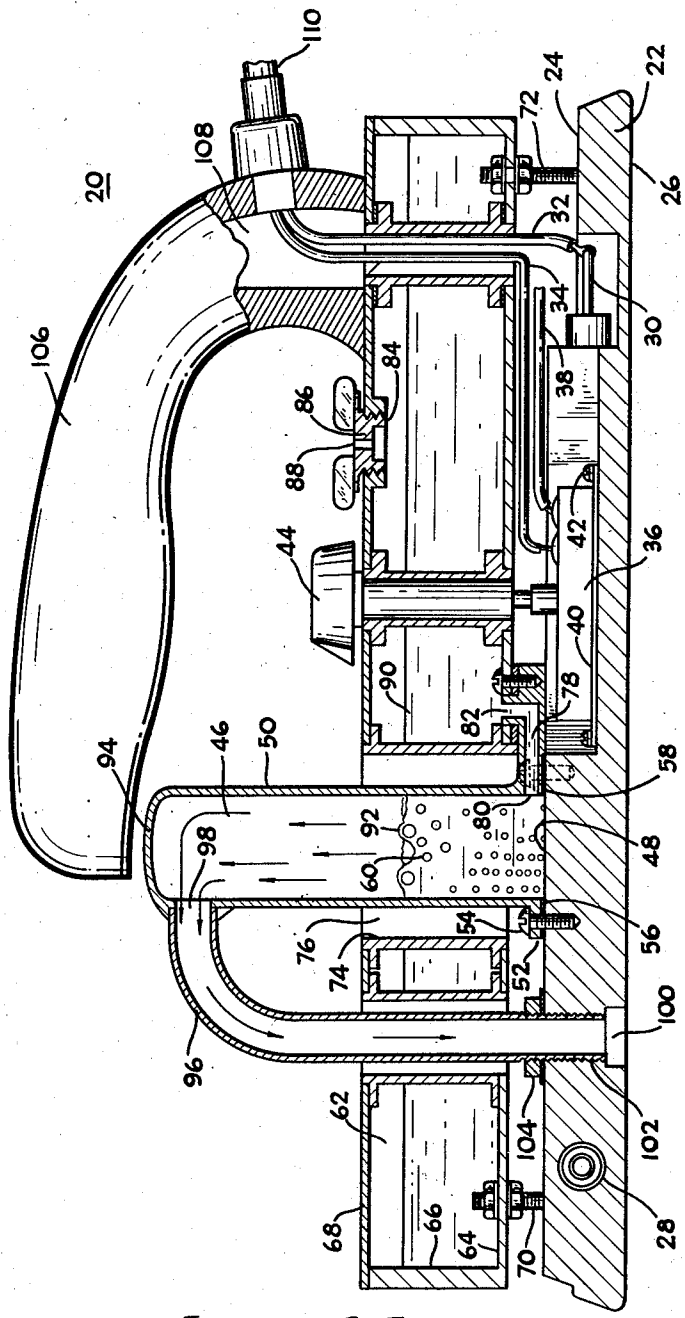
June 10, 1958 E. G. FRANKLIN ET AL 2,837,847

STEAM IRON

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Fig 1



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STEAM IRON

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Fig 2

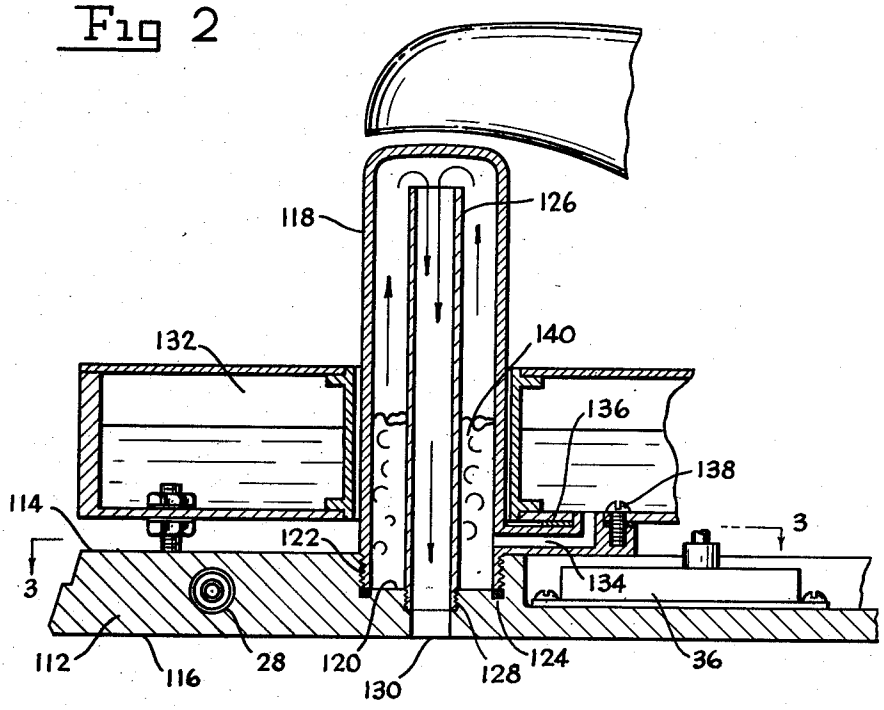
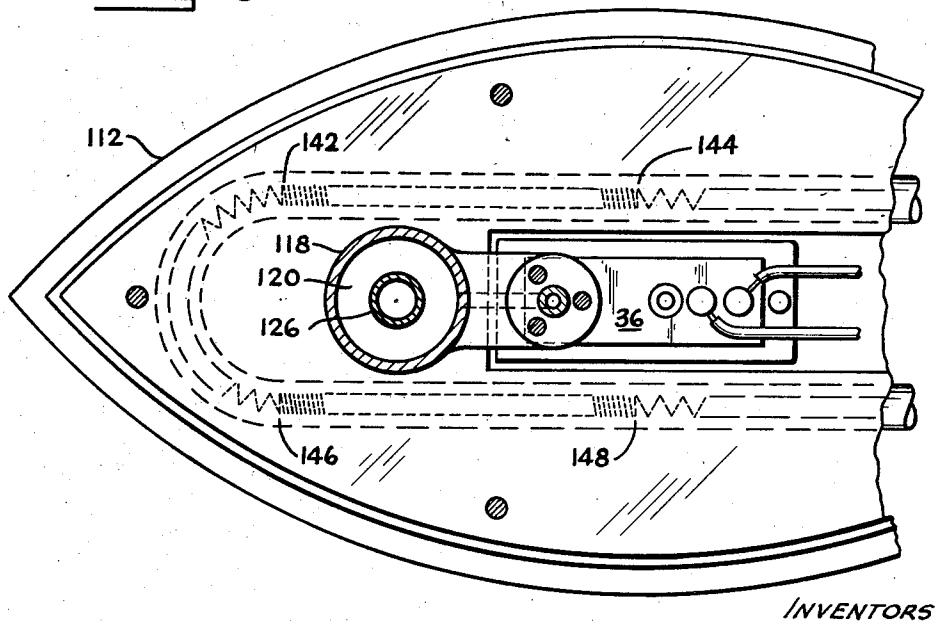


