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(54) ELECTRONIC THERMOSTAT WITH SAFETY ACTIVATED BY RESISTORS

ELEKTRONISCHES THERMOSTAT MIT DURCH WIDERSTÄNDE AKTIVIERTER SICHERHEITSFUNKTION

THERMOSTAT ÉLECTRONIQUE À SÉCURITÉ ACTIVÉE PAR DES RÉSISTANCES

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Description

[0001] The object of the present invention is a safety temperature control device (herein referred to as thermal protector) for heating appliances, in particular for electrically powered storage water heaters.

[0002] The object of the present invention are also temperature adjustment devices (herein referred to as thermo-regulators) incorporating said thermal protector.

[0003] It is known that the thermal protection function has the purpose of preventing the temperature of the controlled heating appliance from exceeding hazardous limits when the thermo-regulation function of the same temperature is faulty.

[0004] Patent application AN2010A000131, filed by the applicant of the current patent, describes a thermostat characterised, among the other things, by the presence of an electronic board having the function of regulation and located in the same box seating the electromechanical actuators of the safety function.

[0005] For a complete description of the prior art in the field of electronic thermo-regulators and electro-mechanical or electronic thermal protectors, reference shall be made to the contents of the above document AN2010A000131, besides the previous patents EP 0651412 and EP 1652017, also held by the same applicant.

[0006] However, in order to facilitate the understanding of the present invention and of the relevant innovative peculiarities, a brief description shall be given herein of an electro-mechanical thermo-regulating and thermal protecting thermostat made according to the technology shown in figure 1.

[0007] Such figure shows an exploded view of a device (hereinafter generically referred to as "thermostat"), the containment box 2 whereof comprises a base 2.1 and a cover 2.2. Reference numeral 3' indicates a thermo-sensitive element extending outside base 2.1 inwards of the environment to be controlled, in particular the storage tank of the water heater.

[0008] In the most widespread version, said thermo-sensitive element 3' substantially consists of a heat-expansible and good heat conductor tube, generally made of brass, wherein a rod 5 with a low heat expansion is coaxially arranged, usually made of INVAR. As the storage water temperature increases, the heat expansible tube 3' is subject to an elongation that also pulls the INVAR rod 5, constrained thereto at the outermost end. Through the action on a stem 5 which in turn acts on a monostable elastic sheet micro-switch 7, said INVAR rod carries out the thermo-regulating role of mechanical actuator on the contacts inside the thermostat, interrupting/restoring the supply to the electrical resistors.

[0009] On the other hand, the thermal protection function is ensured by an actuator consisting of a bistable bimetallic element 4 (commonly called "clickson"), arranged within the thermostat box 2 in a tray 2.4 made in base 2.1 in a position that is sufficiently close to tube 3' so that its temperature is strongly influenced by the same.

[0010] Thus, the above heat expansible tube 3' passively acts as heat conductor as regards the thermal protection function but is also part of an actual actuator (consisting in the combination "heat expansible tube/low heat expansion rod").

[0011] Said clickson 4, as said, consists of a bistable bimetallic disc, capable of suddenly reversing the concavity of its camber when a predetermined critical temperature is reached, causing the opening of special contacts 2.5 through the aid of a cursor 5.2, thus causing the cut off of the power to the electrical resistors.

[0012] As regards the thermal protection function, the above described thermostat of fig. 1 carries out its tasks well; in particular, the opening mechanism of contacts 2.5, by the effect of clickson 4, is simple and reliable. However, said thermal protector as a whole exhibits some well-known limitations, due to both the quite rough tolerance at which the bistable clickson may be calibrated, and to the quite inaccurate relation that exists between the excess temperature of the top of the water heater that the thermal protection function must prevent, and the temperature sensed by clickson 4.

[0013] It should also be noted that in these thermostats, tray 2.4 wherein clickson 4 is seated is intentionally located substantially in contact with the flange of the water heater whereon the thermostat is mounted so that the same clickson 4 is also influenced by the flange temperature.

[0014] In other words, the temperature reached by clickson 4 is a function of the flange temperature and of the water temperature along the entire heat expansible tube 3' and not only of the temperature of the high zone of the water heater that has to be monitored.

