Aug. 20, 1963 R. S. YOPP 3,101,229

ELECTRICAL CONNECTORS

Filed Oct. 7, 1960

Fig. 1.

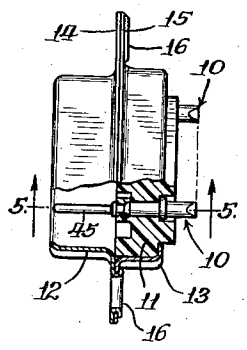


Fig. 2.

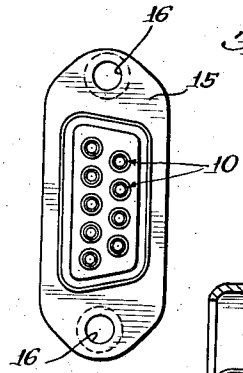
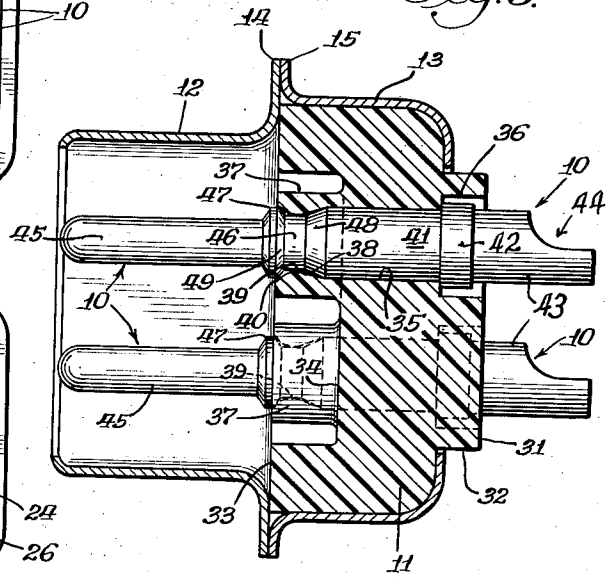


Fig. 5.



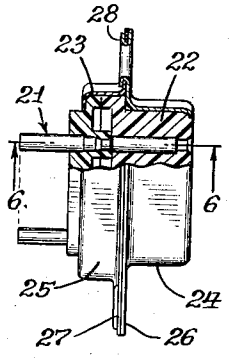


Fig. 3

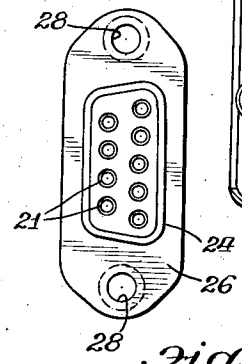


Fig. 4.

Fig. 6.

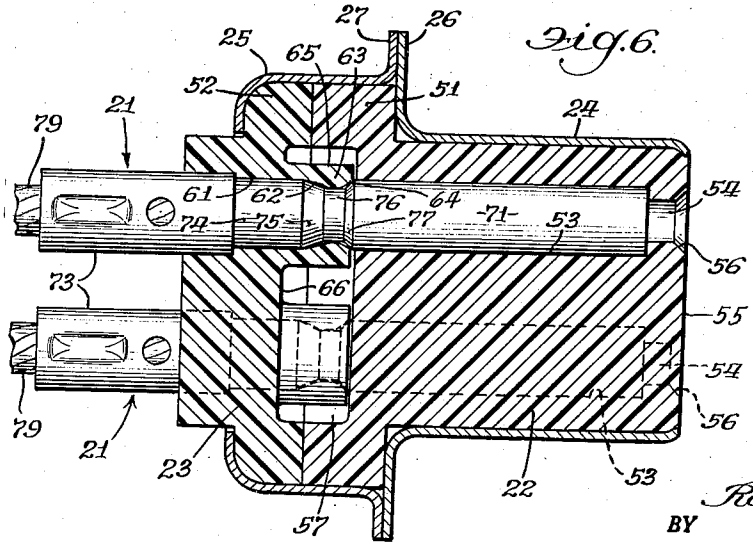
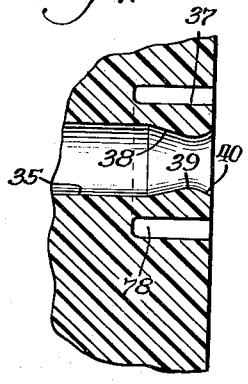


Fig. 7.