Fig 3



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STEAM IRON

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Fig 6

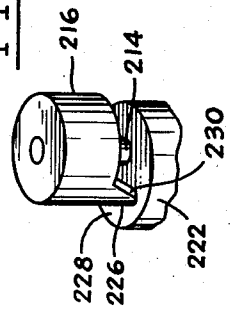


Fig 4

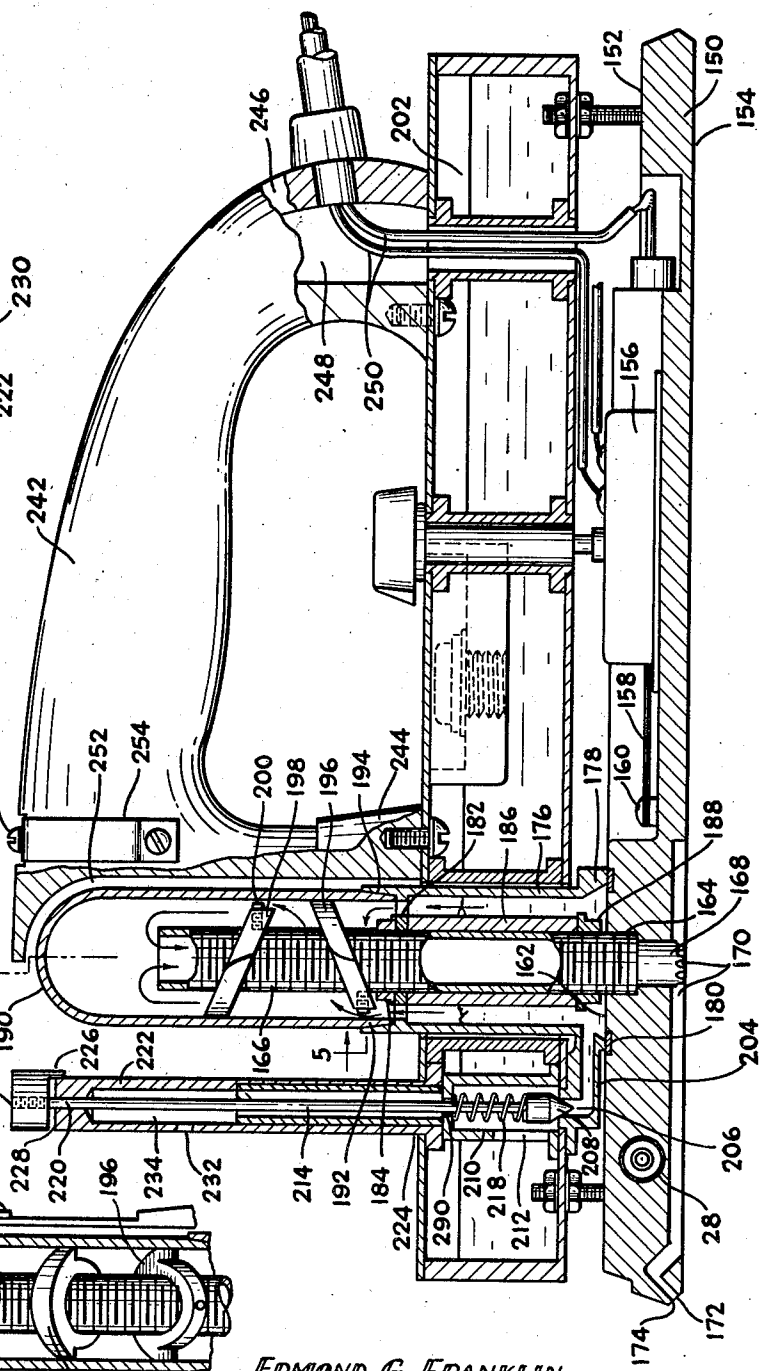
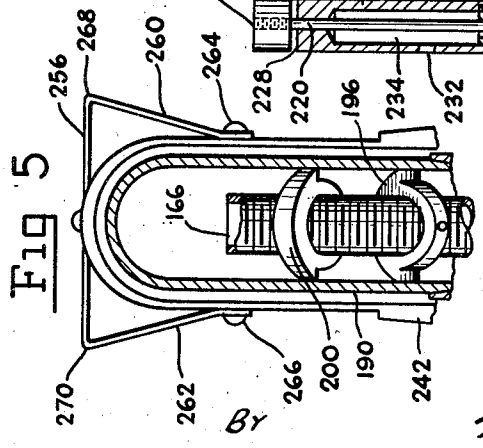


Fig 5



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STEAM IRON

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Fig 7

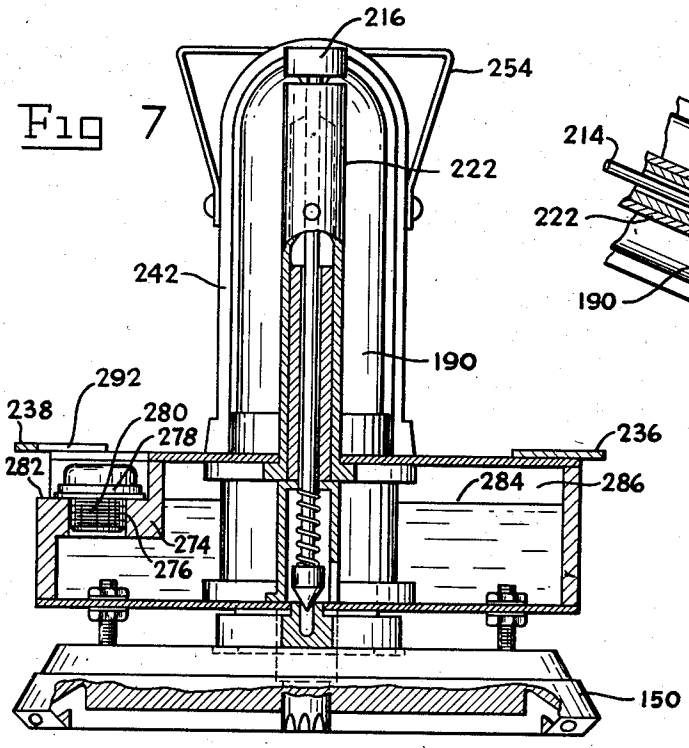


Fig 9

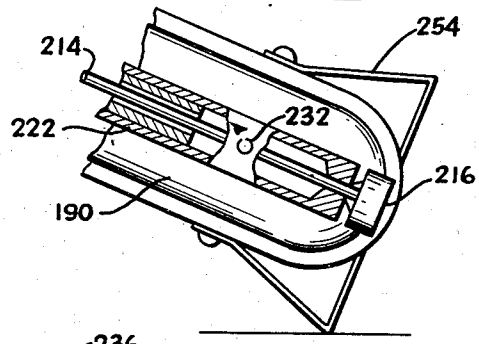
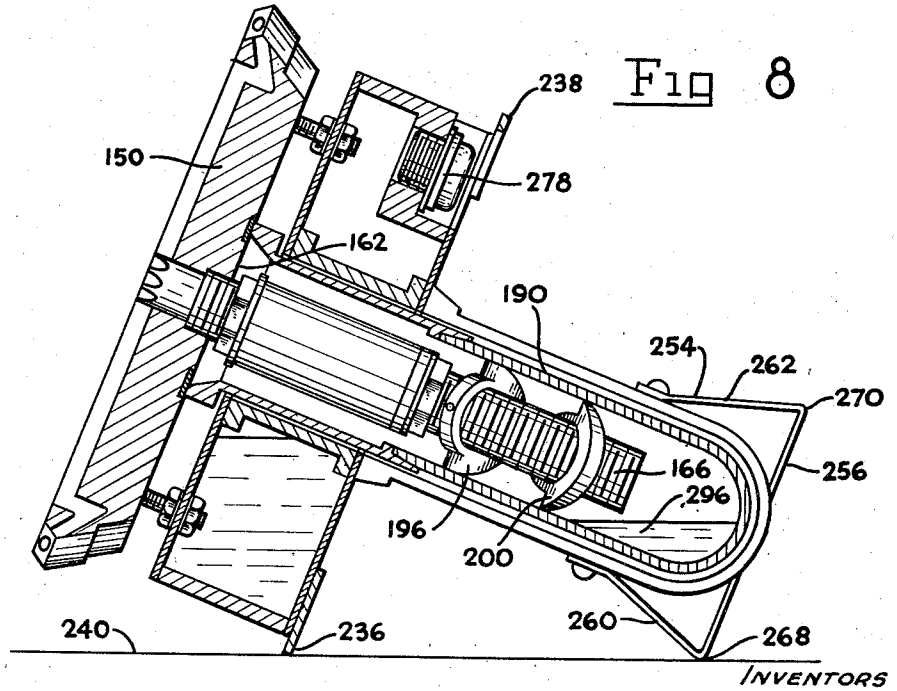