[0015] Small positioning errors of the thermostat on the flange or unusual but not abnormal distributions of the water temperature along the entire heat expansible tube 3', added to the rough calibration that may be obtained, may wrongly trip the thermal protector even when the thermo-regulator exhibits no anomalies.

[0016] In these cases, as is known, the intervention of a technician is required for the so-called manual "reset" of the thermal protector.

[0017] Of course, the construction methods of such appliances and the calibration of clickson 4 are such as to prevent the opposite case with a sufficient margin, that is, that the thermal protector does not trip in the case of an actual failure of the thermo-regulator. However, in order to have safety margins, this may force to limit, through the thermo-regulator, the maximum temperature of the water heater to values quite lower than those actually prohibited by the regulations. This may imply limitations to the thermal energy that may be stored. A further limitation of the thermal protecting thermostats mentioned so far is that, due to the thermal inertia of the masses that must be crossed, there is an unavoidable delay of a few seconds between the time of reaching the abnormal temperature and that when such temperature has effects

on the same thermal protector.

[0018] A further limitation of the thermostats mentioned so far is that from the construction point of view, they are specific for a water storage heater and not usable for other heating appliances.

[0019] The main object of the present invention is to obviate such drawbacks by providing a thermal protector that still comprises a bistable bimetallic element but the operation whereof is substantially influenced only by the temperature existing in the zone to be monitored.

[0020] A second object of the present invention is to provide a thermal protector wherein the fact that the calibration temperature of said bistable bimetallic element may only be obtained roughly is unimportant.

[0021] A third object of the present invention is to provide a thermal protector wherein the position of said bistable bimetallic element is not forced to such positions as to make it receive heat from the water heater through the flange or other heat transmitting means from the zone to be monitored.

[0022] A further object of the present invention is to provide a thermal protector with reduced reaction times upon reaching abnormal temperatures compared to the prior art.

[0023] A further object of the present invention is to provide a single and compact thermostat suitable for acting as thermo-regulator and thermal protector capable of achieving one or more of said objects.

[0024] A further object of the present invention is to provide a thermo-protector or thermal regulator and thermo-protector thermostat usable in a position not in close proximity with the tank of a water heater.

[0025] A further object of the present invention is to provide a thermo-protector or thermal regulator and thermo-protector thermostat that is interchangeable, as regards dimensions and electrical connections, with thermostats according to the prior art.

[0026] A further object of the present invention is to provide a thermo-protector or thermal regulator and thermo-protector thermostat usable in other heating appliances differing from a water storage heater.

[0027] These and other objects, which shall appear clear hereinafter, are achieved with the device illustrated in the following description and in the annexed claims, which constitute an integral part of the description itself.

[0028] Further features of the present invention shall be better highlighted by the following description of a preferred embodiment, in accordance with the patent claims and illustrated in the enclosed designs. Such figures should be considered as having an illustrative and non-limiting purpose, in which:

- figure 2 shows a perspective view of the thermostat according to the invention;
- figure 3 shows an exploded substantially side view of the thermostat of the invention;
- figure 4 shows an exploded substantially bottom view of the thermostat of the invention.

[0029] The features of the invention are now described using the references in the figures.

[0030] With reference to figure 2, reference numeral 1 globally indicates the thermostat comprising, as in the prior art, a containment box 2 that is provided with a base 2.1 and a cover 2.2.

[0031] On top of said base 2.1, special fastons 2.6 (or equivalent electrical connectors) power one or more electrical resistors (not shown in the figure), intended for heating the water contained in the storage tank.

[0032] A probe holder element 3 extends from said base 2.1 of said box 2, suitable for supporting one or more electronic sensors (not shown in the figure), such as NTC or PTC or thermocouple thermistors, or still other per se known types, suitable for transmitting electrical signals correlated to the temperature sensed to the electronic processing means, optionally also through the methods and the means already described in patent application AN2010A000131.

[0033] In particular, said probe holder element 3 may consist of a traditional tubular element or, as shown in the annexed figures, a flat bar. In general, any element intended for performing only the support role for one or more electronic sensors is suitable, since there is no need for it to also act as essential element for the thermal protection function: in fact, in the present invention, such safety function is fully performed by other means and therefore it is not required for said probe holder element 3 to be an actuator as in the case of the combination "heat expansible tube/low heat expansion rod", nor a heat conductor.

