



(51) International Patent Classification:
G05D 23/19 (2006.01)

(21) International Application Number:
PCT/IB2016/000264

(22) International Filing Date:
10 March 2016 (10.03.2016)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
AN2015A000050 20 March 2015 (20.03.2015) IT

(71) Applicant: THERMOWATT S.P.A. [IT/IT]; 21, Via San Giovanni Battista, I-60011 Arcevia (Ancona) (IT).

(72) Inventor: CAPITANELLI, Claudio; Thermowatt S.P.A., 21, Via San Giovanni Battista, I-60011 Arcevia (Ancona) (IT).

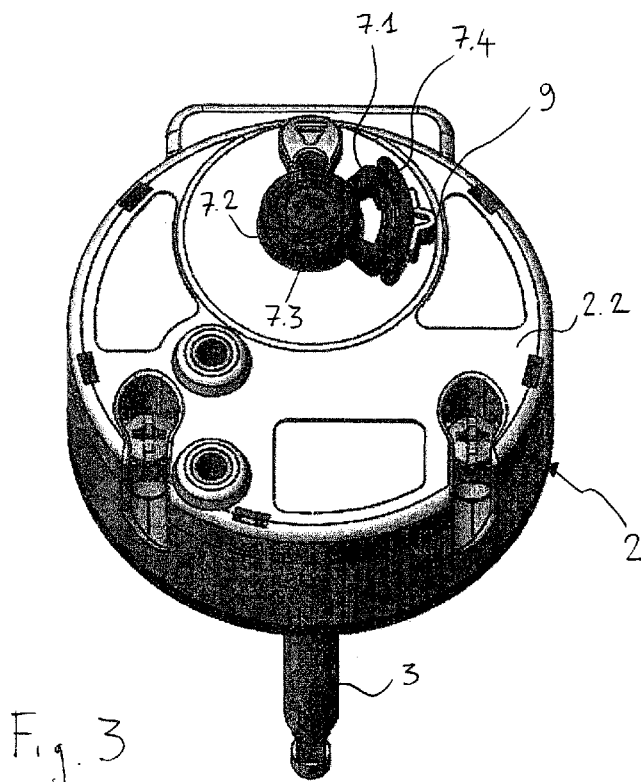
(74) Agent: PREMUR, Rok; MAR.BRE S.R.L., 2 Via San Filippo, I-60044 Fabriano (Ancona) (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: THERMOSTAT WITH REMOVABLE CALIBRATION LOCKING MEANS



(57) Abstract: The object of the present invention is a thermostat (1) having calibration locking means that may be unlocked at user discretion, in order to increase the performance of the water heater whereon said thermostat (1) is installed. Said locking means consist of joining elements (7.41) fracturable as a result of the application of a rotational force on the adjustment knob (7, 7.1) by which the operating temperatures of such thermostat (1) are calibrated. Said adjustment knob (7, 7.1) is also provided with visual and/or sound identification means (7.10, 7.40) in order to facilitate the user in the task of recovering the calibration point T_{box} initially preset, even after the fracture of said joining elements (7.41).

WO 2016/151382 A1



Published:

— *with international search report (Art. 21(3))*

THERMOSTAT WITH REMOVABLE CALIBRATION LOCKING MEANS

DESCRIPTION

The object of the present invention is a thermostat provided with calibration locking means that may be removed at user discretion.

The invention relates to the field of devices for safety control and temperature adjustment of a heating appliance, in particular an electrically-powered storage
5 water heater but, more generally, any household appliance, such as dishwashers and washing machines.

For an exhaustive description of the prior art of such devices (hereinafter generically defined as "thermostats") reference shall be made to the contents of the previous patents EP 0651412, EP 1652017 and WO 2012/014025 held by the
10 same applicant of the present patent.

It is hereby sufficient to briefly describe the features of a possible type of thermostat, with the support of what illustrated in Figure 1 that shows a thermostat according to the prior art.

Reference numeral 1' indicates the thermostat as a whole, comprising a
15 containment box 2' defined by a base 2.1' and a cover 2.2'.

Reference numeral 3' indicates a thermo-sensitive element, extending externally from base 2.1' towards the environment to be controlled (specifically, the storage tank of a water heater).

As per prior art, such thermo-sensitive element 3' may consist of a tube that is
20 heat expansible and good heat conductor, carrying out the function of mechanical

actuator of the inner contacts of the thermostat 1', cutting off or restoring the power supply to the heating elements (electrical resistors, not shown in figure) through a known kinematic mechanism.

5 An actuating element (not shown in figure) is also generally present in the proximity of such thermo-sensitive element 3', in a tray obtained in the base 2.1', intended for carrying out the thermo-protecting function and typically consisting of a bistable bimetallic element, adapted to cause the opening of the contacts of the thermostat when reaching a predetermined temperature through known kinematic return means.

10 Reference 4' indicates the external connection terminals for the power supply of the entire thermostat 1', by which energy is delivered also to optional accessory devices (such as, for example, indicator lamps or acoustic alarms) connected through coupling holes 5'.