Fig 8



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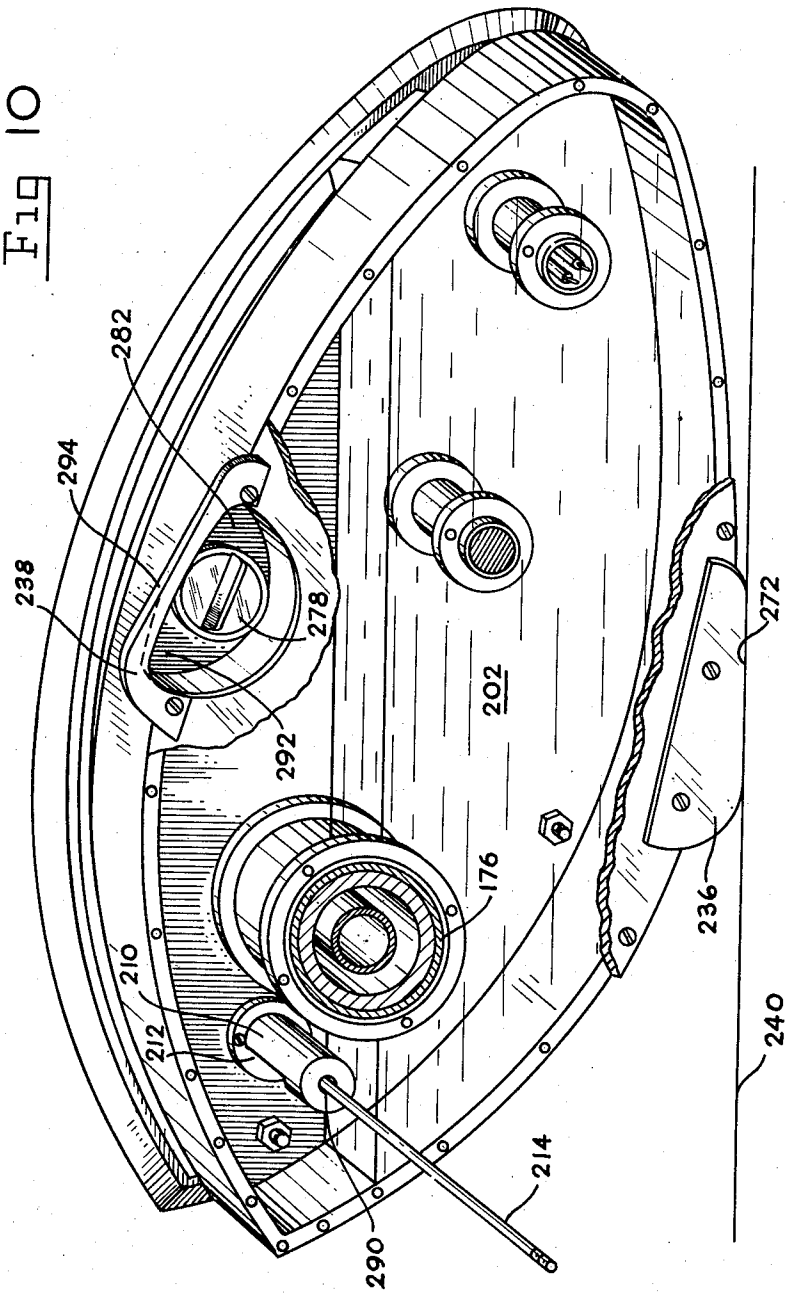
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STEAM IRON

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Fig 10



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2,837,847

STEAM IRON

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Application November 18, 1953, Serial No. 392,859
17 Claims. (Cl. 38—77)

The present invention relates to steam irons and more particularly to irons which are capable of selective operation either as steam irons or dry irons, as well as to improved features contributing to greater ease and efficiency in steam ironing operation.

The steam irons known or generally available on the market prior to the present invention have been of three different primary types. In one of these types, the total supply of water is confined in a relatively large boiler which extends over a major area of the iron.

Either the soleplate of the iron or some separate heating unit is provided to heat substantially all of the water to the boiling point for the generation of steam. The steam is then conducted to the vicinity of the bottom of the iron where it can be projected on the material being ironed. In irons of this type, which have been referred to as the "tea-kettle" type of steam iron, substantially the entire available supply of water in the iron must be brought to the boiling temperature before steam is available. Not only does this present certain operating disadvantages in view of the longer time required to heat such a large volume of water, but furthermore, irons of this type offer a definite safety problem. When a relatively large body of water is boiled, it is possible to generate steam under certain circumstances at such a high rate as to build up dangerous pressures within the iron. Particularly is this true in irons of this type, where a valve is provided to control the flow of steam to the material being ironed. If the valve is inadvertently left closed, or if the steam passages are too small in cross section, serious pressures may build up with consequent danger to the operator.

The second general type of iron which has been available prior to the present invention may be referred to as the "flash" type of steam iron. In such irons water is fed a drop or two at a time from a supply reservoir to a flash generating chamber which is maintained at a relatively high temperature. Theoretically, each drop is flashed into steam the moment it strikes the hot surfaces of this generating chamber and the steam is then conducted to the material being ironed. While irons of the "flash" type have the advantage that the main body of water in the supply reservoir need not be heated, they have numerous other disadvantages, some of which have not been generally recognized.

For example, if the control valve between the tank and generating chamber is opened before the generating chamber is at a proper heat, the water will not be flashed into steam and may accumulate in such quantities that it will pass through the discharge ports and cause spots on the material to be ironed. Similar dripping of water from the iron may occur, if the operator is not sufficiently skilled to adjust the rate of liquid feed accurately during operation. Thus, water may be fed to the generating chamber faster than it can be flashed into steam with the result that portions of the liquid ultimately overflow through the steam outlet tubes. The use of metering valves with small orifices in irons of this type may also lead to unsatisfactory operation due to accumulation of deposits from the water which may further restrict the valve openings after short periods of service.

One of the generally supposed advantages of the flash type steam iron has been the fact that the generating chamber could be maintained so hot that the water would

not only be vaporized into steam, but the steam itself could be superheated and dried before it was passed to the material beneath the soleplate. We have found, however, that for many fabrics a pressing operation is more efficient if the steam discharged onto the fabric is relatively moist, i. e., if its temperature is more nearly at the boiling point of the liquid. It is difficult to maintain such temperatures in a "flash" type of iron since the generating chambers are too small and too hot to prevent superheating of the steam.

There have also been some limited prior disclosures of a third type of iron in which a steam generating boiler contains a relatively small volume of water which is replenished from a supply source during operation. As far as we are aware, such irons have either required special metering or supply valve arrangements to feed the water to the boiler, or they have required hermetically sealed reservoirs which may present a substantial safety problem if heat is conducted even indirectly to the reservoir during operation. In a sealed reservoir air expansion will also force water out more rapidly than the boiler can convert it to steam, with consequent danger of water spots on the material to be ironed.

It is accordingly one object of the present invention to provide an improved steam iron construction of this third type which shall not be subject to the major disadvantages of any of the types discussed above.

A further object is an improved steam iron in which a boiler of limited volume and a supply reservoir are connected so as to eliminate the need of special metering valves or orifices.

Another object is a steam iron construction in which adequate control of the steaming rate is achieved by proper choice of soleplate materials, heat input, and boiler dimensions without the need of precise fluid metering devices.

An additional object is an improved construction in which steam is generated in a body of liquid which is in direct contact with a predetermined limited area of the flatiron soleplate.

A further object is an improved steam iron construction in which the boiler shall include a limited volume of water at all times in order that steam may be generated in the presence of water and its temperature maintained close to the boiling temperature of the water.

Another object is the provision of an improved construction in which the steaming operation may be arrested automatically in response to movement of the iron to a rest position.

An additional object is a steam iron construction designed to permit selective movement of the iron to either one of two alternate rest positions, with automatic interruption of the steaming operation in each of said positions.

Still another object of the invention is a steam iron construction in which the main water supply is contained in a reservoir vented to atmosphere at all times and in which improved construction and location of the venting means permits movement of the iron to a rest position without loss of fluid.

Other objects of the invention will be apparent from the following description in which certain preferred embodiments of the invention are described.

In the drawings which accompany this application, Figure 1 is a side view of an improved steam iron according to the present invention, with certain portions broken away and certain portions shown in section for convenience.

Fig. 2 is a partial similar side view of a modified form of construction according to the invention.

Fig. 3 is a partial sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 1 of a preferred embodiment of the present invention.

Fig. 5 is a partial sectional view on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged partial perspective view of part of the device of Fig. 4.

Fig. 7 is a front view of the device of Fig. 4 with portions broken away and portions shown in section for clearness.

Fig. 8 is a view similar to Fig. 7, but with the iron tilted to one of its side rest positions.

Fig. 9 is a partial view similar to Fig. 8 showing details of the reservoir venting means.

Fig. 10 is a perspective view of the iron in its rest position corresponding to Fig. 8, but with portions broken away to show the liquid level and other details within the tank.