[0034] Besides the usual kinematic return means for carrying out the thermo-regulation and thermal protection functions that shall be described hereinafter, within said box 2 there is also seated an electronic board 8 comprising a microprocessor (see figs. 3 and 4) capable of processing the electrical signals transmitted by the electronic sensors and of generating consequent electrical signals in output through a usual connector that may be inserted in the connection outlet 2.3.

[0035] According to the prior art, said electronic board 8 with the relevant microprocessor are normally intended for managing the thermo-regulation function, giving input for opening/closing the electrical contacts of the circuit powering the connecting fastons 2.6 of the resistors, according to the temperature values sensed by the electronic sensors located on the probe holder element 3.

[0036] According to the present invention, on the other hand, also the thermal protection function is managed by said electronic means, which also give input for acting on the bistable bimetallic element 4 (clickson) which in turn, in a known manner, opens the contacts of the safety circuit and disables the power to the electrical resistors through kinematic return means.

[0037] Figs. 3 and 4 show details of the means and methods for carrying out the thermal protection function ensured by thermostat 1.

[0038] The electronic board 8 seats at least one resis-

tor 6: it should be noted that hereinafter, the term "resistor" refers with no distinction to a resistor or a thermal resistor, preferably of the PTC type, or in any case to any resistive electrical component subject to heating when crossed by electrical current. In the version shown in the annexed figures, while a single resistor 6 is sufficient for the purpose, the presence of a pair of resistors 6.1 and 6.2 is usefully provided, so that the second one performs the designated task in case of failure of the first one.

[0039] When the thermostat regularly carries out the thermal regulation function, said one or more resistors 6 do not receive electrical power from the electronic board 8.

[0040] On the other hand, when the electronic sensors of the probe holder element 3 record that the critical safety temperature has been reached, the microprocessor enables the electrical power to one or more of said resistors 6 by the electronic board 8.

[0041] Said at least one resistor 6 is located in the proximity of clickson 4, in such position (preferably at the bottom) as to be able to heat said clickson 4 up to make it trip. At this point, once the concavity of its camber has taken place, said clickson 4 substantially works in the same manner already seen for the thermostat of the prior art of fig. 1, in short opening the electrical contacts 2.5 for powering fastons 2.6 of the electrical resistors.

[0042] More precisely, clickson 4 is provided with a stem 7 which, upon the inversion of the camber, pulls an anchor 7.2 associated thereto; the latter in turn opens the sheets constituting the electrical contacts 2.5.

[0043] It has been proven that the energy sufficient for the purpose described above that each resistor 6 must deliver is sufficiently low as not to damage the electronic board 8. Moreover, as mentioned, a single resistor or thermistor 6 is already sufficient for tripping clickson 4, whereas the presence of additional resistors only serves for ensuring the operation also in the case of failure of the first resistor: in fact, it is possible to provide for a version wherein a special electronic circuit associated to board 8 is capable of detecting the proper operation or the possible failure of the first resistor 6.1, in this second case disabling the power thereof and activating the second resistor 6.2 or the further resistors.

[0044] Usefully, resistors 6 are PTC as they have the known capability of auto-adjusting the maximum temperature they can reach.

[0045] Said one or more resistors 6 are usually activated by the microprocessor through a low voltage circuit; as an alternative it is also possible for them to be directly powered by the mains high voltage, through one or more piloting TRIACs.

[0046] Therefore, the safety bimetallic and bistable element represented by clickson 4 is subject to the influence of one or more resistors 6 powered by the electronic board 8; thus, unlike the prior art, such clickson is not activated by the probe holder element 3 anymore, neither in the version thereof represented by the "heat expansible tube/low heat expansion rod" or in that of simple heat conductor. On the other hand, in the present invention such configuration of the probe holder element 3 is absolutely unnecessary as it only has to perform the task of supporting the electronic sensors and make the signal recorded thereby reach the underlying electronic board 8, also with the methods and the means already described in patent application AN2010A000131.

[0047] The advantages in terms of accuracy of the operation of thermostat 1 are clear, thanks to the sensitivity ensured by electronic signals processed by special electronic circuits.

[0048] It is clear that the invention achieves all the intended objects.

[0049] The thermal protector is triggered subsequent to signals received from electronic sensors that may be arranged in the most appropriate point.