15 An adjustment knob 7' provided with suitable indicator 7.1' for the initial calibration of thermostat 1' and the subsequent optional temperature variations that are wished to be set is present on the cover 2.2' of said thermostat 1'.

The type of thermostat 1' described hereinabove is only one of the possible ones, but what matters for the purposes of the present invention is that the temperature adjustment knob 7' typically consists of a ring coupled to an underlying knurled
20 ring nut, the rotation whereof allows the setting of the thermostat calibration temperatures, according to the type of water heater and the particular needs of the market to which the product is intended.

Generally, said calibration temperatures match at least the following two operating conditions of the thermostat:

- 25 – a standard temperature (hereinafter abbreviated with "T.perf") by which the value for obtaining the desired performance in terms of hot water available for the user is set;
- a maximum safety temperature (hereinafter referred to as "T.max"), beyond which the thermostat must not operate for safety reasons: such condition
30 is typically set up through the setting of a travel end point, against which the

indicator 7.1' abuts.

Optional and subsequent variations of said calibration temperatures are carried out by the technician (or, less frequently, by the user) by operating directly on the indicator 7.1' of the adjustment knob 7.' or by acting on indirect means associated to said indicator 7.1', such as a further knob located on the water heater control and management interface.

An example of this kind can be found in the earlier document US 2012/0121305, which shows a control knob on which it is possible to act for changing the standard temperature, preset by technical or subsequently modified by the user.

10 This document describes a mechanism associated with the adjustment knob, consisting of a coupling between a retaining prong and a circular dial provided with a series of raised nubs, such that said retaining prong is adapted to lock the dial engaging on one of said nubs.

When the user wants to change the previously set temperature, it must disengage 15 the coupling between the prong and the raised nub of the dial, turn the knob until the desired temperature and then lock the knob again with the mechanism described above.

The next enforcement of the EU Directive ErP (Energy Related Products, applicable to all the appliances for room heating and the production of domestic 20 hot water) and the related ELD legislation on Energy Labelling, shall reflect on the situation just described regarding the standard calibration modes of thermostat 1'.

In fact, with such legislations, there will be the obligation for the manufacturers to affix an energy label highlighting the efficiency class whereto the water heater 25 belongs, evaluated according to the calibration by which the thermostat leaves the factory: hereinafter, such calibration value shall be referred to as "T.box".

It is clear that such EU legislations make the manufactures face a dilemma of which is the optimal calibration value of the thermostat for combining the arising needs for protecting the climate and the environment (imposed by the new ErP and ELD Directives) with those of a more performing use by the end user: in 30

fact, calibrating the thermostat to the value T_{perf} (that thanks to which the user obtains the largest quantity of hot water possible) shall affect negatively the energy efficiency class; while, on the other hand, setting its calibration to the lowest value T_{box} to obtain a better energy class will be detrimental to the performances achievable by the water heater.

The object of the present invention is to obviate such kind of drawbacks, by providing suitable means for the initial and subsequent calibration of a thermostat, adapted to combine the opposing needs of energy efficiency and heat performance.

Another object of the present invention is to provide means for a more precise calibration of the thermostat.

Another object of the present invention resides in providing means for the recovery of the initial calibration.

These and other objects, which shall appear clearly hereinafter, are achieved with a thermostat according to claim 1.

Other objects may also be achieved through the additional features of the dependent claims.

Further features of the present invention shall be better highlighted by the following description of some preferred embodiments, in accordance with the patent claims and illustrated, by way of a non-limiting example, in the accompanying drawing tables, in which:

- Fig. 1 shows a thermostat according to the prior art, as described above, that is, provided with standard calibration means;
- Fig. 2 illustrates an exploded view of the thermostat according to a first variant of the invention, that is, provided with the innovative calibration means that shall be described shortly;
- Fig. 3 shows the assembled thermostat of Fig. 2, according to a first operating configuration;
- Fig. 4 shows a plan view of the thermostat according to the invention, in accordance with a second operating configuration;

– Fig. 5 shows a plan view of the thermostat according to a second variant of the invention.

The features of a preferred variant of the invention shall now be described using the references contained in the figures, in particular of Figs. 2, 3 and 4 relating to
5 the distinctive aspects compared to the so far prior art.

Reference numeral 7 globally indicates the temperature adjustment knob, adapted to define the calibration temperatures of thermostat 1.

Said adjustment knob 7, unlike the prior art illustrated in Fig. 1, comprises two different and, at least initially, separate elements, that is:

10 – an inner bushing 7.3, adapted to couple with the underlying knurled ring nut 8 whereon, as per prior art, it must be acted for the calibration of thermostat 1, and

– an outer ring 7.2, intended to be placed coaxially about said inner bushing 7.3 with the methods and the objects that shall be described shortly.

15 As said, such inner bushing 7.3 is the element whereon the manufacturer acts in order to calibrate the thermostat 1 to the desired temperature: specifically, according to the ErP legislation, said temperature value is equal to T.box, identifying the temperature by which the thermostat 1 leaves the factory and that allows the water heater to hold a better energy classification (according to the
20 ELD Directive) compared to that obtainable in the case that the calibration value was equal to the temperatures T.perf or T.max as defined above, greater than T.box.