The iron shown in Fig. 1 is indicated generally at **20** and includes a soleplate **22** having an upper surface **24** and a lower or bottom surface **26**. Surface **26** is designed for engagement with the material to be pressed.

Heating means for the soleplate **22** are provided, such heating means being shown in the present instance as a cast-in element **28** of the sheathed or "Calrod" type. The element **28** extends across the front of the soleplate and includes portions extending rearwardly along each side of the soleplate terminating in suitable terminals **30**.

One of the heating element terminals **30** is suitably connected to one of the supply leads **32**, while the other supply lead **34** is connected through a thermal switch **36** and a further lead **38** to the remaining heating element terminal (not shown). The thermal switch **36** provides adjustable control means for the heating element for maintaining the desired flatiron soleplate temperatures. The switch includes a bottom plate or flange **40** suitably secured to the soleplate by screws **42** or other means, so that the thermally responsive portion (not shown) of the switch is in direct heat-conductive relationship with the soleplate. The switch **36** includes adjusting means operatively connected to a manual adjusting knob **44** which is accessible to the operator of the iron.

According to one feature of the present invention, a steam generating boiler **46** is provided above the soleplate. Boiler **46** includes a first or lower portion which is in direct heat conductive relationship with a relatively small predetermined area of the upper surface **24** of soleplate **22**. This predetermined area is designated at **48** in Fig. 1 and in this particular embodiment of the invention, the upper surface of the soleplate in this area serves directly as the bottom of the steam generating boiler chamber **46**.

Cooperating with this predetermined area **48** of the soleplate upper surface is an open bottomed upper boiler portion or chamber member **50** which has its lower edges **52** secured in sealing engagement around the edges of the soleplate surface area **48** by suitable screws **54** or equivalent fastening means. A sealing member may be included between the boiler chamber **50** and the soleplate to insure a water tight joint around the bottom of the boiler.

In this particular case, the chamber member **50** is substantially cylindrical and its lower edges at **56** and **58** therefore constitute portions of a circle by which the area **48** is bounded and defined.

According to an important aspect of the present invention, the steam generating boiler **46** is adapted to contain only a limited predetermined amount of liquid indicated at **60** during the steam generating and ironing operation. Portions of this liquid completely cover the entire bottom portion of the boiler including all parts of the soleplate area within the boiler. The cross-sectional area of the boiler **46** is relatively limited and the predetermined area **48** of the soleplate upper surface which is used for supplying heat to generate steam from the liquid in the boiler represents only a small fraction of the total soleplate surface area. Thus the relative volume of water which must be brought to the boiling point initially, before steam generation can take place, is extremely small in comparison with the volumes of water involved in the ordinary "teakettle" type of iron. At the same time, the heat energy required for steam generation is obtained from a relatively small fraction of the total soleplate area. Thus adequate heat is still available in the remaining portions of the soleplate to maintain the soleplate bottom surface at the appropriate temperatures for satisfactory ironing.

As pointed out above, the boiler chamber dimensions are limited. In fact it is desirable that the maximum boiler chamber cross-section parallel to the soleplate shall be no greater than the predetermined soleplate area used for steam generation. In the preferred embodiment to be described below, the effective boiler chamber cross-section is even smaller than said soleplate area. Thus a compact, efficient and economical construction is provided in which the boiler chamber requires a minimum of the available area above the soleplate.

The soleplate upper surface area used as the bottom of the boiler need not be substantially larger than one square inch. Actually such area may fall in the range from substantially 0.7 to 0.9 sq. in. and preferably around 0.8 sq. in. for the operating temperature contemplated in this invention. Thus the steam generating area will be less than $\frac{1}{20}$ to $\frac{1}{40}$ of the total soleplate bottom surface area.

To improve the operating characteristics of the device and to insure adequate and rapid transfer of heat energy from the heating element **28** to both the boiling area **48** of the soleplate upper surface and the lower pressing surface **26** of the soleplate, we prefer to construct the soleplate of material having a relatively high heat conductivity. This heat conductivity should be in the range from substantially 0.24 to 1.0 measured in c. g. s. units (calories per sq. centimeter area per centimeter thickness per degrees centigrade per second). Aluminum and its alloys constitute the preferred soleplate materials for use in combination with the other features of the present invention. The use of materials in this higher conductivity range also insures rapid and accurate control of soleplate temperatures by the thermal switch, since the thermally responsive portion of the switch can respond more promptly to heat losses in the steam generating area and at the bottom of the soleplate as well as to heat input from the heating element.

The present invention also contemplates the provision of means for maintaining the desired limited volume of liquid **60** in the boiling chamber **46**, and replenishing this liquid as it is converted into steam. For this purpose, the iron **20** includes a reservoir **62** having a bottom wall **64**, side walls **66**, and a top wall **68** secured together in liquid-tight relation in known manner. The reservoir is mounted on the iron with the bottom **64** of the reservoir spaced above the soleplate **22** and in relatively poor heat conducting relation therewith. For this purpose, the reservoir is shown as spaced from the soleplate by supporting studs **70** and **72**. Other means of supporting the reservoir may be used in appropriate cases, provided such means are chosen so as to be consistant with the over-all objective of minimizing to the greatest possible extent the transmission of heat from the soleplate to the reservoir. Thus the reservoir is insulated as effectively as possible from the heat of the soleplate.

In the form of reservoir shown in Fig. 1 it will be noted that the tank **62** includes portions substantially surrounding the boiler chamber **50**. The wall **74** of the reservoir which surrounds the boiler is spaced substantially therefrom in order to provide an insulating air space **76** and prevent transfer of heat from the boiler to the tank.

For the transfer of liquid from the reservoir **62** to the

boiler 46 a suitable water conduit 78 is provided. This conduit has one end 80 which opens into the bottom of the steam generating boiler 46 and a second end 82 opening into the bottom of the reservoir 62. Thus the water conduit 78 joins the water containing portions of the reservoir and boiler. The cross-section of this conduit 78 is relatively large and is completely free of restricted valve openings or other metering devices. In fact the cross-section of this conduit should be sufficiently great to provide for transfer of liquid from the tank 62 to boiler 46 much more rapidly than the liquid could possibly be evaporated from the boiler. The use of such a relatively large cross-section in conduit 78 is also instrumental in preventing the "liming" and clogging which often occur after relatively short periods of operation in steam irons having small metering orifices or valves, especially when such irons are used with relatively hard waters. The iron of this embodiment may be equipped with a simple non-metering "on"—"off" valve in this water conduit, as in the embodiment of Figs. 4–10 described below. Such a valve is movable between only two positions for steam or dry ironing operation and is not adjustable to regulate the steaming rate.

The liquid reservoir 62 includes means by which the reservoir can be filled to a predetermined level. In this case, the filling means is shown as constituting a filling opening 84 in the top of the tank. This opening may be closed by a threaded filling plug 86, during operation. The plug is removed when it is desired to fill the tank through the opening. In this case, the location of the plug and opening permits filling the reservoir 62 substantially to capacity.

Another element of the present invention is the provision of means venting the liquid reservoir 62 to atmosphere at all times during operation of the iron. This venting means is shown in the present instance in the form of an air hole or passage 88 in the filling plug 86. The venting means serves the double purpose of preventing any substantial increase of pressure within the reservoir 62 and also of insuring the free flow of liquid from the reservoir 62 into the steam generating boiler 46.

Since the reservoir is vented to atmosphere by the opening 88, and since the steam boiler is also opened to atmosphere by way of the steam tube to be described below, the construction is such that the liquid level within the steam generating boiler 46 will automatically be maintained at substantially the same level as the liquid in the reservoir. The reservoir and boiler liquid levels are shown in Fig. 1 at 90 and 92 respectively.

While these levels will gradually drop as the liquid is converted into steam during normal operation, the change in level within the boiler 46 will have no substantial effect on the rate of steam generation, since this rate is dependent primarily on the size and temperature of the predetermined soleplate area 48 at the bottom of the boiler. The relatively large water conduit 78 provides rapid equalization of liquid levels in the reservoir and boiler to insure the presence of a limited amount of liquid in the boiler at all times. Thus steam is generated in the presence of boiling liquid, so that moist rather than superheated steam may be obtained.