[0050] The position of clickson 4 is not influenced by the need of receiving, more or less directly, heat from the zone the temperature whereof has to be monitored.

[0051] The rough calibration accuracy of clickson 4, by a few degrees, is not a drawback anymore since in any case it reaches the tripping temperature.

[0052] Fig. 4 highlights a possible further feature of the thermostat described above, consisting in the fact that pins 2.7 (suitable for mechanically constraining base 2.1 of box 2 to the underlying electronic board 8), or at least one of them, also perform the role of electrical connectors of the same board 8 to the electrical resistors and to the network.

[0053] The same pins 2.7 also have the role of spacers for the electronic board 8 from base 2.1 of the containment box 2, so as to prevent undesired overheating of the board and create an adequate space for the components thereof, such as said one or more resistors 6, the regulation relay 8.1 and any fuses that protect the contacts of the various relays from overcurrents that would cause the gluing of the same.

[0054] Like any similar device of the prior art, also thermostat 1 can allow the manual reset of clickson 4, once the regular operating conditions of the water heater have been restored: through a special hole 7.1 made on cover 2.2 it is possible to act on the end of stem 7 associated to the clickson, pressing it and thus restoring the initial concavity of the camber of said clickson 4.

Claims

1. Thermal protector for an electrical heater, in particular electrical storage water heater, comprising

   - a bistable bimetallic element (4),
   - connecting connectors (2.6) powering one or more electrical resistances,
   - kinematic return means (7, 7.2; 2.5) associated to said bistable bimetallic element (4) and suitable for activating/deactivating said connecting connectors (2.6),

characterised in that
said bistable bimetallic element (4) is activated through the heating thereof by one or more resistors (6)
- arranged sufficiently close to said bistable bimetallic element (4) so as to heat it to the triggering temperature,
- electrically powered when enabled by the microprocessor of an electronic board (8) when one or more electronic temperature sensors sense the achievement of the critical safety temperature.

2. Thermal protector according to the previous claim, **characterised in that**
only one (6.1) of said one or more resistors (6) is sufficient for activating said bistable bimetallic element (4), the additional resistors (6.2) being activated only in the case of failure of said first resistor (6.1).

3. Thermal protector according to any previous claim, **characterised in that**
said one or more resistors (4) are located on the electronic board (8), underneath said bistable bimetallic element (4), in such position as to distribute their thermal energy on its surface in a sufficient amount to make it perform the function of thermal protection without damaging said electronic board (8).

4. Thermal protector according to any previous claim, **characterised in that**
said one or more resistors (8) are activated by the electronic board (8) through a low voltage circuit.

5. Thermal protector according to any claim from 1 to 3, **characterised in that**
said one or more resistors (8) are activated by the electronic board (8) through the mains high voltage, through one or more piloting TRIACS.

6. Thermal protector according to any previous claim, **characterised in that**
said one or more resistors (6) are PTCs.

7. Thermal protector according to any previous claim, **characterised in that**
said bistable bimetallic element (4) is seated in a tray (2.4) made in the base (2.1) of the containment box (2).

8. Thermal protector according to any previous claim, **characterised in that**
said bistable bimetallic element (4) can be triggered again once the normal operating conditions of the equipment have been restored, by pressing the end of a stem (7) reachable through a hole (7.1) made on the cover (2.2) of the box (2).

9. Thermal protector according to any previous claim, **characterised in that**
at least one of the pins (2.7), suitable for mechanically constraining the base (2.1) of the box (2) to the electronic board (8), is an electrical connection for connecting said electronic board (8) to the mains and to one or more electrical resistances.

10. Thermo-regulating thermostat (1) for an electrical heater, in particular electrical storage water heater, comprising

- an electronic board (8) provided with a microprocessor,
- a probe holder element (3) that extends externally from the base (2.1) of the containment box (2), suitable for supporting one or more temperature sensors suitable for an electronic thermoregulation,
- means for the electrical connection between said one or more sensors and said electronic board (8),

whereby said electronic board (8) and said one or more temperature sensors are the same used by the thermal protector according to claims 1 to 9, a thermal protector according to claim 1 being integrated in said thermo-regulating thermostat (1).