Usually said temperature value T.box is that allowing the thermostat 1 (or better, the water heater that implements said thermostat) to achieve the minimum
25 energy class required by ErP Directive, in such a way that there is no excessive distance, in terms of heat performance, compared to a prior art thermostat (i.e. not calibrated according to the new energy legislations), calibrated on the highest temperature T.perf.

However, it is not excluded that said temperature value T.box is even lower, so
30 that the energy efficiency class is further improved.

In both cases, in view of a considerable improvement from the energy consumption point of view, there is a decay of heat performance of the water heater wherein the thermostat 1 is applied, unable to ensure the availability of hot water in the amounts to which the user was accustomed thanks to the thermostats
5 in use before the recent EU legislations.

The adjustment knob 7 of the present invention allows to obviate this drawback, in particular thanks to the peculiarity of the outer ring 7.2.

According to the preferred variant, said outer ring 7.2, placed around the inner bushing 7.3 with which it is rotatably coupled, is in fact preliminarily welded to
10 the cover 2.2 of the thermostat 1 and, once the calibration of the thermostat 1 to the value T.box through said internal bushing 7.3 is completed, it is joined to the latter by known fixing means, such as laser welding or bonding with adhesive (e.g. cyanoacrylate or UV ultraviolet adhesive).

Therefore, said outer ring 7.2 constitutes one locking means that ensures the
15 retaining and keeping of the calibration value T.box of the thermostat 1 (with consequent assignment of the energy efficiency label resulting from this calibration).

More in detail, as shown in Fig. 3, said outer ring 7.2 comprises:

- a rotation indicator 7.1, consisting of an element with a
20 circumference sector shape, and
- an outer wing 7.4 having substantially a circumference crown shape, concentric to the axis of said outer ring 7.2, constrained to said indicator 7.1 through one or more junction elements 7.41 (in the non-limiting example of the annexed figures, said one or more junction elements 7.41 consist of three teeth,
25 while being sufficient even just one tooth to achieve the object of the present invention).

From the side opposite to that of said indicator 7.1, said outer wing 7.4 (of angular width substantially equal to that of the arc of said indicator 7.1) is securely constrained to a tab 9 on the cover 2.2 of the thermostat 1; or said outer
30 wing 7.4 is securely fixed directly to said cover 2.2.

The constraint between the outer wing 7.4 of the adjustment knob 7 and the tab 9 takes place by known fixing means, such as laser welding or bonding with adhesive (e.g. cyanoacrylate or UV ultraviolet adhesive).

What just described allows to obtain, therefore, a secure locking means of the adjustment knob 7 (composed of the “inner bushing 7.3 - outer ring 7.2 with indicator 7.1 and outer wing 7.4” assembly), with the thermostat 1 calibrated to the temperature value T.box by which it leaves the factory and based on which the energy efficiency class is assigned to the water heater.

Moreover, said locking means is able to prevent unwanted accidental miscalibrations of the thermostat 1, caused by shocks and vibrations during transport and of the various logistics operations to which the product is subjected in the different steps of the distribution chain.

However, such locking means is easily removable by an operator (where “operator” may mean without distinction either the distributor of the product or the installer or the end customer of the water heater whereon such thermostat 1) is implemented in case he wants to change the calibration value T.box, giving up the energy efficiency stated on the label.

In fact the joining elements 7.41 are designed in such a way that a simple rotational forcing of the adjustment knob 7 (acting directly on its indicator 7.1 or through known indirect means associated to said indicator 7.1, such as a further knob of the water heater control interface) allows the operator to fracture them, removing the constraint between the indicator 7.1 and the outer wing 7.4, again granting this adjustment knob 7 the possibility of rotating to calibrate the thermostat 1 to a temperature value different from T. box.

Laboratory tests have determined that it is possible to conceive the constraint represented by said joining elements 7.41 such as to break by applying a torque of approximately 0.3 N·m, that is, a force that can be easily exerted manually but still such as to prevent a fracture due to non-voluntary causes.

In this way the operator can modify the calibration value T.box of thermostat 1, by adjusting it to a higher temperature (e.g. T.perf) to obtain the best

performance in terms of hot water available, or by adjusting it to a lower temperature to further increase the energy efficiency.

Obviously, the adjustment knob 7 is still provided with a travel end stop which prevents it from exceeding the calibration point corresponding to the maximum
5 safety temperature T_{max} , a value which cannot to be exceeded for safety reasons.

From the above description the advantages attainable with the present invention appear clear, the first of which relates to the possibility for the manufacturer to lock the calibration of thermostat 1 to the calibration value T_{box} for obtaining
10 the energy efficiency class required by the EU legislation and to allow, at a later time, the operator to discretionally remove such locking means to change the calibration of thermostat 1 according to his needs.

