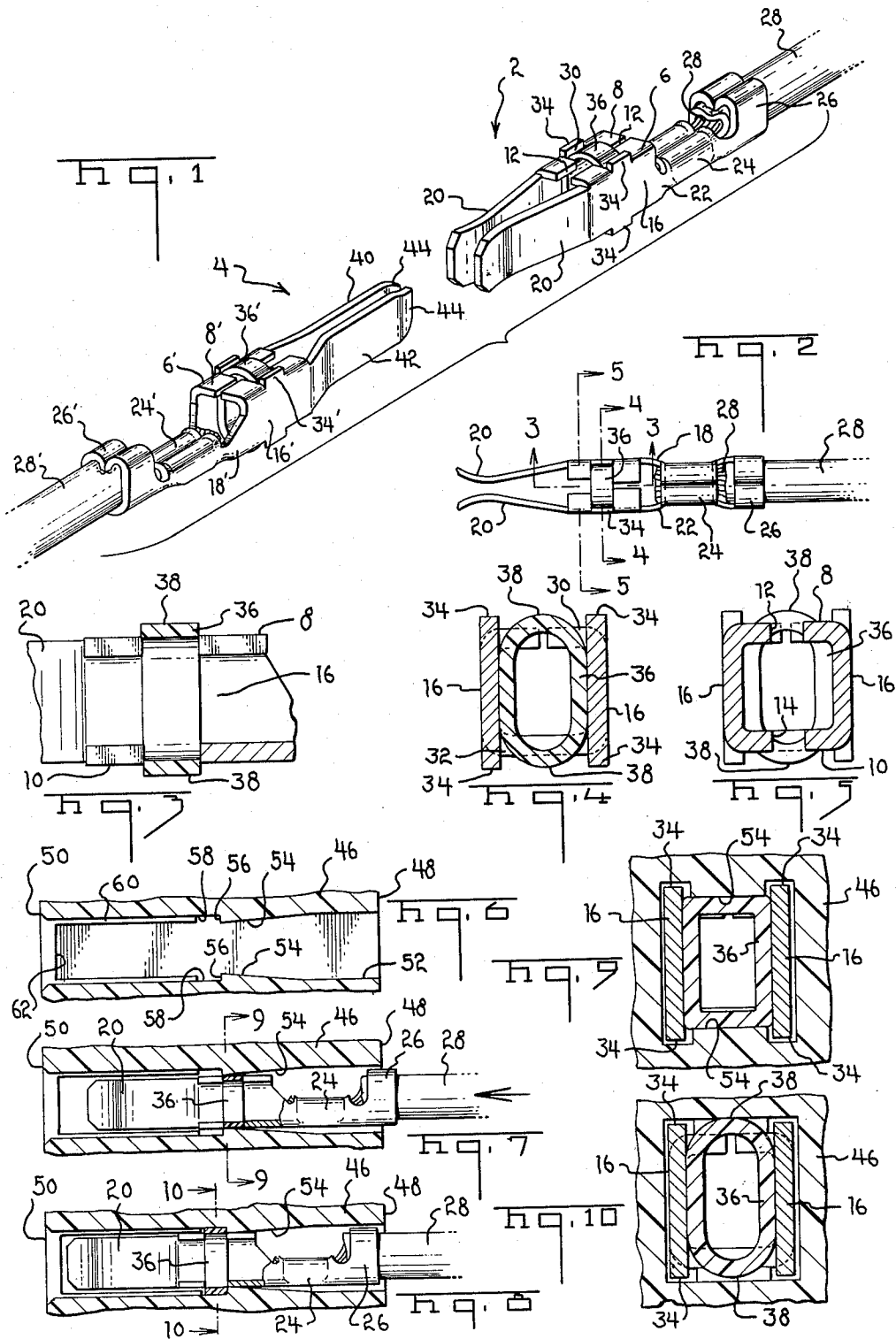


3,155,449.

