



(51) International Patent Classification:
H05B 3/52 (2006.01)

(21) International Application Number:
PCT/IB2012/052894

(22) International Filing Date:
8 June 2012 (08.06.2012)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
RM2011A000286 9 June 2011 (09.06.2011) IT

(71) Applicant (for all designated States except US): **I.R.C.A. S.P.A. INDUSTRIA RESISTENZE CORAZZATE E AFFINI** [IT/IT]; Viale Venezia, 31, I-31020 San Venedemiano (IT).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **COLOMBO, Roberto** [IT/IT]; Via Dina 51, I-31015 Conegliano (IT). **BIASI, Maurizio** [IT/IT]; Via C. Colombo 6, I-31043 Fontanelle (IT). **SONEGO, Carlo** [IT/IT]; Via delle Acque 11, I-33084 Cordenons (IT). **SONEGO, Gino** [IT/IT]; Via Battisti 30, I-31020 San Pietro Di Feletto (IT).

(74) Agents: **CINQUANTINI, Bruno** et al.; Corso di Porta Vittoria 9, I-20122 Milano (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, 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, KM, KN, KP, KR, 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, 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, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))

(54) Title: ARMoured RESISTOR OF AN ELECTRIC HOUSEHOLD APPLIANCE AND A METHOD FOR MANUFACTURING THEREOF

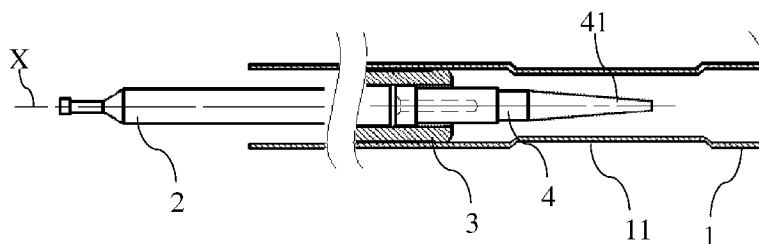


Fig. 3

(57) Abstract: Armoured resistor of an electric household appliance comprising a tube-shaped casing (1) defining a longitudinal development (X) and at least one end, an outer tip (2) at least partially emerging from the interior of said at least one end, an inner tip (4) on the tube-shaped casing, a thermal fuse electrically connecting the outer tip (2) with the inner tip (4); the inner tip is adapted to be connected to a resistive wire; the inside of the tube-shaped casing (1) is filled with insulating powder to insulate the tube-shaped casing (1) from the inner electric components; the tube-shaped casing (1) comprises a narrowing zone (11) at the inner tip (4).



AROMOURED RESISTOR OF AN ELECTRIC HOUSEHOLD APPLIANCE AND A METHOD FOR
MANUFACTURING THEREOF

Field of the invention

The present invention relates to an armoured resistor of an electric household
5 appliance and a method for the manufacture thereof.

Prior art

Armoured electric resistors are used in electric household appliances which come
into contact with water, such as washing machines, dishwashers, etc.

Such armoured resistors incorporate within themselves security systems which, in
10 the event of malfunction of the apparatus or of any component thereof, eliminate
the risk of fires started by said resistor.

Thermal fuses that are capable of interrupting the resistor's power supply when
said resistor exceeds a predetermined temperature in particular are incorporated.

A resistive wire is inserted into the substantially tube-shaped casing and isolated
15 therefrom by means of powdered magnesium oxide.

A metal tip partially projects at each end of tube-shaped casing, which tip is duly
electrically insulated from the tube-shaped casing by means of suitable insulating
sheaths, both tips are intended to be connected to a source of electricity.

A thermal fuse is present in at least one of said ends.

20 Therefore the magnesium oxide electrically insulates the resistive wire from the
metal casing, but is responsible for transporting the heat generated by the resistive
wire towards the outside, for heating water.

The dimensions of the thermal fuse must take account of the following conflicting
requirements:

- 25 - to intervene rapidly in the event of an absence of water to be heated, to prevent
the plastic, which is very close to the resistor, from catching fire.
- To limit the intervention of the thermal fuse following a variation in the heat-
exchange characteristics towards the water due to accumulation of limestone
and lint, such as in the case of a washing machine, and food residues in the
30 case of dishwashers.