A second order of advantages relates to the possibility of achieving a more precise calibration of thermostat 1 compared to the prior art systems normally
15 used, illustrated in the example of Fig. 1: in the latter, in fact, the coupling between the knurled ring nut and the adjustment knob 7', made in a single piece, necessarily causes a slight angular deviation and the resulting miscalibration of the calibration value established by said ring nut.

This angular deviation is substantially equal to a fraction of a turn angle
20 depending on the number of teeth of which the ring nut is provided: by way of an example, the knurling of a ring nut of a thermostat such as that shown in Fig. 1 has 32 teeth, therefore the angular deviation caused by the coupling with the adjustment knob 7' may reach approximately $360^\circ / 32 / 2$.

This kind of drawback is overcome, or at least reduced, thanks to the coaxial
25 coupling between outer ring 7.2 and inner bushing 7.3 described in the present invention: in fact, the calibration of thermostat 1 is assigned only to said inner bushing 7.3 (previously coupled to the knurled ring nut 8), without any risk that the application of such outer ring 7.2 (already preliminarily fixed to the cover 2.2 of thermostat 1) subsequently modifies the calibration established.

30 It is clear that several variants of the locking means described above are possible

to the man skilled in the art, without departing from the novelty scopes of the inventive idea, as well as it is clear that in the practical embodiment of the invention the various components described above may be replaced with technically equivalent ones.

- 5 For example, in the variant of the annexed figures it has been seen that the joining elements 7.41 between the outer wing 7.4 and the indicator 7.1 of the outer ring 7.2 consist of three teeth intended to fracture by the action of a rotational force.

However, such joining elements 7.41 may be replaced by suitable equivalent
10 means (also in amounts different from those shown in the figure), such as one or more welding or bonding spots or adhesive components, always intended to break as a result of an external force that removes the constraint between the said outer wing 7.4 and the “inner bushing 7.3 - outer ring 7.2 with indicator 7.1” assembly.

- 15 It is not necessary to dwell on how to conceive such joining elements, see for example the fracturable constraints of the plastic caps of the bottles.

Likewise, it is possible to provide, with appropriate structural changes of the components of the adjustment knob 7, that such joining elements 7.41 are placed to any intermediate position between the inner bushing 7.3 and the cover 2.2,
20 given that the fundamental condition for obtaining the calibration lock of thermostat 1 to the value T_{box} is that said inner bushing 7.3 can no longer move once the initial calibration phase is completed.

A further construction variant may consist of the making of an adjustment knob 7 consisting of a single piece comprising the inner bushing 7.3 and the outer ring
25 7.2 already assembled together: though in this way it is not possible to obtain a precise calibration as that allowed by the main variant with the two separate elements, there always remains the advantage of the locking means, subsequently removable at the operator discretion.

Another variant may still consist of an adjustment knob 7 comprising the two
30 elements “inner bushing 7.3 - outer ring 7.2” initially separate, to be fastened

together once the calibration of the thermostat 1 to the value T.box through said inner bushing 7.3 is completed, but with such outer ring 7.2 that is fixed to the cover 2.2 only at the end of such initial calibration step.

It should also be reiterated that the configuration and the position of the indicator 7.1, of the outer wing 7.4 and the related joining means 7.41 shown in the figure are only a non-limiting example of a preferred variant of the invention: in fact, they can take different shapes and positions, being it understood the feature of allowing the locking thereof, then removable, of the inner bushing 7.3.

Finally, it is possible to provide for a variant wherein, after the removal of the locking means through fracturing of the joining elements 7.41, there are means for facilitating in any case the operator in the activity of recovery of the calibration of the thermostat 1 to the initial value T.box, for example through identifying elements on the adjustment knob 7 or on the further control interface knob of the water heater or thanks to another type of signals, such as a click perceivable when said temperature value T.box is reached.

By way of a non-limiting example, Fig. 5 shows a possible variant of the invention in which said means are present to facilitate the operator in the action of resetting the initial calibration adjustment corresponding to the operating value T.box, even after the removal of the locking means through breakage of the one or more joining means 7.41. In this exemplary variant, the indicator 7.1 of the outer ring 7.2 is further provided with a concavity 7.10, adapted to cooperate with a reciprocal convex portion 7.40, made on the outer wing 7.4.

In this manner, even after the fracture of the joining means 7.41 (with consequent rotational freedom given to the adjustment knob 7, still within the limits of the predetermined tolerances and the maximum safety temperature T.max), the operator can easily find the calibration point T.box initially preset, in case he wants to return to the best energy configuration: in fact the reciprocal concavities 7.10 and convex portion 7.40 serve as clear identification sign for the operator, as well as shape coupling that recreates once the concavity 7.10 of the indicator 7.1 is again at the convex portion 7.40 of the outer wing 7.4.