ELECTRICAL CONTACT

Filed April 6, 1962

2 Sheets-Sheet 1



Nov. 3, 1964

H. E. HENSCHEN
ELECTRICAL CONTACT

3,155,449

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2 Sheets-Sheet 2

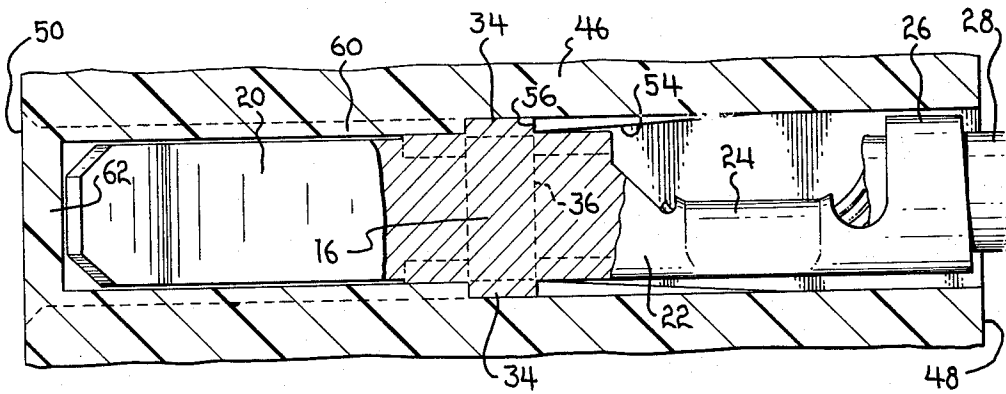


Fig. 11

Fig. 12

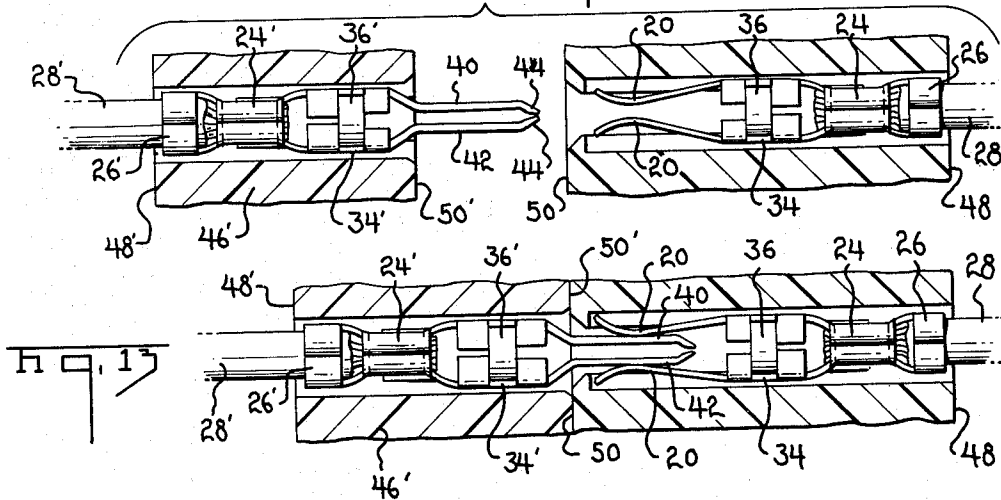


Fig. 13

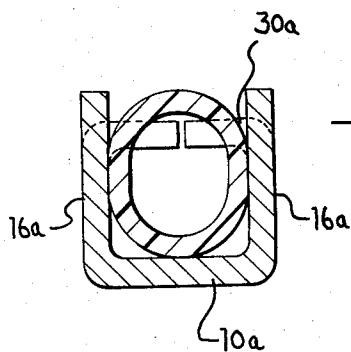


Fig. 14

1

3,155,449

ELECTRICAL CONTACT

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This invention relates to electrical contacts for multi-contact connecting devices.