Patentansprüche

1. Thermoschutz für eine elektrische Heizung, insbesondere einen elektrischen Warmwasserspeicher, umfassend

- ein bistabiles Bimetallelement (4),
- Verbindungsanschlüsse (2.6), die einen oder mehrere elektrische Widerstände mit Strom versorgen,
- kinematische Rückstellmittel (7, 7.2, 2.5), die mit dem bistabilen Bimetallelement (4) verbundenen sind und zum Aktivieren/Deaktivieren der Verbindungsanschlüsse (2.6) geeignet sind,

dadurch gekennzeichnet, dass
das bistabile Bimetallelement (4) durch das Erhitzen davon durch einen oder mehrere Widerstände (6) aktiviert wird,
- die ausreichend nahe an dem bistabilen Bimetallelement (4) angeordnet sind, um es auf die Auslösetemperatur zu erwärmen,
- die elektrisch betrieben sind, wenn sie vom dem Mikroprozessor einer elektronischen Schaltung (8) aktiviert sind, wenn ein oder mehrere elektronische Temperatursensoren das Erreichen der kritischen Sicherheitstemperatur erfassen.

2. Thermoschutz nach dem vorhergehenden Anspruch,
dadurch gekennzeichnet, dass
nur einer (6.1) des einen oder der mehreren Widerstände (6) ausreichend ist, um das bistabile Bimetallelement (4) zu aktivieren, wobei die zusätzlichen Widerstände (6.2) nur im Falle eines Ausfalls des ersten Widerstands (6.1) aktivierten werden.

3. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
der eine oder die mehreren Widerstände (4) auf der elektronischen Schaltung (8) unter dem bistabilen Bimetallelement (4) in einer derartigen Position angeordnet ist (sind), um ihre thermische Energie auf dessen Oberfläche in einer ausreichenden Menge zu verteilen, damit es die Funktion des Thermoschutzes ausüben kann, ohne die elektronische Schaltung (8) zu beschädigen.

4. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
der eine oder die mehreren Widerstände (4) von der elektronischen Schaltung (8) durch eine Niederspannungsschaltung aktiviert wird (werden).

5. Thermoschutz nach einem der Ansprüche 1 bis 3,
dadurch gekennzeichnet, dass
der eine oder die mehreren Widerstände (8) von der elektronischen Schaltung (8) durch die Netzspannung durch eine oder mehrere TRIAC-Steuerungen aktiviert wird (werden).

6. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
der eine oder die mehreren Widerstände (6) PTC-Widerstände sind.

7. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
das bistabile Bimetallelement (4) in einer Schale (2.4) angeordnet ist, die in der Basis (2.1) des Aufnahmegehäuses (2) erstellt ist.

8. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
das bistabile Bimetallelement (4) erneut ausgelöst werden kann, sobald die normalen Betriebsbedingungen der Anlage wieder hergestellt sind, indem das Ende eines Schaftes (7) gedrückt wird, der durch ein Loch (7.1) erreichbar ist, das in der Abdeckung des Gehäuses (2) erstellt ist.

9. Thermoschutz nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
mindestens einer der Schafte (2.7), der geeignet ist, die Basis (2.1) des Gehäuses (2) an der elektronischen Schaltung (8) zu halten, eine elektrische Verbindung ist, um die elektronische Schaltung (8) an das Stromnetz und an einen oder mehrere elektrische Widerstände anzuschließen.

10. Thermoregulierendes Thermostat (1) für eine elektrische Heizung, insbesondere einen elektrischen Warmwasserspeicher, umfassend

- eine elektronische Schaltung (8), die mit einem Mikroprozessor versehen ist,
- ein Sondenhalterungselement (3), das sich extern von der Basis (2.1) des Aufnahmegehäuses (2) erstreckt, das geeignet ist, einen oder mehrere Temperatursensoren für eine elektronische Thermoregulierung zu tragen,
- Mittel für die elektrische Verbindung zwischen dem einen oder den mehreren Sensoren und der elektronischen Schaltung (8),

wobei
die elektronische Schaltung (8) und der eine oder die mehreren Temperatursensoren die gleichen sind, die von dem Thermoschutz nach den Ansprüchen 1 bis 9 verwendet sind, wobei ein Thermoschutz nach Anspruch 1 in das thermoregulierende Thermostat (1) integriert ist.

