June 5, 1956 W. J. SCOTT 2,749,384

PLASTIC CONNECTORS

Filed Nov. 26, 1954

Fig. 1

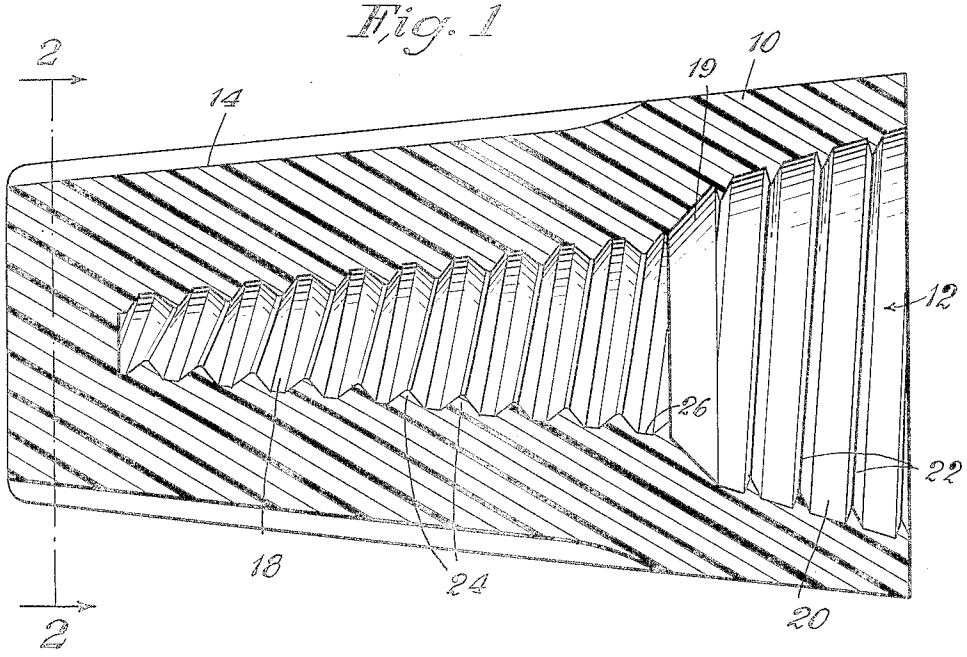


Fig. 2

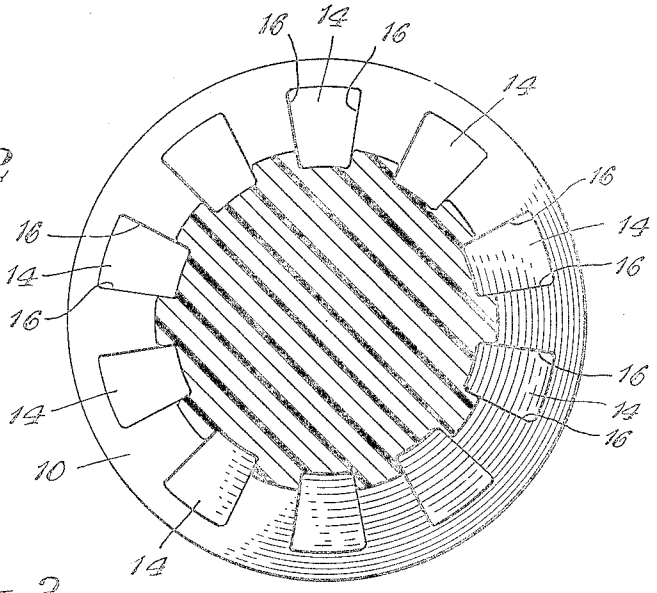
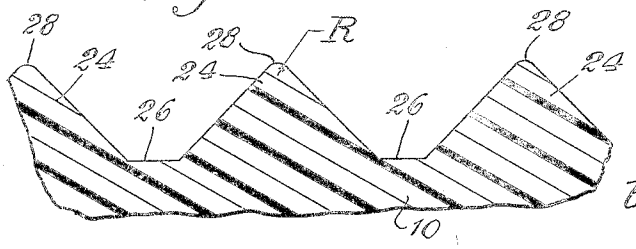


Fig. 3



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PLASTIC CONNECTORS

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Application November 26, 1954, Serial No. 471,217

2 Claims. (Cl. 174—87)

This is a continuation in part of my application Serial No. 343,141, filed March 18, 1953.

