(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 January 2014 (09.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/008442 A1

(51) International Patent Classification:
D06F 39/00 (2006.01) *H05B 3/78* (2006.01)
H05B 1/02 (2006.01) *D06F 39/08* (2006.01)
H05B 3/42 (2006.01) *G01F 23/292* (2006.01)

(21) International Application Number:
PCT/US2013/049397

(22) International Filing Date:
3 July 2013 (03.07.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
TO2012A000598 6 July 2012 (06.07.2012) IT

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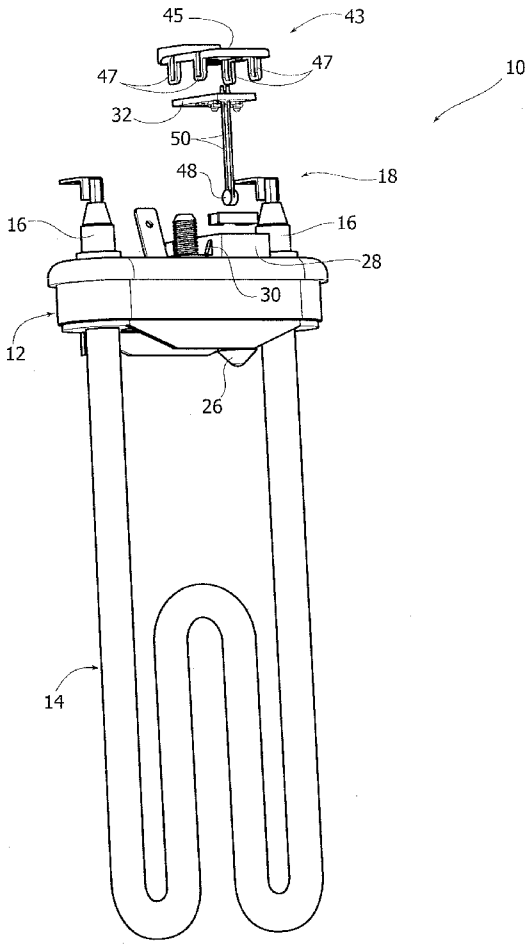
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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR,

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(54) Title: HEATING DEVICE FOR DOMESTIC APPLIANCES WITH OPTICAL LIQUID-LEVEL SENSOR



(57) Abstract: Heating device for domestic appliances comprising a base (12), a coil resistor (14) extending from said base (12), and an optical sensor (18) able to determine the level of washing liquid around said coil resistor (14).

WO 2014/008442 A1

KZ, LA, LC, LK, LR, LS, LT, 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, 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, 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).

Published:

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

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

DESCRIPTION of the industrial invention entitled:
"Heating device for domestic appliances with optical liquid-level sensor"
belonging to: Illinois Tool Works Inc., of the USA, 3600 West Lake Avenue, Glenview, Illinois, 60025 USA
Named inventors: Marco SCLIP, Davide BORDIGNON
Filed on: July 6, 2012

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DESCRIPTION

Field of the invention

The present invention relates to domestic washing appliances, such as washing machines and dishwashers, and concerns a heating device for such domestic appliances that can heat the washing liquid.

Description of the related art

Washing machines and dishwashers are commonly fitted with a resistance heating device for heating the washing liquid. Such domestic appliances are normally fitted with a pressure switch to measure the level of the bath of washing liquid. Domestic washing appliances are commonly fitted with a heating device with a coil resistor that is immersed in the bath of washing liquid. A temperature sensor is also provided to measure the temperature of the bath and to cut off the power to the heating resistor once the bath reaches the preset working temperature.

If the pressure switch measuring the level of the liquid fails, the bath of washing liquid could leave the heating resistor uncovered. In this case, the resistor would quickly reach a high temperature that could damage the heating device. To overcome this drawback, it has already been proposed to incorporate a temperature sensor

in the heating device such as to cut off the power supply to the heating device in the event of excessive temperature increases. However, the temperature sensor may not be able to prevent damage caused by the overheating of the heating resistor.

Scope and summary of the invention

The present invention is intended to provide a heating device for domestic appliances that provides greater safety guarantees against the risk of overheating.