As shown in Fig. 1, the upper portion of the steam generating boiler extend substantially above the maximum liquid level of the reservoir 62. Thus there will be a substantial upper portion of the generating chamber 46 adjacent its top 94 which may receive the steam generated from the liquid within the boiler. In order to convey this steam to the material to be ironed, a steam conduit 96 is provided. This conduit has one end 98 opening into the upper portion of the steam generating boiler 46 near the top wall 94 and above the maximum liquid level in reservoir 62. The other end 100 of the steam conduit 96 is open to atmosphere at a point adapted to discharge steam out on the material being ironed.

In this case, the end 100 is actually led down through a suitable opening in the reservoir 62 and through the soleplate 22, so that the steam strikes the material at a point beneath the soleplate bottom surface 26. The lower portion of the steam conduit 96 may be threaded as indicated at 102 and a suitable lock nut 104 may be provided to assist in locating the lower end of this conduit. The conduit is rigidly connected to the boiler chamber member 50 adjacent the end 98 and is thus also held in place by the securing means for the boiler at 54.

To facilitate manipulation of the iron by a user, a suitable handle 106 is provided. In this case the handle includes a substantially horizontal hand grasping or carrying portion and a rear handle post secured to the rear of the liquid reservoir 62 in known manner. The rear handle post may be hollowed as shown at 108 in order to accommodate the current supply leads 32 and 34 from the supply cord 110.

In operation, with the reservoir filled with water, the steaming rate of this iron may be adjusted selectively for pressing different fabrics. This selective adjustment is achieved by varying the temperature adjustment of the thermal switch. Thus the soleplate temperature is selectively altered. Since the same predetermined soleplate area is effective for all adjustments, the changes in soleplate temperature can be used to vary the rate of steam generations at said area for selective steam pressing of different fabrics.

The modification shown in Figs. 2 and 3 is similar in many respects to the steam iron of Fig. 1. This embodiment includes a soleplate 112 similar to the soleplate 22 and having top and bottom surfaces 114 and 116. An identical heating element 28 may be used to heat this soleplate and is cast into the plate in the configuration previously described.

A boiler chamber member 118 projects upwardly from the soleplate and cooperates with a relatively small predetermined area 120 of the soleplate to provide the complete boiling unit. The chamber member 118 in this case is threaded into a small recess of the soleplate upper surface at 122, and a sealing gasket 124 may be provided to insure a water tight joint.

The steam conduit means of this embodiment differs from that of the previous example in that the conduit extends downwardly within the boiler through the mass of boiling liquid and thence directly out through the bottom of the soleplate. This steam conduit is shown at 126 and has its upper end opening near the top of the boiler chamber 118 well above the maximum liquid level in the boiler and reservoir. The lower end of the steam conduit is threaded at 128 into a threaded recess in the center of the boiler area of the soleplate upper surface. An opening 130 through the bottom surface 116 of the soleplate communicates with the lower end of the steam tube to provide an opening to atmosphere through which the steam can be discharged on the material being ironed.

To supply and maintain the desired limited volume of liquid in the boiler 118, a reservoir 132 similar to reservoir 62 of Fig. 1 is provided. The reservoir communicates with the boiler through a water conduit 134 of relatively large cross-section, which is more than adequate to replenish the liquid in the boiler as rapidly as it can be boiled away. This water conduit 134 may be provided as an integral projection from the boiler chamber 118 or may be formed as a separate member. The integral projection shown in Fig. 2 is then further provided with suitable connections at the bottom of the liquid reservoir 132 by means of the sealing gasket 136 and locking screws 138. Thus the water conduit may serve as a means of supporting the reservoir, with the insulation means 136 preferably having some heat insulating properties to reduce the transmission of heat from the soleplate to the liquid reservoir.

Because the water conduit 134 is of relatively large cross-section and because the tank 132 is vented as in the

case of the device of Fig. 1, while the steam conduit **126** is open to atmosphere at its lower end, the level of liquid **140** in the boiler will be maintained at substantially the same level as that in the tank **132** during operation.

A control thermostat **36** is supplied which may be identical with that of Fig. 1 to serve as control means for maintaining the desired temperatures in the soleplate. The operation of the device of Figs. 2 and 3 will be essentially similar to that of the device of Fig. 1, with certain improvements due to location of the steam conduit. The arrangement of the steam conduit so that it passes back down through the boiling liquid **140** serves a double purpose.

First of all, since the tube is within the boiling liquid, the temperature cannot substantially exceed that of the boiling liquid but must remain substantially near the boiling point of water. Thus the steam passing through the steam conduit will remain essentially at the boiling point temperature and will have no opportunity to become superheated to an undesirable degree before it reaches the material. At the same time, not only does this arrangement prevent overheating of the steam, but it further insures maintenance of the steam at the boiling point temperature so that condensation and the formation of water droplets will be avoided. The location of the steam tube within the water chamber also reduces to some extent the total volume of water for a given boiler diameter.

Because of the presence of the steam tube, it will also be noted that the effective boiling area at the bottom of chamber **118** may be considered as of annular configuration as shown at **120** in Fig. 3. This figure also indicates a desirable adjustment of the resistance of the heating element **28**. As illustrated, the portion of the element at each side of the steam generating area **120** is designed to provide a higher rate of heat energy input than the remaining portions of the element. Thus, between the points **142** and **144** at one side of the generating area, and also between the points **146** and **148** at the other side of the area, the heating element has a greater resistance per unit length than in the front loop portion between points **142** and **146**, or the rear portions behind points **144** and **148**.

While the specific resistance and wattage characteristics may vary to some extent depending on the relative location of the element in the soleplate, the expected operating temperatures and heat losses of the particular iron, the size of the total soleplate area and steam generating area, and the desired steaming rate, the following dimensions have proved satisfactory in one practical embodiment of the invention. In this case, the total area of the bottom surface of the soleplate was substantially 31 square inches. The internal diameter of the steam generating boiler **118** was 1⅛ inches and the external diameter of the steam conduit **126** was ½ inch. Thus the total area of the annular generating portion **120** of the soleplate upper surface was 0.79 or substantially 0.8 square inch.

The total wattage of heating element **28** was 1100 watts, and the wattage per unit length was as follows. In the front loop portion **28** the wattage was 50 watts per inch for a total original length of 2 inches before the element was bent into U-shape. From points **142** to **146** back to the points **144** and **148** the wattage was 100 watts per inch over a total length in each case of 2¾ inches.

The wattage of the remaining rear portions of the element was substantially 82 watts per inch with the length of each rear portion being substantially 2¾ inches. In this particular example, the soleplate was made of an aluminum alloy having a thermal conductivity of substantially 0.33 c. g. s. units at 68° F.

While these specific values and materials can be modified to meet the needs of a particular form of construction, it is important in any case that the thermal conductivity of the material and the construction and relative location of the heating element, steam generating area and thermal switch be so chosen as to supply adequate heat energy to the generating area at all times in spite of losses through the soleplate to the material being ironed. For this purpose, substantially at least half the total expected wattage of the heating element should be available at the small predetermined steam generating area of the soleplate upper surface. In terms of both wattage and temperature, the heat energy available at this area for actual conversion of water to steam should be in the range from 250 to 600 watts while the soleplate temperature is maintained in the range from substantially 325° F. to 450° F. This combinnation will provide satisfactory ironing temperatures at the bottom of the soleplate as well as sufficient heat energy for generation of from 8 to 12 grams of steam per minute, during steam ironing operation. The exact rate of steam generation will again depend on the exact selective setting of the thermal switch, which determines the specific soleplate temperature within the above range.

The device shown in Figs. 4–10 inclusive illustrates a preferred embodiment of the present invention incorporating features of the devices of the previous embodiments in combination with further improvements. As shown in Fig. 4, the iron includes a soleplate **150** having top and bottom surfaces **152** and **154** respectively. The heating element **28**, identical to that previously described, is cast into the soleplate as a means for heating the same. A thermal switch **156** provides means controlling the heating element **28** and is connected in a manner similar to that previously described. In this case, the thermally responsive actuating member for the switch **156** is illustrated as a bimetallic strip **158** secured at **160** in close heat-conducting relationship to the soleplate upper surface just in back of the steam generating area.

The steam generating boiler in the present example is assembled in combination with the steam conduit and soleplate as follows. A relatively small annular area **162** is provided on the upper surface of the soleplate to serve as the bottom of the boiler chamber in a manner similar to that illustrated in Figs. 2 and 3. In the center of this annular area the soleplate includes a downwardly extending opening which is threaded at **164** to receive the lower end of the steam conduit **166**. The opening into which the steam conduit is threaded then extends downwardly at **168** to the bottom of the soleplate, where it communicates with a series of steam grooves **170**. These grooves serve to convey the steam over a wide area of the bottom surface of the soleplate.

In order to be sure that the steam conduit is open to atmosphere at all times and is not blocked by the material being ironed so as to cause back pressures within the boiler, the outer ends of at least some of the steam grooves are provided with vent openings **172**. These openings extend through a beveled edge portion **174** of the soleplate at a point above the level of the bottom surface **154**. Thus the vent openings **172** will still discharge steam to the material being ironed even if the material is positioned so as to block substantially the lower end of opening **168**. We have found that the total cross-section of all of the openings **172** should substantially equal the cross-section of the steam passage **168** and conduit **166** in order to make sure that undesirable back pressures are avoided.

The steam generating boiler itself includes a cylindrical body portion **176** surrounding the steam conduit **166**. The lower end of body **176** is flared outwardly and downwardly to provide a portion of increasing diameter at **178** for engagement around the edges of the annular generating area **162** on the top surface **152** of the soleplate. A gasket member **180** is provided between the flared lower end **178** of the cylindrical boiler member and the soleplate itself in order to provide a liquid tight joint and also in order to minimize the transmission of

heat from the soleplate to the remaining portions of the boiler.

In order to maintain the cylindrical boiler section **176** in position, it is provided with a horizontally extending spider or cross arm **182** having a central opening fitting the threaded steam conduit **166**. A nut **184** may be screwed down the steam conduit above the spider or cross arm **182** to clamp the boiler section **176** firmly against the sealing and heat insulating gasket **180**.

According to a feature of this preferred embodiment of the invention, the boiler includes means restricting its effective internal cross-sectional area from a point just above the soleplate to an amount substantially less than the area of the annular steam generating portion **162** at the bottom of the boiler. In the present case this means includes two features of construction. The first feature, which has already been described, is the reduction in the diameter of the boiler portion **176** as compared to the portion **178** which engages the edges of the soleplate boiling area. Thus the internal diameter of the cylindrical portion **176** is somewhat less than the maximum external diameter of the annular generating section **162**.

The second feature which is used to reduce the cross-sectional area within the portion of the boiler containing liquid to be boiled is the introduction of some sort of insert or filler means within the boiler. In this case, a cylindrical sleeve **186** is mounted on the steam tube **166**. This sleeve may be considered as an annular cylindrical section having an internal diameter adapted to fit the steam conduit **166** and having an external diameter which is sufficient to fill a substantial portion of the remaining free cross-sectional area inside the boiler portion **176**. Preferably the reduction in cross-section within the portion **176** which is available for the containing of liquid should be great enough so that this cross-section is substantially only 50% of the area of the annular portion **162**.

The volume reducing sleeve **186** may be held in position on the steam conduit **166** by the engagement of its upper end beneath the spider or cross-arm **182** and by the provision of a securing nut **188** beneath the sleeve. It will be understood that in the original assembly of this portion of the construction, the nut **188** and sleeve **186** would first be placed on the steam tube **166**, after which the tube would be threaded into the soleplate **150**. The boiler section **176** could then be telescoped outwardly over the steam conduit **166** and the retaining nut **184** placed in position and tightened to lock the assembly.

The upper or second portion of the steam generating boiler is completed by a dome or cylindrical cap, which is closed at its upper end as indicated at **190**. This dome **190** has its lower peripheral edge **192** received within a mating seat **194** at the upper end of the boiler portion **176**. Any suitable connection may be used at this point, such as the use of threads on the mating parts, or simply the use of a suitable cement.

Before the boiler or steam dome **190** is completely secured in position, it is contemplated in this preferred form of the invention that a particular location and arrangement of baffles will be provided. These baffles are illustrated at **196** and **198** respectively and further details of the baffle construction and arrangement are shown in Fig. 5. Each baffle is internally threaded along an axis which extends at an acute angle to the plane of the baffle. Thus when each baffle is screwed onto the threaded steam tube **166**, it will assume an angularly oriented position as shown in Fig. 4. As illustrated in the drawings, set screws **200** may be used to lock the baffles in their adjusted positions and prevent further rotation thereof. The lower baffle then extends upwardly at an angle from the front to the rear of the steam containing portion of the boiler, while the upper baffle extends upwardly from rear to front of the steam dome. It will be noted that the rear portion of the lower baffle **196** and the forward portion of the upper baffle **198**, fit relatively closely within the steam dome **190**. At the same time portions of reduced diameter are provided at the front lower portion of the lower baffle **196** and the rear lower portion of the upper baffle **198**. These cut-away portions extend substantially half-way around each baffle as shown and thus provide a semi-annular passage at the front of the lower baffle and at the rear of the upper baffle. The upper portions of the respective baffles fit the steam dome **190** sufficiently closely to provide downwardly facing pockets. These pockets effectively trap any drops or particles of moisture which might tend to be carried upwardly by the violence of the boiling action within the lower boiler portion **176**.

In order to supply and maintain the desired limited volume of liquid in the boiler portion **176**, a supply tank or reservoir **202** is mounted on the soleplate with the bottom of the tank spaced above the soleplate and in poor heat conducting relation therewith. A water conduit **204** extends between the lower or water containing portions of the reservoir and boiler in a manner similar to that described in the previous embodiments. In this case, however, the end **206** of the conduit which communicates with the reservoir **202** is located on the longitudinal axis of the soleplate and tank forwardly of the boiler area for a purpose to be described below. The cross-section of the water conduit is again large enough to equalize the water levels in the tank and boiler very rapidly as part of the water in the boiler is converted into steam.

In order to permit selective operation of the appliance as either a steam iron or a dry iron, a simple "on"—"off" valve arrangement is provided. The valve member in this case is illustrated as having a portion **208** with a conical tip designed to close the opening **206** in the conduit when dry ironing operation is desired. This valve is contained in a small housing **210** having an opening **212** at its forward end for passage of water from the reservoir **202** into the valve housing and down through the opening **206** to the water conduit.

The valve member **208** is carried on the lower end of a vertical stem **214** which extends upwardly above the iron and terminates in an operating button or handle **216** near the level of the top of the steam dome. A spring **218** within the housing **210** normally urges the valve member **208** downwardly to its closed position.

The upper end of the valve stem **214** passes through a relatively close fitting eccentrically located opening **220** in the upper end of a vent tube **222**. The lower end of this vent tube is secured at **224** to the reservoir. Thus the vent tube serves both as a supporting means for the valve stem **214** and also as a means for maintaining atmospheric pressure above the liquid in the reservoir **202** and thus equalizing the water levels in the reservoir and boiler.

The eccentric opening **220** through which the valve stem **214** projects at the top of the vent tube **222** is in this case located nearer the rear edge of the vent tube than the front, as illustrated in further detail in Fig. 6. The operating button **216** for the valve includes a downwardly extending projection **226**. In the position of Fig. 4 this projection is adapted to slip past the edge of the tube **222** and permit the spring **218** to urge the valve to its closed position.

When the button **216** is raised and rotated, however, the projection **226** may be engaged on the top surface **228** of the vent tube as shown in Fig. 6 to hold the valve stem and valve upwardly against the resilience of spring **218**. In this position a relatively large opening will be provided to permit free flow of liquid from the reservoir **202** through the conduit **204** without any restrictions or metering orifices. The edges of the projection **226** on the button **216** may be sloped or beveled at **230** to facilitate upward camming of the button by a simple rotary movement.

The upper end of the vent tube **222** is provided with an internal chamber **234** of predetermined volume for a purpose described below. A vent opening **232** in the forward end of this tube is spaced below the top of the chamber **234** as illustrated. The vent opening **232** and the space between the remaining portions of the vent tube and the valve stem **214** thus provide for venting the upper portion of the reservoir **202**.

According to a further important feature of the preferred form of the invention illustrated in these figures, the steam iron is provided with means for supporting the iron in a rest position. In this particular case the iron is adapted to be supported selectively in either of two rest positions in which the iron is tilted toward one side or the other from its normal operating position. One such position is illustrated in Fig. 8 from which it will be apparent that the iron is adapted to be tipped selectively to either side on one of the side rest projections **236** or **238**. These projections serve to space the tank and soleplate somewhat above the surface **240** on which the iron is to rest, in order to prevent damage to the supporting surface by the heat of the soleplate.

Cooperating with either of the rests **236** or **238** in this case are suitable projections on the handle of the iron. This handle, as shown particularly in Fig. 4, includes a substantially horizontal hand grasping portion **242** integrally connected to front and rear handle posts **244** and **246** respectively. The rear handle post is provided with a hollow chamber at **248** for accommodation of the supply cord leads **250** in known manner.

The front handle post is hollowed out as shown at **252** in order that the handle may surround and protect a portion of steam boiler. There is, however, a space between the steam dome and boiler members on the one hand and the handle post on the other hand, in order to minimize the transmission of undesired heat to the handle portion.

The particular handle projections which cooperate with the side rest projections **236** and **238** to maintain the iron in either of its rest positions may either be provided as integral portions of the handle itself or such supporting portions may be provided by the addition of a separate member. In this case, such a member is shown at **254** and includes a laterally extending substantially horizontal portion **256** secured by suitable fastening means **258** to the top of the handle at the front handle post portion. At either end of the portion **256**, the strip, which is preferably metallic, is bent downwardly to provide supporting legs **260** and **262** secured by screws **264** and **266** to opposite sides of the front handle post. Thus the member **254** provides corner portions **268** and **270** which serve to space the handle and the upper end of the steam dome slightly above the surface **240** on which the iron is rested. It will be understood that the projecting corner **268** cooperates with the side rest projection **236** to provide one side rest position, while the projection **270** cooperates with the side rest projection **238** to provide the other side rest position (not shown).

As illustrated in Fig. 10, the side rest members **236** and **238** have relatively long bearing portions **272** which are inclined at an angle to the longitudinal axis of the iron. Thus the nose or forward portion of the longitudinal axis of the iron is spaced substantially higher above the supporting surface **240** than the rear portion of the iron axis.

The particular orientation of the edges **272** of the side rests **236** and **238** cooperates with the specific location of the opening **212** in the valve housing **210** through which water passes from reservoir **202** to the water conduit **204** and with the particular fill-limiting means to be described below, to provide a construction in which the flow of liquid from the reservoir to the boiler will be stopped automatically without the manipulation of any value, whenever the iron is tilted into either of its selective side rest positions. Thus, as shown particularly in Fig. 10, by suitable limitation of the total quantity of water in the tank, and by location of the opening **212** at the forward or front end of the reservoir ahead of the steam generating boiler **176**, the opening **212** will be above the water level in the reservoir in the side rest position illustrated in Fig. 10 and also in the corresponding opposite side rest position.

In order to limit the total volume of liquid which may be placed in the reservoir to a volume which will remain below the opening **212** when the iron is in one of its side rest positions as shown in Fig. 10, we have shown a filling plug opening at a level below the top of the reservoir as shown in Fig. 4 and Fig. 7. Thus a portion of the top of the reservoir is downwardly offset as shown at **274** and this portion is provided with a threaded filling opening **276**. A filler plug **278** is provided with a threaded body portion **280** adapted to fit the opening **276** and close it when the plug is in position.

When the plug is removed for filling the reservoir, it is apparent that the maximum levels to which the water in the reservoir may be raised, assuming the iron is in the horizontal position of Fig. 7, is the level defined by the upper surface **282** of the recessed portion **274** in which the filling plug is located. Since the forward portion of the tank is vented, liquid may be filled up to the point where it reaches this level as shown at **284** within the reservoir. The addition of any further liquid will simply result in the liquid running over the edges of the filling opening.

The extent to which the surface **282** must be recessed below the top of the tank is determined by the exact location of the opening **212** through which water passes from the reservoir to the boiler. In general, however, it will be apparent from the teachings of this application that the volume of the air space remaining at **286** above the liquid level in Fig. 7, must be equal to at least the volume of the air space at **288** in Fig. 10 above the maximum possible liquid level in the side rest position.

It might be noted at this point in connection with Fig. 10 that this level is preferably chosen so that not only is the opening **212** located above the liquid level in the rest position, but also the venting opening where the valve stem **214** passes through the top of the reservoir will be above this level. This vent opening location is shown in Fig. 4 at **290**. Thus, when the iron is tilted to the position of Fig. 10 or to its corresponding opposite position, no liquid can enter the opening **212** to add to the supply of liquid in the boiler **176**, nor can any further liquid enter in the vicinity of opening **290** to flow out through the vent tube.

It will be noted in connection with the filling opening **276** and plug **278**, that the particular location of the recessed surface **282** is in the vicinity of the side rest **238**. In order to provide ready access to the filling opening, the side rest is cut away above the filling opening as shown at **292**, and in this respect side rest **238** differs slightly from side rest **236**. The supporting edge **294** of side rest **238**, however, is substantially identical to the corresponding edge **272** of side rest **236**, and their angular orientation is complementary as discussed above in order to insure the desired elevation of the front portion of the iron in either of its rest positions.

By virtue of the features just described, it is apparent that the supply reservoir will remain vented in either the operating or rest position, without loss of fluid, and that communication between the reservoir and boiler through the conduit **204** will be automatically cut off or re-established in response to movement of the iron to or from its rest position.

According to a further feature of the preferred form of the invention, means have been provided to insure the cessation of the boiling action within the steam generating boiler and also to prevent inadvertent loss of liquid through either the steam tube of the boiler or through the vent tube at the front of the iron. In connection with the boiler, if steam ironing operation is being carried out

before the iron is moved to its rest position, there will be a limited predetermined volume of water within the boiler portion **176** at the time the iron is moved to rest position. Thus even though the further supply of liquid is interrupted, in the manner described above, we have found it desirable to make some provision for the liquid already in the boiler.

For this purpose, we have selected the rest position as shown in Fig. 8, so that in that position the upper portion of the boiler or steam dome **190** will be somewhat lower than the hot steam generating surface **162** at the bottom of the boiler. The liquid within the boiler is then automatically removed from the heated boiler surface and carried to the unheated end of the dome **190** as shown at **296**.

According to the invention, we have also located the upper end of the steam conduit tube **166** within this upper or second portion of the steam generating boiler at a point which is above the level of the liquid at **296** when the iron is in its rest position. In other words, even though the iron were filled, as far as permitted by the fill limitation means discussed above, and even though the iron were then tilted immediately to its rest position, the maximum amount of liquid for which the boiler is designed could be accommodated in the portion of the dome **190** below the end of the steam conduit **166** in the rest position.

In order to reduce the size of the steam dome at this point and permit the use of smaller parts with consequent economy of manufacture, we have made provision as discussed earlier in this application for substantially restricting the total volume of water in the boiler. This restriction is obtained by means of the annular sleeve **186** and the narrowed section **176** of the lower portion of the boiler. The invention thus contemplates the careful correlation of the volume of liquid in the boiler with the size and shape of the steam dome portion which lies below the steam conduit tube **166** in the rest position, in order to achieve the objectives just discussed.

Furthermore, the provision of the insulation at **180** between the steam generating area **162** of the soleplate and the remainder of the boiler prevents the rapid transfer of heat to the upper portions of the boiler and thus insures that these portions will be cool enough to stop the steam generation at the appropriate point. The boiler walls and dome may also be made of material of lower thermal conductivity, for this same purpose, as, for example, stainless steel.

As illustrated in Fig. 9, it may sometimes happen that at the instant the iron is tilted to its rest position, there may be some water trapped in the valve chamber **210** and there may be a tendency for this liquid to pass along the valve stem and into the vent tube as the iron is tilted to the rest position of Fig. 9. For this purpose, the vent opening **232** has been spaced a substantial distance from the normal upper end **228** of the vent tube. Thus any liquid which might be trapped in this manner can be accommodated as shown at **298** without loss of such liquid through the opening **232** in the rest position.

The preferred embodiment of Figs. 4–10 thus constitutes a device which may be used selectively as a steam or dry iron. Its steaming rate may be adjusted for steam pressing of different fabrics by variation of the soleplate temperature under the control of the manually adjustable thermal switch, without the use of special liquid metering valves or orifices. The generation of steam is automatically interrupted in an improved manner when the iron is moved to either of its two rest positions both by removal of liquid to a cooler portion of the steam generating chamber and by interruption of the liquid supply to such chamber. Special features of construction prevent the loss of liquid from either the reservoir or boiler chamber when the iron is in a rest position.