Therefore, there is a requirement both for the thermodynamic system to be rapid
for large reductions in the dispersion of heat, on account of the absence of water,

and also for the thermal fuse not to intervene prematurely on account of slight variations in dispersion, for example due to accumulation of sediments.

On the other hand, the known art teaches the subjection of resistors filled with magnesium oxide to what is known as a rolling process, which leads to a 2%-20%
5 reduction in the diameter of the casing. However, rolling is a procedure according to which the tube-shaped casing undergoes a process of narrowing by passing between rollers which, little by little, reduce its diameter in accordance with a cross-section, uniformly along the entire longitudinal development of the casing. This process is rendered necessary by the fact that when the magnesium oxide is
10 inserted into the casing, it tends not to compact, incorporating air which, as is known, is a good thermal insulator. The magnesium oxide is therefore compacted by rolling, improving the thermal conductivity of the layer of magnesium oxide which envelops the resistive wire.

Such a rolling process has nothing in common with the process of narrowing
15 presented in US2846537. The hexagonal cross-section narrowing presented in US2846537 is localised at the bead, in order to ensure that the bead fits perfectly, preventing the insulating material from being able to escape from the armouring.

In case of non-circular cross-section, the same result is obtained with uniform pressure along the whole length of the casing.

20 According to the prior art, uniform reductions of the casing cross-section are within the range from 2% to 20% of the original cross-section.

However, this range cannot be exceeded with such a process, because this leads to excessive work-hardening of the casing. As a result, this breaks during bending of the resistor.

25 **Summary of the invention**

About aim of the present invention is to provide an armoured resistor for an electric household appliance, having improved thermal fuse behaviour in respect of the accumulation of sediments on the resistor without prejudicing the security thereof.

30 The aim of the present invention is an armoured resistor for an electric household appliance according to claim 1.

Such narrowing, localised at the inner tip, is limited to a portion of the longitudinal development of the casing and not to the entire length, as in the rolling process.

Advantageously, thanks to the present invention, an increase in the thermal conductivity of the magnesium oxide at the level of a proximal zone of the thermal fuse, which increase is obtained due to narrowing at least at one portion of the inner tip, enormously improves fuse behaviour, by determining a synergistic effect between the behaviour of the fuse and the presence of the localised narrowing.

This effect has been demonstrated by numerous different laboratory tests.

A further aim of the invention is to provide a method for a manufacturing an armoured resistor of an electric household appliance which enables an armoured resistor to be obtained having improved thermal fuse behaviour in respect of the accumulation of sediments on the resistor, without prejudicing the security thereof.

Such narrowing locally modifies the thermal conductivity of the magnesium oxide.

This translates into improved local heat dispersion during normal operation of the resistor, that is, when it is submerged in water. At the same time, the conduction of heat produced by the resistive wire towards the thermal fuse is not reduced in the disadvantageous case of dry operation of the armoured resistor; in brief, the narrowing does not modify the speed of intervention of the thermal fuse, as a result of which the resistor security in the event of operation under conditions of abnormal overheating (for example in the absence of water) is not prejudiced.

Furthermore, thanks to the present invention, the mechanical characteristics of the resistor are not prejudiced during the process of bending thereof.

Another subject of the invention is a method of manufacturing an armoured resistor of an electric household appliance.

As will be illustrated in what follows, the method of manufacturing the present invention may also be applied to pre-existing armoured resistors or those anyhow manufactured according to alternative methods.

The dependent claims describe preferred embodiments of the invention, forming an integral part of the present description.

Brief description of the drawings

Further characteristics and advantages of the invention will be more evident in the light of the detailed description of preferred, though not exclusive, embodiments of an armoured resistor of an electric household appliance, which resistor is
5 illustrated by way of a non-limiting example, with the aid of the drawings attached, wherein:

Fig. 1 represents a portion of one end of an armoured resistor, prior to rolling,

Fig. 2 represents the same part as in Fig. 1, after the rolling process,

Fig.3 shows the same portion of the preceding figures according to the present
10 invention.

The same numbers and the same letters used for reference in the figures indicate the same members or components.