My invention resides in the field of connectors for electrical wires, cables, leads, conductors and the like, and is an improvement on prior devices for joining two or more electric wires or conductors in an efficient insulated connection. More specifically, my invention is a new and improved electrical connector of the screw on variety, which is composed of a cap or shell with an internally threaded bore adapted to be turned down over the ends of two or more electric wires or conductors which have been stripped of their insulation and initially grouped together, the cap or shell thus covering the stripped ends of the conductors so as to insulate the same, as well as forming a tight, strong efficient electrical connection between the wires.

Another object of my invention is a new and improved connector for two or more electric conductors that provides a strong as well as efficient electrical connection.

Another object of my invention is a new and improved electrical connector of the screw on variety which is easy to manufacture, inexpensive to produce and very efficient in use.

Another object of my invention is a new and improved connector of the screw on type which, when screwed or turned down over the stripped ends of the conductors, will not abrade or cut them due to the action of the threaded portion of the connector thereon.

Another object of my invention is a new and improved all plastic connector which does not require any metal inserts or fastening means so that the connector can be manufactured and produced in final form, in a plastic casting or molding machine.

Other objects will appear from time to time in the ensuing specification and drawings.

Figure 1 is a side view, taken in section, showing my new and improved connector cap or shell with its internal threaded bore;

Figure 2 is a sectional view taken along line 2—2 in Figure 1; and

Figure 3 is an enlarged view in section of the threads formed in the bore of the cap.

In Figure 1 my connector **10** is shown generally in the shape of a frustum of a cone with an internal tapered bore 12. Throughout a substantial portion of the length of the connector's outer surface a plurality of grooves **14** may be provided, the vertical walls **16** on each side of the grooves being co-extensive with the axis of the connector's center line so that the sides of all the grooves, if extended, would pass through the center line of the connector.

The bore **12** of the connector is divided into three portions, namely, an inner portion **18**, an intermediate portion **19**, and an outer portion **20**. It should be noted that the angle of divergence of the inner portion **18** is substantially less than the angle of divergence of the outer portion **20** and the outer portion is used primarily to

guide the wires or conductors properly to the interior of the connector and secondarily, to serve as an additional holding means. The intermediate position has the greatest angle of divergence. The conical walls of the outer portion **20** may be threaded at **22**, as shown in Figure 1, so as to firmly engage the insulation surrounding the inserted conductors and prevent the wires from easily being withdrawn from the bore of the connector.

The inner portion **18** of the bore is threaded in a manner so that a tight, efficient joint and connection is formed. The threads **22** in the outer portion **20** do not have any particular shape of dimensions and can be made in any well known, conventional fashion.

The connector I have shown in the drawings is specifically made of a plastic material. It should be noted that the connector does not have any type of crimpable ferrule, coil spring insert or other wire holding means. When the twisted bare wires are inserted into the bore of a connector, the plastic threads **24** on the inner portion of the bore are harder than the annealed or semi-annealed wires of the conductors. Thus, as the connector is twisted or turned over the wires or conductors, the wires are forced to the interior of the bore and the threads **24** form partial threads or grooves on the exposed surfaces of the conductors. The plastic threads **24** directly engage the wires and will not cut or abrade the surfaces of the wires, rather they will smoothly indent and slowly work-harden the surface of the wires. As the connector is smoothly twisted over the wires, the partial threads formed in the conductors become increasingly hardened until the wires work-harden sufficiently to prevent further thread formation. At this stage the twisted stripped ends of the wires will substantially cease their inward movement in the bore portion **18** and will begin to rotate with the bore, which serves to further coil the insulated portion of the conductors outside of the connector. This results in a very tightly wound connection between the wires, and the twisting action will cease when the operator can no longer rotate the connector **10**.

It is very important that the threads **24** in the inner portion of the bore do not cut the wires as they are being rotatably inserted into the interior of the connector and for this purpose I mold my entire connector from a plastic. I have found that an alpha-cellulose filled, melamine-formaldehyde, thermosetting molding compound is very satisfactory for these purposes. However, various other compounds have also proven successful. For example, I have also found that an alpha-cellulose filled, urea formaldehyde, thermosetting molding compound also will generally satisfy the various characteristics of the desired material. The general name for these types is amino which designates both urea and melamine.