Revendications

1. Protecteur thermique pour un appareil de chauffage électrique, notamment chauffe-eau électrique à accumulation, comprenant

- un élément bimétallique bistable (4),
- des connecteurs de raccordement (2.6) équipant une ou plusieurs résistances électriques,
- des moyens cinématiques de renvoi (7, 7.2; 2.5) associés audit élément bimétallique bistable (4) et appropriés pour activer / désactiver lesdits connecteurs de raccordement (2.6),
caractérisé en ce que
ledit élément bimétallique bistable (4) est activé par l'intermédiaire du chauffage de celui-ci par une ou plusieurs résistances (6)
- disposé suffisamment près dudit élément bimétallique bistable (4) de manière à le chauffer à la température de déclenchement,
- alimenté électriquement lorsqu'il est activé par le microprocesseur d'une carte électronique (8) lorsque l'un ou plusieurs capteurs électroniques de température détectent la réalisation de la

température critique de sécurité.

2. Protecteur thermique selon la revendication précédente,
caractérisé en ce que
un seul (6.1) de ladite une ou plusieurs résistances (6) est suffisante pour activer ledit élément bimétallique bistable (4), les résistances supplémentaires (6.2) étant activées uniquement dans le cas d'une défaillance de ladite première résistance (6.1).

3. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
lesdites une ou plusieurs résistances (4) sont situées sur la carte électronique (8), au-dessous dudit élément bistable bimétallique (4), dans un poste de distribution de leur énergie thermique sur sa surface en une quantité suffisante pour faire exécuter la fonction de protection thermique sans endommager ladite carte électronique (8).

4. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
lesdites une ou plusieurs résistances (8) sont activées par la carte électronique (8) à travers un circuit à basse tension.

5. Protecteur thermique selon l'une quelconque des revendications de 1 à 3,
caractérisé en ce que
lesdites une ou plusieurs résistances (8) sont activées par la carte électronique (8) à travers le réseau haute tension, par un ou plusieurs TRIACS de pilotage.

6. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
lesdites une ou plusieurs résistances (6) sont PTC.

7. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
ledit élément bimétallique bistable (4) est logé dans un bac (2.4) ménagé dans le fond (2.1) de la boîte de confinement (2).

8. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
ledit élément bimétallique bistable (4) peut être déclenché à nouveau, une fois que les conditions normales de fonctionnement de l'appareil ont été restaurées, en appuyant sur l'extrémité d'une tige (7) accessible à travers un trou (7.1) réalisé sur le couvercle (2.2) de la boîte (2).

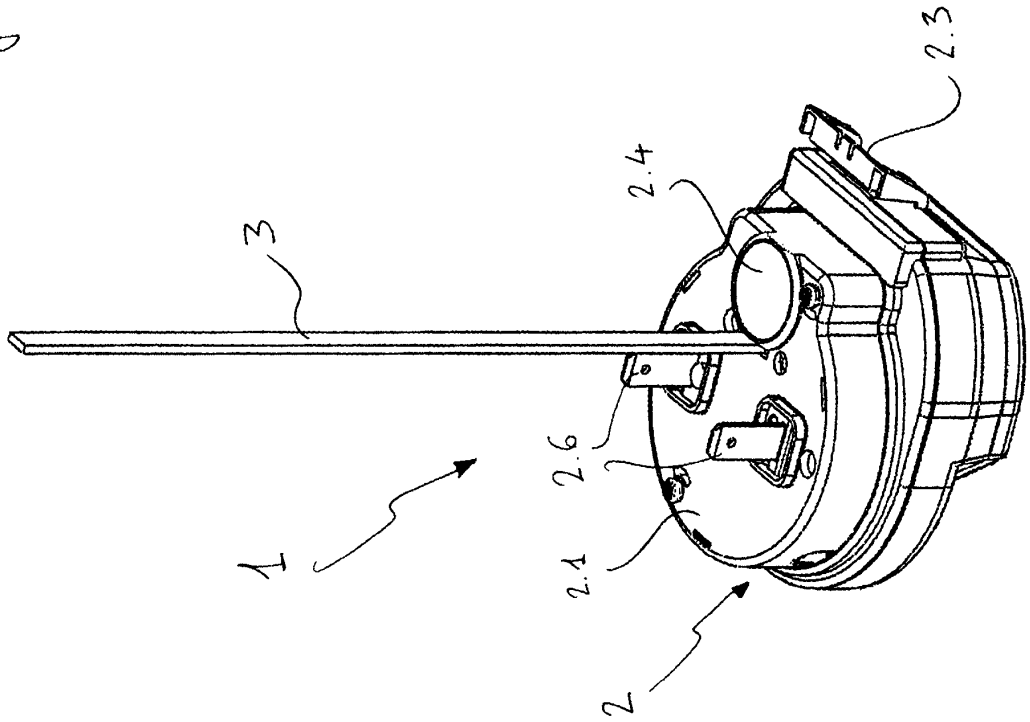
9. Protecteur thermique selon l'une quelconque des revendications précédentes,
caractérisé en ce que
au moins l'une des broches (2.7), appropriées pour limiter mécaniquement la base (2.1) de la boîte (2) de la carte électronique (8), une connexion électrique pour connecter ladite carte électronique (8) sur le secteur et à une ou plusieurs résistances électriques.