According to the present invention, this objective is achieved by a heating device having the features set out in claim 1.

The claims are an integral part of the teaching provided in relation to the invention.

Short description of the drawings

The present invention is described in detail below with reference to the attached drawings, which are provided purely by way of non-limiting example, in which:

- Figure 1 is a partially exploded perspective view of a heating device for domestic appliances according to the present invention,

- Figure 2 is a partially exploded axial cross-section of the heating device in figure 1, and

- Figure 3 is an axial cross-section of the optical sensor indicated by the arrow III in figure 2.

Description of embodiments of the invention

In figures 1 and 2, reference sign 10 indicates a resistance heating device for domestic washing appliances, such as washing machines or dishwashers.

The heating device 10 includes a base 12 bearing a coil resistor 14. The extremities of the coil heater 14 are attached to the base 12 and are connected electrically to

two terminals 16 that protrude from the base 12 on the side opposite the coil resistor 14.

The heating device 10 includes an optical sensor 18 on the base 12. The optical sensor 18 is able to determine the liquid level around the heating device 10.

With reference to figure 3, the optical sensor 18 is preferably a reflection sensor and includes a waveguide 20 formed by an elongated hollow body 22 made of transparent plastic material, such as polycarbonate. The body 22 has an elongated cavity 24 and a substantially conical closed extremity 26. The body 22 has an enlarged head 28 with teeth 30 on the outside thereof. The body 22 has a cylindrical central section between the head 28 and the extremity 26, with a wall of constant thickness.

The optical sensor 18 includes a printed circuit board 32 bearing a light emitter 34 and a light receiver 36. The front of the light emitter 34 and the front of the light receiver 36 face the walls of the body 22 and are diametrically opposite one another. Preferably, the body 22 includes two lenses 23 (figure 3) arranged in front of the light emitter 34 and of the light receiver 36, to collimate the light emitted by the light emitter 34 and to focus the light reflected by the light guide 20 on the light receiver 36. Preferably, the lenses 23 are formed entirely on the body 22 by varying the profile of the front surface of the body 22.

The light emitter 34 and the light receiver 36 are optically separated from one another by a screen 38 with an internal annular wall 40 and an external annular wall 42. The internal annular wall 40 optically isolates the light emitter 34 from the light receiver 36. The external annular

wall 42 optically isolates the light emitter 34 and the light receiver 36 from the side walls of the head 28.

The printed circuit board 32 is attached to the body 20 by means of a cover 43 with a base wall 45 that bears against the printed circuit board 32 and a plurality of arms 47 that clip onto the teeth 30 of the body 22.

The optical sensor 18 may have an integrated temperature sensor 46. The temperature sensor 46 includes an NTC resistor 48 seated in the cavity 24 near to the closed extremity 26. The NTC resistor 48 is connected to the printed circuit board 32 by means of terminals 50. The cavity 24 may be filled with a material having high thermal conductivity to encourage the transmission of heat between the walls of the body 22 and the NTC resistor 48.

With reference to figure 2, the body 22 of the optical sensor 18 is inserted and attached in a hole 52 in the base 12. The extremity 26 of the body 22 protrudes from the base 12 on the same side as the coil resistor 14. The head 28 of the body 22 protrudes from the base 12 on the same side as the terminals 16. The sensor 18 is connected by a connector (not shown) to a power and control circuit of the domestic appliance.

In operation, the light emitter 34 emits a luminous flux L that is propagated in the wall of the body 22 as shown in figure 3. A first part L' of the luminous flux is dispersed outside the luminous body 22 through the inclined walls of the conical extremity 26. A second part of the luminous flux L'' is reflected inside the body 22 and reaches the light receiver 36. The part of the optical flux L' dispersed outside the body 22 depends on the ratio between the refraction coefficients between the material used for the body 22 and the material surrounding the body

22. The amount of the flux L' dispersed varies depending on whether the extremity 26 is surrounded by air or by washing liquid. The amount of the flux L' dispersed also depends on the level of the washing liquid around the body 22. The light receiver 36 receives the reflected flux L'' and provides an electrical signal indicating the intensity of the reflected flux L''. Since the intensity of the flux L'' varies as a function of the level of liquid around the extremity 26, the sensor 18 is therefore able to provide precise information regarding the level of the washing liquid around the coil resistor 14. The information provided by the level sensor 18 helps to prevent damage being caused to the heating device 10 by overheating in the event of an erroneous level measurement by the pressure switch. The sensor 18 also provides, by means of the temperature sensor 46, a measurement of the temperature of the washing liquid which is used to cut the power to the heating device 10 when the preset temperature is reached.