CLAIMS

1. Thermostat (1) for the safety and adjustment of a heating appliance, in particular an electrical storage water heater, comprising:
 - 5 – a containment box (2), having a base (2.1) and a cover (2.2),
 - thermo-regulating means (3) adapted to cut-off and restore the power supply of one or more heating elements,
 - calibration means (7, 7.1, 8) of the operating temperatures (T.perf, T.max, T.box), comprising an adjustment knob (7, 7.1) acting on an underlying
10 knurled ring nut (8),
characterised in that
said adjustment knob (7, 7.1) further comprises locking means with relative joining elements (7.41) adapted to lock said adjustment knob (7, 7.1) to said cover (2.2), so as to prevent the change of the operating temperature (T.box)
15 initially calibrated,
said joining elements (7.41) capable of being subsequently subjected to breakage, so as to remove said locking means of said adjustment knob (7, 7.1) and allow the change of said operating temperature (T.box) initially calibrated.
2. Thermostat (1) according to the previous claim,
20 characterised in that
said adjustment knob (7, 7.1) comprises:
 - an inner bushing (7.3) acting on said underlying knurled ring nut (8) for the calibration of said operating temperatures (T.perf, T.max, T.box),
 - an outer ring (7.2) with relative rotation indicator (7.1), said outer ring
25 (7.2) being located coaxially to said inner bushing (7.3) and securely constrained thereto once the calibration of said initial operating temperature (T.box) has ended,
 - an outer wing (7.4) constrained, on one side, to said rotation indicator (7.1) through said joining elements (7.41) and, on the other side, to a tab (9)
30 located on said cover (2.2) of said thermostat (1), the constraint with said tab (9)

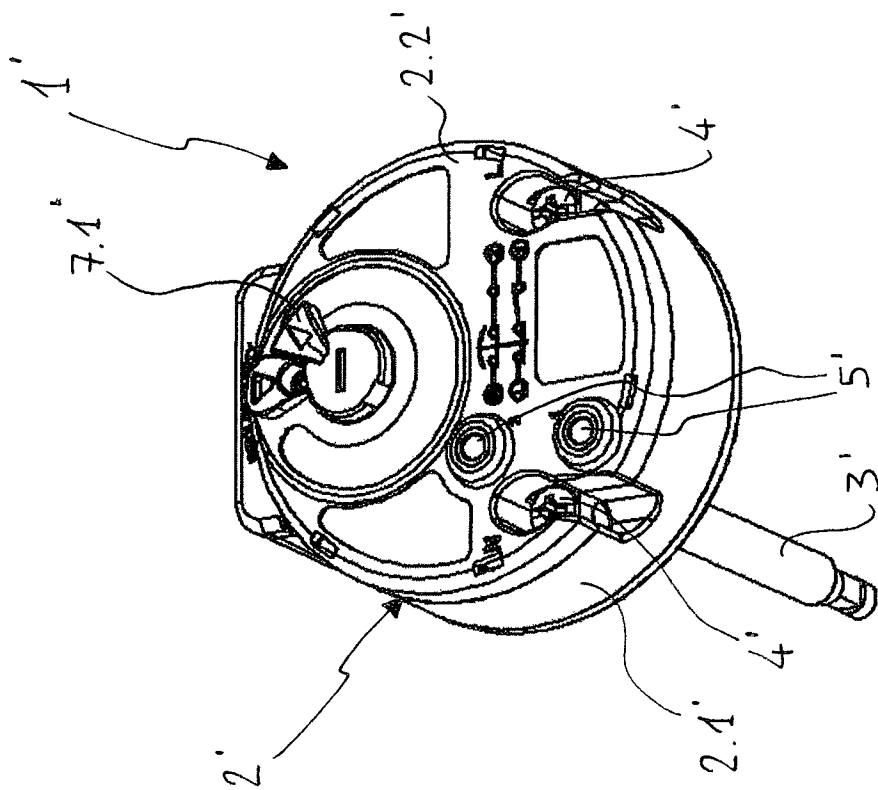
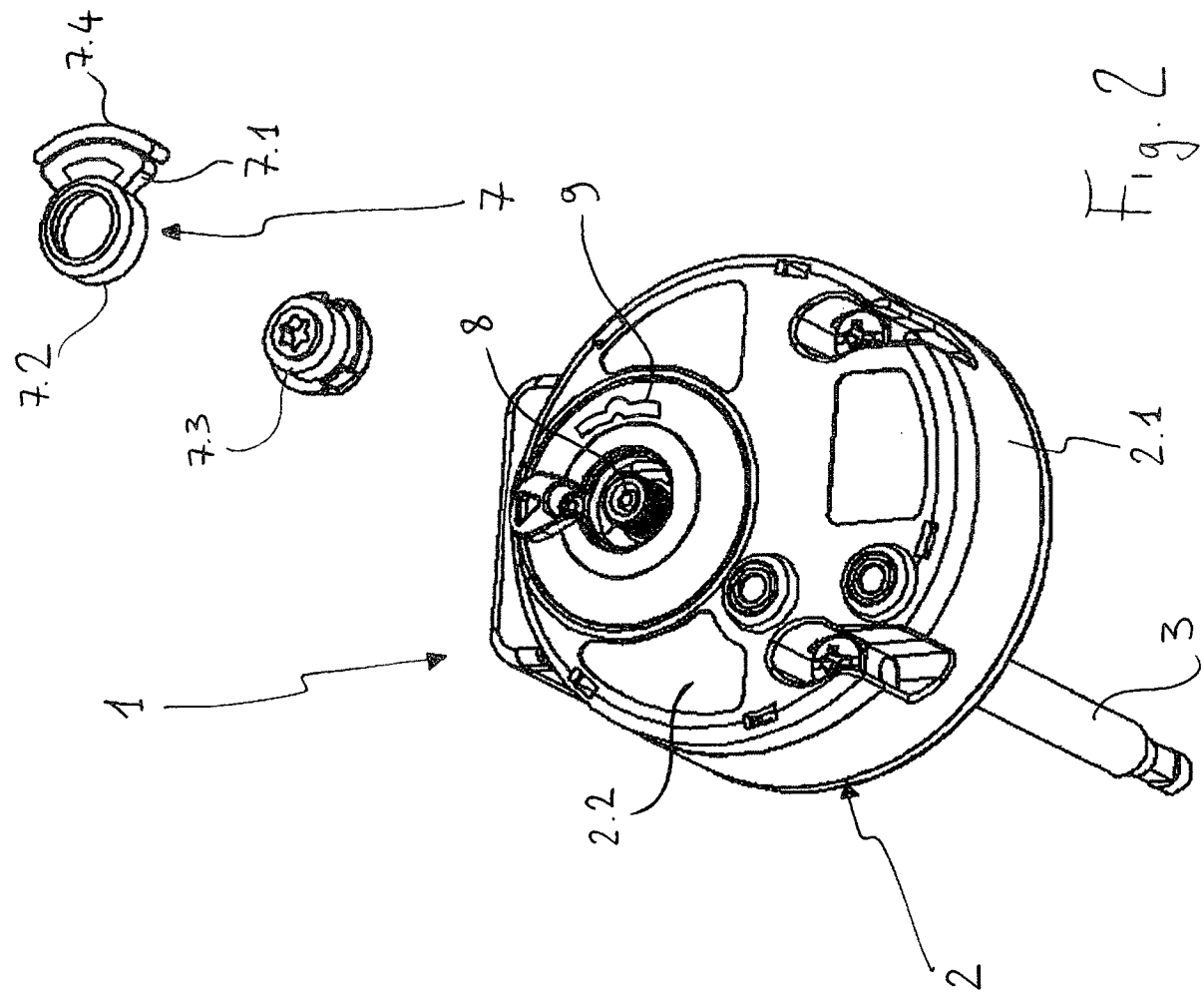
taking place before the calibration of said initial operating temperature (T.box), said outer wing (7.4) remaining constrained to said tab (9) once said joining elements (7.41) have been subjected to breakage.

