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(54) IMPROVEMENTS IN OR RELATING TO MALE PLUG UNITS

(71) We, JOHN CRAWSHAW TAYLOR, a British subject of Edge Lee, Bishops Lane, Buxton, Derbyshire, and OTTER CONTROLS LIMITED, a British Company, of Otters 'Ole, Market Street, Buxton, Derbyshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to male pin plug units.

Previously male pin plug units have been provided including thermally controlled switches which are adapted for use with electric kettle elements. Such plug units include two electrical connection pins generally produced from circular cross-section solid brass stock for supplying current to the kettle element and usually a third earth connection pin generally of solid brass of substantially rectangular cross-section, the pins being positioned in the plug in a predetermined array which corresponds to the standard socket for connecting a kettle to a power supply. In the normal construction of electric kettles it is preferred that the heating element be positioned as close to the bottom of the kettle as possible and with this construction it has been found that the leads from the kettle element do not exactly register with the brass pins in the plug unit. In order to meet this problem the leads are generally led straight from the kettle element to terminals which may be in the form of ferrules in the plug unit and these terminals or ferrules are connected to the appropriate pins by conductive strips of metal which are rivetted into place. Usually the earth connection from the element is fixed to the plug unit remote from the earth pin this connection also acting as a mounting point for the plug unit. A conductive strip is then required between this connection and the earth pin. Similarly the electric contacts of the thermally controlled switch are not usually positioned so that one of them may be connected directly onto one of the solid pins so that a conductive strip is necessary between the pin and the con-

tact. The provision of rivets or rivet ends on the pins is expensive and a time consuming operation. If the rivetted assembly is not tight and/or the metal is oxidized current heating takes place which can damage the unit.

According to the invention there is provided a male pin plug unit for use with an electrical heating element comprising a thermally controlled switch, at least two pins adapted to mate with an electrical supply socket, and a terminal spaced from each pin for connection to the electrical heating element, at least one of said pins being hollow and having a conductive strip integral therewith, said hollow pin and integral strip being shaped from a flat metal blank.

In a preferred embodiment of the invention contacts for the thermally controlled switch are provided between one of the terminals and one of the pins usually the live pin. In this embodiment, therefore, the end of the conductive strip remote from the pin forms one of the switch contacts. The terminal for the pin is formed from a flat metal blank shaped so as to provide the terminal and a leaf spring integral therewith. The other switch contact is provided at the end of the leaf spring remote from the terminal. The conductive strip integral with the other pin usually the neutral pin is directly connected to its associated terminal.

If desired the said other pin, conductive strip and associated terminal may be constructed from a single blank.

It is preferred that the blanks be designed such that two pins have circular cross-section to mate with standard sockets.

As stated previously, male pin plug units of the kind under consideration are generally provided with a third earth pin of substantially rectangular cross-section. Preferably therefore the male plug unit is provided with a third hollow pin, which third pin is formed from a flat metal blank preferably shaped such that the said third pin will have a rectangular cross-section to mate with standard sockets. The terminal associated with said third pin, to which an earth

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connection from the heating element is to be connected, is spaced apart from said third pin, and it is preferred that the blank for the third pin should be shaped so as to form a hollow pin having a conductive strip integral therewith, i.e. similar in principal though not necessarily in form to the first and second pins.

It will be appreciated that hollow pins are not as strong as solid pins and this is particularly true of a pin which is not of circular cross-section. Thus if desired one or all of the pins may be reinforced for example by filling the or each pin with plastics material.

It has been normal practice in the construction of electric elements for kettles to lead the cold ends of the element through apertures in the base of a cup and to secure the element sheath to the cup by brazing. The cup is adapted to receive a male pin plug unit, the leads from the element being soldered to the terminals in the plug unit. However, soldering of the leads in the terminals is difficult and time-consuming to carry out satisfactorily. Moreover a kettle element experiences considerable vibration when heated, particularly when the liquid in the kettle is boiling and these vibrations may seriously weaken the soldered joints between the leads and their associated terminals.

Very often when the liquid in a kettle has boiled the liquid is immediately removed therefrom so that the hot element is no longer surrounded by liquid and hence the temperature of the element rises considerably above the boiling point of the liquid. Also, it sometimes happens that the kettle, after liquid therein has been boiled and removed, is immediately refilled with cold liquid. These operations subject the element to considerable thermal shocks and thus have a deleterious effect on the soldered joints.

If the element is switched on dry with insufficient or no water in contact therewith, the element may attain a high temperature level before any safety device switches off the element. The resulting differential expansion between the cold element leads and the element sheath may also weaken a soldered joint.

It is also common practice to remove the socket from the plug unit before filling the kettle and to reapply the socket after the kettle is filled. The repeated removal and replacement of the socket imposes a strain on the pins of the plug unit which may cause the soldered connections at the terminals to fracture.

Accordingly the or each terminal in the male pin plug unit according to the invention is preferably of hollow tubular form, at least a part of the side thereof adjacent one end being removed, a metal clip being

locatable around said one end, in engagement with said terminal and/or associated lead to urge the terminal and associated lead together.

Preferably the clip has a tongue for engagement with the lead itself. It may also be found advantageous, in order to improve the grip of the clips, to provide a tongue to engage on the terminal itself so as to further increase the pressure between the terminal and the clip.

If desired a recess may be provided in the plug body within which the clip is receivable when in position around the end of the terminal.

Preferably the said clip is made of metal sufficiently resilient to deform slightly so that the associated terminal and lead are firmly maintained in electrical contact under all practical circumstances, the clip taking up any movement due to differential expansion or vibration.

Specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a view of the side of a male pin plug unit from which pins project;

Fig. 2 is a view from the other side of the plug unit of Fig. 1 with the thermally responsive element omitted;

Fig. 3 is a perspective view of the plug of Fig. 1;

Fig. 4 shows a metal blank;

Fig. 4A shows in side view the blank of Fig. 4 which has been shaped to form a neutral pin, a terminal and a conductive strip therebetween;

Fig. 4B shows the combined pin, terminal and strip of Fig. 4A viewed from the direction of the arrow X in Fig. 4A;

Fig. 5 shows a metal blank for forming a combined terminal and leaf spring;

Fig. 5A shows in plan view the blank of Fig. 4 as shaped to form a combined terminal and leaf spring;

Fig. 5B shows in side view the shaped blank of Fig. 5A;

Fig. 6 shows a metal blank for forming an earth pin of rectangular cross-section having a conductive strip integral therewith;

Fig. 6A shows the blank of Fig. 6 in the partly shaped condition;

Fig. 6B is a front view of the blank of Fig. 6 as shaped;

Fig. 6C is a side view of the shaped blank of Fig. 6B;

Fig. 6D is an end view of the shaped blank of Fig. 6B;

Fig. 7 shows a metal blank for forming a line pin of circular cross-section having a conductive strip integral therewith;

Fig. 7A shows the shaped blank of Fig. 7 in side view;

Fig. 7B is an end view of the shaped blank of Fig. 7A.

Fig. 8 is a diagrammatic perspective view of a plug unit showing the relative dispositions of the shaped blanks of Fig. 4A, Fig. 6B and Fig. 7B;

Fig. 9A shows a clip in plan view;

Fig. 9B shows the clip of Fig. 9A in side elevation;

Fig. 10 shows in section on the line x—x of Fig. 1 the plug unit of Fig. 1 connected to an element and

Fig. 11 shows a part of the plug of Fig. 1 on an enlarged scale with the clip of Fig. 9A in position.

Referring to Figs. 1, 2 and 3 of the drawings, the male pin plug unit comprises a main body part 10 of plastics material in the form of a hollow cylinder which is closed at one end 12 and open at the other end 14. Two pins of circular cross-section 16, 18 and a third pin 20 of rectangular cross-section project outwardly from the closed end 12. Two terminals in the form of ferrules 22 and 24 extend through the closed end for the reception of leads from an element. A terminal in the form of a ferrule 26 for an earth connection is provided adjacent to the third pin 20.

As shown in Fig. 2, the base of the pin 18 and the ferrule 24 are connected by a metal strip 28 and the base of pin 20 and ferrule 26 are connected by a metal strip 30. The strip 30 and the base of the pin 20 are embedded in the plug body. A conductive strip in the form of a leaf spring 32 is connected to the ferrule 22, and end 34 of the spring remote from the ferrule 22 constitutes one of the contacts of a thermally controlled switch (not shown) which may be of the kind described in our British Patent Specification No. 1,064,643. A substantially L-shaped rigid strip of metal 36 projects from one end from the base of the pin 16, the other end of the strip forming the other contact of the thermally controlled switch.

As can be seen in Figs. 1 and 3 D-shaped recesses 23, 25 are provided in the closed end 12, the ferrules 22 and 24 extending respectively through the bottom of said recesses such that each ferrule is adjacent to and spaced apart from the arcuate portion of its associated recess. Apertures 27, 29 are formed in the bottom of recesses 23, 25 respectively, said apertures extending through the closed end and being adapted to accommodate live and neutral element leads respectively.

Referring now to Fig. 4, there is shown a metal blank from which are formed the pin 18, ferrule 24 and strip 28. The blank comprises a large rectangular part 38 and a small rectangular part 40 linked by strip 28. The end of the part 38 remote from

part 40 is formed with a plurality of teeth 42.

In order to form the integral pin 18, ferrule 24 and strip 28, the sides 46 and 48 of the part 38 are brought together so that the part 38 takes the shape of a hollow substantially cylindrical body, i.e., the pin 18. The sides 50 and 52 of the part 40 are also urged towards each other so that the part 40 takes a part cylindrical shape, i.e. the ferrule 24 (Fig. 4B). The teeth 42 are shaped to form a part spherical end to the pin 18. The part of the strip 28 adjacent the pin 18 and the part of the strip 28 adjacent the ferrule 24 are bent through 90° so that the pin 18 and ferrule 24 are disposed with respect to the strip as shown in Fig. 4A.

The assembly thus formed can now be mounted in the main body part 10 but is preferably incorporated therein during moulding thereof so that it is firmly secured in place.

Fig. 5 shows a metal blank for forming a combined ferrule 22 and leaf spring 32, which comprises a substantially U-shaped part 54 and the leaf spring 32, which in this embodiment is of wedge-shaped form, extending from an integral with the U-shaped part 54.

The arm 56 of the U-shaped part is urged downwardly through 90° (as viewed in Fig. 5) along arcuate fold line 58, the edges 60 and 62 being urged towards each other to form a part cylindrical shape (Figs. 5A and 5B), i.e., the ferrule 22. The leaf spring is also bent through an angle of about 30° relative to the major plane of the U-shaped part as can be seen in Fig. 5B to give the contact pressure between the two electrical contacts when the spring is assembled substantially straight.

The shaped blank is fitted into the main body part by two fixing screws inserted through holes 55 in the U-shaped part 54 and received into the main body part.

Fig. 6 shows a form of metal blank for forming the earth pin 20, terminal 26 and interconnecting strip 30. The blank comprises a first substantially rectangular part 64 and a second substantially rectangular part 66 having a length substantially the same as part 64 but a width less than that of part 64. The parts 64 and 66 are joined by a short, narrow strip 68. The strip 30 extends between the end of the part 64 remote from part 66, and the ferrule 26 which is of annular shape.

In order to form the combined pin 20, ferrule 26 and strip 30 from this blank, edge parts 70 and 72 of part 64 are bent upwardly along dotted lines 74 and 76 respectively and edge parts 78 and 80 of part 66 are bent upwardly along dotted lines 82 and 84 respectively. It will be observed that when

edge part 70 is bent as aforesaid, the strip 30 will be carried with it and will thus be disposed in a plane normal to the plane of the blank. The strip 30 is then bent along fold line 86 outwardly from the blank to the position shown in Fig. 6A.

As can be seen in Fig. 6A, the overall width of the part 66 is less than the distance between the edge parts 70 and 72, and therefore by appropriate bending at the strip 68 the part 66 can be brought snugly between the edge parts 70 and 72, thereby forming the hollow pin 20 of substantially rectangular cross-section having ferrule 26 and interconnecting strip 30 integral therewith (Figs. 6B, 6C and 6D).

As with the previously described assembly described with reference to Figs. 4, 4A and 4B the combined pin 20, ferrule 26 and strip 30 can be incorporated in the main body part 10, preferably when the main body part is moulded.

Referring now to Fig. 7, there is shown a metal blank comprising a rectangular part 92 having the L-shaped metal strip 36 extending from one end thereof. The end of the part 92 remote from the strip 36 is formed with a plurality of teeth 93. To form the combined line pin 16 and strip 36 the edges 94 and 96 of the part 92 are brought together to form the hollow pin 16 and the strip 36 is bent at right angles to the pin 16 as shown in Figs. 7A and 7B. The teeth 93 are also urged towards each other to close off the end of the pin and give the said closed end a substantially part spherical form.

The relative positions of the pins formed from the blanks of Figs. 4, 6 and 7 are shown clearly in Fig. 8 and are preferably such that the plug will mate with a BS. socket 3283 or a BS. socket 4491.

Referring to Fig. 10 in order to connect a plug of the kind described to a kettle element, leads 100, 102 from an element, are inserted into the apertures 27, 29 respectively and secured therein and electrically connected to ferrules 22, 24 by means of clips 104, 106 respectively of the kind shown in greater detail Figs. 9A and 9B.

Each clip is preferably made of resilient metal sheet such as spring sheet steel and is D-shaped, the dimensions thereof being such that the clip will seat snugly within one of the D-shaped recesses 23, 25 in the body 10. A substantially heart shaped aperture 108 is formed in the D-shaped sheet thereby defining a tongue 110. A further small tongue 111 provided at 112 in the heart shaped aperture opposite the tongue 111 increases the pressure with which the ferrule 22 or 24 is urged against the lead and bites into the ferrule 22 or 24 to prevent removal of the clip, the radius of curvature of the free end of tongue 111 which engages against

the ferrule 22 or 24 being substantially the same as the radius of curvature of the outside of the ferrule 22 or 24. The free end 114 of the tongue 110 is inclined to the major plane of the clip as shown more clearly in Fig. 9B, to form a tooth, to bite into the cold lead of the element.

In order to make an effective connection between, for example, the ferrule 22 and element lead 100 the clip 104 is placed in the D-shaped recess 23 and urged towards the bottom of the recess. The distance between the tongue 111 and the free end 114 of the tongue of the clip is chosen such that it is less than the overall width of the lead 100 and ferrule 22 whereby the insertion of the clip in the recess urges the ferrule and lead tightly together and further locks the clip in position by the tooth 114 biting into the cold lead so that the element lead 100 is permanently secured to the plug unit (Figs. 10 and 11). The lead 102 is, of course, secured in a similar fashion by clip 106.

Because the clip is of spring steel, it can flex to allow some movement of a lead due to vibration or thermal shock without in any way impairing the electrical connection between the lead and associated ferrule.

As can be seen from Fig. 10 the plug unit can, according to the invention, be connected to an electrical element so that no part of the element leads or ferrules projects beyond that surface of the body from which the pins 16, 18 and 20 project. This was not the case in certain prior arrangements and thus it has been common practice to cover the surface and projecting ferrules and leads with a hollow plastics cap. When caps are used it is also common practice to put the name of the element manufacturer thereon and this presents problems since the one type of plug unit might be used with elements made by a number of different manufacturers so that a different cap is required for each manufacturer of elements.

According to this embodiment of the invention, however, the hollow plastics cap can be replaced by a flat sheet or disc of paper or cardboard secured to the surface of the body from which the pins 16, 18 and 20 project, an impact adhesive and the name of an element manufacturer can easily be printed on a paper or cardboard cover as aforesaid.

The invention is not restricted to the above described embodiments, many variations being possible without departing from the scope thereof. Thus for example, with regard to the blank of Fig. 4, the position of the strip 28 relative to the parts 38 and 40 can be altered so that the line between the abutting edges 46 and 48 in the formed pin 18 appear at any desired location when the assembly is mounted in the main body part. Similarly with regard to the blank of

Fig. 7, the position of the strip 36 relative to the part 92 determines the location of the line formed between the abutting edges 94 and 96 in the formed pin 16 when the assembly is mounted in the main body part.

WHAT WE CLAIM IS:—

1. A male pin plug unit for use with an electrical heating element comprising a thermally controlled switch, at least two pins adapted to mate with an electrical supply socket and a terminal spaced from each pin for connection to the electrical heating element, at least one of said pins being hollow and having a conductive strip integral therewith, said hollow pin and integral strip being shaped from a flat metal blank.
2. A male pin plug unit as claimed in Claim 1, and comprising two contacts for the thermally controlled switch, one of said contacts being provided on, and adjacent the end of, a conductive strip remote from one pin.
3. A male pin plug unit as claimed in Claim 2, wherein the terminal for said one pin is formed from a flat metal blank of a shape such as to provide the terminal and a leaf spring integral therewith, the other of said contacts being provided on said leaf spring.
4. A male pin plug unit as claimed in claim 1, wherein a pin is formed from a blank of a shape such as to provide a hollow pin having integral therewith a conductive strip and a terminal.
5. A male pin plug unit as claimed in any preceding claim, wherein two pins have a circular cross-section.
6. A male pin plug unit as claimed in any preceding claim, and comprising a third pin of substantially rectangular cross section.

A male pin plug unit as claimed in Claim 6, wherein the third pin is formed from a flat metal blank.

8. A male pin plug unit as claimed in claim 7, wherein the third pin is formed from a flat metal blank of a shape such as to provide a hollow pin of substantially rectangular cross-section having a conductive strip integral therewith.

9. A male pin plug unit as claimed in any preceding claim wherein the or each hollow pin is reinforced.

10. A male pin plug unit as claimed in any preceding claim, wherein the or each terminal is of hollow tubular form, at least a part of the side thereof adjacent one end being removed to thereby expose an element lead receivable therewithin the plug unit further comprising a metal clip locatable around said one end for urging the terminal and associated lead together.

11. A male pin plug unit as claimed in claim 10, wherein said clip includes a tongue engageable with an element lead.

12. A male pin plug unit as claimed in claim 10 or claim 11, wherein the pins and terminals are mounted in a plug body, there being a recess in said plug body surrounding the or each terminal, the or each recess being adapted to receive a clip therewithin.

13. A male pin plug unit as claimed in any of claims 10 to 12, wherein the or each clip is made of metal.

14. A male pin plug unit substantially as described herein with reference to and as illustrated in the accompanying drawings.

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Fig. 7, the position of the strip 36 relative to the part 92 determines the location of the line formed between the abutting edges 94 and 96 in the formed pin 16 when the assembly is mounted in the main body part.

WHAT WE CLAIM IS:—

1. A male pin plug unit for use with an electrical heating element comprising a thermally controlled switch, at least two pins adapted to mate with an electrical supply socket and a terminal spaced from each pin for connection to the electrical heating element, at least one of said pins being hollow and having a conductive strip integral therewith, said hollow pin and integral strip being shaped from a flat metal blank.
2. A male pin plug unit as claimed in Claim 1, and comprising two contacts for the thermally controlled switch, one of said contacts being provided on, and adjacent the end of, a conductive strip remote from one pin.
3. A male pin plug unit as claimed in Claim 2, wherein the terminal for said one pin is formed from a flat metal blank of a shape such as to provide the terminal and a leaf spring integral therewith, the other of said contacts being provided on said leaf spring.
4. A male pin plug unit as claimed in claim 1, wherein a pin is formed from a blank of a shape such as to provide a hollow pin having integral therewith a conductive strip and a terminal.
5. A male pin plug unit as claimed in any preceding claim, wherein two pins have a circular cross-section.
6. A male pin plug unit as claimed in any preceding claim, and comprising a third pin of substantially rectangular cross section.

A male pin plug unit as claimed in Claim 6, wherein the third pin is formed from a flat metal blank.

8. A male pin plug unit as claimed in claim 7, wherein the third pin is formed from a flat metal blank of a shape such as to provide a hollow pin of substantially rectangular cross-section having a conductive strip integral therewith.

9. A male pin plug unit as claimed in any preceding claim wherein the or each hollow pin is reinforced.

10. A male pin plug unit as claimed in any preceding claim, wherein the or each terminal is of hollow tubular form, at least a part of the side thereof adjacent one end being removed to thereby expose an element lead receivable therewithin the plug unit further comprising a metal clip locatable around said one end for urging the terminal and associated lead together.

11. A male pin plug unit as claimed in claim 10, wherein said clip includes a tongue engageable with an element lead.

12. A male pin plug unit as claimed in claim 10 or claim 11, wherein the pins and terminals are mounted in a plug body, there being a recess in said plug body surrounding the or each terminal, the or each recess being adapted to receive a clip therewithin.

13. A male pin plug unit as claimed in any of claims 10 to 12, wherein the or each clip is made of metal.

14. A male pin plug unit substantially as described herein with reference to and as illustrated in the accompanying drawings.

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