Naturally, notwithstanding the principle of the invention, the design details and embodiments may be varied significantly from the description and illustrations without thereby moving outside the scope of the invention as defined in the claims below.

CLAIMS

1. Heating device for domestic appliances, comprising a base (12) and a coil resistor (14) that extends from said base (12), characterized in that it includes an optical sensor (18) that can determine the level of washing liquid around said coil resistor (14).

2. Device as claimed in claim 1, characterized in that said optical sensor (18) includes a light guide (20) formed by an elongated body (22) made of transparent plastic material inserted into a hole (52) in said base (12), the elongated body (22) having a substantially conical extremity (26) that protrudes from said base (12) on the same side as said coil resistor (14).

3. Device as claimed in claim 2, characterized in that said optical sensor (18) includes a printed circuit board (32) bearing a light emitter (34) and a light receiver (36) frontally facing a wall of said body (22) and optically isolated from one another by means of a screen (38).

4. Device as claimed in claim 2, characterized in that it includes a temperature sensor (46) seated in a cavity (24) of said elongated body (22).

5. Device as claimed in claim 4, characterized in that said temperature sensor (46) includes an NTC resistor (48) arranged to coincide with a closed extremity of said cavity (24) and connected to said printed circuit board (32) by means of terminals (50).

6. Device as claimed in claim 3, characterized in that the body (22) includes two lenses (23) arranged opposite the light emitter (34) and the light receiver (36).

7. Device as claimed in claim 6, characterized in that said lenses (23) are formed entirely on the body (22) by varying the profile of the front surface of the body (22).