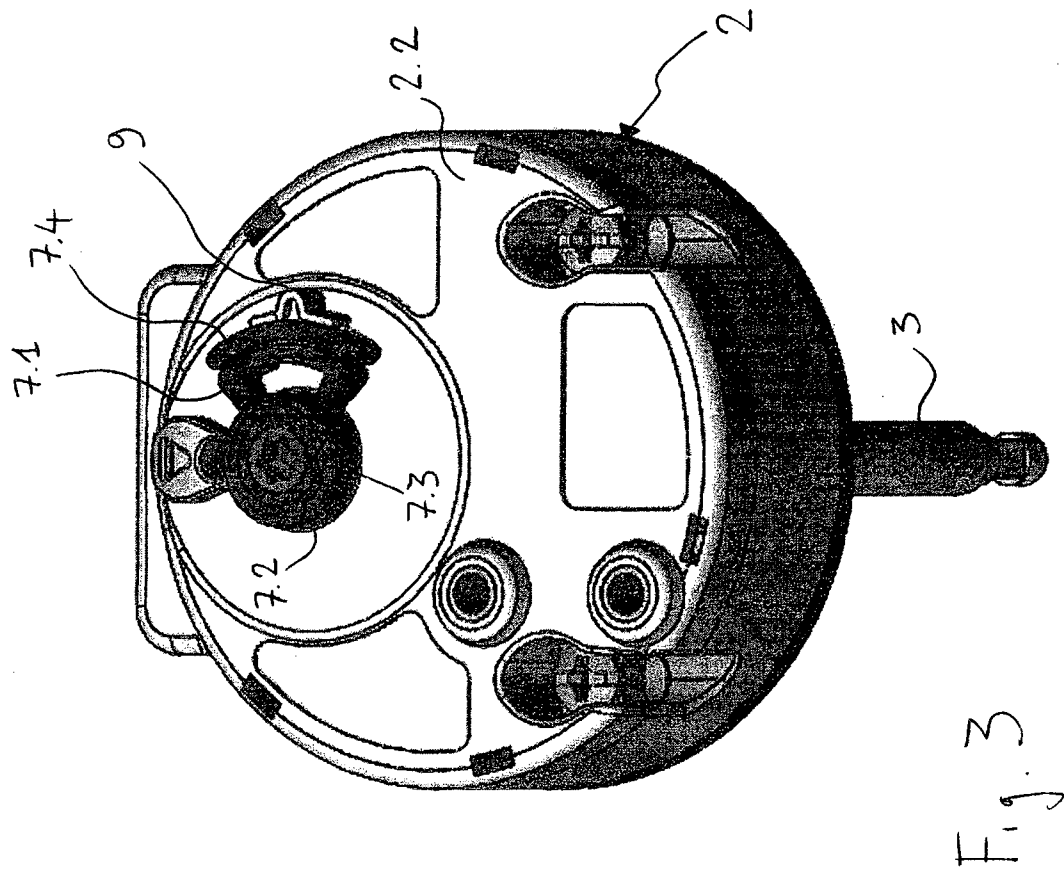
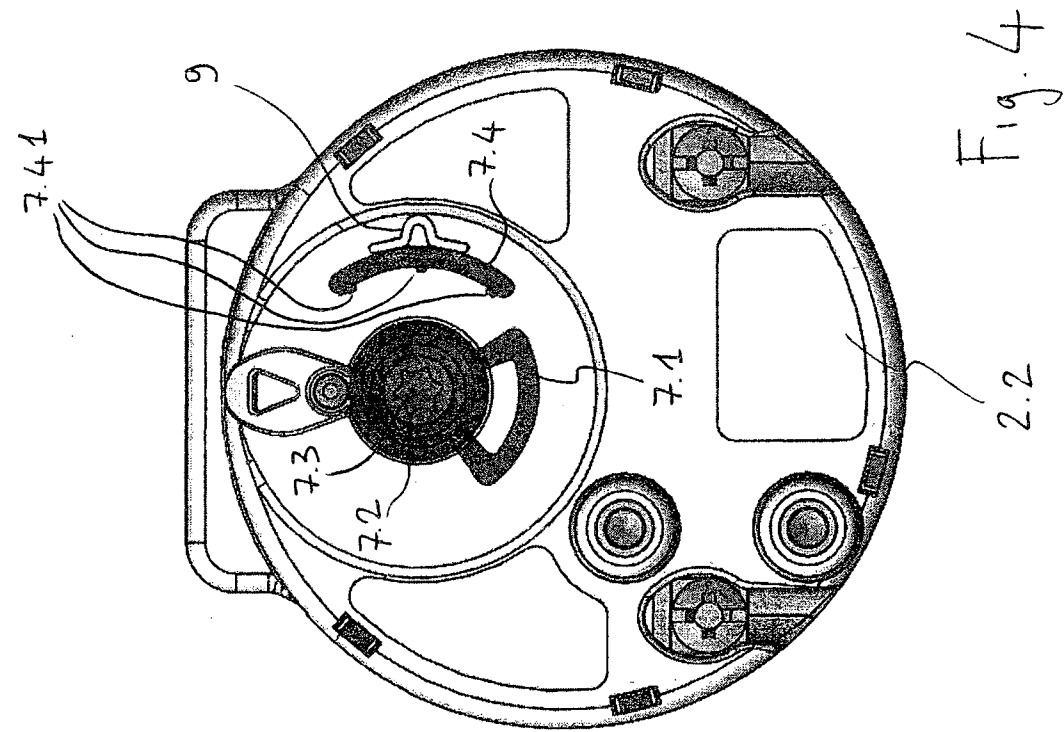
3. Thermostat (1) according to any previous claim,
5 characterised in that
said joining elements (7.41) are subjected to breakage through the application by an operator of a rotational force on said adjustment knob (7, 7.1), by acting directly or indirectly on said rotation indicator (7.1).
4. Thermostat (1) according to the previous claim,
10 characterised in that
said joining elements (7.41) comprise one or more teeth,
said rotational force being equal to about 0.3 N·m.
5. Thermostat (1) according to claim 2, characterised in that
said rotation indicator (7.1) of said outer ring (7.2) has a circumference sector
15 shape,
said outer wing (7.4) having a crown shape of circumference concentric to the axis of said outer ring (7.2) and angular width substantially equal to those of the arc of said circumference sector of said rotation indicator (7.1).
6. Thermostat (1) according to any previous claim,
20 characterised in that
said operating temperature (T.box) initially calibrated and not changeable in presence of said locking means is the temperature value such as to achieve at least the minimum energy efficiency class in accordance with the EU legislation ErP,
25 said operating temperature (T.box) being that with which said thermostat (1) leaves the factory, lower than the operating temperatures (T.perf, T.max) reachable by said thermostat (1) following the removal of said locking means.
7. Thermostat (1) according to any previous claim,
characterised in that
30 said adjustment knob (7, 7.1) comprises a travel end stop adapted to prevent the