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ELECTRICAL CONNECTORS

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The present invention relates to electrical connectors, and particularly to connectors of such design and construction that the connector contacts may be individually removed and replaced, as desired. While the inventive concept is believed to be of rather broad application, it is particularly adaptable for the construction of miniature or sub-miniature multi-contact rack-and-panel connectors.

It is the primary object of the present invention to provide electrical connectors wherein the individual contacts, which may be extremely small and unusually closely grouped with respect to each other, may be spaced from each other the minimum distance deemed necessary to achieve the desired voltage and flash-over rating of any given connector, yet wherein the individual contacts may be easily and quickly removed and replaced, although held in their dielectric mountings with sufficient firmness to prevent accidental displacement.

A further object of the invention is to provide connectors, and particularly miniature connectors including a multiplicity of relatively small, telescoping pin-and-sleeve contacts, with dielectric mountings so arranged that the individually removable contacts have a limited, closely controlled, degree of freedom of movement or "play," both as to spacing and alignment. In practice, this provides a predetermined degree of compliance to compensate for reasonable manufacturing tolerances in the center-to-center spacing of the individual contacts, as well as compensating for any minor misalignments that might otherwise cause jamming or hard operation of the connector.

A further object is to provide connectors of the general type described above, wherein it is practicable to attach the individual contacts of the connector to the ends of flexible wire conductors before assembly, and to thereafter snap the individual contacts into position in the dielectric mountings of the plug and receptacle of the connector. In practice, the contacts may be of alternative types such that they may be either soldered or crimped to the flexible conductors with which they are associated.

A still further object is the provision of connectors as indicated above, wherein the contacts may be so designed that they are free for individual rotation within their dielectric mountings, in order to avoid twisting or tortional stresses on the conductors to which they are attached.

Another important object of the invention is the provision of improved electrical connectors wherein the contacts can be readily removed for inspection, replacement or for attachment to the flexible conductors with which they are used, in an assembly characterized by relatively few parts and by absence of spring clips, tines, latches or other small or delicate fasteners characteristic of the prior art. According to the present invention, the individual contact elements each comprise only a single metallic part, a group of which may be held in position in a dielectric mounting consisting of a single molding of insulating plastic.

Further objects are to provide connectors as described above which are simple to operate, compatible and interchangeable with other connectors of similar sizes constructed in accordance with prior art practices, and so designed as to be suited to economical methods of manufacture by the use of conventional types of equipment.

A present preferred form of the invention is illustrated in the drawings of the present specification, wherein:

FIGURE 1 is an enlarged side elevational view of a miniature electrical connector plug constructed in accordance with the teachings of the present disclosure, with portions of the connector shell and the dielectric insert therein broken away to more clearly illustrate the contacts carried thereby;

FIGURE 2 is a similarly enlarged front elevational view of the connector illustrated in FIGURE 1;

FIGURE 3 is an enlarged side elevational view of a connector socket adapted to receive the connector of FIGURES 1 and 2 with portions of the metal shell and the dielectric inserts therein broken away to illustrate the internal contacts thereof; and

FIGURE 4 is a similarly enlarged front elevational view of the socket of FIGURE 3.

FIGURE 5 is a greatly enlarged (10×) fragmental transverse sectional view taken substantially on the plane of the line 5—5 of FIGURE 1 with portions of the metallic shell of the connector omitted for clarity;

FIGURE 6 is a similarly enlarged transverse sectional view taken substantially on the plane of the line 6—6 of FIGURE 3, also showing the portions of the connector shell omitted.