FIG. 1

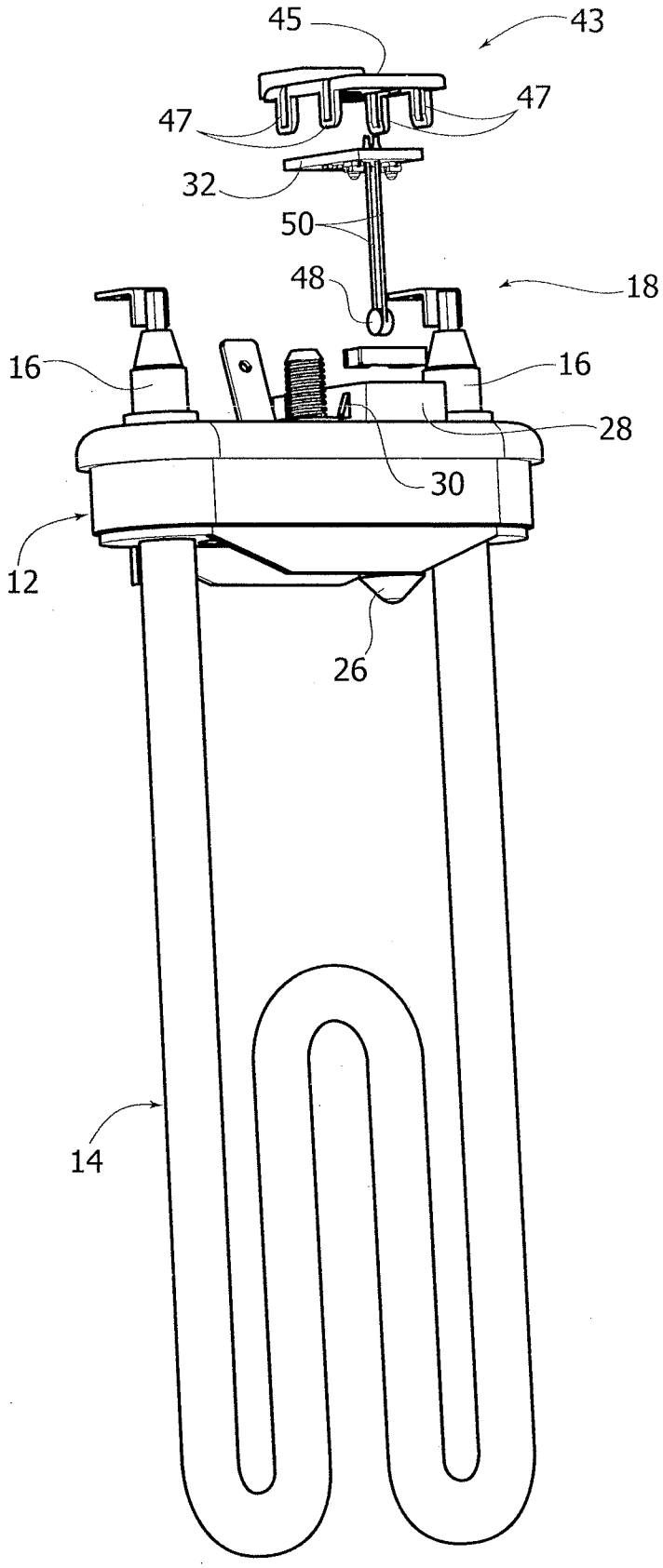


FIG. 2