One widely used type of electrical contact for multi-contact connecting devices is adapted to be secured to a wire end and then inserted into a cavity in an insulating block. Contacts of this type are provided with a retaining means for holding the contact in the block after insertion. In common prior art practice, this retainer may comprise a spring which projects beyond the surface of the contact and which is adapted to be resiliently deflected during insertion until it is moved past a shoulder in the cavity against which it lodges to prevent retrograde movement of the contact.

An object of the present invention is to provide an improved contact for multi-contact connecting devices. A further object is to provide an improved retention means for contacts of the type intended to be inserted into an insulating block. A still further object is to provide a retention means which is mounted within the contact. A still further object is to provide a retention means for contacts which is highly resistant to unintentional damage or destruction. A further object is to provide an improved contact which can be manufactured from a metal having a relatively high ductility and a low yield strength, such as copper, without sacrifice of contact pressure.

These and other objects of the invention are achieved in one specific embodiment comprising a contact having a transverse opening extending therethrough intermediate its ends. A short section of polymeric tubing is contained in this opening in a manner such that segmental portions extend through the opening and laterally beyond the surface of the contact. The tubing should be sufficiently hard or firm to be self-supporting and should be sufficiently elastic to permit it to deform under radial compression until the protruding segments are entirely contained within the opening. The contact is used with a cavity in an insulating housing having a tapering sidewall so that as the contact is inserted, the protruding portions of the tubing are compressed until the tapered section of the sidewall has been passed after which the tubing returns to its normal position. The protruding segments then function as retainers for cooperation with complementary shoulders in the cavity and prevent withdrawal of the contact therefrom.

In the drawing:

FIGURE 1 is a perspective view showing a pair of matable contacts in accordance with a preferred embodiment of the invention.

FIGURE 2 is a top plan view of the socket contact of FIGURE 1.

FIGURE 3 is a side sectional view taken along the lines 3-3 of FIGURE 2 showing the central portion of the socket contact.

FIGURES 4 and 5 are transverse sectional views taken along the lines 4-4 and 5-5 of FIGURE 2.

FIGURE 6 is a longitudinal sectional view of a portion of an insulating block and showing the profile of a cavity in the block adapted to receive the contact socket of FIGURE 2.

FIGURES 7 and 8 are views similar to FIGURE 6 illustrating the insertion of the socket contact into the cavity.

FIGURES 9 and 10 are views taken along the lines 9-9 and 10-10 of FIGURES 7 and 8.

FIGURE 11 is a longitudinal profile sectional view on

2

an enlarged scale with parts broken away showing the socket contact in a cavity in an insulating block.

FIGURE 12 is a plan sectional view showing a blade contact and a socket contact, each contact being disposed in a cavity in an insulating block.

FIGURE 13 is a view similar to FIGURE 12 but showing the insulating blocks and the contacts in engagement with each other.

FIGURE 14 is a transverse sectional view showing a modified form of the invention.

FIGURE 1 shows a preferred embodiment of the invention in the form of a pair of matable contacts 2, 4 which are crimped onto the ends of wires and which are adapted to be inserted into cavities in dielectric blocks. Ordinarily a plurality of cavities will be provided in each of a pair of blocks and a plurality of socket contacts 2 will be inserted into the cavities of one of the blocks while the plug contacts 4 will be inserted into the cavities of the other of the blocks so that when the blocks are brought into engagement with each other, the individual contacts will be engaged with their mating counterparts. Since the contacts 2, 4 are substantially identical in their central and rearward sections, a description of one, insofar as the central and rearward sections are concerned, will suffice for both. The socket contact 2 will therefore be described in detail and corresponding parts of the plug contact 4 will be identified by the same reference numerals differentiated by means of prime marks.