FIGURE 7 is a fragmental, detail cross-sectional view of a slightly modified form of contact cavity in accordance with the present disclosure.

The connector plug of FIGURES 1 and 2 consists, essentially, of a multiplicity of male contact pins 10, each mounted in the dielectric (molded nylon) insert 11 of the connector shell or housing, which consists of a forward sleeve 12 and a back cap 13, each formed of thin sheet metal and having peripheral flanges 14 and 15 fastened to each other by eyelets 16, which also serve as screw holes for mounting the connector on other equipment. As best seen in FIGURES 1 and 5, the peripheral edges of the dielectric insert 11 are confined between the sleeve 12 and back cap 13 so that the dielectric is firmly mounted within the metallic shell of the connector.

It is obvious that connectors according to the present invention may be within a wide range of sizes, shapes and contours, but in the preferred practice of the invention, the connectors are about one-half the dimensions illustrated in FIGURES 1 to 4 of the drawings, with the contacts arranged in staggered rows and with the sleeve 12 formed in a somewhat trapezoidal shape (FIGURE 2) to polarize the connector and prevent improper insertion of the connector plug into its socket.

The connector socket, best illustrated in FIGURES 3 and 4 of the drawings, comprises a multiplicity of female contact members 21 disposed in staggered relation in parallel rows (FIGURE 4) in a dielectric mounting consisting of a forward insert 22 and rearward insert 23, both enclosed within and confined between the metallic sleeve 24 of the socket and the metallic back cap 25 of the connector. The sleeve 24 and cap 25 are provided with marginal flanges 26 and 27, eyeletted together at 28 to provide screw holes for mounting of the socket.

As heretofore indicated, the novelty of the present invention resides in the means by which the metallic contacts of the connector plug and its socket are mounted in the dielectric inserts thereof. According to the present invention, the contacts may be snapped into position in the contact cavities in a manner to retain themselves therein so firmly that they cannot be dislodged by coupling or uncoupling of the connector plug and socket, yet with their mounting such that they may be removed at will for inspection, replacement or for the attachment of conductors. A preferred means by which this is done is illustrated in FIGURE 5, wherein it will be seen that the dielectric insert 11 has its rearward face 31 provided

with a marginal shoulder 32 which projects from the central opening in the back cap 13 while the front face 33 of the insert includes a recessed surface 34 which, as illustrated, is practically coextensive with the contact area of the connector. The insert has a multiplicity of generally parallel, spaced apart contact cavities which include central cylindrical bores 35 illustrated as including counterbored portions 36 at their rearmost ends and which have projecting sleeves 37 extending forwardly from the recessed face 34 at the front of the insert. The sleeves 37 are of relatively thin-walled formation, with their interior walls 38 tapering inwardly from the cylindrical portion 35 of the cavity to a restricted collar 39 adjacent the outwardly flared mouth surfaces 40 at the forward end of each of the sleeves.

The male contact pins 10 of the connector plug each include a cylindrical mounting shank 41 extending from an enlarged shoulder 42 seated in the counterbore 36 and adjacent the terminal 43 of the contact (which may be provided with a solder pocket 44 or formed as a crimping sleeve), to a cylindrical telescoping slide pin 45 at the forward end of the contact. The mounting shank 41 of each of the contacts has an annular groove 46 turned therein, however, thus forming a reduced diameter neck separated from the slide pin 45 of the contact by an annular shoulder 47. The groove 46 is preferably cut with a gently tapered portion 48 leading from the shank 41 of the contact to the neck, and a more abrupt cam surface 49 between the neck and the shoulder 47.