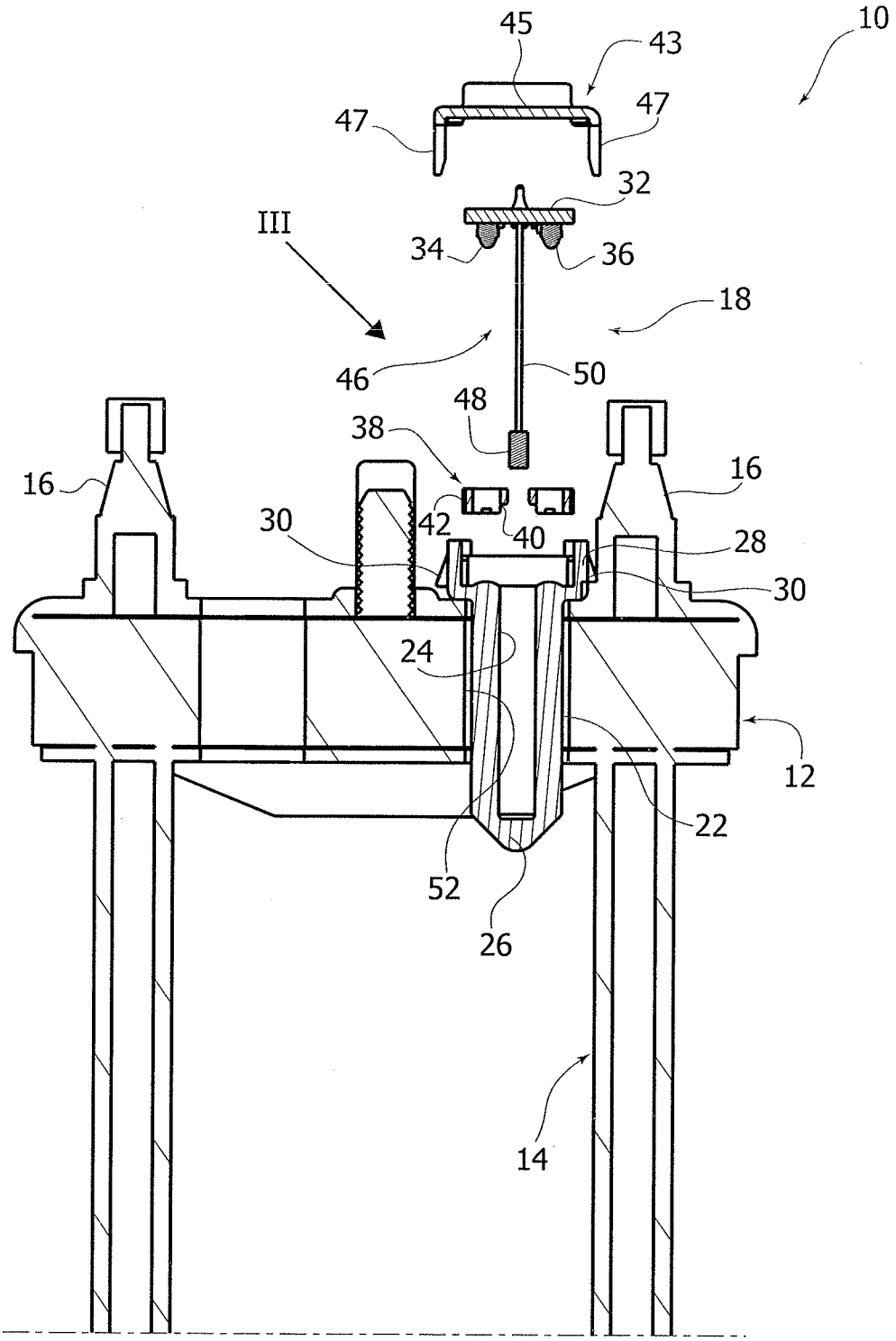
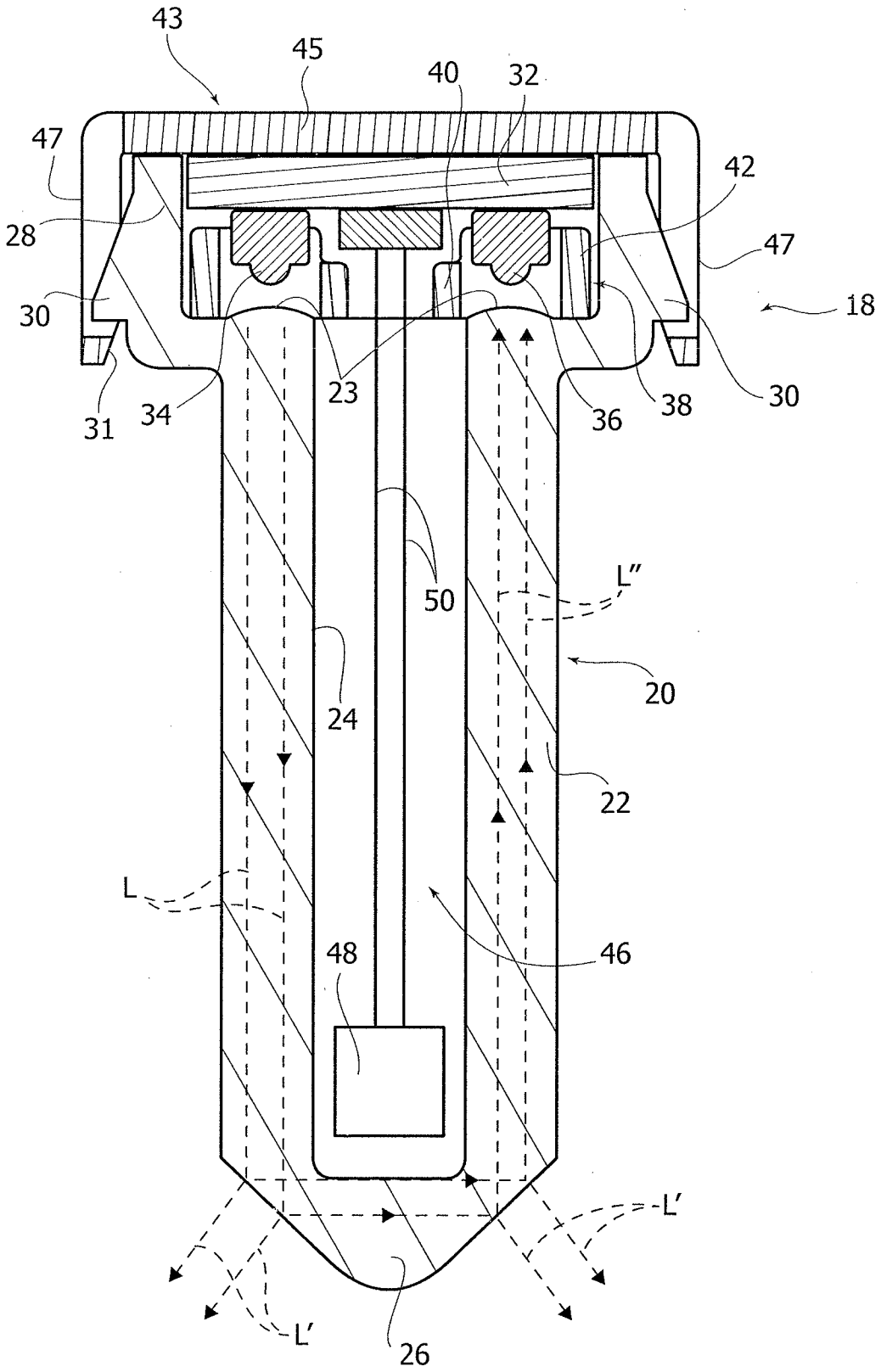