The contacts 2, 4 of the disclosed embodiment are of sheet metal construction formed from strip metal stock by conventional die stamping and forming methods. Socket contact 2 comprises an intermediate section 6 of rectangular cross section having a first pair of opposite sides 8, 10 which are medially divided by axially extending open seams 12, 14. The remaining vertical sides 16, 16 are substantially parallel to each other and each has a contact arm 20 extending forwardly and inwardly along the contact axis. The ends of the arms 20 are slightly divergent in order to facilitate the entry of the blade portion 40 therebetween when the contacts are moved relatively towards each other.

The rearward side of the intermediate portion 6 has a wire crimp portion extending therefrom which is integral with the side 10 and the lower portions of the sides 16 at 18 and 22. A first pair of ears 24 extend from opposite sides of the crimp portion and are curled inwardly towards each other and downwardly into crimped engagement with the strands of the wire 28 to establish an electrical connection therewith. An additional pair of ears 26 may be provided which are crimped onto the insulation of the wire as shown in FIGURE 1 in order to provide a strain relief for the electrical crimp 24 and to enhance the tensile properties of the connection.

The sides 8, 10 have centrally located aligned openings 30, 32 which are formed by punching out a portion of the sidewalls during manufacture. The punching and subsequent bending operations are carried out in a manner such that ears 34 are provided on each side of both of the openings, these ears constituting planar extensions of the sidewalls 16.

A relatively short section of polymeric tubing 36 is contained between the opposed faces of the sidewalls 16 and is held in compressed condition by these sidewalls so that cylindrical segments 38 project through the openings 30, 32 and beyond the planes of the sidewalls 8, 10. In order to achieve this effect, the tubing should have a normal outside diameter which is greater than the distance between the opposed internal faces of the sides 16 so that it will be resiliently deformed when it is inserted through one of the openings. Additionally, the diameter of the tubing should be such that after insertion into the contact, the length of its major axis will be

greater than the distance between the external surfaces of the sidewalls 8, 10.

The tubing 36 functions as a retaining means for preventing withdrawal of the contact from an insulating housing and may be any one of several commonly available polymeric materials. In general, it can be stated that the tubing should be sufficiently hard or firm to be self-supporting, should be capable of undergoing a substantial amount of elastic deformation, and should return to its normal shape, or nearly to its normal shape, after deformation. Specifically, the tubing must be capable of being elastically deformed until the entire section of tubing is contained between the opposed faces of the sides 16 of the contact and within the planes of the external surfaces of the sides 8, 10 as is shown in FIGURE 9. After such deformation the tubing should return to its oval shaped cross section (FIGURE 10) with the segments 38 protruding through the openings 30, 32. Some suitable polymeric materials for the tubing are discussed below.

The blade contact 4 has an intermediate and a rearward section which is substantially identical to the corresponding sections of the socket contact as pointed out above. The forward end of this blade contact comprises a pair of inwardly directed arms 40, 42 which extend from the sidewalls 16'. At their extreme ends, these arms are directed inwardly towards each other as at 44 to facilitate their entry between the arms 20 of the socket contact.

The insulating housing 46 into which the socket contact 2 is inserted has a plurality of cavities extending therethrough from its rearward face 48 to its mating face 50 which is positioned against a corresponding face of a mating housing in usage. Each of the cavities has a rearward generally rectangular section 52 which is sufficiently large to permit passage of the rectangular central section of the contact. A pair of inclined surfaces 54 are provided on opposite sides of the rectangular section and slope toward the cavity axis. As best shown in FIGURE 9, these inclines do not extend to the sides of the cavity but are centrally located therein so that clearance remains for the ears 34 on the sidewalls 16. The central portion of the cavity has a forwardly facing shoulder 56 at the ends of the inclines 54 and a short rectangular section 58. The cross section of this central rectangular section is again slightly greater than the cross section of the central portion of the contact and the length of this section is slightly greater than the length of the retainer 36. The forward end portion of the cavity in the block in which the socket contacts are mounted has fillet-like ribs in each corner 60 and the mouth of the cavity which opens into the mating face has opposed ribs 62 on its sides to prevent insertion of an oversized test probe which might damage the socket contact. The block or housing 46' which receives the blade contacts is somewhat shorter than block 46 and does not have a corresponding forward section.

The contact is inserted into the cavity from the rearward face 48 thereof by locating the contact with the sides 8, 10 in alignment with the sides of the cavity having the inclined the surfaces 54 thereon. It will be noted that the height of disclosed embodiment is somewhat greater than its width and that the cavity is proportionately dimensioned. This feature prevents insertion of the contact in any orientation other than the required orientation.

As shown in FIGURES 7 and 8, the contact is merely pushed into the cavity and the inclined surfaces press the protruding segments 38 of the tubing inwardly until it is entirely contained within the central portion of the contact (FIGURE 9). Upon further insertion, and after the section of tubing in the contact has passed the shoulder 56, the tubing retainer returns to its normal position so that the segments 38 extend beyond the surfaces 8, 10. When the parts are in this position, the faces of these

segments will be in opposed relationship with the shoulders 56 so that an attempted withdrawal of the contact from the cavity, as by pulling on the wire 28, will result in the faces of the segments being brought against the shoulders. Withdrawal of the contact is thus precluded by the imposition of a shear stress upon the retainer. Forward movement of the contact beyond the position of FIGURE 8 is prevented by the ears 34 which function as stops bearing against the fillets 60 in the corners of the cavity.

If it is desired to remove the contact from the cavity, it is merely necessary to insert a two-pronged tool along the opposite sides of the cavity from the mating face 50 inwardly and compress the tubing retainer 34 until its surface, and particularly the segments 38, are permitted to clear the shoulder 56.

A wide variety of polymeric materials can be used for the tube retainer 36 and the selection of a particular material will depend upon the precise characteristics desired. Some suitable materials are, for example, polycarbonates (commercially available under the trademark Lexan), nylon, polyurethane, polypropylene, and butyl rubber. These materials are readily available in hardnesses and states of plasticity which are sufficiently deformable to undergo the deformation required upon insertion of the contact into the cavity. Of the materials mentioned above, the polyurethanes are extremely tough and can be used where an extremely high retention force is required. Where the retention force is extremely high, the contact can not be withdrawn from the cavity by pulling upon the wire without destruction of the contact itself. Under other circumstances, it may be desired to have a somewhat lower retention force so that the contact can be withdrawn from the cavity upon application of some predetermined pulling force on the wire. Under such circumstances a material having a relatively lower elastic modulus would be required, for example, a softer polyurethane or a nylon. The polycarbonates constitute an additional class of materials which are highly suitable for the practice of the invention in that they provide good elevated temperature properties as compared with many other polymeric materials. The tube retainer may merely be cut from an extruded or molded plastic tube or can be separately molded if desired.

The length of the tubing section of the embodiment of FIGURE 1 is not critical although the retainer should be sufficiently long so that it will be stressed in shear upon imposition of a pulling force on the conductor 28. If the section of plastic tubing is extremely short, the projecting segments 38 might bend when an axial load is imposed on the wire rather than be stressed in shear. The minimum length required to avoid such bending will vary for polymeric materials of different types; it has been found that when a nylon is used, for example, the length of tube section should be about one third of its outside diameter. It should be added that the longer the tube section, the higher will be the force required to insert the contact into the cavities so that an unduly long retainer is not desirable.