According to the preferred practice of the invention, the annular grooves 46 of the several contacts are cut to a depth of about one-sixth of the radius of the annular shoulders 47, and the dielectric inserts of the connector are formed of molded nylon (known in the trade as Zytel–101) with the openings in the restricted collars 39 of a normal diameter about five-sixths of the diameter of the cylindrical portions 35 of the contact cavities. With parts thus formed, the relatively thin nylon walls of the sleeve have sufficient elasticity and yieldability that the contacts may be seated in the dielectric by being pushed into position from the rear, or may be removed by an overload axial force in the opposite direction, but the nylon collars grip the annular grooves in the contacts with sufficient tenacity to retain them in position against all normal axial forces encountered in use. It follows that while they can be deliberately removed if desired, they will not be accidentally dislodged during insertion or withdrawal of the connector plug in its socket.

The contacts of the connector socket are also arranged for insertion or removal from the dielectric inserts in the manner illustrated in FIGURE 6 of the drawings. In this figure it will be observed that the forward insert 22 and rear insert 23 of the socket each include marginal shoulders 51 and 52 by which these inserts are held between the metallic shell members 24 and 25. The forward insert 22 is provided with a plurality of aligned contact cavities, each consisting of a generally elongated cylindrical bore 53 having a reduced diameter aperture 54 at the front face 55 of the insert with the mouth of the aperture flared at 56 if desired, to facilitate insertion of the connector pins 45 heretofore described. The rear face of the insert 22 is recessed at 57 to leave the marginal shoulder 51 engaging the marginal shoulder 52 of the rear insert 23. The insert 23 has contact cavities in alignment with each of the bores 53 in the front insert, and each of these cavities has a cylindrical bore 61 with a tapered portion 62 leading to a reduced diameter collar 63 adjacent the flared mouth 64 at the end of the sleeve 65 which projects forwardly from the recessed front face 66 of the insert 23.

The female contacts 21 of the socket each include a cylindrical telescoping split-sleeve slide portion 71 adapted to receive the pins 45 heretofore described. Each of these sleeves is joined with a cylindrical crimping terminal 73 by a mounting shank 74 having a tapered portion 75 leading to a reduced diameter neck 76, with an angular cam surface 77 between the neck and the forward sleeve 71 of the contact.

It will be obvious from examination of FIGURE 6 that, after the dielectric inserts 22 and 23 are assembled within the metallic shell members 24 and 25, the individual metallic contacts 21 may be inserted into the connector socket merely by forcing the forward ends of the contacts into the cavities from the rear of the connector with force sufficient to expand the elastic collar portions 65 of the insert 23. As the contacts reach their proper positions, the elasticity of the collars and their supporting sleeves causes them to close snugly about the annular grooves in the contacts, holding them in their operative positions. In this respect, the action will be the same irrespective of whether the sleeves on the insert project from the face surface thereof as in FIGURE 6, or whether the sleeves are recessed as by the formation of a circular channel around each cavity, as illustrated at 78 in FIGURE 7.

The present invention thus provides connectors wherein the individual contacts may be attached to the conductors by soldering or crimping, as desired, and thereafter inserted into the connector dielectric. In practice, this is done by the application of a semicircular mounting tool designed to partially encircle the contacts, but cut away to clear the conductors 79 extending therefrom. It is thus a simple, quick and easy operation to snap the individual contacts into position in the connector plug or socket in a manner such that they are held with sufficient firmness to preclude the possibility of accidental displacement.

Having thus described the invention, what I claim as new and desire to protect by United States Letters Patent is:

1. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including a cylindrical bore to slidably receive the shank of a contact and separate, individual contact retaining means for each cavity consisting of a relatively thin-walled tubular sleeve integral with said plastic body and in axial alignment with one of said bores; said sleeves each having a restricted expansible collar, with said sleeves spaced from each other whereby they may be individually expanded; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a cylindrical mounting shank fitted within the bore of a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a slide portion extending forwardly therefrom; each of said contacts having an annular groove around the contact, with the restricted collar of one of the aforesaid retaining sleeves snugly engaging the annular groove of each of said contacts, and securing the contact against displacement by coupling forces of the contacts, with angularly disposed cam surfaces in said annular groove coacting with the aforesaid sleeves to expand the collars thereof and individually release the contacts in response to overload axial thrust thereupon.

2. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including a cylindrical bore to slidably receive the shank of a contact and separate, individual contact retaining means for each cavity consisting of a relatively thin-walled tubular sleeve integral with said plastic body and in axial alignment with one of said bores as an extension thereof; said sleeves each having a wall thickness less than one-half of the diameter of its associated cavity and including internally tapered walls extending to a restricted expansible collar of the sleeve and terminating in a flared mouth at the end of said sleeve, with said sleeves spaced from each other whereby they may be individually

expanded; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a cylindrical mounting shank fitted within the bore of a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a telescoping slide portion extending forwardly therefrom; each of said contacts having an annular groove around the contact between the mounting shank and the telescoping slide portion, with the restricted collar of one of the aforesaid retaining sleeves snugly engaging the annular groove of each of said contacts, and securing the contact against displacement by coupling forces of the contacts, with angularly disposed cam surfaces in said annular groove coacting with the aforesaid sleeves to expand the collars thereof and individually release the contacts in response to overload axial thrust thereupon.

3. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including a cylindrical bore to slidably receive the shank of a contact and separate, individual contact retaining means for each cavity consisting of a relatively thin-walled tubular sleeve integral with said plastic body and in axial alignment with one of said bores as an extension thereof; said sleeves each having a wall thickness less than one-half of the diameter of its associated cavity and including internally tapered walls extending to a restricted expansible collar of the sleeve and terminating in a flared mouth at the end of said sleeve, with said sleeves spaced from each other whereby they may be individually expanded; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a cylindrical mounting shank fitted within the bore of a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a telescoping slide portion extending forwardly therefrom; each of said contacts having an annular groove around the contact between the mounting shank and the telescoping slide portion, with the restricted collar of one of the aforesaid retaining sleeves snugly engaging the annular groove of each of said contacts, and securing the contact against displacement by coupling forces of the contacts.

4. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including a cylindrical bore to slidably receive the shank of a contact and separate, individual contact retaining means for each cavity consisting of a relatively thin-walled tubular sleeve integral with said plastic body and in axial alignment with one of said bores; said sleeves each having a restricted expansible collar, with said sleeves spaced from each other whereby they may be individually expanded; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a cylindrical mounting shank fitted within the bore of a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a slide portion extending forwardly

therefrom; each of said contacts having an annular groove around the contact, with the restricted collar of one of the aforesaid retaining sleeves snugly engaging the annular groove of each of said contacts, and securing the contact against displacement by coupling forces of the contacts.

5. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including separate, individual contact retaining means consisting of a restricted expansible collar in said cavity; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a mounting shank fitted within a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a telescoping slide portion extending forwardly therefrom; each of said contacts having an indentation between the mounting shank and the telescoping slide portion, with the restricted collar of a cavity snugly engaging the indentation of each of said contacts to firmly secure the individual contacts against normal axial forces, but with angularly disposed cam surfaces on said contacts to expand the collars thereof and individually release the contacts in response to overload axial thrust thereupon.

6. In an electrical connector, a dielectric body consisting of an integral molding of relatively firm plastic insulating material with a plurality of generally parallel contact cavities extending therethrough; with each cavity in the dielectric body including a cylindrical bore to slidably receive the shank of a contact and separate, individual contact retaining means for each cavity consisting of a restricted, resilient expansible collar; in combination with metallic contacts carried in the aforesaid cavities of said dielectric body, with each of said contacts including a cylindrical mounting shank fitted within the bore of a cavity, with a terminal of each contact extending rearwardly from said mounting shank and a slide portion extending forwardly therefrom; each of said contacts having an annular groove around the contact between the mounting shank and the slide portion, with the restricted collar of one of the aforesaid cavities engaging the annular groove of each of said contacts to firmly secure the individual contacts against thrust forces incident to coupling of said contacts; with angularly disposed cam surfaces in the annular grooves of said contacts to expand said collars and individually release the contacts in response to overload axial thrust thereupon.

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