10. Thermostat (1) pour un appareil de chauffage électrique thermo-régulation, notamment chauffe-eau électrique à accumulation, comprenant

- une carte électronique (8) équipée d'un microprocesseur,
- un élément de support de sonde (3) qui s'étend à l'extérieur à partir de la base (2.1) de la boîte de confinement (2), approprié pour supporter un ou plusieurs capteurs de température appropriés pour une thermo-régulation électronique,
- des moyens pour la connexion électrique entre ledit un ou plusieurs capteurs et ladite carte électronique (8),

par lequels
dans ladite carte électronique (8) et ledit un ou plusieurs capteurs de température sont les mêmes que ceux utilisés par le dispositif de protection thermique selon les revendications de 1 à 9, un dispositif de protection thermique selon la revendication 1 étant intégré dans ledit thermostat à régulation thermique (1).

Fig. 2



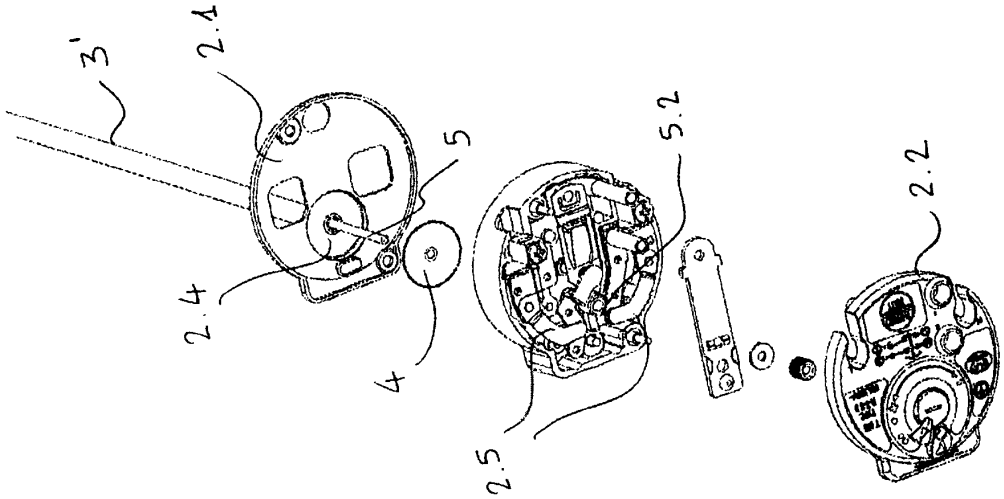


Fig. 1

Fig. 4

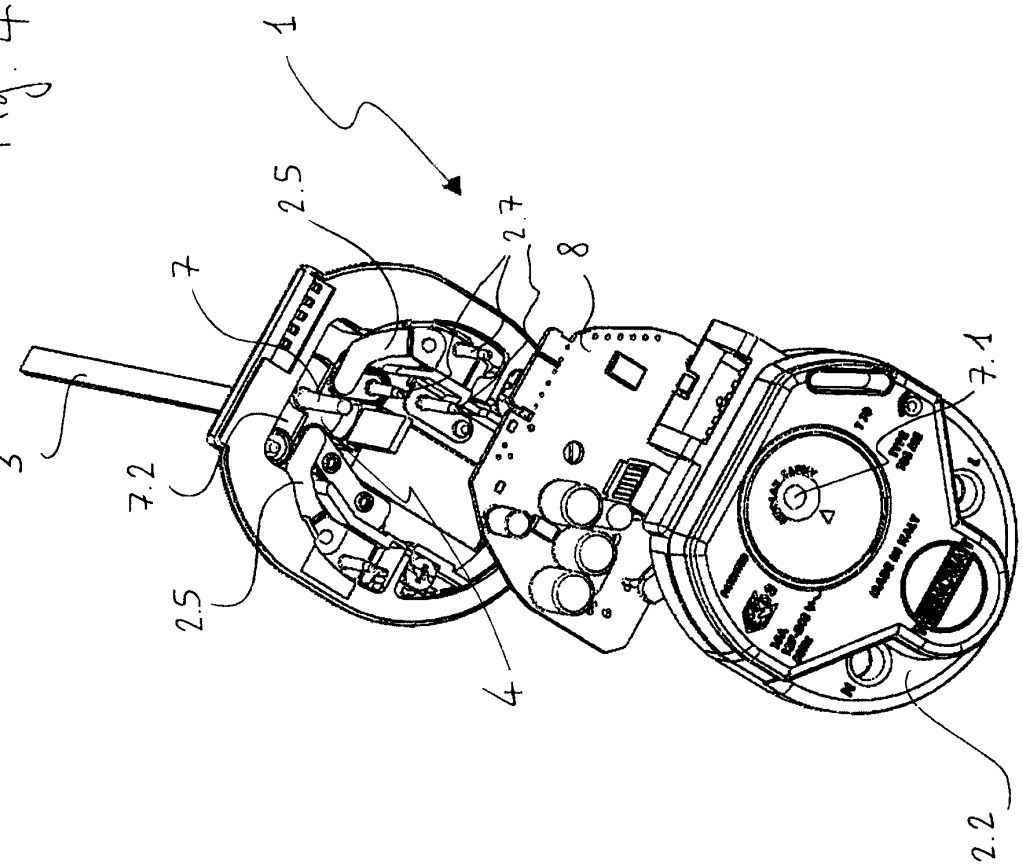
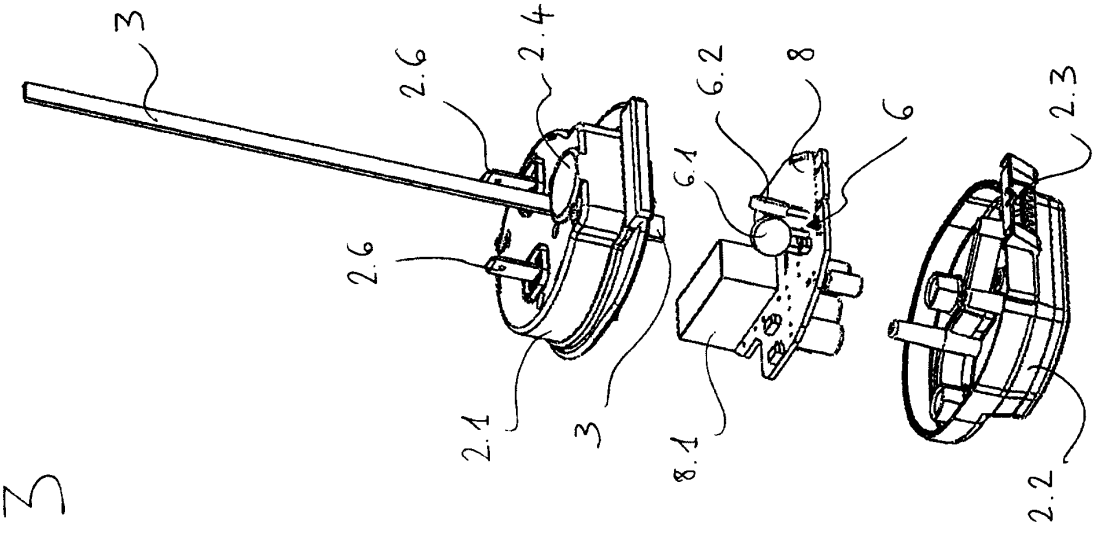


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

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