

Fast cooling steam iron

The invention relates to a steam iron comprising: a soleplate; a steam generator operative to convert water into steam, the steam generator comprising a steam chamber which is thermally coupled to the soleplate; means for sensing an actual temperature of the soleplate and means for setting a desired temperature of the soleplate.

5 Such a steam iron is known from United States Patent No. 4,939,342. During ironing the user of a steam iron selects a soleplate temperature depending on the properties of the fabric to be ironed. When the user selects a lower temperature, it takes a considerable time until the soleplate is cooled down to the lower desired temperature, particularly when the iron cools down freely on a tray or in heel rest position. A further problem with steam
10 irons is the risk of scorching when the iron is left unattended on the fabric.

Object of the invention is to provide a steam iron with reduced cool-down time when a lower soleplate temperature has been selected. It is a further object of the invention to provide a steam iron with reduced risk of scorching when the steam iron is left unattended on a fabric.

15 To obtain the above objects, according to the invention the steam iron as specified in the opening paragraph is characterized in that the steam iron further comprises a control means for comparing the actual temperature and the desired temperature of the soleplate and for generating an activation signal for activating the steam generator if the actual temperature is higher than the desired temperature.

20 The steaming action of the steam generator cools down the soleplate, because the evaporation of water withdraws heat from the soleplate. The cool-down time to a lower soleplate temperature is thereby reduced considerably. The means for setting the desired soleplate temperature may comprise a dial or buttons for manually selecting the temperature. The steaming action can further be used when the ironing work is finished. In that case the
25 switch-off of the steam iron is considered as a very low desired soleplate temperature. The cooling of the iron after use increases the safety. The means for setting may comprise a means for providing a preset soleplate temperature which is indicative of scorching of the fabric to be ironed. In this case the cooling of the soleplate by evaporating water is used to prevent scorching if the iron is left on the fabric. A soleplate with low heat inertia is

advantageous as it cools down in shorter time so that the risk of scorching is reduced still further.

A preferred embodiment is characterized in that the steam generator further comprises a water tank for containing water to be converted into steam and a water pump for pumping water from the water tank to the steam chamber, the water pump being operative in response to the activation signal. The use of a water pump enables an accurate dosing of the water to be evaporated depending on the needs during cool-down, anti-scorching, normal steaming and shot of steam.

The steam iron according to the invention may be further provided with a hand sensor to detect whether the iron is in use or not, a position sensor to detect horizontal and vertical position of the iron and a motion sensor to detect whether the iron is being moved or not. The hand sensor, the position sensor and the motion sensor enable to detect a situation in which it may be concluded that the steam iron is left unattended on a fabric and that cooling of the soleplate is needed to prevent scorching. The motion sensor can be a conventional mercury pool switch, ball switch or can be based on measurement of the lower power need of the soleplate when the iron is left on the fabric. A much safer way is to provide the iron with a stand for receiving the iron in a rest position and means for detecting the reception of the iron in the stand. As long as the iron is not placed in the stand and is in horizontal position and not touched by the user, it can be concluded that the iron is resting unattended on the fabric and that cooling of the soleplate by evaporating water is needed. The means for detecting the reception of the iron in the stand can be for example a switch in the steam iron, which switch is engaged by a notch protruding from the stand which corresponds with a recess in the steam iron.

The above and other features and advantages of the invention will be apparent from the following description of exemplary embodiments of the invention with reference to the accompanying drawings, in which:

Figure 1 shows schematically a cross section of a first embodiment of a steam iron according to the invention;

Figure 2 shows a flow chart of a control program for the first embodiment;

Figure 3 shows schematically a cross section of a second embodiment of a steam iron according to the invention; and

Figure 4 shows a flow chart of a control program for the second embodiment.

Like reference symbols are employed in the drawings and in the description to represent the same or similar item or items.

Fig. 1 shows a first embodiment of a steam iron according to the invention. The steam iron has a conventional soleplate 2 which is heated by an electrical heating element 4. The actual temperature of the soleplate 2 is sensed by means of a temperature sensor 6, for instance a PTC-resistor, a NTC-resistor or a thermo-couple element. The desired temperature of the soleplate 2 is set by the user by means of a temperature selector or dial 8, but any other known setting means such as push buttons, touch buttons or knobs are possible as well. A controller 10 compares the actual temperature with the desired temperature and controls the heater 4, for example with a triac, to make the actual temperature equal to the desired temperature. The steam iron is further provided with a steam generator 12 comprising a water tank 14, a water pump 16 and a steam chamber 18 which is heated by the soleplate 2. The water pump 16 pumps water from the water tank 14 to the steam chamber 18 via a hose 20. The water evaporates in the steam chamber 18 and escapes via steam vents 22 in the soleplate 2.

According to the invention the water pump 16 is activated under command of an activation signal AS from the controller 10 when the user selects with dial 8 a desired temperature which is lower than the actual temperature of the soleplate 2 sensed by temperature sensor 6. The evaporation of water in the steam chamber 18 cools down the steam chamber 18 and so the soleplate 2. In this way the cool-down time can be reduced considerably compared with the time for cooling when the steam iron is resting on its heel or on a tray. Assuming a heat capacity of 480 Joule/°C of the soleplate 2, it follows that the water consumption for steaming and so for cooling is about 0.2 gram water per degree Centigrade of the soleplate temperature. With 20 grams steam per minute the temperature drops about 100 degrees Centigrade in one minute. This corresponds to a cooling power of about 860 Watt. On a tray the dissipation of the iron is between 50 and 100 Watt. Hence the cooling time can be shortened by a factor 10 or more by steaming.

All electrical parts receive suitable AC or DC supply voltages in a conventional manner not shown. The controller 10 is preferably a microprocessor with suitable interface circuits to the dial 8, the temperature sensor 6, the heating element 4 and the water pump 16. Fig. 2 shows a flow chart for heating and cooling of the soleplate 2. The inscriptions to Fig. 2 are listed in Table I below:

Table I	
Block	Inscription
200	Start
202	$T_{\text{soleplate}} > T_{\text{desired}}?$
204	activate water pump
206	control $T_{\text{soleplate}}$

The actual temperature of the soleplate $T_{\text{soleplate}}$ is compared (block 202) with the desired temperature T_{desired} set by the user using the dial 8. If the actual temperature of the soleplate is higher than the desired temperature, then the controller 10 activates the water pump 16 (block 204) by sending an appropriate activating signal AS to the water pump 16 and the soleplate is cooled down. After cooling down or if the desired temperature is not lower than the actual temperature, the controller 10 continues to control the heater 4 of the soleplate to maintain the desired soleplate temperature.

The steam generator can, of course, also be used for normal steaming or for producing a shot of steam. The controller 10 sends appropriate activation signals of suitable duration to the water pump 16 depending on the actual or programmed steaming need.

Fig. 3 shows a second embodiment of a steam iron according to the invention. In this embodiment the cooling effect of evaporating water is used not only for obtaining a fast cool-down of the soleplate after the setting to a lower desired temperature, but also for reducing the risk of scorching of the fabric to be ironed. Also not necessary it is preferred to employ a thin low heat inertia soleplate 2 which is, for example, heated by a thick film heating element 4. The low heat inertia reduces the risk of scorching considerably because of the fast decay of the soleplate temperature to lower temperatures. Regarding the cool-down by evaporation of steam after setting of a lower desired soleplate temperature the steam iron of Fig. 3 works as explained in relation to the embodiment of Fig. 1 and the accompanying flow chart of Fig. 2.

In order to prevent scorching the embodiment of Fig. 3 is provided further with a hand sensor 24 in the handgrip 26 of the steam iron. The hand sensor 24 can be of any conventional type, for example a capacitive sensor, a mechanical sensor, a resistive sensor or

an optical sensor. The hand sensor 24 signals to the controller 10 whether the steam iron is being used (in-use) or not (not in-use) by the user. Inside the controller 10 or at any suitable place inside the steam iron there is provided a position sensor 28 which signals to the controller 10 whether the steam iron is in a substantially horizontal position or in a substantially vertical position. The steam iron is in the substantially horizontal position when it is being moved over the fabric to be ironed or when it is resting on a tray or on the ironing board. The steam iron is in the substantially vertical position when it is resting on its heel. Inside the controller 10 or at any suitable place inside the steam iron there is further provided a motion sensor 30 which signals to the controller 10 whether the steam iron is being moved by the user or not. The position sensor 28 and the motion sensor 30 can each be of conventional design, for example a mercury pool switch mounted inside the steam iron in an appropriate position. A very safe way of motion detection is the provision of a stand 32 for placing the steam iron when it is not in use and means for detecting whether the steam iron is placed on the stand or not. The means can be a switch 34 engaged by a notch 36 on the stand 32. The switch 34 signals to the controller 10 whether the steam iron is certainly moving or not and provides a very safe indication of non-movement.

Fig. 4 shows a flow chart for combined fast cooling and scorch prevention. The inscriptions to Fig. 4 are listed in Table II below:

Table II	
Block	Inscription
400	Start
402	handgrip touched by user?
404	iron in horizontal position?
406	$T_{\text{soleplate}} > T_{\text{desired}}?$
408	activate water pump
410	control $T_{\text{soleplate}}$
412	iron placed on stand
414	$T_{\text{soleplate}} > T_{\text{scorching}}?$
416	activate water pump

If the handgrip 26 is touched by the user (block 402), then the signals from the position
 15 sensor 28 and from the motion sensor 30 or the stand detection switch 32 is ignored and the
 steam iron operates as already explained in relation to the flow chart of Fig. 2. Blocks 406,
 408 and 410 of Fig. 4 correspond to blocks 202, 204 and 206, respectively, of Fig. 2. If
 desired, the steps of blocks 406 and 408 may be omitted from the flow chart of Fig. 4. If the
 handgrip is not touched by the user (block 402), then the controller 10 tests whether the iron
 20 is in a substantially horizontal position (block 404). If not, then the iron is in the
 substantially vertical heel rest position and the control of the heating of the soleplate can
 proceed as shown and explained in the flow chart of Fig. 2. This means that, if the user
 selects a lower temperature in the vertical heel rest position, the soleplate is cooled down by
 evaporating water. If the iron is in the substantially horizontally position (block 404), then
 25 the controller 10 tests whether the iron is on stand or not (block 412). If the iron is on stand,
 the control returns to normal temperature control (block 406), otherwise the scorching
 prevention is enabled. The temperature of the soleplate is compared with a soleplate
 temperature $T_{\text{scorching}}$ which is indicative of scorching of the fabric being ironed (block 414).
 If the actual temperature $T_{\text{soleplate}}$ of the soleplate is greater than the scorching temperature

T_{scorching}, then the controller 10 activates the water pump (block 416) to cool down the soleplate 2 and any fabric underneath the soleplate. As can be understood from the flow chart of Fig. 4 the scorching prevention by activating the steam generator takes place if the handgrip of the iron is not touched and the iron is in the horizontal position and is not placed
5 on the stand.

The execution of the actions in the flow charts of Figs. 2 and 4 can be done by means of a suitably programmed microcontroller or microprocessor and appropriate interface circuitry which are known *per se* and can be advantageously combined with other microprocessor controlled functions and features of the steam iron, such as steaming rate,
10 shot of steam and auto shut off.

CLAIMS

1. A steam iron comprising: a soleplate (2); a steam generator (12) operative to convert water into steam, the steam generator (12) comprising a steam chamber (18) which is thermally coupled to the soleplate (2); means (6) for sensing an actual temperature of the soleplate (2) and means (8) for setting a desired temperature of the soleplate (2), characterized in that the steam iron further comprises a control means (10) for comparing the actual temperature and the desired temperature of the soleplate (2) and for generating an activation signal (AS) for activating the steam generator (12) if the actual temperature is higher than the desired temperature.
2. A steam iron as claimed in claim 1, characterized in that the steam generator (12) further comprises a water tank (14) for containing water to be converted into steam and a water pump (16) for pumping water from the water tank (14) to the steam chamber (18), the water pump (16) being operative in response to the activation signal (AS).
3. A steam iron as claimed in claim 1 or 2, characterized in that the means (8) for setting comprises a user operable temperature selector (8).
4. A steam iron as claimed in claim 1, 2, or 3, characterized in that the steam iron comprises a hand detection means (24) for indicating whether the steam iron is in-use or not in-use, the control means (10) being responsive to the hand detection means (24) and being operative to generate the activation signal (AS) if the iron is in-use.
5. A steam iron as claimed in claim 4, characterized in that the steam iron further comprises a position detection means (28) for indicating a substantially vertical position of the steam iron, the control means (10) further being responsive to the position detection means (28) and being operative to generate the activation signal (AS) if the iron is not in-use and in the substantially vertical position.
6. A steam iron as claimed in claim 1 or 2, characterized in that the means for setting comprises a means (10, 414) for providing a preset soleplate temperature which is indicative of scorching of the fabric to be ironed.
7. A steam iron as claimed in claim 6, characterized in that the steam iron comprises a motion detection means (30, 32-36) for indicating whether the steam iron is in-motion or not in-motion, the control means (10) being responsive to the motion detection



means (30, 32-36) and being operative to generate the activation signal (AS) if the iron is not in-motion.

8. A steam iron as claimed in claim 7, characterized in that the steam iron further comprises a position detection means (28) for indicating a substantially horizontal position of the steam iron, the control means (10) further being responsive to the position detection means (28) and being operative to generate the activation signal (AS) if the iron is not in-motion and in the substantially horizontal position.

9. A steam iron as claimed in claim 8, characterized in that the steam iron further comprises a hand detection means (24) for indicating whether the steam iron is in-use or not in-use, the control means (10) further being responsive to the hand detection means (24) and being operative to generate the activation signal (AS) if the iron is not in-motion and in the substantially horizontal position and not in-use.

10. A steam iron as claimed in claim 7, 8 or 9, characterized in that the motion detection means (32-34) comprises a stand (32) for receiving the steam iron in a rest position and means (34, 36) for detecting the reception of the iron in the stand (32).

11. A steam iron as claimed in claim 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, characterized in that the soleplate (2) has a low heat inertia.