The combinations of elements and features of construction which have been described in connection with the foregoing embodiments thus make possible the production of a steam iron which substantially accomplishes the objectives set forth at the beginning of this specification. Since minor variations and changes of construction will be apparent to persons skilled in this field, it is intended that this invention shall cover all such changes and modifications as fall within the spirit and scope of the attached claims.

Now, therefore, we claim:

1. A steam iron comprising a soleplate having top and bottom surfaces, a reservoir above said soleplate for containing water therein at a predetermined maximum level electrical heating means for the soleplate, means providing a steam generating boiler chamber defined by wall portions having their lower edges in sealing engagement around the edges of a relatively small predetermined constant area of said top surface and their upper edges above said predetermined water level, and means normally maintaining a predetermined small volume of liquid in the boiler chamber with portions of the liquid covering the entire soleplate top surface area within the chamber throughout normal ironing movements for generation of steam in the presence of such liquid by heat conducted from the heating means to the liquid throughout said predetermined soleplate top surface area, said last-mentioned means including means connecting said reservoir and said boiler chamber for maintaining the liquid level within said boiler chamber at least as high as that within said reservoir, and steam conduit means having one end communicating with said boiler chamber at a point above said predetermined maximum water level and having another end located to discharge steam on the material to be ironed by said bottom surface of the soleplate.

2. A steam iron according to claim 1 in which said predetermined area is less than substantially one square inch.

3. A steam iron according to claim 1 in which said predetermined area of said soleplate upper surface at the bottom of the boiler chamber has an area less than substantially $\frac{1}{20}$ of the total area of the soleplate bottom surface.

4. A steam iron according to claim 1 having adjustable control means for the heating means for supplying heat energy equivalent to at least fifty percent of the total wattage consumption of the iron to said predetermined area of the upper surface for generation of steam during steam ironing operation.

5. A steam iron according to claim 1 having adjustable control means for the heating means for supplying heat energy at the rate of substantially 250 to 600 watts to said predetermined area of the upper surface for generation of steam during steam ironing operation.

6. A steam iron according to claim 6 having the soleplate constructed of material having a thermal conductivity in the range from substantially 0.24 to 1.0 measured in c. g. s. units, and adjustable control means for the heating means for maintaining the soleplate at any one of a plurality of pre-selected temperature in the range from substantially 325° F. to 450° F. during steam ironing operation, and the size of said predetermined area of the top surface being in the range from substantially 0.7 to 0.9 square inch.

7. In a steam iron comprising a soleplate having top and bottom surfaces, heating means for said soleplate, and a water reservoir above the soleplate having means for limiting the filling of the reservoir to a predetermined maximum water level, the improvement comprising a steam generating boiler adapted to contain a limited volume of water at all times during operation and having a lower portion in direct heat-conducting relation with a predetermined area of said top surface close to said heating means for boiling said water by heat from said area, said boiler extending upwardly above said maximum reservoir water level, steam conduit means having one end opening into said boiler above said maximum water

level and having its other end open to atmosphere at a point adapted to discharge steam onto material ironed by said bottom surface, means normally venting the reservoir to atmosphere at a point above said maximum water level during steam-ironing operation, and a water conduit connecting the water-containing portions of the reservoir and boiler during operation, said water conduit having a relatively large cross-section throughout its length, and the combination and relative location of said water conduit, venting means and steam conduit means automatically maintaining essentially the same water level in said boiler as in said reservoir throughout such operation.

8. A steam iron according to claim 7 having valve means controlling said water conduit and being manually operable between either one of only two positions consisting of a first position in which the conduit is completely open for rapid equalization of boiler and reservoir water levels throughout steam ironing operation and a second position in which the conduit is completely closed for dry-ironing operation or storage, and said steam conduit extending downwardly from said one end, through the water in said boiler and thence directly to said other end, thereby maintaining the steam temperature in said conduit means close to the boiling temperature of the water for discharge onto said material.

9. A steam iron according to claim 21 having means selectively supporting the iron in a rest position in which a portion of the steam generating boiler is located below said predetermined area, said portion having a volume greater than the maximum volume of liquid maintained in the boiler during operation in ironing position, movement of the iron from operating to rest position thereby automatically removing all the liquid from said predetermined soleplate area and stopping the further generation of steam.

10. A steam iron according to claim 9 having means substantially reducing the free cross sectional area within an intermediate region of the boiler chamber just above the soleplate area and thereby limiting the volume of liquid in said chamber to an amount substantially less than the product of said predetermined soleplate area times the depth of liquid above said area.

11. A steam iron according to claim 10 in which the free cross sectional area at normal water levels within the region above the soleplate is not more than 50% of said predetermined soleplate area.

12. In a steam iron comprising a soleplate having top and bottom surfaces, heating means for said soleplate, and a water reservoir having a bottom spaced above the soleplate top surface in poor heat conducting relation therewith and having means for limiting the filling of the reservoir to a predetermined maximum water level, the improvement comprising means defining a separate steam generating boiler chamber having its bottom in direct heat transferring relation to a predetermined portion of said top surface close to said heating means, said boiler chamber extending up through said reservoir to a point substantially above said maximum reservoir water level, steam conduit means having one end opening into said boiler chamber above said maximum water level and having its other end open to atmosphere at a point adapted to discharge steam onto material ironed by said bottom surface, means normally venting the reservoir to atmosphere at a point above said maximum water level during steam-ironing operation and a water conduit connecting the bottom of said reservoir and said boiling chamber during such operation, said water conduit having throughout its length a cross section substantially greater than that required for replenishing the water converted to steam in said boiler and the combination and relative location of said water conduit, venting means and steam conduit means automatically maintaining essentially the same water level in said boiler as in said reservoir throughout such operation.

13. A steam iron according to claim 12 in which said steam conduit extends from said one end downwardly within said boiler through the liquid therein and thence directly through the soleplate with said other end of the conduit opening at the bottom surface of the soleplate, the relative location and length of said conduit thereby maintaining the steam close to the boiling point of the water in said boiler for discharge onto said material.

14. A steam iron according to claim 13 in which said soleplate bottom surface has a plurality of open grooves communicating with said other end of the steam conduit, the ends of at least a portion of said grooves opening to atmosphere through the soleplate above the plane of the bottom surface and thereby venting the steam conduit to atmosphere even when said grooves and conduit are partially blocked by the material being ironed.

15. A steam iron according to claim 14 in which the total cross-section of said grooves opening through the soleplate is substantially as great as the cross section of said steam conduit.

16. A steam iron comprising a soleplate having a central longitudinal axis, a steam generating chamber heated by the soleplate, a liquid reservoir above the soleplate, a water conduit connecting the chamber and reservoir for flow of liquid from the reservoir to the chamber during steam ironing operation, supporting means constructed and located to support the iron selectively in either of two side rest positions in which the iron is tilted to one side or the other around said axis with one and the same predetermined end of the soleplate axis higher than the other end of the axis in each of said side rest positions and with the soleplate rotated at least substantially 90° around said axis from its normal ironing position, and means automatically interrupting the flow of liquid through said conduit in response to movement of the iron to each of said rest positions, said last mentioned means including the location of a portion of said conduit at a point below the normal operating liquid level in said reservoir, said point being located along said axis near said one predetermined end, and means limiting the maximum normal volume within said reservoir to an amount which is accommodated below said point in each of said side rest positions.

17. A steam iron comprising a soleplate having top and bottom surfaces, heating means for said soleplate, a steam generating boiler having a lower first portion in direct heat-conducting relation with a predetermined area of said top surface close to said heating means and an upper second portion located above the first portion in the normal operating position of the iron, means thermally insulating said upper portion from said lower portion, means for maintaining a limited predetermined volume of liquid in said boiler during ironing, steam conduit means having one end opening into the upper portion of said boiler above said liquid and having its other end opening at a point adapted to discharge steam onto material ironed by said bottom surface, and means for supporting the iron in a rest position in which said second portion of the boiler is below said first portion of the boiler and the liquid in said boiler is gravitationally shifted to the thermally insulated second portion, the volume of said second portion located below the steam conduit opening in said rest position being greater than the maximum predetermined volume of liquid in said boiler.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,837,847 June 10, 1958

Edmond G. Franklin et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 13, for "combinnation" read -- combination --; column 14, line 53, for the claim reference numeral "6" read -- 1 --; column 15, line 27, for the claim reference numeral "21" read -- 7 --.

Signed and sealed this 26th day of August 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents