June 24, 1958 R. J. KING 2,840,676

WATERPROOF ELECTRICAL COUPLINGS AND HEATING ELEMENT

Filed May 18, 1956

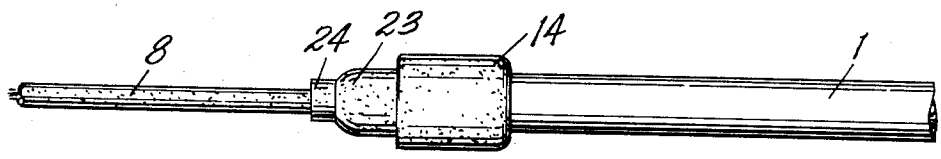


FIG. 1.

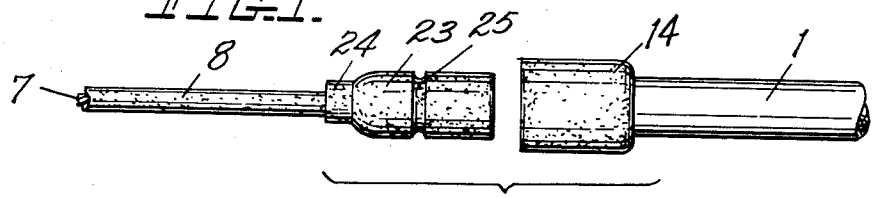


FIG. 2.

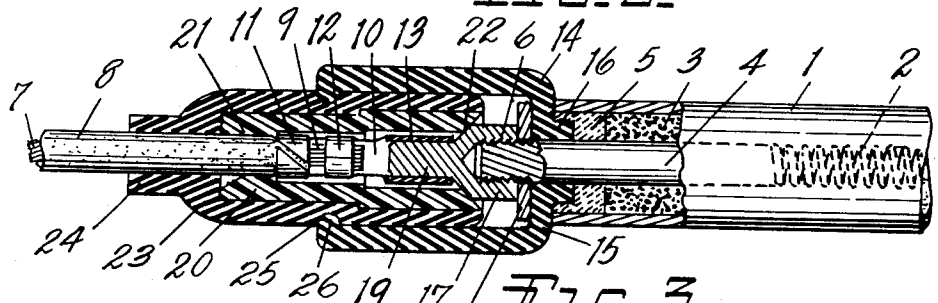


FIG. 3.

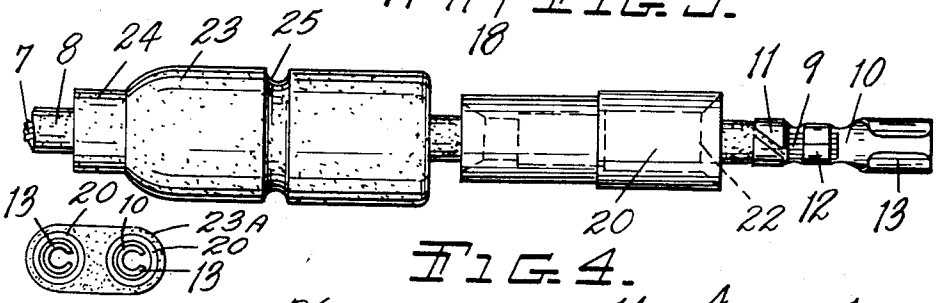


FIG. 4.

FIG. 6.

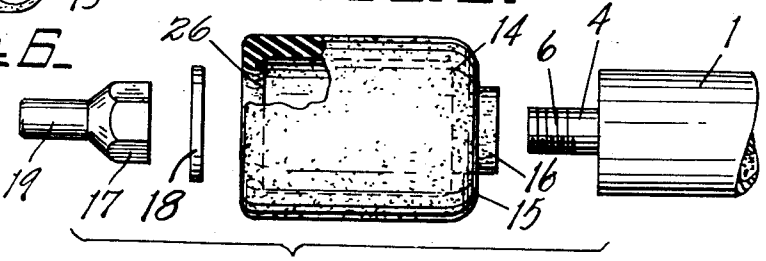


FIG. 5.

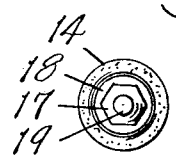


FIG. 7.

INVENTOR.
Robert J. King
BY
Otto A. Earl
Attorney.

United States Patent Office 2,840,676 Patented June 24, 1958

2,840,676

WATERPROOF ELECTRICAL COUPLINGS AND HEATING ELEMENT

Robert J. King, Allegan, Mich., assignor, by mesne assignments, to McGraw-Edison Company, a corporation of Delaware

Application May 18, 1956, Serial No. 585,723

14 Claims. (Cl. 201—67)

This invention relates to improvements in water proof electrical couplings and heating element. The principal objects of this invention are:

First, to provide a releasable coupling and electrically connecting a flexible supply conduit to a rigid heating element which coupling will be water proof.

Second, to provide a water proof coupling particularly for immersion type heating elements which will be water proof and which will not be adversely affected by the temperature existing at the end of the heating element.

Third, to provide an electrical coupling engageable between the terminal end of a heating element and the end of a supply conduit in which the case of the coupling is sealed to the end of the heating element and to the insulated exterior of the conduit as well as between the separable parts of the coupling case.

Fourth, to provide a two part separable case for enclosing a releasable connection between two electrical conductors with a relatively rigid electrically insulating supporting member for insulating a yieldable rubber case in sealing relation around the connection.

Other objects and advantages of the invention will be apparent from a consideration of the following description and claims. The drawings of which there is one sheet, illustrate two highly practical embodiments of the coupling connection.

Fig. 1 is a fragmentary elevational view of the coupling in connected operative position.

Fig. 2 is a fragmentary elevational view of the coupling in separated or disconnected condition.

Fig. 3 is a fragmentary axial cross sectional view through the coupling in connected operative condition.

Fig. 4 is a fragmentary elevational view of the elements of the female side of the coupling connection in partially assembled and adjusted position.

Fig. 5 is an exploded elevational view of the parts of the male side of the coupling connection with a portion of the shell broken away in cross section.

Fig. 6 is an end elevational view of a double conductor form of the female end of the coupling connection.

Fig. 7 is an end elevational view of a single conductor form of the male end of the coupling connection.

The coupling connection of the invention is designed primarily for use with immersion type electrical heating elements adapted to be inserted freely into pails or tanks of liquid and provides a water proof releasable connection between the ends of the immersion heating element insulated electrical supply conduits or conductors so that there will be no leakage of electricity into the liquid in the event that the heat element is thrust too deeply into the liquid or tips over in the pail or tank to immerse the coupling connection.

In the drawings 1 indicates the outer tubular metal sheath of an electrical heating element. The sheath 1 encloses an electrical resistance heating element 2 in the form of a spiral wire packed in an electrically insulating refractory material 3 such as magnesium oxide. The end of the resistance element 2 terminates in inwardly

spaced relation from the end of the sheath and is secured as by welding to the end of a terminal rod 4 that projects outwardly from the end of the sheath. An insulating plug 5 in the end of the sheath around the rod retains and seals the refractory packing and the terminal rod in the sheath. The plug is of plastic-like material such as a thermo setting expoxy resin or a silicone silastic that flows into all voids and seals to the sheath terminal and around the end 16 of the neoprene sheath to be described. It is heat cured in place. The outer end of the terminal rod is threaded as at 6. This construction is normally standard in electrical heating elements and it is pointed out that the length of the terminal rod 6 spaces the end of the sheath from the area of extreme heat created by the resistance element 2.

The electrical conductor for supplying energy to the resistance element 2 is a standard commercial product consisting of a stranded cable 7 enclosed in an insulating cover 8 of flexible rubber or synthetic material such as neoprene. The end of the cover 8 is stripped back behind the end of the stranded cable 7 as at 9 and a connector clip 10 of standard construction is attached to the conductor. The connector 10 includes a rear or inner split band 11 that is clamped around the end of the cover 8 and a front or outer split band 12 that is clamped in electrical contacting relation around the bared ends of the stranded cable. The outer end of the connector 10 is folded into an incomplete cylindrical socket 13 adapted to slidably and frictionally receive a male connector element.

The structure for forming a releasable electrical connection between the forgoing parts and for excluding water from the connection consists of an outer tubular shell 14 of moulded neoprene having a bottom wall 15 lapped against the end of the shaft 1. The wall 15 has a hole through which the end of the terminal rod 6 projects in tight sealing relation and a thickened boss 16 on the bottom wall projects into the shaft in abutting relation to the block 5. A nut 17 is threaded on the end of the terminal rod 6 and presses a washer 18 against the bottom wall 15 to tightly seal the bottom wall to the end of the sheath 1 and to further seal the boss 16 against the packing block 5. The outer end of the nut 17 is extended into a smooth circular stud 19 that is sized to fit within the previously described socket 13 on the connector 10. The stud 19 terminates well within the side walls of the shell 14.

The supply conductor 7 and the connector 10 are surrounded first by a relatively rigid electrically insulating tubular sleeve 20. The sleeve is made of synthetic plastic material such as nylon and has an inner end 21 of reduced internal diameter that snugly fits around the end of the covering 8 on the supply conductor and abuts axially against the first band 11 on the conductor. The outer end of the sleeve 20 is internally sized to enclose the socket 13 in spaced relation thereto and is further beveled as at 22 to seat against the end of the nut 17 outwardly from the end of the socket 13. Positioned telescopically around the sleeve 20 is a second flexible insulating tubular shell 23 having a rear or inner end 24 snugly embracing the covering 8 on the supply conductor and abutting axially against the end of the sleeve 21. The side walls of the shell 23 fit snugly around the outer surfaces of the rigid sleeve 20 and are radially supported from the inside thereby. The outer surface of the shell 23 is sized to fit snugly within the side walls of the first shell 14 and to project a substantial distance thereinto. The inner shell 23 is provided with an external annular groove 25 completely therearound which lockingly receives an inwardly projecting annular rib 26 formed around the inside of the outer shell 14 when the coupling and the shells are fully axially engaged.

It is pointed out that the inner rigid sleeve **20** functions to hold or stabilize the connector **10** and its socket **13** so that the stud **19** can be easily pressed into the socket when making the electrical connection. The sleeve **20** further supports the side walls of the inner shell **23** as they are pressed into the outer shell and after assembly prevents the inner shell from collapsing inwardly out of sealing contact with the outer shell to permit liquid to leak into the coupling. The rib and groove connection **25, 26** between the inner and outer shells further forms a yieldable sealing connection between the two shells to exclude liquid and also provides a yieldable interlock resisting axially disengagement of the two shells and the electrical coupling. The electrical heating element and the electrical supply cable and coupling connection are used in their readily available commercial form and the enclosing end sealing elements of the coupling are easily moulded or formed and applied to the standard structures. The coupling connection can be made between a single end of an electrical heat element and a single supply conductor as shown in Figs. 1 to 5 and 7 or the flexible shells **14** and **15** can be mounted in oblong shape to embrace and coact with a plurality of heating elements and electrical conductors as is shown in Fig. 6. Fig. 6 shows a modified inner shell **23A** of generally oval shape having two passages therethrough receiving two insulating sleeves **20** and two electrical conductors **7** with their connectors **10**. The coupling sleeve for the heating element to coact with this coupling would be increasingly elongated.

Having thus described the invention what is claimed as new and is desired to be secured by Letters Patent is:

1. A waterproof flexible electrical connection for an electrical heating element having a rigid tubular metal sheath with an electrical resistance element packed in insulating magnesium oxide as a refractory therein with a rigid rod connected to the end of the resistance element and having a threaded end projecting from the end of the sheath comprising an insulating plug in the end of the sheath around the rod, a cylindrical tubular shell of flexible rubber material having a bottom wall seated against the end of said sheath and fitting snugly around the end of said rod, a boss on said shell projecting into said sheath, a nut threaded on the end of said rod, a washer under said nut pressing the bottom of said shell against the end of said sheath and pressing said boss into said plug, a smooth stud on the outer end of said nut projecting outwardly of said shell but recessed substantially inwardly from the outer end thereof, a flexible electrical conductor having a flexible insulating coating, a connector having a split band clamped around said coating and a second band clamped in electrical contact with a bared portion of the end of the conductor, said connector having a concavely bent socket portion frictionally receiving said stud, an inner sleeve of relatively rigid synthetic plastic material sleeved around the end of said conductor and said connector and having an inner end of reduced inner diameter tightly engaged with said coating and abutted axially outwardly against said first band, the outer end of said sleeve being concave and seating against said nut, a second shell of relatively flexible rubber material having an inner end tightly engaging said coating and having its outer end tightly embracing said inner sleeve and projecting into tight sealing engagement in said first shell, said second shell having an external groove completely therearound, and an internal rib completely around the outer end of said first shell fitting in said groove, said insulating plug being formed of a thermo setting plastic material heat cured in place while in contact with said first tubular shell.

2. A waterproof flexible electrical connection for an electrical heating element having a rigid tubular metal sheath with an electrical resistance element packed in insulating refractory therein with a rigid rod connected to the end of the resistance element and having a threaded end projecting from the end of the sheath comprising an insulating plug in the end of the sheath around the rod, a tubular shell of flexible material having a bottom wall seated against the end of said sheath and fitting snugly around the end of said rod, a boss on said shell projecting into said plug, a nut threaded on the end of said rod, a washer under said nut pressing the bottom of said shell against the end of said sheath and pressing said boss into said plug, a stud on the outer end of said nut projecting outwardly of said shell but recessed substantially inwardly from the outer end thereof, a flexible electrical conductor having a flexible insulating coating, a connector having a split band clamped in electrical contact with a bared portion of the end of the conductor, said connector having a concavely bent socket portion frictionally receiving said stud, an inner sleeve of relatively rigid insulating material sleeved around the end of said conductor and said connector and having an inner end of reduced inner diameter tightly engaged with said coating and abutted axially outwardly against said band, the outer end of said sleeve seating against said nut, a second shell of relatively flexible rubber material having an inner end tightly engaging said coating and having its outer end tightly embracing said inner sleeve and projecting into tight sealing engagement in said first shell, said second shell having an external groove completely therearound, and an internal rib completely around the outer end of said first shell fitting in said groove, said insulating plug being formed of a thermo setting plastic material heat cured in place while in contact with said first tubular shell.

3. A waterproof flexible electrical connection for an electrical heating element having a rigid tubular metal sheath with an electrical resistance element packed in insulating refractory therein with a rigid rod connected to the end of the resistance element and having a threaded end projecting from the end of the sheath comprising an insulating plug in the end of the sheath around the rod, a cylindrical tubular shell of flexible material having a bottom wall seated against the end of said sheath and fitting snugly around the end of said rod, a boss on said shell projecting into said sheath, a nut threaded on the end of said rod, a washer under said nut pressing the bottom of said shell against the end of said sheath and pressing said boss against said plug, a stud on the outer end of said nut projecting outwardly of said shell but recessed substantially inwardly from the outer end thereof, a flexible electrical conductor having a flexible insulating coating, a connector clamped in electrical contact with a bared portion of the end of the conductor, said conductor having a concavely bent socket portion frictionally receiving said stud, an inner sleeve of relatively rigid insulating material sleeved around the end of said conductor and said connector and having an inner end of reduced inner diameter tightly engaged with said coating and abutting axially outwardly against said connector, the outer end of said sleeve being concave and seating against said nut, a second shell of relatively flexible material having an inner end tightly engaging said coating and having its outer end tightly embracing said inner sleeve and projecting into tight sealing engagement in said first shell, said second shell having an external groove completely therearound, and an internal rib completely around the outer end of said first shell fitting in said groove, said insulating plug being formed of a thermo setting plastic material heat cured in place while in contact with said first tubular shell.

4. A waterproof flexible electrical connection for an electrical heating element having a rigid tubular metal sheath with an electrical resistance element packed in insulating refractory therein with a rigid rod connected to the end of the resistance element and having a threaded end projecting from the end of the sheath and an insulating plug recessed in the end of the sheath around the rod

comprising a cylindrical tubular shell of flexible material having a bottom wall seated against the end of said sheath and fitting snugly around the end of said rod, a nut threaded on the end of said rod pressing the bottom of said shell against the end of said sheath, a stud on the outer end of said nut projecting outwardly of said shell but recessed substantially inwardly from the outer end thereof, a flexible electrical conductor having a flexible insulating coating, a connector clamped in electrical contact with a bared portion of the end of the conductor, said connector having a concavely bent socket portion frictionally receiving said stud, an inner sleeve of relatively rigid insulating material sleeved around the end of said conductor and said connector and having an inner end of reduced inner diameter tightly engaged with said coating, the outer end of said sleeve seating against said nut, and a second shell of relatively flexible material having an inner end tightly engaging said coating and having its outer end tightly embracing said inner sleeve and projecting into tight sealing engagement in said first shell, said second shell having an external groove completely therearound, and an internal rib completely around the outer end of said first shell fitting in said groove.

5. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having a threaded end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible rubber material on the ends of said sheath and said conductor, a nut threaded on said rod, a washer under said nut and clamping the end of one sleeve axially against the end of said sheath, the other shell having a tubular portion sealingly embraced around the coating on said conductor, a stud on said nut slidably and frictionally retained in said socket with the end of the socket abutted against said nut, and a sleeve of relatively rigid insulating material supported internally by said coating and said nut and radially supporting the inside of the interfitting portions of said shells, said shells having interfitting radial projections and depressions completely therearound.

6. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having a threaded end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod, and clamping the end of one sleeve axially against the end of said sheath, the other shell having a tubular portion sealingly embraced around the coating on said conductor, a stud on said nut slidably and frictionally retained in said socket, and a sleeve of relatively rigid insulating material supported internally by said coating and said nut and radially supporting the inside of the interfitting portions of said shells, said shells having interfitting radial projections and depressions completely therearound.

7. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having a threaded end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod, a washer under said nut and clamping the end of one shell axially

against the end of said sheath, the other shell having a tubular portion sealingly embraced around the coating on said conductor, a stud on said rod slidably and frictionally retained in said socket, and a sleeve of relatively rigid insulating material supported internally by said nut and radially supporting the inside of the interfitting portions of said shells, said shells having interfitting radial projections and depressions completely therearound.

8. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having a threaded end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod, a washer under said nut and clamping the end of one shell axially against the end of said sheath, the other shell having a tubular portion sealingly embraced around the coating on said conductor, a stud on said rod slidably and frictionally retained in said socket, and a sleeve of relatively rigid material supported internally by said nut and radially supporting the inside of the interfitting portions of said shells.

9. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having an end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod and clamping the end of one shell axially against the end of said sheath, the other shell defining a hole sealingly receiving the coating on said conductor, a stud on the end of said rod slidably and frictionally retained in said socket, and a sleeve of relatively rigid material supported internally by said nut and radially supporting the inside of the interfitting portions of said shells, said shells having interfitting radial projections and depressions completely therearound.

10. A water proof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having an end projecting out of said sheath, and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod and clamping the end of one shell axially against the end of said sheath, the other shell defining a hole sealingly receiving the coating on said conductor, and a stud on the end of said rod slidably and frictionally retained in said socket, said shells having interfitting radial projections and depressions completely therearound.

11. A water proof electrical connection between a resistance element having a rigid sheath and a flexible conductor having a flexible coating comprising a rigid rod electrically connected to said resistance element in said sheath and projected out of the end of the sheath and having a stud on its outer end, a connector electrically and mechanically clamped to said conductor and forming a socket removably receiving said stud, a first flexible tubular shell axially clamped in sealing relation to the end of said sheath by a nut threaded on the end of said rod and axially embracing said stud in radially spaced relation thereto, a second flexible tubular shell slidably and sealingly engaging said coating and radially embracing said connector, the end of said second shell being telescopically and sealingly engaged within said first shell,

and radially extending surfaces on said shells axially interlocked in the engaged position of said stud and said socket.

12. A waterproof electrical connection between a resistance element having a rigid sheath and a flexible conductor having a flexible coating comprising a rigid rod electrically connected to said resistance element in said sheath and projected out of the end of the sheath and having a stud on its outer end, a connector electrically and mechanically clamped to said conductor and forming a socket removably receiving said stud, a first flexible tubular shell axially clamped in sealing relation to the end of said sheath by a nut threaded on the end of said rod and axially embracing said stud, a second flexible tubular shell slidably and sealingly engaging said coating and radially embracing said connector, the end of said second shell being telescopically and sealingly engaged with said first shell, and radially extending surfaces on said shells axially interlocked in the engaged position of said stud and said socket.

13. A waterproof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having an end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod and clamping the end of one shell axially against the end of said sheath, the other shell defining a hole sealingly receiving the coating on said conductor, a stud on the end of said rod slidably and frictionally retained in said socket, a sleeve of relatively rigid material supported internally by said nut and radially supporting the inside of the interfitting portions

of said shells, said shells having interfitting radial projections and depressions completely therearound, the shell on said sheath having a boss projecting into the end of the sheath and around said rod, and a sealing plug of thermo setting material in the end of said sheath and around said boss, said plug being cured in place around said boss.

14. A waterproof connection between a heating element having a rigid tubular sheath with a resistance element insulatingly supported therein and a rigid conducting rod connected to the end of the resistance element and having an end projecting out of said sheath and a flexible conductor having an insulating coating and a connector on the end of the conductor forming a socket, said connection comprising telescopically interfitting shells of flexible material on the ends of said sheath and said conductor, a nut threaded on said rod and clamping the end of one shell axially against the end of said sheath, the other shell defining a hole sealingly receiving the coating on said conductor, a stud on the end of said rod slidably and frictionally retained in said socket, a sleeve of relatively rigid material supported internally by said nut and radially supporting the inside of the interfitting portions of said shells, the shell on said sheath extending around said rod, and a sealing plug of thermo setting material in the end of said sheath and around said rod, said plug being cured in place.

References Cited in the file of this patent

UNITED STATES PATENTS

1,991,591	Abbott	Feb. 19, 1935
2,269,194	Finlayson	Jan. 6, 1942
2,379,942	Webber	July 10, 1945
2,455,102	Temple	Nov. 30, 1948
2,659,795	Boggs	Nov. 17, 1953