falling garments to come into direct contact with the heating strands **40-1, 40-2, 40-3**. Also, since the perforated plate **42**, by virtue of its proximity to the heating strands **40-1, 40-2, 40-3**, becomes heated, it provides additional heat transfer surface for heating the circulating air entering the cabinet interior **10-9** via opening **28**.

A pair of upwardly and inwardly disposed plates **30, 30** are secured to false bottom **27** adjacent the front and rear edges of the opening **28** and deflect the air issuing from opening **28** to the center of the cabinet interior **10-9**.

The steam generator **16**, which is located in the cavity **36** underlying the false bottom **27**, provides two principal and highly advantageous operating characteristics. These are, first, the generation of steam instantaneous upon introduction of water into the steam generator from a local supply such as a water main and, second, the generation of steam in a predetermined quantity per garment conditioning cycle irrespective of variations in pressure of the local water supply to which the steam generator is connected. To accomplish these advantages, the steam generator **16** includes a heat sink **50** in the form of a block having a planar horizontal surface **51**, the circumferential edge of which is completely surrounded by an upstanding wall **52** to form a cavity or receptacle **53**. The heat sink **50** is preferably fabricated of material such as cast iron having a low specific heat and high density. The cavity **52** is sealed by a metal plate **54** which seats on the upper edge of upstanding wall sections **52**. A heater **55**, preferably of the electrical resistance type, is mounted to the bottom surface of the heat sink block **50** for heating the block when energized from a power supply **41** under the control of a thermostatic regulator **56** which responds to a temperature sensor **57** imbedded or attached to the

heat sink **50.** Preferably two temperature-sensing elements **57** (only one of which is shown) are provided. One of the temperature-sensing elements causes the thermostatic regulator **56** to terminate energization of the heat **55** when the heat sink **50** has reached a desired upper temperature limit, e.g., 450°F. while the other temperature sensor precludes the commencing of another cycle until the heat sink has at least reached some predetermined lower temperature limit, such as 400°F. The temperature sensors **57** and thermostatic regulator **56** are conventional and well known components in the heating field and, accordingly, are not further described herein.

When a predetermined amount, or charge, of water is introduced into the cavity **53,** by means to be described, a conversion of water to steam occurs instantaneously as the water contacts the heat sink surface **51** which is maintained at a high temperature substantially above the temperature at which water boils under the atmospheric air pressure conditions present in cavity **53.** The heat sink **50** preferably has a mass and specific heat selected to store heat in an amount sufficient to prevent the temperature of the surface **51** from dropping below, or even near, the boiling point of water in the course of converting to steam the predetermined quantity of water, or charge, introduced into the cavity **53** per garment conditioning cycle. In this way the charge of water introduced into cavity **53** will continue to be converted into steam from the moment of its introduction into the cavity until all of the water has been boiled.

Communicating with the cavity **53** of the heat sink **50** is a water conduit **60** which connects to a conventional unregulated pressure water supply **61** via a constant flow output, pressure insensitive valve **62** controlled by a timer **63.** It is essential that the valve **62** be of the general type which provides at its output a constant flow rate per unit time independent of fluctuations in pressure of the fluid entering its inlet. Controlling the valve **62** is a timer **63** which, under command of a signal from a control circuit (not shown) functions to open the valve **62** for a predetermined period of time, thereby effecting delivery of a predetermined quantity of water, for example, 12 ounces, from unregulated pressure water supply **61** to the heat sink cavity **53,** irrespective of variations in the pressure of the water supply **61** to which the steam generator **16** may be connected.

