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(54) STEAM IRON

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the Laws of the State of New York, United States of America, of 1 River Road, Schenectady 12305, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to steam irons; and seeks to provide a combination flash/flooded boiler system steam iron that provides flexibility by modifying the water valve structure to take advantage of both types of operating systems. Thus; flooded operation provides wet or saturated steam at a high rate and lower operating temperatures for a shorter time, or flash operation provides dry or superheated steam at a lower rate and is available at higher temperatures for a longer time to provide an iron with large user flexibility.

There are generally two well-known systems of steam irons and these are the flooded boiler and the flash boiler iron and irons are usually one version or the other. The flooded boiler is not widely used in this country but is well-known and is used abroad. This allows water to drip into a soleplate steam boiler at a rate greater than the rate at which steam is formed in the boiler so that the boiler remains flooded and heat transferred to the tank is minimized. The steam formed in the boiler is separated from the remaining boiler water and directed first into the tank and then ducted to the soleplate and fabric. A typical flooded boiler steam iron is shown in U.S. Patent No. 3,156,054.

The other system known as the flash boiler converts the water immediately into steam and has the advantage of providing very quick steam operation after starting with a cold iron. However, to accomplish rapid steaming it is necessary to have high temperature for the metallic components in

which the steam is generated and delivered. Thus, the steam is relatively dry and substantially above the water boiling temperature. This steam is not as satisfactory as a wetter lower temperature steam for moistening fabrics since it does not readily condense on the fabric to assist in ironing. Also, its steam rate does not vary with the temperature setting since it is a function of the drip rate and the wattage of the iron. This latter system has been particularly successful commercially in this country.

Thus, both flash boiler and flooded boiler irons are well-known and irons usually are one version or the other with the flash boiler being more popular in this country. The prior art has not provided a simple and inexpensive iron using advantages of both the flooded boiler and the flash boiler to provide a high rate or large quantity of wet steam at low temperature settings at iron temperatures above 212°F (100°C) and also sufficient dry steam at a lower rate for a long time at high temperatures to provide great flexibility to the user.

The present invention provides a steam iron having a water tank and a steam generating soleplate having a boiler therein, metering means intermediate the water tank and the boiler for selectively preventing flow of water therebetween and for selectively permitting flow of water at a plurality of flow rates, said plurality of flow rates including a first rate selected to maintain the boiler in a flooded condition at least during iron operation at the first range of ironing temperatures and a second rate selected to maintain the boiler in a flash steam condition at least during iron operation at a second range of operating temperatures, and distribution means communicating with the boiler for supplying steam generated therein to a point of use.

In order that the invention may be clearly understood, a preferred embodiment thereof will now be described by way of example only with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevation, partially in sec-

tion and broken away, of the steam iron; and

Fig. 2 is a perspective, partially broken away, of a modification of part of the iron of Fig. 1.

Referring to Fig. 1, a steam iron embodying the invention typically includes a soleplate 10, connected cover 12, and operating handle 14. In accordance with conventional practice, soleplate 10 may be cast from aluminium with an electrical heating element usually of the sheath type in which an electrical resistance 16 extends through a protective sheath with the heating element separated from the sheath by an insulating compound such as a mass of granulated and compressed magnesium oxide. The entire heating element 16 is cast into the soleplate. The temperature of the soleplate is set by temperature control knob 17 connected to operate a thermostat, generally indicated at 18, all as well-known in the art. Uniform heat distribution is provided by extending the heating element 16 in a loop from the rear along the iron side to the forward end and then rearwardly along the other side.

For steam generation, soleplate 10 has a steam boiler 20 and a suitable water tank 22 supplies water thereto under control of on-off water valve structure, generally indicated at 24, that includes a valve stem 26 suitably actuated by step button 28 through known linkage whereby water drips through orifice 30 into the hot boiler 20 and is converted into steam. Valve stem 26 may be lowered to close off orifice 30 and stop steam generation for dry ironing. The generated steam is directed through steam distributing passages under coverplate 32 and thence out of steam ports 34 to the fabric being ironed. A steam collecting dome 36 is tightly sealed to coverplate 32 in any suitable fashion and also supports various components of the iron including the water valve body 38 and may carry pressure balancing tube 40 which transmits pressure from the boiler to the upper portion of the water tank 22. Generally, though not necessarily, the balance tube will extend above the water surface and this is intended as the upper portion of the tank. All connections to the steam dome are liquid tight, accomplished by brazing, metal spinning, or other well-known techniques. If the iron is operated under pressure, a uniform pressure may be maintained by a steam pressure regulator as fully described in U.S. Patent No. 3,041,757.

In order to equalize pressure throughout the system, balance tube 40 extends above the water line in water tank 22 to ensure the same steam pressure in the upper portion of the tank as in boiler 20 and for greater flexibility, the iron may be operated as a

spray as shown generally at 42 and both systems are well-known.

The structure thus far described is generally conventional and is well-known in the art. If the flooded boiler system is used, water valve 24 is sized to permit water flow into the boiler at a rate greater than the rate at which steam is formed so the boiler remains flooded. If the flash system is used the parts are sized so that water drips into boiler 20 and is immediately flashed into steam and carried to its point of use. Both systems are well-known and widely used.

The present iron combines the two systems in a unique manner to provide many advantages, and especially the ability of the iron to provide steam at a high rate at higher temperatures being also double the rate at which the normal flash boiler system produces. This is achieved by the combination of the two systems resulting in the ability of the systems to interact with one another. Thus, the water from tank 22 is dripped through valve 24 into boiler 20. The valve opening or liquid passage 44 is designed or sized to coact with orifice 30 and pass enough water so that it is supplied to the boiler at a rate greater than the rate at which steam is formed in the boiler at lower ironing temperatures so the boiler operates flooded. The lower temperatures typically are in the range of 230°F (110°—170°) to 340°F. Also, means is provided to operate in conjunction with the sized passage 30 to restrict water flow through the passage to convert the boiler to flash steam operation at higher temperatures, namely, those above 255°F (124°C). It should be noted that this temperature is at restricted flow as opposed to the unrestricted flow for the lower temperatures noted above for flooded conditions. This restrictive means may be any suitable structure to lower the flow rate and conveniently takes the form of a reduced pin portion 46 formed on the end of valve stem 26 to be disposed through the orifice 30 into passage 44 and restrict the water flow. Mechanical steam rate variation is controlled by reduced pin portion 46 with high steam rate operation with the pin portion 46 out of the valve body 38 for flooded operation and low steam rate operation with the pin 46 in passage 44 so that the water flow is cut down through a reduced annular passage around pin 46. Thus, there are at least two selective rates of water flow and steam by sizing liquid passage 44 for operation of boiler 20 in either flooded or flash condition in conjunction with the position of pin 46 out or in the passage respectively. The different water flow rates may be obtained by a reduction such as by the stepped pin 46 or tapered pin or any equivalent construction. Of course, the iron

can always operate as a flash boiler at any temperature.

Since the production of steam in the flooded operation results in steam boiling through the water in boiler 20, it is typical flooded boiler steam or wet steam and it is necessary to separate the steam and water so that only steam can exit steam ports 34. To this end, there is supplied a conduit means connecting the boiler 20 and the upper portion of water tank 22 and this may conveniently be the balance tube 40. Thus, all steam or steam and water generated must pass up the balance tube and into the space in the upper portion of the water tank. Since steam in flooded operation has water with it a suitable separator such as the horizontal baffle plate 48 extends over and is spaced from the end of the balance tube in the upper portion of the tank to impede flow into the tank so that fluid striking the baffle allows the steam to pass around and into the tank whereas the water strikes the baffle and is deflected thereby and carried into the tank by its velocity where it then falls back by gravity to the free water surface of the tank. Thus, all generated steam is conducted to the upper portion of the tank 22. For the steam to exit the iron, there is provided a suitable steam-conveying conduit 50 that, as shown in Fig. 1, extends above the balance tube 40 and above the baffle 48 where it can pick off only steam and direct it down into distribution passages 52 under coverplate 32 to be distributed out of ports 34 in the conventional manner. It will be understood that this is the only means by which the steam may reach the exit ports 34 — by the steam-conveying conduit 50 in the upper or steam portion of water tank 22. By extending the baffle 48 over the balance tube only, the steam exiting from the water tank does not carry any water droplets with it. This is a usual arrangement in a flooded boiler iron. As shown in Fig. 1, it may be convenient to place the conduit 50 inside the balance tube 40. As will be explained, the steam-conveying conduit 50 may be tapered along its length as shown in order to provide an audible steam sound.

An alternative arrangement is shown in Fig. 2 where balance pressure tube 40 serves as the conduit from boiler 20 and adjacent and separate steam-conveying conduit 54 returns the steam to passages 52 and thence to the fabric being ironed out of the ports 34. The separate and adjacent tubular conduits utilize present iron construction and minimize structural changes. Either way, the operation is identical and these are merely two slightly different delineations.

While the steam normally will be conducted to soleplate steam ports, it can be directed to any suitable point of use such

as through a nozzle as in U.S. Patent No. 3,722,117.

From the description of the combination flood/flash boiler iron noted above, there are numerous advantages and modes of operation as will now be explained. In this combination iron there are three prior use systems all incorporated into one unique system. First, with pin 46 in orifice 30 and liquid passage 44, water flow into the boiler is reduced and the system functions as a standard flash boiler at all normal steam iron temperatures — usually above 255°F (124°C). This is essentially the same operation as used on all flash steam irons for a lower steam rate. Thus, the pin "in" permits flash steam operation over the entire temperature range at a lower steam rate. Second, when the pin is out of the orifice, water flow is at a higher rate through liquid passage 44 and the iron operates as a flooded boiler iron at low iron temperatures where the water flows in faster than it can be boiled off as steam and the iron operates as a flash boiler at high iron temperatures where the water is converted to steam as fast as it flows in. Both of these latter modes are high steam rate systems and the iron is able to provide steam at the rate of 0.35 to .040 pounds (16.0 — 18.1 gm) of water per minute at the high temperatures or under flash steam operation whereas previously, with standard flash boiler operation only, as noted above, the rate has been in the range of .017 — .024 pounds (7.7 — 10.9 gm) of water per minute. Therefore, the steam rate is almost a 100 percent increase on flash steam operation. The iron is then self-regulating and automatically adjusts itself to produce flooded operation as the temperature drops and simultaneously automatically adjusts its steam rate at a lower value. Third, the steam separator system works as a separator during flooded operation and as a steam delivery system during flash operation, i.e., the baffling assists separating the steam from the water by impingement during flooded boiler operation and operates as a conduit only or delivery system during flash operation when the fluid is all steam and no water is mixed in.

There are numerous advantages to this unique combination of systems. A, the iron will not drop or spit water from the soleplate at any normal ironing temperature — steam rate combination. This is true of flooded boiler irons in general and is true of this combination because of the inability of any water to enter the steam carrying means 54 in any normal mode of operation — no water can reach the soleplate — only steam. B, during high steam rate operation, when the pin is out of the orifice and the iron is at high temperature and water is

being flashed as fast as it enters the boiler, the iron has an automatic steam rate adjustment that starts when the boiler starts to flood. While flashing, the water valve dictates the steam rate. As the temperature of the iron is lowered there is not enough heat to flash all the water to steam and flooding starts. Now the steam rate becomes a function of the available heat instead of the available water. Thus, as the iron temperature is lowered there is less heat available and hence a lower steam rate because it automatically becomes a flooded boiler operation. C, a third advantage of this iron is its ability to provide saturated steam at iron temperatures above 212°F (100°C). During flooded operation, the steam is generated under water much as it is generated in a teakettle. Because of this excess water, all the heat that would normally superheat the steam is consumed as heat of vaporization by the excess water, i.e., the heat goes into heating the water rather than superheating the steam. The steam thus generated leaves the boiler at 212°F — (100°C) — again like a teakettle — and this operation continues until there is no excess water in the boiler. Therefore, when the water valve 24 provides excess water to the boiler, which boiler may be above 212°F (100°C) the steam will be produced at 212° (100°C) at standard atmospheric conditions because it is just boiled off. This "cool" or "wet" steam is more useable since, as saturated steam, it only has to lose its heat of vaporization to condense on the ironed goods. Superheated steam, on the other hand, must lose not only its heat of vaporization but additionally that sensible heat which brought the steam to the superheated condition. The more easily condensed saturated steam is desirable for ironing. D, another advantage of this iron is the mechanical adjustment of the steam rate — that is the pin in or out of the orifice. This mechanical adjustment controls the water valve to provide continuous flash boiler operation for longer steaming. This can provide a substantially uniform steam rate throughout the steam band of temperatures and is intended to provide a steam rate for permanent press or very light-weight ironing jobs. From the user's point of view, this means that the iron, because of its ability to operate flash or flooded, can be operated flooded over a shorter period of time with a maximum very high steam rate throughout the temperature range or, if less steam is desired, it can be operated as a flash boiler with the pin in the orifice and a lower steam rate over a longer period of time. In either case, in the low temperature range and, regardless of whether the iron is set for either high or low steam rates, the system automatically adjusts itself to limit the steam flow to the heat avail-

able so that the fabric can always be dried while ironing. In other words, the system is self-regulating so that, for example, it cannot provide a high steam rate at a low temperature where it would not then be possible for the iron to dry the fabric. A standard flooded boiler only iron will operate at highest temperature settings with a maximum of steam over a short range of time and require constant fillings and no other mode is available. Also, a flash boiler iron will operate over a long period of time with fewer fillings but at a lower steam rate and no other mode is available. The present iron gives the user a choice in a single iron that she did not have before — the choice of constant filling for a high steam rate operating flooded or a lower steam rate and fewer fillings when operating as a flash boiler. Thus, the user sets the operation of the iron rather than the iron setting the mode of operation for the user. E, another feature is the elimination of soleplate dripping which occurs when water runs out of the soleplate ports. The separation baffle system returns all steam or steam and water mixture to the water tank with the steam remaining in the free air space to be picked up and exhausted through the steam carrying means. Because the opening of the steam carrying means or conduit is generally above the free water surface during normal ironing or when the iron is on the heel rest water cannot get into the passages 52 to cause soleplate flooding. If the iron is inadvertently stored on the soleplate with the water valve open, no water will be able to reach the soleplate area.