Detailed description of a preferred embodiment of the invention

With reference to the drawings, figure 1 shows a portion of one end of any
15 armoured resistor prior to rolling. Numeral 1 indicates the outer casing, 2 the tip, 3 box, as well as 31 the space between the box 3 and the casing 1 and a so-called inner tip 4 the purpose of which tip is to connect the thermal fuse 6 to the resistive wire, not represented here since it may be of any type. The point of connection
20 between the inner tip 4 and the resistive wire may also be of any kind. Use of the attribute tube-shaped here does not imply that any cross-section should be circular. It may be of any shape, but preferably circular.

Fig. 2 shows the same portion of Fig. 1 following the process of reducing the cross-section of the casing, for example by rolling. It can be seen that the space 31, also called "air", has disappeared. In other words, the box adheres perfectly to
25 the casing and vice versa.

It is also understood that the box 3 is made so as to deform and adhere perfectly to the casing during any process of reduction of the cross-section of the casing. By "cross" is meant perpendicularly relative to the axial development X of the casing.

30 In general, but not necessarily, the inner tip 4 is of a shape which tends to taper at the inner end 41 directed towards the inside of the casing, that is, to the right with reference to the drawings.

In accordance with the present invention, the armoured resistor comprises a localised narrowing of the casing 1 along a length corresponding to the inner tip.

For example, astride the inner end 41 of the inner tip 4

Therefore, during dry operation of the resistor, the heat is no longer adequately dissipated in the environment and establishes alternative routes. That is, as well as propagating through the inner tip 4 which is in direct contact with the resistive wire, the heat also dissipates via the magnesium oxide or an equivalent insulating powder which exhibits improved thermal conductivity within the zone of narrowing, precisely because it is narrower, until it reaches the thermal fuse, which intervenes more promptly.

On account of the above, the thermal fuse may be dimensioned in such a way that slight increases in temperature due to possible accumulation of sediments on the casing may be overlooked.

The narrowing has limited axial extension, that is, along the X-development of the armoured resistor, which preferably does not exceed the length of the inner tip. Furthermore, this narrowing preferably does not involve the part of the casing in contact with the box 3.

According to a preferred variant of the invention, the longitudinal development of the narrowing may vary. A preferred length of this development may be within the range from at least 0.5 to 4 times the average outer diameter of the casing.

By average outer diameter is meant a average diameter calculated within a zone different from that affected by the narrowing.

Thus, if the average outer diameter is 10 mm, the zone of narrowing 11 may extend axially for 5 to 40 mm and beyond.

Furthermore, it is preferable for the narrowing to be such as to present a diameter within the range from 70% and 98% of the average outer diameter, that is, calculated within a zone outside the narrowing.

This narrowing 11 may be given to the casing 1 at any point in the manufacture of the resistor or after manufacture thereof.

This narrowing may be provided in many ways. For example, by means of planar or radially circular pressing, also called sectoral pressing, or by coining.

The radially circular pressing/re-pressing reduces the diameter of the zone involved via a plurality of sectors which radially compress the zone in question, maintaining a substantially circular geometry of the portion affected by the narrowing. The total extent of narrowing may be obtained by means of further operations, successively repeated.

Even though coining is a procedure which reduces the axial ends in an extremely localised manner, within a few hundredths of a millimetre to 1 or 2 mm, the possibility of this process too being validly usable is not excluded.

It is worth highlighting that the above-mentioned narrowing ratios refer to a preferably uniform narrowing both along the X axis of development of the casing, and along a cross-section of the zone affected by the narrowing. However, this does not detract from the fact that the narrowing may not be relative to these two directions, for example giving rise to another cross-section, or to two or more consecutive narrowings, etc.

The process of manufacturing the armoured resistor may provide for a prior or subsequent step of reducing the average outer diameter of the tube-shaped casing 1, that is, of the portions of the tube-shaped casing 1 remaining relative to said zone(s) of narrowing 11. Preferred reductions in percentage are of the order of 0% to 20%.

The advantages deriving from application of the present invention are clearly that better behaviour of the thermal fuse and of general operation are achieved without prejudicing its mechanic behaviour during bending of said resistor.

If the armoured resistor comprises a fuse at both ends, the narrowing may be located at one or both inner tips 4.

The members and the characteristics illustrated in the various preferred embodiments may be combined with one another without exceeding the scope of the protection of the present application.

CLAIMS

1. Armoured resistor of an electric household appliance comprising a tube-shaped casing (1) defining a longitudinal development (X) and at least one end, an outer tip (2) at least partially emerging from the interior of said at least one end, at least
5 one inner tip (4) of the tube-shaped casing, a thermal fuse (6) electrically connecting the outer tip (2) to the inner tip (4), the inner tip (4) being adapted to be connected to a resistive wire, an inner part of the tube-shaped casing (1) being filled with insulating powder to insulate the tube-shaped casing (1) from the inner electric components,
10 characterized in that said tube-shaped casing (1) comprises a narrowing zone (11) at least at one portion of said at least one inner tip (4).
2. A resistor according to claim 1, wherein said narrowing zone (11) has a length, according to said longitudinal development (X), from at least 0.5 to 4 times the average outer diameter of the tube-shaped casing (1).
- 15 3. A resistor according to claim 1 or 2, wherein said narrowing zone (11) has an average diameter from 70% to 98% of the remaining average outer diameter of the tube-shaped casing (1).
4. A method of manufacturing an encased resistor of an electric household appliance comprising a tube-shaped casing (1) defining a longitudinal
20 development (X) and at least one end, an outer tip (2) at least partially emerging from said at least one end, at least one inner tip (4) of the tube-shaped casing, a thermal fuse (6) electrically connecting the outer tip (2) to the inner tip (4), the inner tip (4) being adapted to be connected to a resistive wire, an inner part of the tube-shaped casing (1) being filled with insulating powder to insulate the tube-
25 shaped casing (1) from the inner electric components,
the method comprising at least one step of introducing at least one narrowing zone (11) in at least one portion of said at least one inner tip (4).
5. A method according to claim 4, wherein said step comprises at least a pressing process.
- 30 6. A method according to claim 4, wherein said step comprises at least a circular, radial pressing process.
7. A method according to claim 4, wherein said step comprises at least a coining

process.

8. A method according to claim 5 or 6 or 7, wherein said narrowing zone (11) has a length, according to said longitudinal development (X), from at least 0.5 to 4 times the remaining average outer diameter of the tube-shaped casing (1).
- 5 9. A method according to one of the claims from 5 to 8, wherein said narrowing zone (11) has an outer average diameter from 70% to 98% of the remaining outer diameter.
10. A method according to one of the claims from 5 to 9, comprising a step, before or after the introduction of the narrowing zone (11), wherein the outer average
- 10 diameter of the tube-shaped casing (1) is reduced in percentage from 0% to 20%.

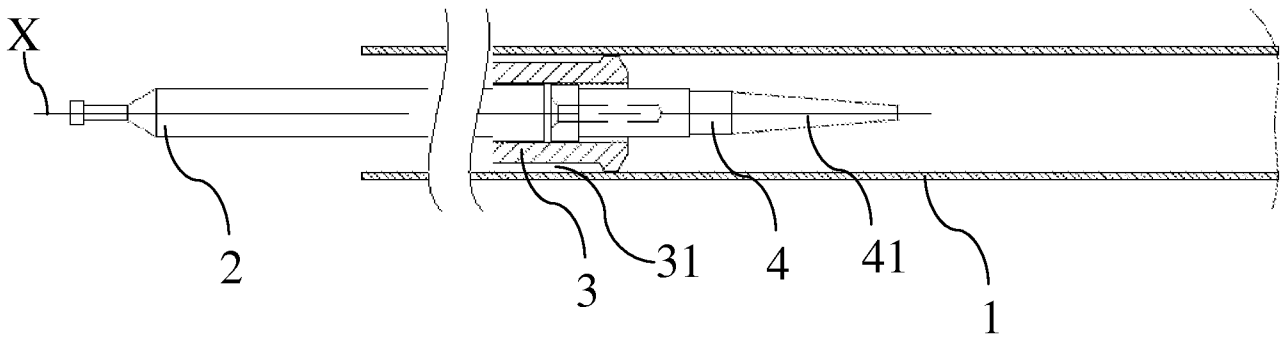


Fig. 1

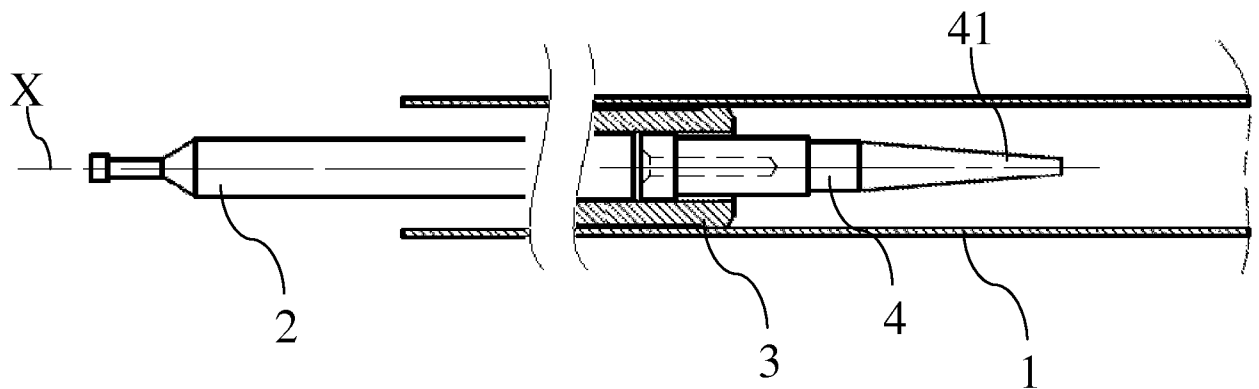


Fig. 2

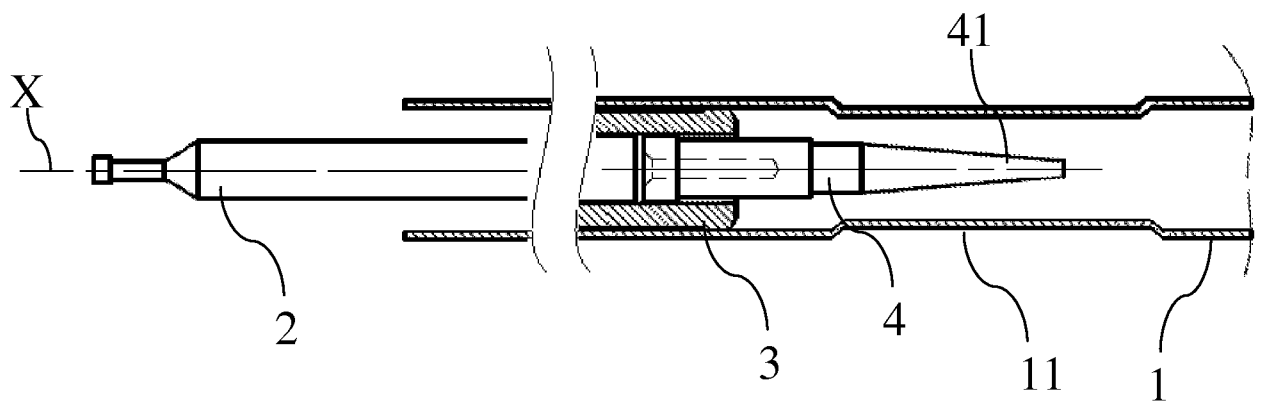


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/052894

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B3/52
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)
H05B

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.
Y	EP 0 086 465 A1 (ELPAG AG CHUR [CH]) 24 August 1983 (1983-08-24) figures 1,2,7	1-10
Y	----- US 2 846 537 A (THORNHILL NORMAN B) 5 August 1958 (1958-08-05) cited in the application figures 1-4, 7, 9, 11 column 3, lines 24-26	1-10
A	----- US 1 960 221 A (KELLY WILLIAM D ET AL) 22 May 1934 (1934-05-22) figures 1,3,5-6 -----	1-10

☐

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

"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

"P" document published prior to the international filing date but later than the priority date claimed

"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

28 August 2012

Date of mailing of the international search report

03/09/2012

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

Pierron, Christophe

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/052894

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0086465	A1	24-08-1983	DE 3204875 A1 EP 0086465 A1	01-09-1983 24-08-1983
US 2846537	A	05-08-1958	NONE	
US 1960221	A	22-05-1934	NONE	