Provision of means to provide a constant quantity of water to the steam generator **16** irrespective of pressure fluctuations in the water supply to which the steam generator is connected is particularly advantageous when the steam cabinet is utilized in a conventional self-service, coin-operated laundry and drycleaning installation having a large number, for example, 20–50, clothes washers. In such an installation, the pressure of the local water supply **61,** for example, the city water main, will vary to a large extent depending upon the number of clothes washers being utilized at any given time. Obviously, every time a clothes washer begins to draw water from the city main, there is a drop in pressure of the water supply, at least temporarily. the combination of valve **62** and timer **63** of this invention provides a predetermined quantity of water to the steam generator cavity **53** for generation into steam and subsequent conditioning of clothes in the steam cabinet **10,** notwithstanding unpredictable fluctuations in pressure of the city water main which are prevalent in self-service, coin-operated installations where clothes washers utilize water at unpredictable times and rates.

Communicating with the interior **53** of the steam generator heat sink **50** is a tubular fitting **64** which has extending from opposite arms thereof tubular branch conduits **65** and **66** which pass through the false bottom **27** of the steam cabinet and channels **33, 33** terminating with their exit ends **65'** and **66'** in the cabinet interior **10-9.** Tubular fitting **64,** in combination with the branch conduits **65** and **66,** are unrestricted and distribute steam to the interior of the cabinet **10-9** generated in the cavity **53** when the water input thereto via conduit **60** vaporizes upon contact with the heated sink surface **51.**

An important aspect of this invention is the fact that by maintaining the heat sink **50** at a temperature substantially above the boiling point of water, steam is instantaneously generated as an incident to introduction of water into the heat sink cavaity **53** via conduit **60.** Thus, the normal delays commonplace when conventional immersion water heaters and the like are used are avoided. Another important characteristic of this invention is that the steam generator provides a predetermined quantity of steam per garment conditioning cycle irrespective of fluctuations in pressure of the city water main to which the steam generator is connected. A third advantage of this invention is that all the water introduced into the cavity **53** is converted to steam since at all times the water is in contact with the heated surface **51.** This is contrary to the operation of immersion heaters where often some of the water in the bottom of the pan in which the immersion heater is located is out of contact with the immersion heating element and, hence, is not converted to steam. Additionally, since the cavity **51** is open to the atmosphere via tubes **65** and **65'**, the steam produced is at a low pressure and non-hazardous. Finally, by locating the heat sink **50** in the path of the recirculating air, the air will be heated by the heat sink as well as by heating strands **40-1,** 40-2, 40-3 as it flows through cavity **36.**

While the invention has been described as useful in vaporizing water, it will be understood that other fluids susceptive of vaporization with the apparatus of this invention may be employed, and accordingly the term "water" as used in the claims includes such other fluids.

The invention has been described in conjunction with a steam cabinet, but it is of equal value in other steam operated devices such as steam irons, spotting boards and form finishers and it is intended that this invention apply to these and other devices using evaporated fluids. For example, when the invention is used in the steam iron, the timer **63** controlling the valve **62** is replaced by a manually operated switch which opens the valve for a variable interval dependent upon the deviation of manual actuation of the switch to provide a charge of water which is independent of water supply pressure variations and dependent only upon the duration of switch actuation. Of course, when used in a steam iron the steam tubes **65** and **65'** communicate with the steam emission holes in the bottom of the iron.

With reference to FIG. **3,** a portable iron **98** is shown adapted to be provided with steam from a remote steam generator **120** constructed in accordance with the principles of this invention. The portable iron **98** includes a sole plate **100** having a bottom surface **102** which is designed to slidingly engage the fabric being

pressed. The sole plate **100** is maintained at a desired temperature dependent upon the nature of the fabric being pressed by an electrical resistance heating element **104** which is in heat transfer relationship to the sole plate. The resistance heating element **104** is connected between positive and negative power lines **128** and **130** via a thermostatically controlled switch **105** which is responsive to a temperature-sensing element **107** embedded in the sole plate **100.** When the temperature of the sole plate **100** reaches the predetermined desired level, the movable contact **105**A of the thermostatically controlled switch **105** transfers from a closed-circuit condition to an open-circuit condition, terminating energization of the resistance heating element **104.** Conversely, when the temperature of the sole plate **100** drops below the predeterined level, the thermostatically controlled switch element **105** reverts to a closed-circuit condition re-energizing the resistance heating element **104,** in turn increasing the temperature of the sole plate **100** to the desired level.

Located above the combination resistance heating element and sole plate **100, 104** is a housing **106** which in combination with the resistance heating element **104** defines a cavity **108** into which steam is introduced via flexible hose **112** connected to the remote steam generator **120.** Steam introduced into the cavity **108** is applied to the fabric being pressed via a pluraity of perforations **113** provided in the combination resistance heating element **104** and sole plate **100.**

The housing **106** is provided with a handle **114** for facilitating manipulation of the iron. A manually operated single pole, single throw electrical switch **116** conveniently mounted to the handle **114** is provided to control, in a manner to be described, the generation of steam by the steam generator **120** which, via hose **112,** cavity **108** and perforations **113** is ultimately applied to the fabric being ironed.

The steam generator **120** includes a heat sink **122** comprising a bottom **122**A, sides **122**B and a top **122**C which collectively establish a cavity **122**D. The heat sink **122** is maintained at a predetermined temperature, for example 450°F, by a thermostatically controlled electrical resistance heating element **124,** which is preferably embedded in the base **122**A of the heat sink **122.** The resistance heating element **124** is connected between power lines **128** and **130** via a htermostatically controlled switch **126.** Switch **126** is responsive to a temperature sensing element **126**A embedded in the heat sink **122.** When the temperature of the heat sink **122** as sensed by the temperature sensing element **126** reaches the desired 450° temperature level, the movable contact **126**B thereof is transferred from a closed-circuit condition to an open-circuit condition, de-energizing the resistance heating element **124.** When the heat heat sink temperature has dropped below the predetermined 450°F limit, the temperature sensing element **126**A places the movable contact **126**B in a closed-circuit condition, re-energizing the resistance heating element **124** to return the temperature of the heat sink to the desired level.

Water is supplied to the cavity **122**D of the heat sink **122** for conversion into steam and ultimate application to the fabric via hose **112,** cavity **108** and perforations **113,** from a public water main **132** which is unregulated with respect to pressure. Specifically, water is input to the heat sink cavity **122**D via a water pipe **134** in which is placed a pressure-insensitive valve **136** of the type described in connection with the embodiment of FIG. **2,** namely, of the type which provides a constant output flow rate irrespective of the pressure of the public water supply **132.** Thus, when the valve **136** is open, the flow rate through the valve from the public water supply **132** to the cavity **122**D will be constant irrespective of fluctuations in the pressure of the public water supply.

The valve **136** is placed in an open condition to permit the flow of water therethrough under the control of the movable armature **138**A of a solenoid **138.** Armature **138**A is mechanically linked to the valve operator by suitable means, shown schematically with dotted line **140.** Solenoid valve **138** is energized by an electrical pulse generator **142,** across whose output terminals **142**A and **142**B the solenoid **138** is connected. The pulser **142,** when energized in a manner to be described, provides across its output terminals **142**A and **142**B pulses of the general nature of waveform **142**E. The pulses output from the pulse generator **142** have a low duty cycle, i.e., have a pulse width which is a small fraction of the pulse spacing, preferably one-twentieth (5 percent).

In practice a pulse width of 0.02 seconds and a pulse spacing of 0.38 seconds has been found satisfactory. Obviously, other pulse widths and spacings could be used to avoid flooding of the heat sink cavity.

The pulser **142,** which has its output terminals **142**A and **142**B connected across the solenoid **138,** has its input terminals **142**C and **142**D connected across the power lines **128** and **130** via the manually operated electrical switch **116** mounted on the iron handle **114** and a relay contact **150**A of a relay **150.** Relay **150** is connected between power lines **128** and **130** via a thermostatically controlled switch **152** responsive to a temperature sensing element **152**A embedded in the heat sink **122.** When the temperature of the heat sink exceeds a predetermined low temperature limit, e.g., 400°F, the movable contact **150**B of thermostatically controlled switch **152** is placed in a closed-circuit condition, energizing relay **150,** in turn closing relay contact **150**A. With relay contact **150**A in a closed-circuit condition, the pulser **142** is enabled, that is, is readied for energization upon actuation of the manually controlled switch **116.**

Assuming the heat sink **122** has reached a predetermined low temperature limit, which low temperature limit is selected to assure conversion to steam of all water input to cavity **122**D via valve **136** at a rate established by the combined operation of the pulser and the valve, the movable contact **152**B of thermostatically controlled switch **152** will close, energizing relay **150,** in turn closing relay contact **150**A to enable the pulser **142** to be energized upon subsequent actuation of switch **116.** Under such circumstances, when the manually operated switch **116** is placed in its closed-circuit condition, the pulser **142** will be energized. With the pulser **142** energized, the low duty cycle pulses are input to the solenoid **138** energizing this solenoid on an intermittent basis in synchronism with the intermittent pulses provided by the pulser. So long as the heat sink temperature exceeds 400°F and the switch **116** is actuated, the solenoid **138** will be intermittently energized at low duty cycle, in turn placing, via solenoid armature **138**A, the valve **136** in an open-condition on an intermittent basis, allowing water to intermittently flow from the public water supply **132** to the heat sink cavity

122D. The intermittent energization of the solenoid **138** and intermittent operation of the valve **136** are in synchronism with the intermittent pulses provided by pulser **142.** The duty cycle of the pulses output from the pulse generator **142** and the flow rate of the valve **136** when in its open condition are selected such that if the switch **116** is maintained closed, all water input to the cavity **122D** will be converted to steam, thereby avoiding flooding of the cavity **122D.**

The low duty cycle pulses, which preferably have a pulse width equal to approximately 5 percent of the pulse spacing, as noted, intermittently produce opening of the valve **136** on a correspondingly low duty cycle basis. For example, if the manually operated switch **116** is closed continuously for a 4-second interval, ten equally spaced pulses having a width of 0.02 seconds and a spacing of 0.38 seconds will be input to the solenoid **138** in turn opening the valve **136** for ten equally spaced **0.02** second intervals. By utilizing a low duty cycle to operate the valve in response to the manual switch **116,** should the switch be maintained in a closed-circuit condition on a continuous basis for a protracted period of time, the intermittently operated valve **136** will provide to the heat sink cavity **122D** from the public water supply **132** a quantity of water which will be fully converted into steam by the generator **120,** thereby avoiding flooding of the heat sink cavity **122D.** Thus, even if the operator were to maintain the switch **116** in a closed-circuit condition for an extended period, the valve **136** is operated on a low duty cycle, intermittent basis, preventing flooding of the cavity **122D** with water.

The pulser **142** may take a variety of form and, for example, may consist of a free-running, or astable, multivibrator which is asymmetric in the sense that the pulser width is unequal to the pulse spacing such as is represented by wave form **142E.**

From the foregoing disclosure of the general principles of the present invention and the above description of the preferred embodiment, those skilled in the art will readily comprehend various modifications to which the present invention is susceptible. Accordingly, I desire to be limited only by the scope of the following claims:

I claim:

1. A steam generator connectable to a supply of variable pressure water for providing in response to actuation of a switch steam at a specified rate irrespective of water pressure variations, comprising:

a heat sink having a high temperature surface defining a cavity therein communicating with the atmosphere for containing in contact therewith water which boils at a specified temperature,

a heater in heat transfer relationship to said heat sink for heating said heat sink surface to said high temperature, said high temperature being substantially above said specified boiling temperature,

a thermostatic regulator for maintaining said heat sink surface at approximately said high temperture,

a valve having an outlet connected to said heat sink and having an inlet connectable to said variable pressure water supply, said valve constructed to provide, when open, an output water flow at a constant rate per unit time independent of water supply pressure fluctuations, and

valve control means responsive to continued actuation of said switch for intermittently opening said valve to cause said valve to deliver to said heat sink, on an intermittent basis, a specified quantity of water directly correlated to the time duration said switch is continuously actuated, said intermittent opening of said valve being at a relatively low duty cycle to avoid flooding of said heat sink by prolonged and continuous actuation of said switch.

2. The steam generator of claim **1** wherein said switch is an electrical switch and said valve control means includes:

a pulse generator responsive to said switch for providing low duty cycle electrical pulses when said switch is continuously actuated, and

an electromechanical actuator responsive to said pulses for intermittently opening said valve to cause said valve to deliver to said heat sink, on an intermittent basis, a specified quantity of water directly correlated to the time duration said electrical switch is continuously actuated.

3. A steam generator connectable to a supply of variable pressure water for providing a specified quantity of steam irrespective of water pressure variations, comprising:

a heat sink having a high temperature surface defining a cavity therein communicating with the atmosphere for containing in contact therewith a charge of water which boils at a specified temperature,

a heater in heat transfer relationship to said heat sink for heating said heat sink surface to said high temperature, said high temperature being substantially above said specified boiling temperature,

a thermostatic regulator for maintaining said heat sink surface at approximately said high temperature,

a valve having an outlet connected to said heat sink and having an inlet connectable to said variable pressure water supply, said valve constructed to provide, when actuated, an output water flow at a constant rate per unit time independent of water supply pressure fluctuations, and

valve control means for controlling the actuation of said valve to cause said valve to deliver to said heat sink a specified quantity of water directly correlated to the time duration said valve is actuated by said valve control means.

4. The combination comprising:

a portable electric iron,

a supply of pressurized water at a pressure which varies unpredictably with time,

an electrical switch mounted to said iron,

a heat sink having a high temperature surface defining a cavity therein at substantially atmospheric pressure for containing in contact therewith water which boils at a specified temperature,

a heater in heat transfer relationship to said heat sink for heating said heat sink surface to a high temperature, said high temperature being substantially above said specified boiling temperature,

a thermostatic regulator for maintaining said heat sink surface at approximately said high temperature,

a valve controlled by said switch and having an outlet connected to said heat sink and having an inlet connected to said variable pressure water supply, said valve constructed to provide, when open, an output water flow at a constant rate per unit time

independent of water supply pressure fluctuations, and

a flexible steam conduit connecting said heat sink cavity to said portable electric iron for facilitating application of steam generated by said heat sink to a fabric being pressed by said portable iron.

5. The combination of Claim **4** further comprising:

valve control means interconnecting said switch and said valve and responsive to continued actuation of said switch for intermittently opening said valve to cause said valve to deliver to said heat sink, on an intermittent basis, a specified quantity of water directly correlated to the time duration said switch is continuously actuated, said intermittent opening of said valve being at a relatively low duty cycle to avoid flooding of said heat sink by prolonged and continuous actuation of said switch.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,869,815

DATED : March 11, 1975

INVENTOR(S) : Norman J. Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Related U.S. Application Data, [63], change Pat. No. 3,085,561 to Pat. No. 3,805,561.

Column 2, line 11, change the word "boiling" to --boiler--.

Column 6, line 31, change the word "where" to --were--.

Column 6, line 60, change the number "52" to --53--.

Signed and Sealed this

twenty-sixth Day of August 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,869,815

DATED : March 11, 1975

INVENTOR(S) : Norman J. Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Related U.S. Application Data, [63], change Pat. No. 3,085,561 to Pat. No. 3,805,561.

Column 2, line 11, change the word "boiling" to --boiler--.

Column 6, line 31, change the word "where" to --were--.

Column 6, line 60, change the number "52" to --53--.

Signed and Sealed this

twenty-sixth Day of *August 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks