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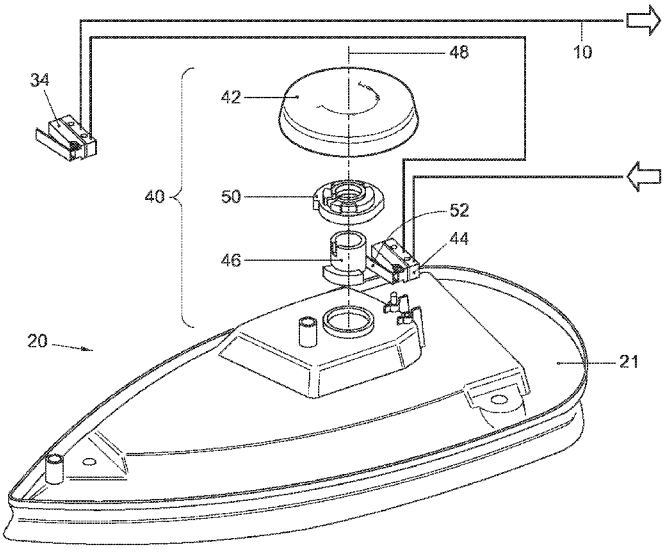


FIG. 2

(57) Abstract: Provided is a steam system, including a steam generator and a steam ejector, that prevents steam from being released from the steam generator to the steam ejector in case a nozzle temperature-dependent condition, typically a sufficient nozzle temperature to prevent or overcome condensation of released steam, is not satisfied. This behavior is realized using an electric circuit that is constructionally simple, reliable and economical, and that is well suited for application in steam systems in which the steam release controls and the steam re leaser tend to be spaced too far apart to enable a viable mechanical solution. Such steam systems include steam iron systems and garment steamers.

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Steam system

FIELD OF THE INVENTION

The invention relates to steam systems comprising a steam ejector and a steam generator, and more in particular to means configured to control steam generation by the steam generator and/or steam release from the steam ejector.

BACKGROUND

Steam systems form a generic class of domestic appliances that are often used for garment care purposes. The class encompasses the sub-class of steam iron systems. Steam iron systems may comprise an iron (the steam ejector) that is connected to an external steam generator. Because of the external steam generator, which typically features a powerful boiler and a relatively large steam reservoir, steam iron systems allow for the release of relatively large quantities of steam at relatively large pressures and high temperatures in comparison to steam irons that feature a relatively small, internal evaporation chamber.

A problem commonly associated with current steam iron systems arises from the fact that the steam, once generated by the external steam generator, has to be transported to steam outlets in the soleplate of the iron. On its way to these outlets, the initially hot steam may cool down and, in case the temperature of the soleplate of the iron is relatively low, may even partially condense on the soleplate. Such condensation results in undesired, irregular and somewhat violent water spitting behavior of the iron. The situation may aggravate if the release of steam from the steam generator is triggered at a cold start cycle, that is, when steam in a hose that bridges the distance between the steam generator and the iron has cooled off substantially, causing condensation of the steam in the hose even before it reaches the soleplate.

Although a steam iron system is probably the best-known example of a steaming device that exhibits the problem of water spitting, this problem is certainly not unique to steam iron systems. Other steam systems, such as for example garment or clothes steamers, may suffer from the same issue. As far as the above-described problem is concerned, such garment steamers differ from steam iron systems primarily in that they feature a hand-held, heated steam head instead of an iron. It will therefore be appreciated that

the above exposition of the problem is, mutatis mutandis, applicable to such alternative steam systems.

WO 2005/054564 discloses a steam iron system that is programmable in accordance with the material of the textile item to be ironed. The system is capable of storing a plurality of ironing programs, each one of which relates to suitable operating values of the soleplate temperature of the iron and the steam pressure generated in a steam generator connected to the iron. An ironing program may or may not provide for the emission of steam. In the latter case, pressing a steam release switch on the iron – which is under the control of electronic means – does not result in a command signal to an electromagnetic valve in the steam generator to release steam. Accordingly, ironing programs associated with a low soleplate temperature may be set so as not to provide for steam emission in order to prevent undesired water spitting. A prominent drawback of the disclosed system, however, is that it is rather complicated and involves high manufacturing costs. Said electronic means, for example, include one or more electronic processing units (microprocessors), electronic storage means, displays etc., which render the solution rather uneconomical.

It is therefore an object of the present invention to provide for a steam system, e.g. a steam iron system, which incorporates a structurally simple, reliable and more economical solution to the problem of water spitting.

SUMMARY OF THE INVENTION

The steam system according to the invention comprises a steam generator, a steam ejector and a duct. The steam generator includes a water reservoir and a steam release assembly, the latter including a steam releaser and an electrical steam releaser-actuator. The steam ejector includes a heatable nozzle, comprising at least one steam outlet; a first switch assembly, switchable between a first state and a second state; and a second switch assembly, switchable between a third state and a fourth state. In use, the third and fourth states are indicative of a temperature of the nozzle. The duct connects the water reservoir of the steam generator to the at least one steam outlet in the nozzle of the steam ejector. The steam releaser is disposed in the duct, and configured to close off the duct when the steam releaser-actuator is not powered. The steam system further comprises an electric circuit for controlling the steam releaser. The electric circuit includes, in series, the first switch assembly, the second switch assembly, the steam releaser-actuator and a power source or power source connection, and is configured such that the steam releaser-actuator is powerable to operate

the steam releaser if and only if the first switch assembly is in the second state and the second switch assembly is in the fourth state.

In a steam system according to the invention, the steam release assembly is configured such that the steam releaser (e.g. a valve) is biased to close off the duct. The steam releaser thus prevents the flow of water, either in liquid or vaporized form, from the steam reservoir to any steam outlets in the nozzle of the steam ejector when the steam releaser-actuator is not powered. Accordingly, when steam is to be released, the steam releaser-actuator needs to be powered in order to bring the steam releaser in a position that does not block the duct. This fact, taken in conjunction with the serial configuration of the electric circuit, subjects the release of steam to a cumulative condition: both the first and the second switch assembly have to be in an even state to enable powering of the steam releaser actuator through the electric circuit. Phrased otherwise: the electric circuit is configured such that the second switch assembly – whose state is related to the temperature of the nozzle – is capable of cutting off power to the steam releaser actuator. Such a power cutoff overrides the state of the first switch assembly and causes the steam releaser to move into its default position, closing off the duct, thereby preventing the release of steam. Apart from enabling an overriding control over the release of steam, the 'normally closed'-bias of the steam releaser also provides a fail-safe mechanism that prevents steam from being released suddenly in the case of an interruption of the power supply to the steam system, including the electric circuit.

The steam system according to the invention thus prevents steam from being released from the steam generator to the steam ejector in case a nozzle temperature-dependent condition, typically a sufficient nozzle temperature to prevent or overcome condensation of released steam, is not satisfied. This behavior is realized using an electric circuit that is constructionally simple, reliable and economical, and that is particularly suited for application in steam systems in which the steam release controls and the steam releaser tend to be spaced too far apart to enable a viable mechanical solution. As mentioned above, steam systems in which the invention may be applied include steam iron systems and garment steamers. In the case of a steam iron system, the 'steam ejector' may be formed by the iron, whereas the 'nozzle' may include the soleplate of the iron.

According to an embodiment of the invention the first switch assembly comprises a steam release control, moveable between a first position and a second position, and a first micro-switch, said first micro-switch being incorporated in the electric circuit. The steam release control is configured for mutual cooperation with the first micro-switch, such that the steam release control in its first position causes the first micro-switch to effect the

first state of the first switch assembly, while the steam release control in its second position causes the first micro-switch to effect the second state of the first switch assembly.

According to another embodiment of the invention, the second switch assembly comprises a temperature control for setting a temperature of the nozzle of the steam ejector, and a second micro-switch, said second micro-switch being incorporated in the electric circuit. The temperature control and the second micro-switch are configured for mutual cooperation, such that a setting of the temperature control that corresponds to a temperature above a certain threshold value causes the second micro-switch to effect the fourth state of the second switch assembly, while a setting of the temperature control that corresponds to a temperature below a certain threshold value causes the second micro-switch to effect the third state of the second switch assembly.

Both switch assemblies may thus comprise a micro-switch. Micro-switches are economical and reliable components that can easily be incorporated in the electric circuit. In addition, micro-switches may interface with a variety of controls, possibly user-operable, in order to enable adjustment of the states they occupy.

The state of the first switch assembly may directly reflect a user's desire for steam. The control for operating the first micro-switch may therefore be implemented as a user-operable component, e.g. a steam release trigger, a first, unpressed position of which may be associated with the first state of the first switch assembly, while a second, pressed position may be associated with the second state of the first switch assembly. The state of the second switch assembly, on the other hand, is related to the temperature of the nozzle of the steam ejector. The circumstance that the temperature of the nozzle is too low to prevent or overcome condensation of steam near the at least one steam outlet in the nozzle may preferably be associated with the third state of the second switch assembly, while, conversely, the circumstance that the nozzle temperature is sufficient to prevent or overcome condensation of steam may be associated with the fourth state of the second switch assembly. It will be clear that any condensation of steam may be overcome by conversion of the condensate to steam using heat energy from the nozzle. The control for effecting the respective states of the second micro-switch may be user-operable or not, as will be elucidated infra.

In an advantageous embodiment, the temperature control of the second switch assembly includes a rotatable shaft, said shaft being provided with a cam that extends radially with respect to a rotational axis of the shaft, and the degree to which the cam extends radially

outward varies along its radial circumference, and wherein said cam is configured to interact with the second micro-switch.

A mechanical, user-operable temperature control fitted with a cam to interface with the second micro-switch is a low cost solution that fits in with the general design of contemporary steam irons. After all, most steam irons already come equipped with a rotatable temperature dial that enables a user to choose the desired temperature setting for the soleplate. Fitting a shaft of the temperature dial with a cam easily allows the control to interface with a micro-switch that is incorporated in the electric circuit.

In an embodiment of the invention, the first micro-switch of the first switch assembly and/or the second micro-switch of the second switch assembly locally break(s) the electric circuit when the respective switch assembly is in an odd state (i.e. the first respectively the third state), and locally closes the electric circuit when the respective switch assembly is in an even state (i.e. the second respectively the fourth state).

Binary micro-switches that switch between an open and a closed state are both low cost and durable, and may therefore be applied advantageously. Binary switch behavior is especially favorable in the case of the second switch assembly, which is to differentiate between a too low (below threshold) and a sufficient (above threshold) nozzle temperature to prevent or overcome condensation of water in or on the nozzle. The first micro-switch may also be binary, but it is contemplated that a non-binary micro-switch, e.g. a micro-switch with a gradually adjustable electric resistance, may be employed as well, and may in some circumstances be more favorable.

In case the steam system according to the invention is a steam iron system, it may be combined or integrated with other ironing accessories or requirements. A steam iron system may for example be integrated with an ironing board. The ironing board itself may be of a conventional design and include a variety of features, such as board heating, suction functionality to hold garments in place and/or blowing functionality to provide an air cushion below garments being ironed. In such an ironing assembly, the steam generator of the steam iron system may be conveniently disposed below the ironing board, for example in a base thereof, which base may centrally accommodate any equipment necessary for the other features as well.

These and other features and advantages of the invention will be more fully understood from the following detailed description of certain embodiments of the invention, taken together with the accompanying drawings, which are meant to illustrate and not to limit the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 schematically illustrates the configuration and wiring scheme of an exemplary steam iron system according to the present invention;

Fig. 2 illustrates the construction of the second switch assembly as a part of the steam iron schematically depicted in Fig. 1; and

Figs. 3 - 9 illustrate the operation of the second switch assembly as shown in Fig. 2.

DETAILED DESCRIPTION

Fig. 1 schematically illustrates the configuration and wiring scheme of an exemplary steam iron system 1 according to the present invention. The steam iron system 1 comprises a steam iron 20, shown schematically on the left, and a steam generator 60, shown schematically on the right of the Figure. The steam iron 20 comprises a soleplate 22, a first switch assembly 30 and a second switch assembly 40. These components will now be elucidated and exemplified in turn hereinbelow.

The soleplate 22 comprises a number of steam outlets 24, distributed across a surface of the soleplate according to a suitable pattern. The steam outlets 24 fluidly connect a steam chamber 26, located adjacent the soleplate 22 on an inner side thereof, to the outside world. To enable controlled heating of the soleplate 22, the iron may include a thermostat and heating means 28. The soleplate 22, the thermostat and the heating means 28 may all be of a conventional design, and are not elaborated upon here in detail.

The first and second switch assemblies 30, 40 are incorporated in series in an electrical circuit 10 that effectively controls the release of steam from the steam generator 60. Both switch assemblies 30, 40 are switchable between two states: a first and a second state for the first switch assembly 30, and a third and a fourth state for the second switch assembly 40. The different states may typically correspond to a locally broken electric circuit 10 (the odd states), and a locally closed electric circuit (the even states). Only when both switch assemblies 30, 40 are in an even state, i.e. the second state respectively the fourth state, the electric circuit 10 is closed and capable of powering a steam releaser-actuator 74 to effect the release of steam. The two switch assemblies 30, 40 serve different purposes, as will become clear from the following exemplification.

The first switch assembly 30, which is depicted schematically as a rectangular box in Fig. 1, may typically include a user-operable component in the form of a steam release

control that allows a user to consciously select a certain desired steam rate, e.g. a fixed steam rate chosen from a series of discrete steam rates, or a momentary steam boost. The user-operable component may be mechanical in nature, such as a push button or a trigger provided on or near a handle of the iron 20, and hence be moveable between a first and a second position. Alternatively, the user-operable component may be non-mechanical, and for example include an optical or capacitive sensor that detects the presence of a user's finger on a soft-touch button. It is also contemplated that, instead of a user-operable component, a mechanical or non-mechanical sensor may be used to detect the presence of an article to be ironed under the soleplate of the iron. Detection of the finger, respectively detection of an article to be ironed under the soleplate, may be associated with a second position of an employed sensor, while absence of the finger or article may be associated with a first position. The user-operable component / article detection sensor may interact with or include a first micro-switch 34 (see Fig. 2) that is incorporated in the electric circuit 10. The first switch assembly 30 may preferably be configured such that the user-operable component in its first position causes the first micro-switch 34 to effect the first state of the first switch assembly, while the user-operable component in its second position causes the first micro-switch to effect the second state of the first switch assembly.

As mentioned, from a user's perspective, the first switch assembly 30 may be unambiguously associated with the release of steam from the steam generator 60. Alternatively, however, a user-operable component of the first switch assembly 30 may be withdrawn from the conscious control of the user, and for example be integrated in an intuitively moveable handle of the iron 20. In one such embodiment, the handle may be spring loaded, and be displaceable from its default position, corresponding to the first state of the first switch assembly 30, towards a pressed-down position, corresponding to the second state thereof. Since users tend to push an iron's handle down harder when the garment being ironed is more wrinkled, such a configuration allows for intuitive, subconscious control over the steam releaser 72.

As may be inferred from the intuitive handle-example, the first micro-switch 34 is not necessarily binary in nature in the sense that it has merely two distinct physical conditions (e.g. completely open/conductive and completely closed/non-conductive). The first micro-switch 34 may for example include a variable resistor or potentiometer whose resistance varies with the position of the handle. In any electrical circuit with components connected in series, the voltage drop across one component may influence the voltage drop across another. Accordingly, the variable electric resistance of the potentiometer in the

electric circuit 10 may, apart from its own voltage drop, influence a voltage drop across the steam releaser-actuator 74. As any action undertaken by the powered steam releaser-actuator 74 may be dependent on the voltage drop it experiences, a gradually variable voltage drop can be used to actuate the steam releaser 72 to a greater or lesser degree. In such an embodiment, the first state of the first switch assembly 30 may correspond to a locally broken electric circuit 10, or to one in which the electric resistance of the first micro-switch 34 is within a range of reasonably large values. The second state of the first switch assembly 30 may then correspond to a locally closed electric circuit 10, and more in particular to a range of electric resistance values of the potentiometer, wherein the values are sufficiently low to enable adequate powering of the steam releaser-actuator 74.

In Fig. 1, the second switch-assembly 40 is also depicted schematically as a rectangular box. When the iron 20 is in use, the state of the second switch assembly 40 is related to the temperature of the soleplate 22. To this end, the second switch assembly 40 may include a user-operable component, such as a soleplate temperature control in the form of a temperature dial 42 (see Fig. 2). The soleplate temperature control may be configured for cooperation with a second micro-switch incorporated in the electric circuit 10, such that a setting of the temperature control that corresponds to a temperature above a certain threshold value causes the second micro-switch to effect the fourth state of the second switch assembly, while a setting of the temperature control that corresponds to a temperature below a certain threshold value causes the second micro-switch to effect the third state of the second switch assembly.

Alternatively, the second switch assembly 40 may comprise no user-operable components. The second switch assembly 40 may, for example, include a temperature switch of the snap action type, such as a bi- or tri-metallic strip or disc, which is exposed to heat given off by the soleplate 22 of the iron 20. In one embodiment, such a temperature switch may itself be part of the electric circuit 10, for example in the form of a circuit breaker that locally breaks the electric circuit 10 when the temperature of the soleplate 22 drops below a certain threshold value. In another embodiment, the temperature switch may physically operate a second micro-switch 44 (see Fig. 2) that is incorporated in the electric circuit 10 instead. In yet another hybrid embodiment the second switch assembly 40 includes both a user-operable component and a number of fixed-temperature thermostats having double temperature switches. Here, a 'double temperature switch' means a *pair* of temperature switches, one of which is 'normally closed', and one of which is 'normally open' below a characteristic temperature. The normally closed temperature switches are optionally

incorporated in an electrical circuit that powers the heating means 28 controlling the soleplate temperature, while the normally open temperature switches are optionally incorporated in the electric circuit 10 that feeds the steam releaser-actuator 74 controlling the release of steam. A user-operable temperature control is used to select precisely which thermostat/pair of temperature switches is to be incorporated in the heating means 28 and the circuit 10 respectively. It is noted that the second switch assembly 40, irrespective of the embodiment, is preferably configured such that the fourth state corresponds to a locally closed electric circuit 10 and warrants a sufficient soleplate 22 temperature to prevent or overcome condensation of steam thereon, while the third state does not.

Now that the iron 20 has been described in some detail, the steam generator 60, shown on the right of Fig. 1, will be elucidated. It comprises a water reservoir 62, a pump 64, and a boiler 66.

The water reservoir 62 holds the water that is to be vaporized and subsequently delivered to the steam outlets 24 in the soleplate 22 of the iron 20. It may be implemented as a tank or container, but may also be formed by the water mains to which the steam iron system 1 may be connectable. The term 'water reservoir' in claim 1 is therefore intended to include a 'water mains connection'.

The water reservoir 62 and the steam outlets 24 are connected through a duct 90. The duct 90 may include a variety of structures that share the property of being a pass-through for water travelling from the water reservoir 62 to the steam outlets 24, such as the pump 64, the boiler 66 and the steam chamber 26. In between the steam generator 60 and the iron 20, the steam duct 90 may preferably be implemented as a thermally insulated hose, both to prevent a user from burning himself to the hot steam conveying duct, and to prevent the steam from cooling off due to thermal interaction with a relatively cold environment. The term 'duct' is thus to be construed broadly.

In the embodiment shown in Fig. 1, a pump 64 is used to transfer water from the water reservoir 62 to the boiler 66, and more in particular to a steam reservoir 70 thereof. The steam reservoir 70 is preferably heated by heating means 68 so as to cause any liquid water fed to the steam reservoir to be vaporized. In use, steam may be allowed to accumulate in the steam reservoir 70 until it has reached a sufficient temperature and pressure for it to be released. The release of steam from the steam reservoir 70 may be controlled by the steam releaser 72. In the depicted embodiment, the steam releaser 72 may be a valve of any suitable kind, e.g. a gate valve, a butterfly valve, a ball valve, etc. and be disposed in the duct 90. The steam releaser 72 may be operated through a suitable electrical steam releaser-actuator 74,

such as a solenoid or an electrical motor. In the embodiment of Fig. 1, only the release of steam (i.e. not its generation) is controlled by the steam releaser 72. In another embodiment, both the generation of steam and its release from the steam generator 60 may effectively be controlled by the steam releaser. Such may for example be the case when the steam releaser 72 controls the flow of water from the water reservoir 62 to a section of the duct 90 that is heated by heating means 68, but not closed off by a further downstream valve. In such an embodiment, the steam releaser 72 and its actuator 74 may thus be implemented as a controllable pump 64.

An electric circuit 10 serially connects the first switch assembly 30, the second switch assembly 40, the steam releaser-actuator 74, and an electrical power source 2 or power source connection. The power source 2 may be of any suitable type, and for example be formed by a battery. Alternatively, the electric circuit may – as such – not include the power source 2, but instead allow for an external one, such as the electricity grid, to be connected thereto via a power source connection.

The operation of the electric circuit 10 is as follows. In use, the power source 2 provides for a voltage drop across the circuit 10. When the circuit 10 is effectively broken, because the first switch assembly 30 is in the first state and/or the second switch assembly 40 is in the third state, no or insufficient current flows to power the steam releaser-actuator 74. Hence, the steam releaser 72 is and remains inactive/unpowered. It is understood that this condition occurs when the soleplate temperature is too low to prevent or overcome the condensation of steam, as this condition triggers the third state of the second switch assembly. With the second switch assembly 40 in its third state, the state of the first switch assembly 30 is irrelevant. However, when the temperature of the soleplate 22 is raised to above the threshold temperature that warrants non-condensation of steam, the second switch assembly 40 will shift into the fourth state, locally closing the circuit 10. As a result, the first switch assembly 30 may be operated to effectively close the electric circuit 10 as a whole, enabling control over the steam releaser-actuator 74.

Attention is now invited to a preferred embodiment of the steam iron system 1 according to the invention. This embodiment will be clarified with reference to Figs. 2-9. Fig. 2 schematically illustrates in some structural detail the construction of the second switch assembly 40 as a part of the steam iron 20. Shown is a base body 21 of the steam iron 20 and, on top of it, an exploded view of the second switch assembly 40. In an assembled condition of the iron 20, an underside of the base body 21 would connect to the soleplate 22, while a topside would connect to a cover part. Both the soleplate 22 and the upper cover part of the

housing of the iron 20 may be of a conventional design and are omitted from Fig. 2 for reasons of clarity. Turning now to the electrical circuit 10, and the first 30 and second 40 switch assemblies incorporated therein.

In the preferred embodiment, the first switch assembly 30 may include a user-operable steam trigger (not shown) and a first micro-switch 34. The first switch-assembly 30 may be configured such that activation of the steam trigger, corresponding to a request for steam, causes the first micro-switch 34 to pass into the second state. Likewise, deactivation of the steam trigger may cause the first micro-switch 34 to return to its first state. The steam trigger of the first switch assembly 30 may be disposed underneath a handle of the iron 20, in connection with the micro-switch 34 that itself may be hidden from the eye.

The second switch assembly 40 may include a rotatable temperature dial 42. The temperature dial 42, which is common on many present-day irons, provides a user with control over the temperature of the soleplate 22. The temperature dial 42 may itself be part of a conventional heating assembly. Such a heating assembly may typically comprise a continuously variable thermostat that is controllable by the temperature dial 42, and soleplate heating means 28 (see Fig. 1), e.g. a resistance heating element, in turn controlled by the thermostat. As heating assemblies for the soleplates 22 of steam irons are known in the art, they will not be elaborated upon here any further.

The user-selected setting of the temperature dial 42 is indicative of the temperature of the soleplate 42. This fact may be taken advantage of by providing the second switch assembly 40 with a cam 50, which cam may serve as an actuator for a second micro-switch 44. In the embodiment of Fig. 2 the cam 50 is a separate component, provided underneath the temperature dial 42. In an alternative embodiment, however, the cam 50 may be an integral part of the temperature dial 42. In an assembled state of the second switch assembly 40, the cam 50 is secured between the temperature dial 42 and a rotational shaft 46 that supports the temperature dial. The cam 50 may extend in a radial direction from an axis of rotation 48 of the temperature dial 42 and the rotational shaft 46. The radius of the cam 50, i.e. the distance over which the cam extends radially outward from the axis of rotation 48, may vary along its radial circumference (i.e. depend on the azimuthal angle with a plane perpendicular to the axis of rotation 48 taken as a reference plane).

A second micro-switch 44 is disposed adjacent the cam 50 in such a way that the two components interact. In the embodiment of Fig. 2, the second micro-switch 44 is provided with a spring loaded lever 52 that is biased towards, and in at least some positions of the temperature dial 42 against, the circumferential edge of cam 50. As the temperature

dial 42 is rotated to adapt the temperature setting of the soleplate 22 of the iron 20, so is the cam 50. The extent to which the cam 50 thereby obstructs the bias of the lever 52 to unfold (i.e. move away from the body of the micro-switch 44) depends on its orientation, and more in particular, on the radius of the portion of the cam 50 that faces the lever 52. When, during rotation of the temperature dial 42, the radius of the portion of the cam 50 that faces the lever 52 increases, the cam will, at least from a certain position on, abut the lever and effectively fold it in (i.e. move it towards the micro-switch 44 body) against the biasing force that attempts to fold the lever out against the cam. When, on the other hand, the radius of said cam portion decreases, the biased lever 52 is given space to fold out. It is understood that the position of the lever 52 is related to the state of the second switch assembly 40. In the depicted embodiment, a collapsed, pushed in lever 52 corresponds to the third state of the second switch assembly 40 – i.e. a locally broken circuit 10 – whereas an unfolded, pushed-out lever, loose of the circumference of the cam 50, corresponds to the fourth state – i.e. a locally closed circuit 10.

The interaction between the cam 50 and the second micro-switch 44 is further illustrated by Figs. 3-9. The Figures schematically show a top view of the cam 50 and the second micro-switch 44, wherein the cam is shown in different rotational positions. The cam position shown in Fig. 3 corresponds to a "Zero"- or "Minimum"-temperature setting for the soleplate 22 of the iron 20, whereas the cam positions shown in Figures 4-9 correspond to increasingly higher temperatures. By way of visual aid in interpreting the cam positions, Figs. 3-9 depict a ring-shaped temperature indicator 56, much like the ones provided on temperature dials 42 of conventional irons (cf. the temperature dial in Fig. 2). The temperature indicator 56 includes a series of dot-sets. The larger the number of dots opposite the (fixed) pointer 58, the higher the temperature setting. The temperature indicator 56 is overlaid by the second micro-switch 44 where appropriate to improve drawing legibility.

As can be seen clearly in Figs. 3-9, the radius of the cam 50 varies along its radial circumference. In Fig. 3, illustrating a Zero- or Minimum- temperature setting, a portion of the cam 50 having a relatively large radius contacts the lever 52 of the second micro-switch 44, and forces it into a folded position that corresponds to the third state of the second switch assembly 44 (i.e. a locally broken circuit 10). Increasing the temperature setting by rotating the temperature dial 42, and hence the cam 50, in a clock-wise direction first effects a change in the position of the lever 42 when the temperature setting passes the two-dots mark. See Fig. 5. At this point, the cam portion abutting the lever 52 exhibits an abrupt decrease in radius. Turning the temperature dial 42 and the cam 50 even further allows

the lever 52 to unfold (Fig. 6), and eventually to come loose of the cam 50 (Figs. 8 and 9). An unfolded lever 52, free of contact with the cam 50 as shown in Figs. 8 and 9, corresponds to the fourth state of the second switch-assembly 40 (i.e. a locally closed electric circuit 10). Hence, the soleplate temperature corresponding to the two-dot mark forms a temperature threshold above which the steam releaser-actuator 74 may be controlled via the first switch assembly 30 to operate the steam releaser 72.

Regarding the radial profile of the cam 50, it is noted that the cam comprises an 'over-travel' 51 of about 15° (see Fig. 3). This is to ensure that the lever 52 always contacts the cam 50 at a Zero- or Minimum temperature setting. Furthermore, the cam 50 and the lever 52 are configured such that it is possible, once the two-dot mark has been passed, to turn the cam and the temperature dial 42 back to a lower temperature setting. Indeed, if the lever 52 would have its pivot point on the opposite side of the second micro-switch 44 (i.e., in the Figures, on the 'upper' side instead of 'lower' side), it would be impossible to do so.

Although illustrative embodiments of the present invention have been described above, in part with reference to the accompanying drawings, it is to be understood that the invention is not limited to these embodiments. Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In particular it is noted that the above description of certain embodiments of a steam iron system is, mutatis mutandis, equally applicable to other steam systems, such as for example garment steamers. Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, it is noted that particular features, structures, or characteristics of one or more embodiments may be combined in any suitable manner to form new, not explicitly described embodiments.

CLAIMS:

1. A steam system (1) comprising:

- a steam generator (60), including:

- a water reservoir (62);

- a steam release assembly including a steam releaser (72) and an electrical steam releaser-actuator (74);

- a steam ejector (20), including:

- a heatable nozzle (22), comprising at least one steam outlet (24);

- a first switch assembly (30), switchable between a first state and a second state;

- a second switch assembly (40), switchable between a third state and a fourth state, said third and fourth states – in use – being indicative of a temperature of the nozzle;

- a duct (90), said duct connecting the water reservoir of the steam generator to the at least one steam outlet in the nozzle of the steam ejector, the steam releaser being disposed in the duct and configured to close off the duct when the steam releaser-actuator (74) is not powered; and

- an electric circuit (10) for controlling the steam releaser (72), said electric circuit including, in series, the first switch assembly (30), the second switch assembly (40), the steam releaser-actuator (74) and a power source (2) or power source connection, the electric circuit being configured such that the steam releaser-actuator is powerable to operate the steam releaser if and only if the first switch assembly is in the second state and the second switch assembly is in the fourth state.

2. The steam system according to claim 1, wherein the first switch assembly (30) comprises:

- a steam release control, moveable between a first position and a second position; and

- a first micro-switch (34), said first micro-switch being incorporated in the electric circuit (10);

wherein the steam release control is configured for mutual cooperation with the first micro-

switch, such that the steam release control in its first position causes the first micro-switch to effect the first state of the first switch assembly, while the steam release control in its second position causes the first micro-switch to effect the second state of the first switch assembly.

3. The steam system according to claim 2, wherein the steam release control includes a user-operable component.

4. The steam system according to claim 2 or 3, wherein first micro-switch (34) locally breaks the electric circuit (10) when the first switch assembly (30) is in the first state, and wherein the first micro-switch locally closes the electric circuit (10) when the first switch assembly is in the second state.

5. The steam system according to any of the claims 1 to 4, wherein first micro-switch (34) includes an electrical resistor whose resistance can be adjusted gradually through the steam release control, and wherein the resistance of the electrical resistor in the first state of the first switch assembly is larger than the resistance thereof in the second state of the first switch assembly.

6. The steam system according to any of the preceding claims, wherein the second switch assembly (40) comprises:

- a temperature control (42, 46, 50) for setting a temperature of the nozzle (22) of the steam ejector; and

- a second micro-switch (44), said second micro-switch being incorporated in the electric circuit (10);

wherein the temperature control and the second micro-switch are configured for mutual cooperation, such that a setting of the temperature control that corresponds to a temperature above a certain threshold value causes the second micro-switch to effect the fourth state of the second switch assembly, while a setting of the temperature control that corresponds to a temperature below a certain threshold value causes the second micro-switch to effect the third state of the second switch assembly.

7. The steam system according to claim 6, wherein the temperature control includes a rotatable shaft (46), said shaft being provided with a cam (50) that extends radially with respect to a rotational axis (48) of the shaft, and the degree to which the cam extends

radially outward varies along its radial circumference, and wherein said cam is configured to interact with the second micro-switch.

8. The steam system according to any of claims 6 and 7, wherein the second micro-switch (44) locally breaks the electric circuit (10) when the second switch assembly (40) is in the third state, and wherein the second micro-switch locally closes the electric circuit (10) when the second switch assembly is in the fourth state.

9. The steam system according to any one of claims 1 to 5, wherein the second switch assembly (40) comprises:

- a fixed-temperature switch, said temperature switch being incorporated in the electric circuit (10) and configured to effect the third state of the second switch assembly when a temperature of the nozzle (22) of the steam ejector (20) is below a certain threshold value, and to effect the fourth state of the second switch assembly when the temperature of the nozzle is above a certain threshold value.

10. The steam system according to claim 9, wherein the fixed-temperature switch serves as a circuit breaker, locally breaking the electric circuit (10) when the second switch assembly (40) is in the third state, and locally closing the electric circuit (10) when the second switch assembly is in the fourth state.

11. The steam system according to claim 6 or 9, wherein the threshold value is a nozzle temperature at which condensation of steam in the nozzle (22) is prevented or overcome.

12 The steam system according to any one of the preceding claims, wherein the steam releaser is a valve (72).

13. The steam system according to any one of the preceding claims, wherein the steam release assembly includes a pump (64) that embodies both the steam releaser (72) and the electrical steam releaser-actuator (74).

14. The steam system according to any one of the preceding claims, wherein the duct (90) comprises a steam reservoir (70) of a boiler (66), and wherein the steam releaser (72) is disposed downstream of the steam reservoir.

15. An ironing board assembly, including a steam system (1) according to any of the preceding claims, wherein the steam ejector is formed by an iron and wherein the nozzle is formed by a soleplate of the iron.

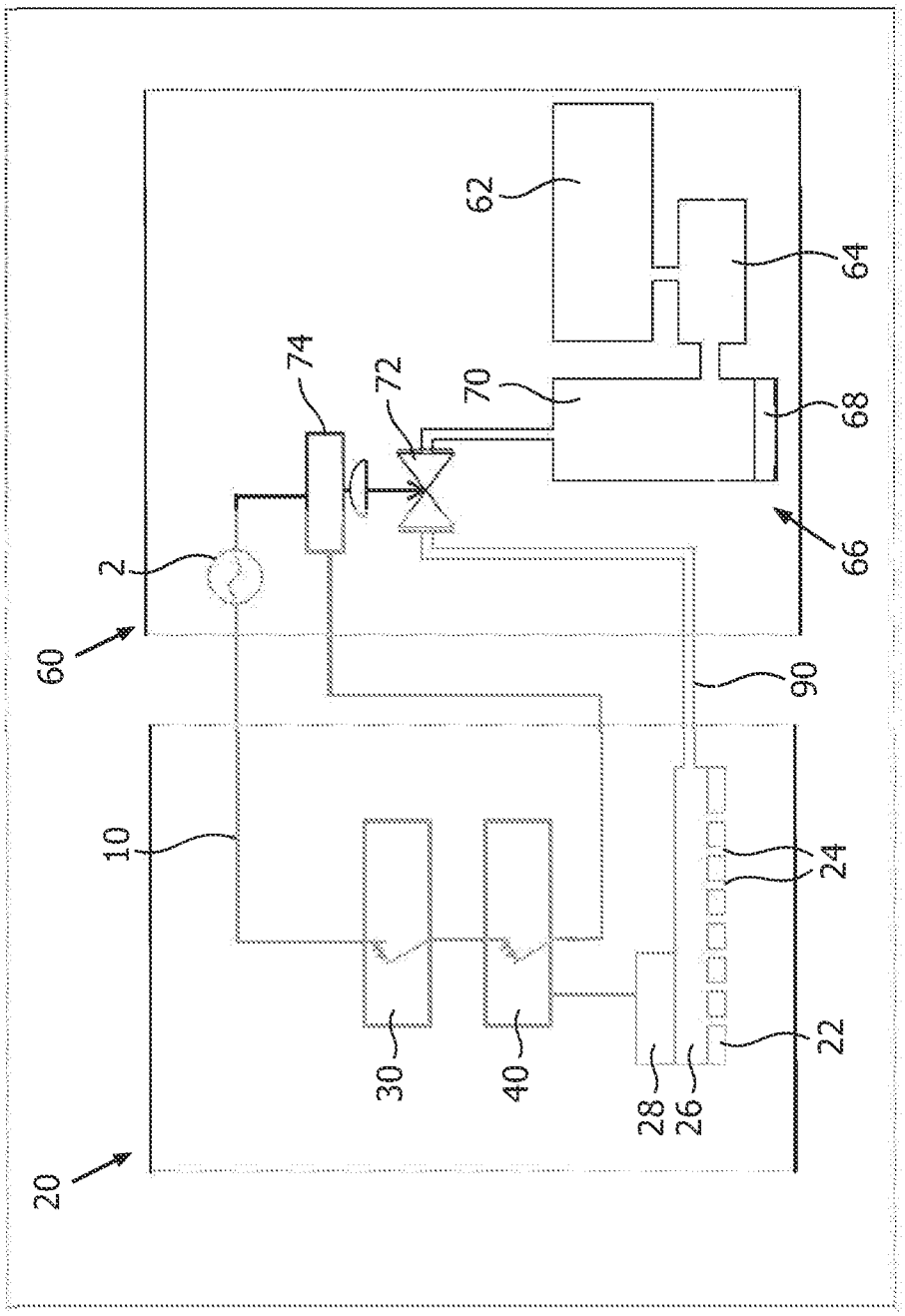
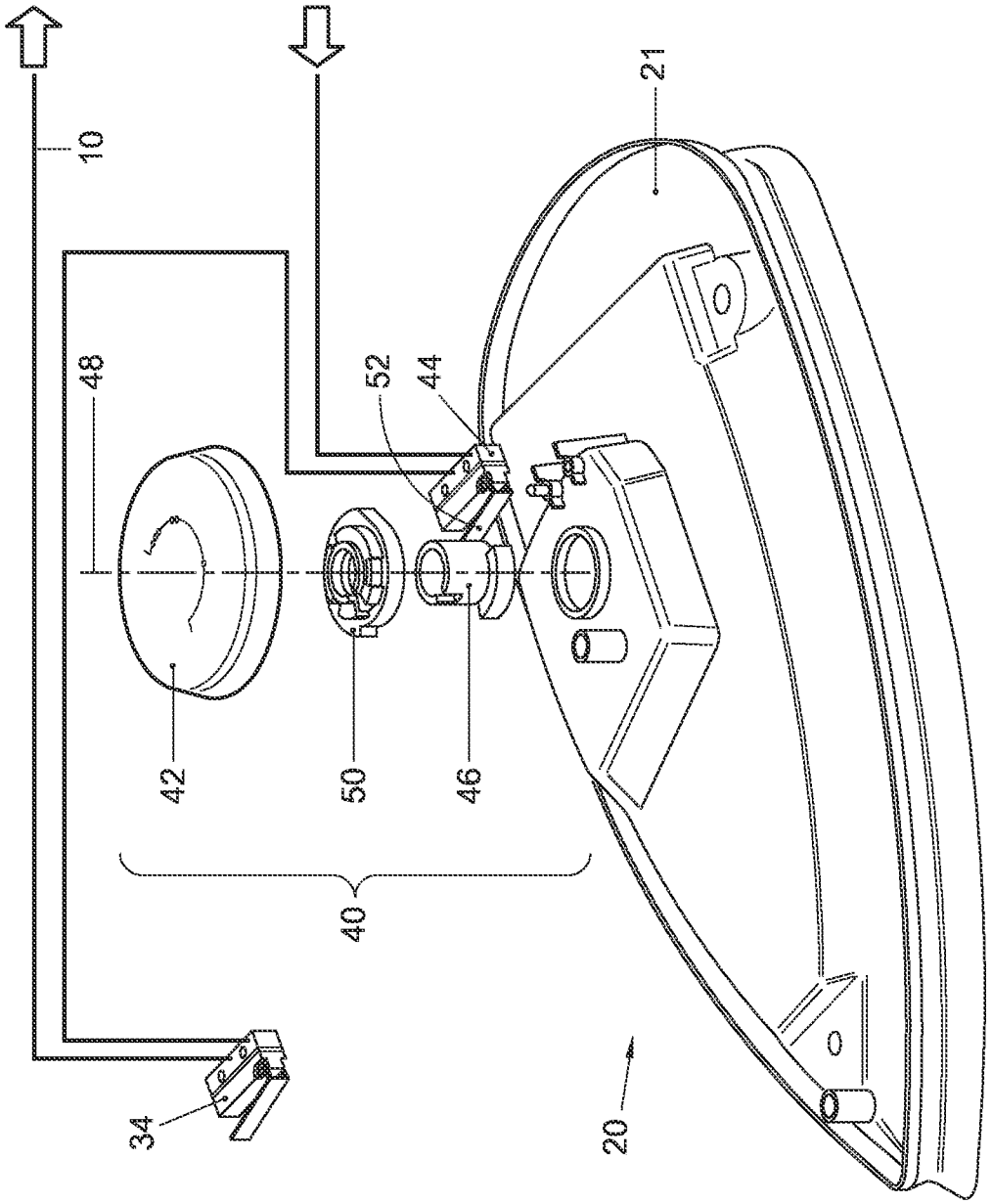


FIG.1

FIG. 2



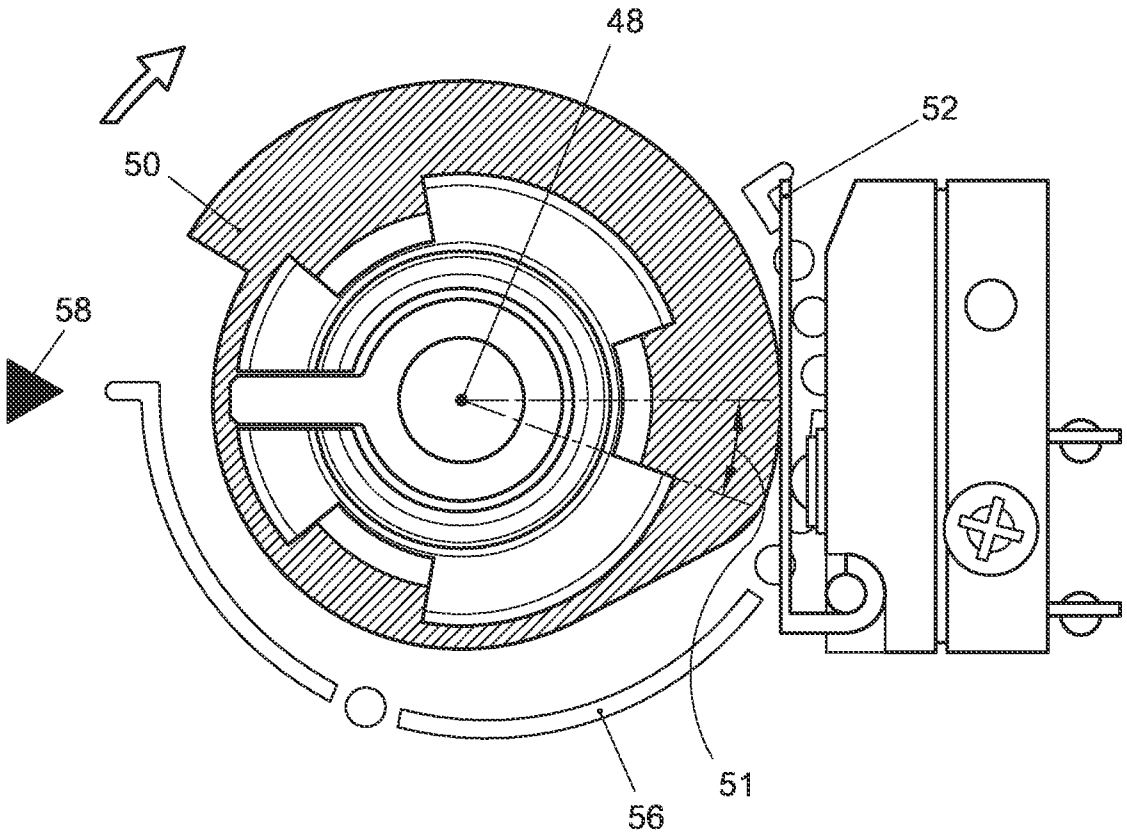


Fig. 3

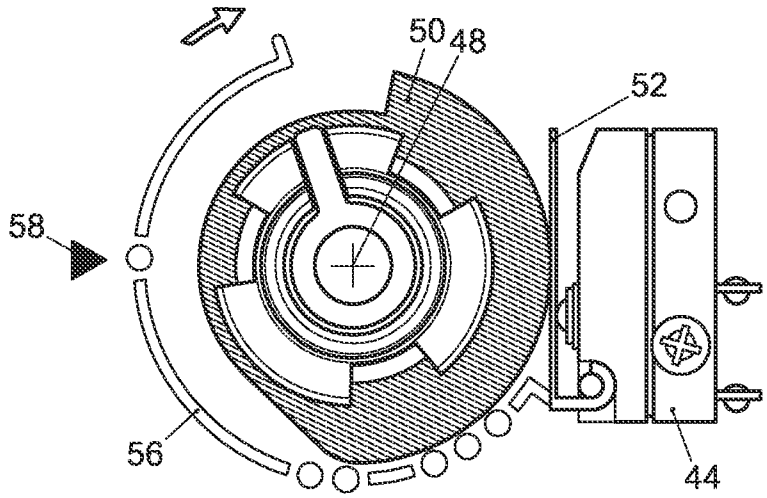


Fig. 4

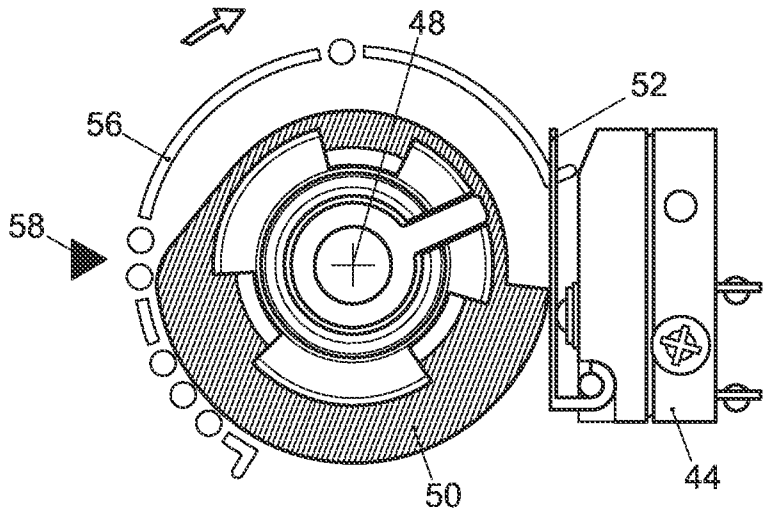


Fig. 5

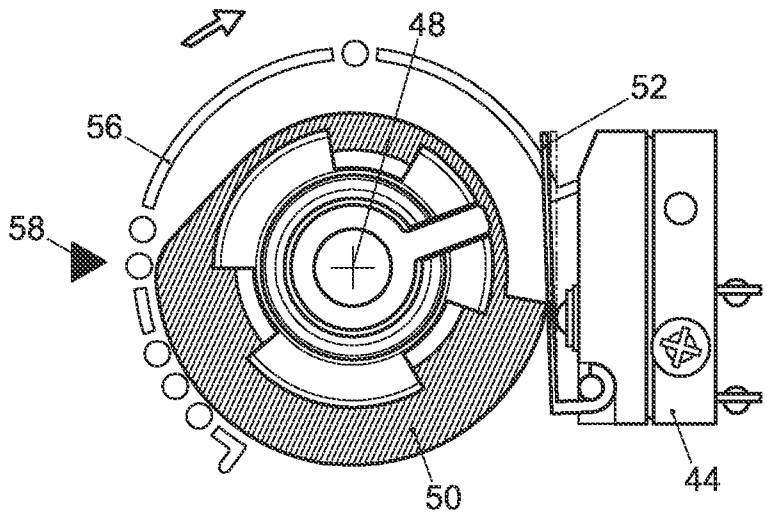


Fig. 6

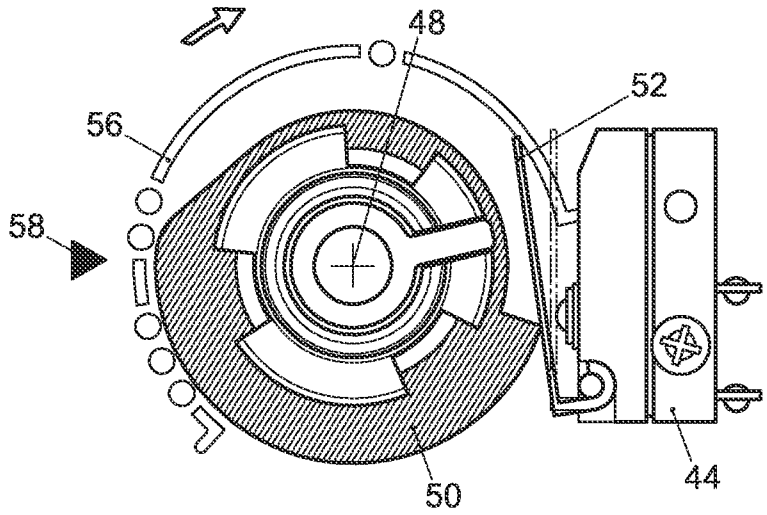


Fig. 7

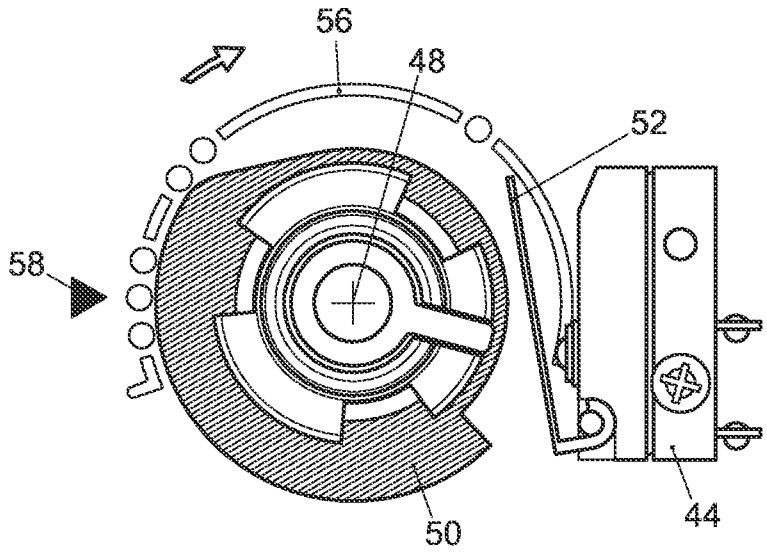


Fig. 8

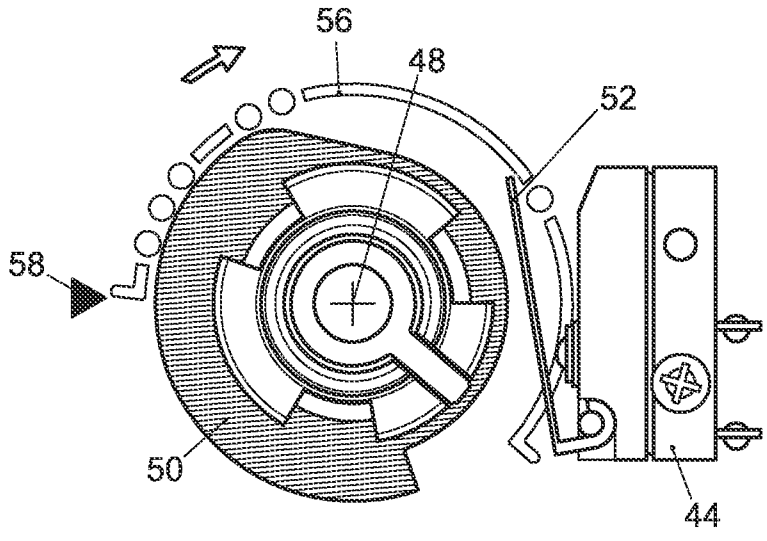


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/052463

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F75/12 D06F75/26 D06F75/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2007/085931 A2 (TUNBOW ELECTRICAL LTD [CN]; LEE PAK MAN [CN]) 2 August 2007 (2007-08-02) page 1 - page 7; figures 1-4	1,5,6, 8-12,14, 15 7
X	JP 2 136180 A (MATSUSHITA ELECTRIC IND CO LTD) 24 May 1990 (1990-05-24) * abstract; figures 3-5	1-6, 8-11,14, 15
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Y	GB 860 945 A (SUNBEAM CORP) 15 February 1961 (1961-02-15) page 3 - page 7; figures 1-8	7

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 September 2010	16/09/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Richmond, Sarah

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/052463

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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