calibration point corresponding to the maximum safety temperature (T.max) from being exceeded.

- 8.** Thermostat (1) according to any previous claim, characterised in that
- 5 it comprises identifying elements to allow the recovery by the operator of the calibration point corresponding to the operating temperature (T.box) initially calibrated, even after the removal of said locking means.
- 9.** Thermostat (1) according to the previous claim, characterised in that
- 10 said identifying elements comprise coupling means of reciprocal shape, respectively made on the indicator (7.1) of the outer ring (7.2) and on the outer wing (7.4).
- 10.** Thermostat (1) according to the previous claim, characterised in that
- 15 said coupling means of reciprocal shape comprise a concavity (7.10) made on said indicator (7.1) of the outer ring (7.2), adapted to cooperate with a reciprocal convex portion (7.40), made on said outer wing (7.4).
- 11.** Electrical storage water heater, characterised in that it comprises the thermostat (1) according to any claim from 1 to 10.

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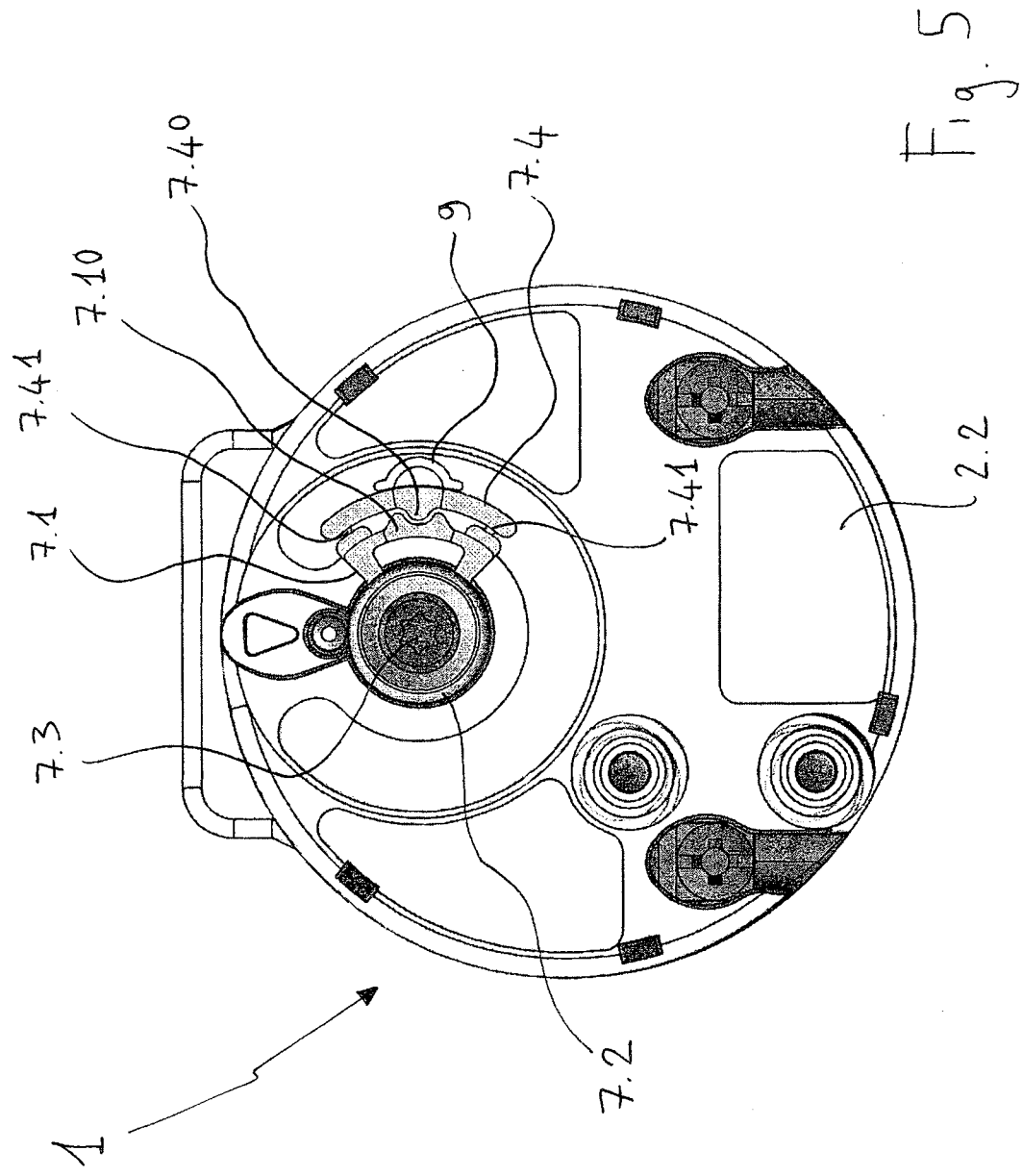


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/000264

A. CLASSIFICATION OF SUBJECT MATTER

INV. G05D23/19
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)

G05D F24H H01H G05G F16K

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/121305 A1 (FIRESTINE DAVID MICHAEL [US]) 5 September 2002 (2002-09-05)	1-8,11
Y	the whole document	9,10
Y	----- US 4 455 886 A (SCHMITT DONALD J [US]) 26 June 1984 (1984-06-26)	9,10
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A	----- FR 2 369 674 A1 (SNIPELSKI JACQUES [FR]) 26 May 1978 (1978-05-26)	1-11
	the whole document	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

21 June 2016

Date of mailing of the international search report

28/06/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Vañó Gea, Joaquín

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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