The invention presents several obvious advantages as compared with the prior art type of metal spring retainers. One salient advantage is that the retainer is fully protected since it is contained almost entirely within the central portion of the contact and between the ears 34 so that no amount of handling or ordinary abuse will destroy its functional usefulness. Additionally, the pull-out force required to remove the inserted contact from its cavity can be closely controlled by judicious selection of the material of the retainer. In other words, a softer tube retainer permitting a lower pull-out force than a relatively hard and relatively high elastic modulus material. It is also advantageous that since the retainer is contained entirely within the contact, the surface of the contact is free of projecting or surrounding parts which

heretofore have imposed design limitations which were sometimes undesirable. As an example of this advantage, it can be pointed out that the contact socket 2 has arms 20 which extend from the transition section 18, 22 of the contact to the ends of the arms. Upon insertion of the plug between the arms 20, these arms bend on a relatively long bending radius or moment arm which extends from the transition section to the ends of the arms 20. Insofar as the flexure of the arms 20 is concerned, these arms can be considered to extend from the transition section 18, 22 to the end of the terminal. This feature can be translated into a distinct advantage in terms of contact design and performance in that the contact can be made of a relatively ductile material having a low yield point, pure copper for example, without sacrifice of the amplitude of elastic deflection in the arms. If, on the other hand, the retainer to be provided in surrounding relationship to the central portion 6 of the contact, as in prior art devices, the bending radius of the arms 20 would extend only from the ends of these arms to the central portion 6 of the contact, for the reason that if the retainer surrounded this central portion, then the central portion could not be permitted to undergo deformation.

While the embodiment of FIGURE 1 of the invention employs a short section of polymeric tubing as a retainer, it will be obvious that other shapes can also be used, for example, the retainer could comprise a solid cylindrical member of a deformable foam-like material such as a polyurethane. The cross section of the retainer could also be, for example, channel-shaped or H-shaped so long as it partially projected through one of the openings of the central portion of the contact to provide a shear surface for cooperation with the retaining shoulder in the cavity.

FIGURE 14 shows an alternative embodiment of the invention in which only one opening 30a is provided in the intermediate portion of the contact and the section of tubing is supported by the side 10a as well as the sides 16a. This embodiment is particularly adapted for contacts intended for relatively smaller wires (e.g. AWG #16-24) than the embodiment of FIGURE 1.

The foregoing description does not show a specific external configuration for the block 46 but shows only the form of the cavities in the block. It will be understood that the block can be of any convenient shape. A wide variety of cylindrical and prismatic blocks are known to the art.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. A stamped and formed sheet metal contact terminal, said contact having a ferrule-forming portion at one end thereof whereby said terminal is adapted to be crimped onto an electrical conductor, a pair of arms extending from said ferrule-forming portion, said arms extending on opposite sides of the axis of said terminal and being flexible towards and away from said axis upon engagement of said terminal with a mating contact, and polymeric retaining means contained between said arms intermediate the ends thereof, said retaining means projecting radially beyond said arms and being inwardly deformable upon insertion of said contact into a cavity to permit passage of said retaining means past a construction in said cavity.

2. A stamped and formed sheet metal contact terminal, said terminal having a generally channel-shaped ferrule-forming portion at one end thereof, a pair of co-extensive arms extending from said ferrule-forming portion on opposite sides of the axis of said terminal, said arms being deflectable towards and away from said axis on a moment arm extending the full length of each arm, and a polymeric retainer contained between said arms intermediate the ends thereof, said retainer normally projecting radially beyond said arms and being engageable with a first shoulder in a cavity to retain said contact in said cavity.

3. A contact terminal as set forth in claim 2 wherein said polymeric retainer comprises a short section of polymeric tubing contained between said arm, said tubing being compressed between the opposed sides of said arms and deformed to a generally oval shaped cross-section with the portion of said tubing at the ends of the major axis projecting radially beyond said arms.

4. A contact terminal as set forth in claim 2 wherein said arms are provided with ears extending on opposite sides of projecting portions of said polymeric retainer, said ears being engageable with a second shoulder in said cavity to prevent movement of said contact beyond said second shoulder.

5. A contact terminal as set forth in claim 2 wherein said arms are provided with spaced-apart flanges extending transversely between said arms, said retainer being contained between said flanges.

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