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FIG. 3


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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/049397

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F39/00 H05B1/02 H05B3/42 H05B3/78 D06F39/08
G01F23/292
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 H05B G05D A47L F24H G01F

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)
EPO-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 Y	US 2011/310927 A1 (BOMBARDIERI GIOVANNI [IT] ET AL) 22 December 2011 (2011-12-22) the whole document -----	1 2-7
X Y	EP 1 690 971 A2 (EGO ELEKTRO GERAETEBAU GMBH [DE]) 16 August 2006 (2006-08-16) the whole document -----	1 2-7
A	EP 0 787 848 A1 (MERLONI ELETTRODOMESTICI SPA [IT] WRAP SPA [IT]) 6 August 1997 (1997-08-06) the whole document -----	1
Y	EP 1 335 060 A1 (ZANGENSTEIN ELEKTRO [DE] EMZ HANAUER GMBH & CO KGAA [DE]) 13 August 2003 (2003-08-13) the whole document -----	2-7

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

[X] 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 December 2013	17/12/2013

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/049397

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/049397

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1 245 713 A1 (WHIRLPOOL CO [US]) 2 October 2002 (2002-10-02) the whole document	2-7
Y	US 2005/236592 A1 (WIRTHLIN ALVIN R [US]) 27 October 2005 (2005-10-27) the whole document	2,3,6,7
Y	EP 1 816 899 A2 (BLECKMANN GMBH & CO KG [AT]) 8 August 2007 (2007-08-08) the whole document	4,5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/049397

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011310927 A1	22-12-2011	EP 2331740 A1	15-06-2011
		EP 2543762 A2	09-01-2013
		RU 2011116068 A	27-10-2012
		US 2011310927 A1	22-12-2011
		WO 2010035080 A1	01-04-2010
EP 1690971 A2	16-08-2006	CN 1828162 A	06-09-2006
		DE 102005007935 A1	24-08-2006
		EP 1690971 A2	16-08-2006
		RU 2006104432 A	20-09-2007
		US 2006191496 A1	31-08-2006
EP 0787848 A1	06-08-1997	DE 69712380 D1	13-06-2002
		DE 69712380 T2	09-01-2003
		EP 0787848 A1	06-08-1997
		ES 2177838 T3	16-12-2002
		IT TO960076 A1	05-08-1997
EP 1335060 A1	13-08-2003	EP 1335060 A1	13-08-2003
		US 2003142316 A1	31-07-2003
EP 1245713 A1	02-10-2002	DE 20022433 U1	06-09-2001
		EP 1245713 A1	02-10-2002
US 2005236592 A1	27-10-2005	US 2005236592 A1	27-10-2005
		WO 2005106382 A2	10-11-2005
EP 1816899 A2	08-08-2007	AT 535129 T	15-12-2011
		DE 102006005321 B3	20-09-2007
		EP 1816899 A2	08-08-2007
		PL 1816899 T3	31-07-2012
		US 2007210107 A1	13-09-2007

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claim: 1

Improving the controlling of heating device

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2. claims: 2-7

Optimisation of configuration of an optical sensor