In general, the plastic material used should have a hardness greater than the hardness of the metal conductors. I have found that a plastic material with a hardness of at least Rockwell E–90 approximately or greater, should be used. Another factor of the plastic material is its tensile strength and the plastic material of my connector has a minimum tensile strength of 5,000 pounds per square inch.

The type of plastic materials set forth above is thermosetting and they have sufficient hardness so that they will properly groove or thread the surfaces of the wires and will work-harden the metal surfaces during the twisting action. In addition, they have sufficiently high strength and heat resistant properties to withstand the various temperature and stress conditions to which such connectors are subjected. Of course, if a thermoplastic material can be produced with these properties, my connector could be made out of it.

When a connector is made from plastic the form of

the thread 24 in the inner portion of the bore takes on an added importance due to the type of connection and holding action that is necessary in addition to the work-hardening which the threads produce on the surface of the wires. In Figure 3 I have shown an enlarged sectional view of the threads 24 and it will be noted that the crowns 28 are rounded so as to present a smooth work-hardening surface to the wires. In effect, the threaded form has a rounded shape with sides disposed at 90-degrees. The depth of the thread will relate to the radius R on the crown so that I acquire a deep thread with a strong buttress or engaging surface for the wires. By this threaded contour the area that is engaged on the wires by the plastic crown 28 on the threads is not too large and the resistance offered to the user who is turning the cap down over the wires is not too great for satisfactory operation.

The crowns 28 of the threads take on the form of an extended wire coil insert which has a radius R. By extending the hypothetical wire insert, sufficient space or clearance is allowed between adjacent turns of the coil so that the metal of the conductors that flows in and around the crow 28 during the work-hardening process will have sufficient room for adequate penetration into the spaces 26 to thus effect a proper and strong connection.

To provide the best contact between the shell and the stripped end of the wires, it is necessary that the soft wires be grooved, rather than cut or abraded. The crowns on the threads must groove the wires and I have found that the radius R of these crowns should be .005 inch or less. I have found that a connector with crowns having a radius of .002 inch work exceptionally well.

While I have shown and described the preferred form of my invention, it should be understood that numerous changes, alterations and modifications can be made within the scope and spirit without departing therefrom, and I wish that my invention be unrestricted except as by the appended claims.

The use, operation and function of my invention are as follows:

The invention is in the field of connectors and is a screw on cap type cap connector. Prior to this invention, connectors of this type were composed of generally an insulating cap or shell with a metal securing member. For example, the coil spring is a cylindrical ferrule adapted to be crimped by dies or the like.

My invention differs from prior connectors in that it is all plastic. This is to say that I have no coil spring insert or crimpable ferrule. The threaded surface of the bore of the cap directly engages the stripped end of the wires. The crowns of the threads are rounded so that they will groove and not cut the surface fo the wires. This produces a work-hardening effect upon the copper wires which adds to the efficiency of the connection.

To my knowledge this is the first screw on type connector which is made entirely of plastic insulating material. It is, of course, old to make a connector of this type out of porcelain or glass, however, the threads will cut the copper wires and for this reason my connector, in addition to being more inexpensive, will also provide a stronger joint.

I claim:

1. An insulating molded all plastic cap for covering and connecting by compression the stripped ends of a plurality of insulated electrical conductors or the like, comprising a shell of rigid insulating material formed with a generally conical exterior surface and a generally conical bore closed at its small end by an end wall and open at its large end to accept the stripped ends of the conductors, and a wire engaging surface in the bore of said shell integral with the shell and including an elongated threaded section with threads having predetermined, well rounded crowns so that they will smoothly groove and displace the metal of the conductors thereby forming interlocking threads in the wires without abrasion, the crowns of the threads having a predetermined radius between .002"–.005" and functioning as a non-abrasive metal working surface, the well rounded crown of each thread being spaced a sufficient distance from its adjacent crowns, the elongated threaded section having a pitch relative to and many times greater than the crown diameter, and the thread depth of the threaded section being a number of times greater than the crown diameter, such that a wide root cavity between adjacent threads is provided to receive and form an interlock with metal worked from the conductors by the pressure of rotating the cap as transmitted to the conductors through the well rounded crowns, the material of the cap including the integral wire engaging surface being an amino thermo-setting plastic.

2. The structure of claim 1 in which the sides of the threads leading up to the well rounded crowns are flat and smooth, and are disposed at an acute angle relative to the plane of the crowns, the root of the threads between adjacent sides being flat in cross section and generally conical in overall appearance about the bore of the shell as an axis.

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