Since this iron will produce different rates of steam, it is possible, if desired, to audibly indicate the rates. Consequently, a noise may be produced in the steam carrying means 50 as shown in Fig. 1, by shaping it in a tapered form to act as a megaphone with orifice-like opening 56 at the entrance. By tapering outwardly from the orifice 56, the shape amplifies the noise made by the steam passing through the orifice 50 at a high velocity. The velocity is varied, and hence the noise, by the amount of water converted to steam. Therefore, at the high steam rate there is a higher level of noise than at the low steam rate.

It will be seen that by the combination flooded/flash boiler arrangement obtained by sizing the liquid passage 44 and modifying the valve so that water may flow through the valve at different rates with the location of the pin structure, advantages are obtained that are unavailable in previous irons and because of the interaction between the systems, these advantages are greater than the individual advantages of either the flooded boiler or the flash boiler irons singly. The unique combination has produced a highly

flexible iron with the attendant advantages as explained.

WHAT WE CLAIM IS:—

1. A steam iron having a water tank and a steam generating soleplate having a boiler therein, metering means intermediate the water tank and the boiler for selectively preventing flow of water therebetween and for selectively permitting flow of water at a plurality of flow rates, said plurality of flow rates including a first rate selected to maintain the boiler in a flooded condition at least during iron operation at a first range of ironing temperatures and a second rate selected to maintain the boiler in a flash steam condition at least during iron operation at a second range of operating temperatures, and distribution means communicating with the boiler for supplying steam generated therein to a point of use.

2. A steam iron according to claim 1, wherein the first rate established by said metering means is selected to maintain the boiler in a flash steam condition during iron operation at temperatures exceeding the upper limit of said first range.

3. A steam iron according to claim 1 or claim 2, wherein the lower limit of said first range is substantially lower than the lower limit of said second range.

4. A steam iron according to any one of claims 1 to 3, wherein said metering means comprises passage means communicating with the water tank and the boiler and movable valve structure cooperating with said passage means to control the flow area of said passage means.

5. A steam iron according to claim 4, wherein said movable valve structure includes a conventional stem and orifice, said stem having a reduced portion for disposal in said orifice to restrict the water flow for said flash steam operation.

6. A steam iron according to any one of the preceding claims, wherein said distribution means comprises:

a balance tube connecting the boiler and the upper portion of the tank to carry steam and water carried thereby to the tank and balance pressure therebetween, and

a conduit for conveying steam from the tank to a point of use.

7. A steam iron according to any one of the preceding claims, wherein said distribution means further comprises steam separation means for removing water entrained in steam generated in the boiler prior to delivery of the steam to a point of use.

8. A steam iron according to claim 7 when dependent upon claim 6, wherein said steam separation means comprises means impeding flow from said balance tube into said tank.

9. A steam iron according to claim 8, wherein said impeding means is a baffle plate extending over and spaced from the end of said balance tube in the upper portion of said tank whereby steam escapes into the tank and water striking the baffle plate falls onto the free water surface in said tank.

10. A steam iron according to any one of claims 6 to 9, wherein said balance tube and said steam-conveying conduit are separated and adjacent tubular conduits.

11. A steam iron according to any one of claims 6 to 9, wherein said balance tube and said steam-conveying conduit are concentric tubular conduits.

12. A steam iron according to claim 11 when dependent upon claim 9, wherein the baffle plate extends over and is spaced from the balance tube only.

13. A steam iron according to claim 12, wherein said steam-conveying conduit extends above the baffle plate to receive steam only.

14. A steam iron according to claim 13, wherein the steam-conveying conduit is tapered along its length.

15. A steam iron according to claim 14, wherein the steam-conveying conduit is tapered outwardly from an orifice entrance disposed above said baffle plate.

16. A steam iron according to any one of the preceding claims, wherein the soleplate is provided with steam ports and said distribution means is arranged to carry the steam to said soleplate ports and fabric being ironed.

17. A steam iron substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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2. A steam iron according to claim 1, wherein the first rate established by said metering means is selected to maintain the boiler in a flash steam condition during iron operation at temperatures exceeding the upper limit of said first range.

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