May 18, 1965 R. H. ELLIS 3,184,701

CONTACT-POSITIONING STRUCTURE FOR A RESILIENT CONNECTOR INSULATOR

Filed Sept. 25, 1961 3 Sheets-Sheet 1

FIG. 1.

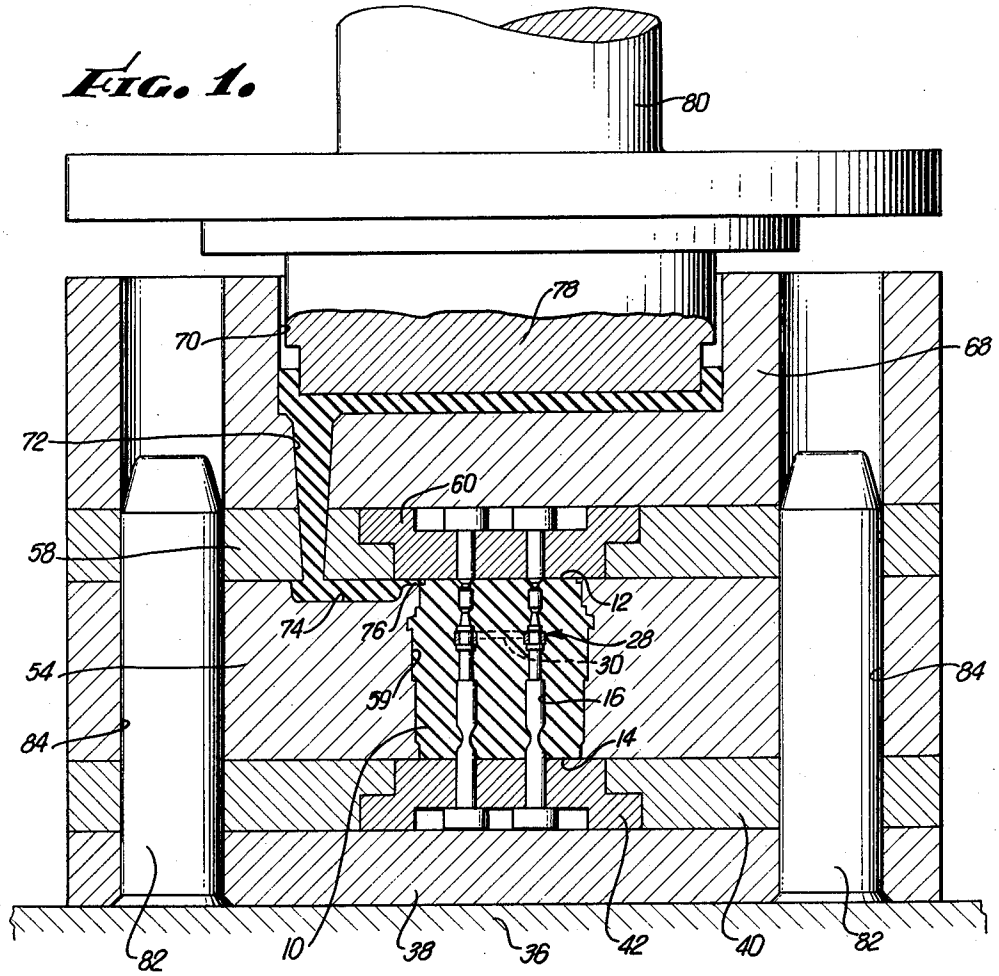

FIG. 2.

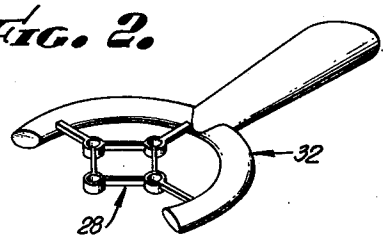

FIG. 3.

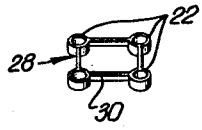

FIG. 4.

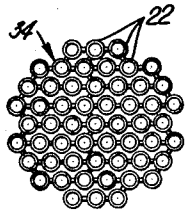

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FIG. 5.

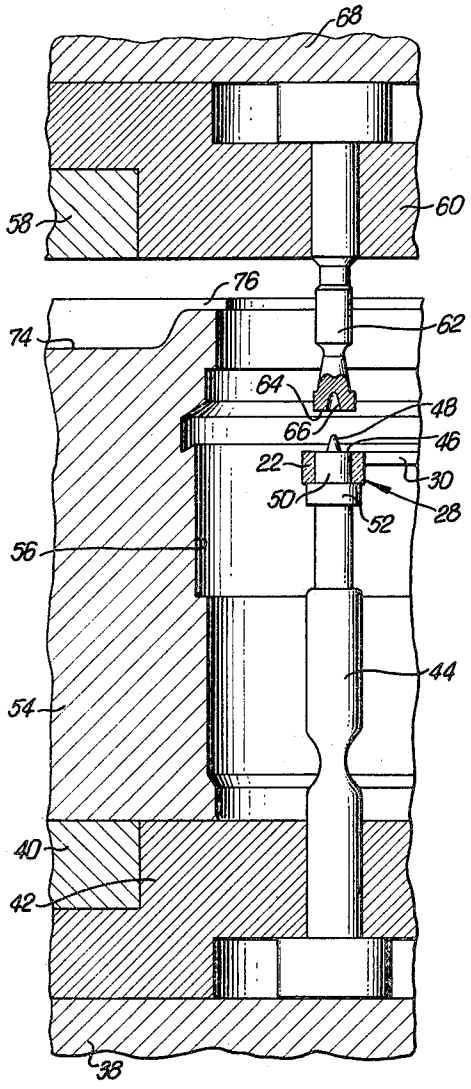


FIG. 6.

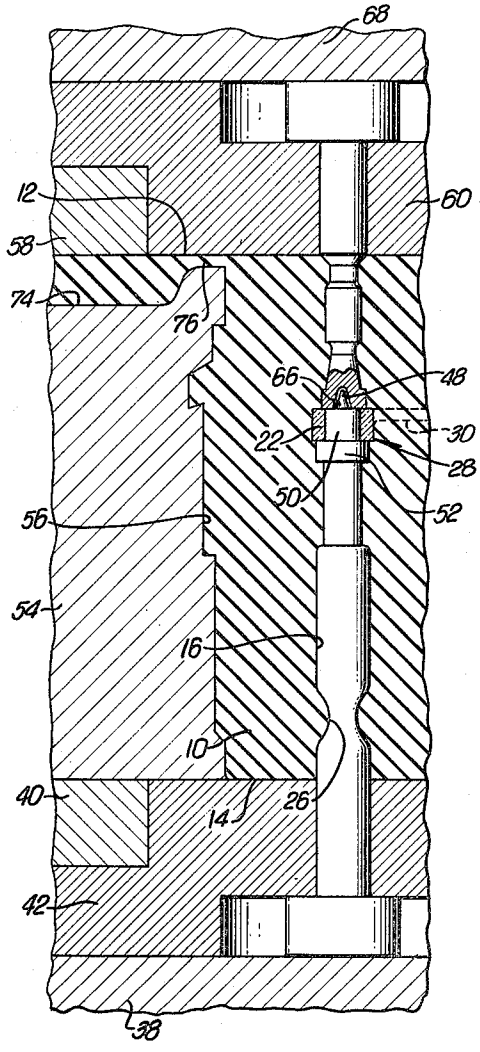
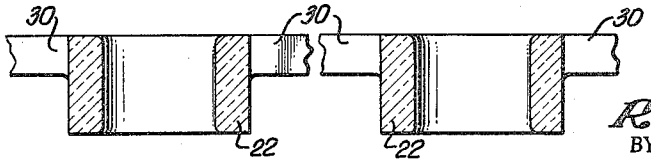


FIG. 7.



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Filed Sept. 25, 1961 3 Sheets-Sheet 3

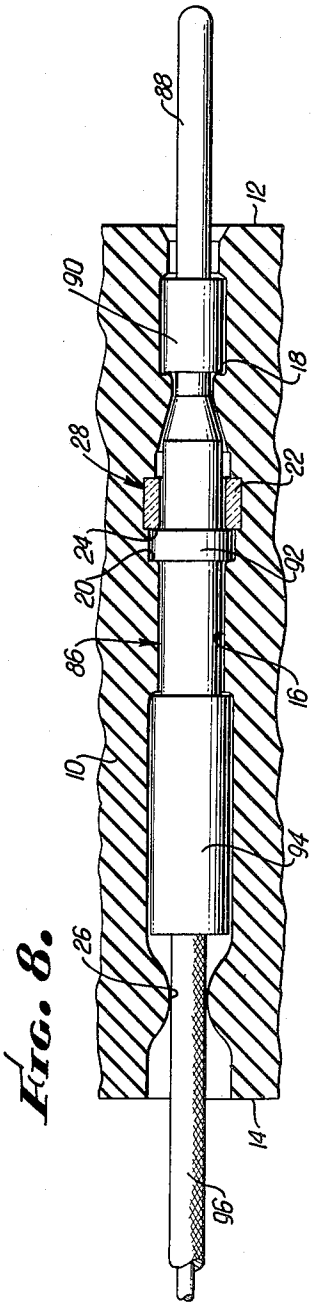

FIG. 8.

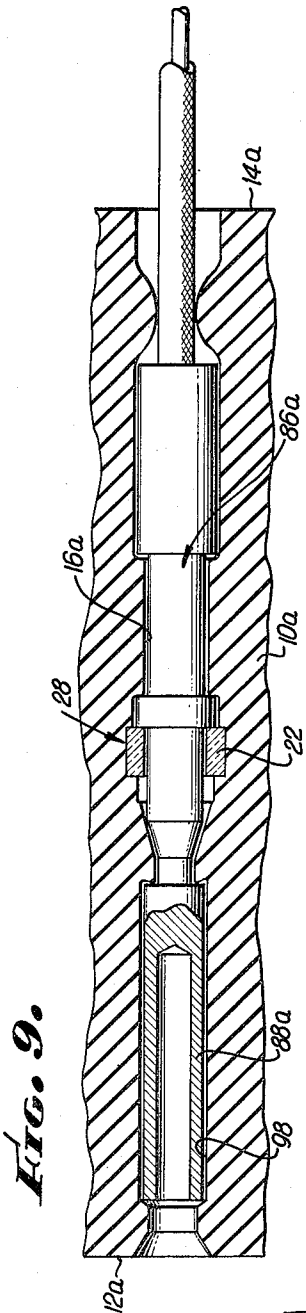

FIG. 9.

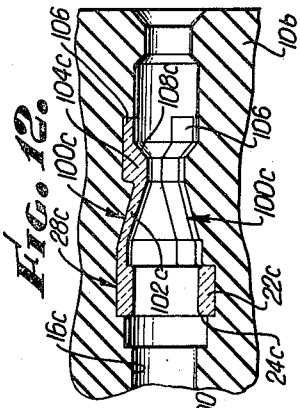

FIG. 12.

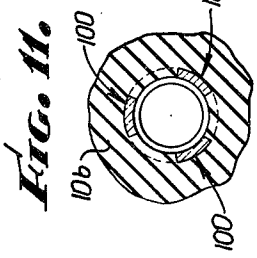

FIG. 11.

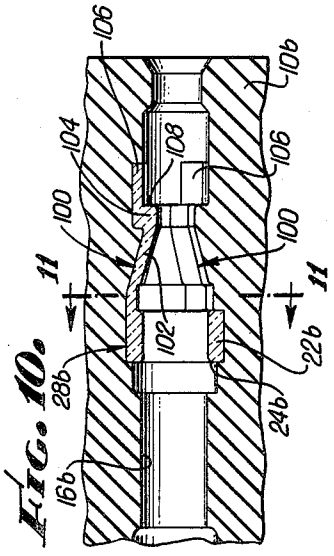

FIG. 10.

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3,184,701

CONTACT-POSITIONING STRUCTURE FOR A RESILIENT CONNECTOR INSULATOR

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Filed Sept. 25, 1961, Ser. No. 140,580
7 Claims. (Cl. 339—59)

The present invention relates to electrical connectors wherein a plurality of contact terminals are mounted in one insulation body or block and complementary contact terminals are mounted in another insulation body or block. Normally one set of the contact terminals would be pins and the complementary set would be sockets, but other types of mating terminals can be employed. The present invention relates particularly to the mounting and positioning of the contact terminals in an insulation body which is composed of resilient elastomer material.

Electrical connector insulation bodies for supporting a plurality of contact terminals are in many instances composed of resilient elastomer material. Among other advantages, such resilient insulator bodies can be made in one piece while still having undercut cavities in the contact terminal-receiving bores of the insulator, whereas with rigid insulation bodies two or more blocks of insulation material are required to provide such undercut cavities for positioning and retaining the contacts in the bores. This unitary resilient insulator structure simplifies connector construction and eliminates moisture traps usually present in multiple rigid insulator structures, and resiliency of the insulator body permits insertion and removal of the contact terminals from the insulator bores without having the connector disassembled. Resilient insulation bodies have the further advantage of tightly moisture-sealed engagement with the contact terminals, while at the same time permitting slight lateral shifting of the contact terminals for proper alignment of mating terminals.

Resilient insulator bodies for electrical connectors such as those described above have particular utility where the contact terminals are adapted to be pushed through respective bores in the insulation body from the rear end thereof so that the contacting ends of the terminals either protrude or are accessible from the forward end of the insulation body in position for effecting physical and electrical engagement with mating terminals. The insulator bores and terminals in such connectors have complementary shoulders so that when the terminals are fully advanced they will become locked in place against axial movement in either direction. By this means, the connectors comprising insulation bodies and outer shells may be completely made up with the exception of the contact terminals, and the terminals may then be individually connected at their rear ends as by crimping, soldering, welding or otherwise to respective conductor wires, and then the terminals inserted into the insulator bores from the rear. Furthermore, by the application of a sufficient rearward force, the resilient insulation material defining the shoulders in the bores will give way to permit rearward removal of the termianls for replacement or repair or reconstituting the pattern in a multiplicity of terminals.

Despite the above and other advantages in the use of resilient connector insulation bodies, one difficulty which has been found to be present in connection with resilient

insulation bodies, particularly where small size contacts are employed, is that when a contact terminal is pushed into its respective bore in the insulation body it is usually difficult to determine when the terminal has reached its correct forwardmost limit of travel due to the fact that the arresting shoulder in the bore is composed of the resilient insulation material, and will give way somewhat when it engages a complementary shoulder on the contact. This problem can be minimized when the terminals are inserted in factory production by the use of proper equipment which limits the extent of insertion of the contacts, but in the usual circumstance wherein the terminals are attached to conductors and inserted in the field, the problem is serious.

A further problem in connection with the use of such resilient insulator bodies in electrical connectors is that the shoulders in the bores of the insulation body which retain the terminals against axial movement in either direction once the terminals are properly inserted in the bores are also of the resilient insulation body material, and therefore permit a certain amount of axial shifting of the terminals and uncertainty in the positiveness of the mounting of the terminals.

In view of these and other problems it is an object of the present invention to provide a resilient electrical connector insulation body with a contact terminal-receiving bore having a substantially rigid stop shoulder member secured therein for positively limiting the final positioning of a contact terminal which is inserted into the bore.

Another object of the invention is to provide, in a resilient electrical connector insulation body having a plurality of contact terminal-receiving bores therethrough, a web or matrix of substantially rigid insulation material which is molded into the resilient insulation body and which presents rigid stop shoulder means in each of the terminal-receiving bores for limiting axial movement of the contact terminals in at least one direction in the bores, and it is also an object of the invention to provide a novel method for producing the resilient insulation body with this contact positioning web or matrix disposed therein.

Further objects and advantages of this invention will appear during the course of the following part of this specification, wherein the details of construction, mode of operation and novel method steps of preferred embodiments of the invention are described with reference to the accompanying drawings, in which:

FIG. 1 is a vertical section, with portions in elevation, illustrating the molding of a resilient electrical connector insulation body with the contact positioning web of the present invention disposed therein.

FIG. 2 is a perspective view showing the contact positioning web or matrix which is being molded into the insulation body in FIG. 1, the web or matrix as shown in FIG. 2 being attached to supporting structure for convenience in coating the web or matrix so that it will be intimately bonded within the resilient insulation body.

FIG. 3 is a perspective view of the web or matrix shown in FIG. 2 after it has been broken away from the supporting structure.

FIG. 4 is a plan view illustrating a web or matrix similar to that shown in FIGS. 2 and 3 but embodying a large number of individual contact terminal positioning rings.

FIG. 5 is an enlarged, fragmentary vertical section illustrating a portion of the mold of FIG. 1 prior to closing of the mold, and particularly showing the split core pin arrangement employed in the mold and the manner in which the contact positioning web is placed in the mold before the mold is closed.

FIG. 6 is a view similar to FIG. 5, but with the mold in the closed position and the resilient insulator body formed within the mold.

FIG. 7 is a greatly enlarged fragmentary vertical section showing a portion of the contact positioning web.

FIG. 8 is an enlarged, fragmentary vertical section illustrating the mounting of a pin contact terminal in a bore of the resilient insulation body, and particularly showing the manner in which an individual ring portion of the positioning web limits forward positioning of the contact terminal.

FIG. 9 is a view similar to FIG. 8, but illustrating the mounting of a socket contact terminal.

FIG. 10 is a fragmentary vertical section showing a modified form of the substantially rigid contact positioner.

FIG. 11 is a cross-sectional view along the line 11—11 of FIG. 10.

FIG. 12 is a fragmentary sectional view similar to FIG. 10, but illustrating an additional modification in the structure of FIG. 10.

FIGS. 1, 5 and 6 illustrate one form of apparatus in which a resilient elastomer insulation body for an electrical connector may be molded. These figures, as well as FIG. 8, illustrate a resilient insulation body **10** which is adapted to receive and support therein a multiplicity of pin contact terminals. A similar insulation body for receiving and supporting socket contact terminals is shown in FIG. 9, and will be described in detail hereinafter. It will be understood that both the external shape of insulation body **10** and the wall configuration of the terminal-receiving bores extending through insulation body **10**, will vary according to the type and shape of connector in which the insulation body is employed, and the type and configuration of the contact terminals which are mounted in the insulation body. Further, although the insulation bodies shown and described herein are particularly adapted for receiving pin and socket contact terminals, it will be appreciated that they may be adapted to receive other mating types of terminals, such as hermaphrodite terminals, within the scope of the invention.

The insulation body **10** may be molded from any desired resilient dielectric material; i.e., the material may be any desired elastomer insulation material. Examples of some suitable elastomer materials which may be used, but to which the present invention is not necessarily limited, are neoprene (polychloroprene), natural rubber, silicone, polyurethane, buna-S (butadiene-styrene type), buna-N (buna nitrite), or the like.

The resilient insulation body **10** may have a substantially uniform hardness throughout, or it may may have portions of different hardnesses as set forth in U.S. patent application Serial No. 95,770, filed February 27, 1961, for Multi-Hardness Resilient Connector Insulator. Although the present invention is not limited to the use of a resilient insulation material for the insulation body of any particular hardness, it has been found in practice that a preferred maximum hardness is about 85 (Shore Durometer), the hardness of the resilient insulation material being controlled by the amount and type of filler materials which are mixed in with the elastomer material.

The following is a formula which has been found acceptable for the molding of the resilient insulation body, and is set forth by way of example only, and not by way of limitation.

Table I below lists the ingredients and quantities thereof by weight which are combined to form a batch of the material for molding insulation body **10**. It will be appreciated that the size of this batch is merely a convenient one, and may be varied as desired, provided the relative weights of the ingredients in the batch are as indicated.

Table I

Ingredient:	Weight in pounds
Neoprene WRT	85.00
Stearic acid (rubber grade, such as Stearite)	1.00
Magnesium oxide (such as Maglite M)	4.00
Zinc oxide (lead free, as by the French Process)	5.00
Siliceous material (such as HiSil 233)	25.00
Hard clay (such as Suprex clay)	30.00
Paraffine wax	1.00
Polyethylene (such as Plaskon 8406)	2.00
Anti-oxidant (such as Aminox)	2.00
Ultra-marine blue (such as 1285 Blue)	0.50
Titanium dioxide (such as Unitane O–220)	5.00
Curing agent (such as NA–22)	1.00
Neoprene GN / Butaprene SL comprising an elastomer master batch	15.00
Black color master batch	1.00

The "black color master batch" in Table I comprises the following ingredients in the following relative proportions by weight: Neoprene GN, 100.00; coloring black (such as Wyex EPC Black), 50.00; sodium acetate, 1.00; and light oil (such as Bear Flex LPO), 5.00.

The Neoprene WRT, Neoprene GN and Butaprene SL provide the base polymer, while the stearic acid, magnesium oxide and zinc oxide are standard ingredients employed to modify the base polymer to provide desired physical characteristics in the final product. The siliceous material, HiSil 233, hardens and strengthens the final product, and the clay also acts to harden the product, so that the siliceous material and clay may together be considered as the "filler" serving to give the product the desired hardness.

The paraffine serves as a lubricant, primarily to wet the batch, while the polyethylene functions as a lubricant which helps release the cured product from the mold. The anti-oxidant limits oxidation of the end product.

The ultra-marine blue is a coloring agent which cooperates with the titanium dioxide, a white coloring material, and the "black color master batch," to produce a desired gray color for the final product.

The "elastomer master batch" is separately mixed because of the affinity of its two ingredients for each other; and the ingredients of the "black color master batch" are also separately mixed in a batch as a preferred means of preparing the "coloring black" so as to standardize the coloring of the product.

The preferred milling procedure for combining the ingredients set forth above in Table I is as follows: First, the "elastomer master batch" and the "black color master batch" are prepared. These "master batches, and also the final batch containing all of the materials, are preferably mixed on water cooled rolls. In preparing the "elastomer master batch" the procedure is preferably as follows: band the Neoprene GN on the mill rolls and mill in the Butaprene SL; and bring the mill roll temperature up to 180° F. minimum for fluxing of the Butaprene into the Neoprene.

The overall material batch is preferably prepared according to the following steps:

(1) Place the "elastomer master batch" and the "black color master batch" on tight mill rolls and blend together well by cutting back and forth.

(2) Add in Neoprene WRT and adjust mill roll opening for proper bank; blend well by cutting back and forth.

(3) Add the stearic acid and blend in.

(4) Add the magnesium oxide.

(5) Blend in the polyethylene.

(6) Blend in the anti-oxidant.

(7) Mill in the titanium dioxide and ultra-marine blue together.

contact-positioning web 28 so as to apply a coating of bonding material thereto.

Although the present invention is not limited to the use of any particular bonding agent or to any particular method of applying the bonding agent to the contact positioning web, the following is an example of a bonding agent and of the method of applying it which have proved useful in practice: First, the contact-positioning web 28 is washed in a suitable solvent, such as toluene, which both cleans and etches the surfaces of the web 28. Second, the web 28 is coated, as by spraying, with a primer coating which adheres well to the material of the web 28. A suitable primer has been found to be "Chemlock No. 203" which is oven-dried after application for about 10 minutes at about 200° F. to dry off its solvents. Next, a final coating is applied, as by spraying, of a material which adheres well both to the primer coating and to the elastomer material of the insulation body 10. A suitable final coating is "Chemlock No. 220," which again is dried for about 10 minutes at 200° F. to drive off its solvents. These coatings are essentially rubber-based cements. In practice, this coating of bonding agent is on the order of about two thousandths of an inch thick, and the openings in the stop rings 22 are provided slightly larger than the desired final opening sizes in order to compensate for the thickness of the coating of bonding agent. The contact-positioning web 28 may, for convenience, be left connected to its support 32 during the application of the coating of bonding agent, and then after the bonding agent has been applied and dried, the positioning web 28 may be broken away from the support 32 so that it can be placed in the mold as hereinafter described.

Referring now particularly to FIGS. 1, 5 and 6, the mold structure there shown is by way of illustration only, and it will be understood that different mold structures may be employed for accomplishing the same results, with contemplated production molds including moldable cavities and automatic actuating means.

The mold structure is disposed on a suitable table or base 36, the lower portion of the mold structure including a back-up plate 38 disposed on the table or base 36, with an insert holder plate 40 on top of back-up plate 38. The insert holder plate 40 supports a pin mounting insert 42 within which a multiplicity of core pin members 44 are mounted so as to project upwardly therefrom. Each of the core pin members 44 has a flat inner end surface 46 disposed at right angles to the axis of the core pin member, with a registry projection 48 extending axially from the flat end surface 46. Further, each core pin member 44 has a cylindrical end portion 50 terminating at the flat inner end surface 46, with a stop collar 52 just below this cylindrical end portion 50. The distance from stop collar 52 to the flat inner end surface 46 is substantially equal to the axial extent of each of the stop rings 22 forming a part of the contact positioning web 28.

Disposed above the insert holder plate 40 is a mold cavity plate 54 having a mold cavity 56 therein. The core pin members 44 extend only part way through the mold cavity 56.

Above mold cavity plate 54 is another insert holder plate 58 within which a pin mounting insert 60 is supported, the insert 60 serving to support a multiplicity of core pin members 62 which are axially aligned with respective core pin members 44. Each of the core pin members 62 has a flat inner end surface 64, with a registry recess 66 therein. In the assembled condition of the mold members as shown in FIG. 1 and FIG. 6, the flat inner end surfaces 46 and 64 of opposed pairs of the respective core pin members 44 and 62 will abut against each other, with the registry projections 48 entering respective registry recesses 66 for alignment of the core pin members. Thus, the core pins employed in the mold structure may be termed split core pins, in that each of them is divided into two sections which come into the mold cavity from opposite directions.

When the mold is open, with insert holder plate 58 and the structure above it removed from mold cavity plate 54, and after a preceding insulation body has been removed from the mold cavity, the contact positioning web 28 is set in the mold cavity 56 with each of the stop rings 22 slidably engaged over the cylindrical end portion 50 of a respective core pin member 44, in the manner shown in FIG. 5. In the contact positioning web 28 the center-to-center distances between the respective stop rings 22 are the same as the center-to-center distances between the respective core pin members 44, so that the contact positioning web 28 may be easily slipped into its operative position in the mold cavity as shown in FIG. 5. When the contact positioning web 28 is thus positioned in the mold cavity, the upper insert holder plate 58 is moved down flat against the mold cavity plate 54 as shown in FIGS. 1 and 6, and in this position of the mold parts the stop rings 22 will be accurately positioned in the mold cavity between the respective core pin stop collars 52 and the respective flat inner end surfaces 64.

The mold structure is completed by a back-up plate 68 above the insert holder plate 58, back-up plate 68 having a cylindrical recess 70 therein within which the elastomer material is placed for injection into the mold cavity. A sprue 72 extends down from the cylindrical recess 70, communicating with a runner or transfer passage 74 in mold cavity plate 54, which in turn communicates with a feeder port 76 through which the elastomer material enters into the mold cavity 56. A piston member 78 is slidable in the cylindrical recess 70, and is connected to a plunger 80 of a hydraulic press, so that downward movement of plunger 80 will force piston member 78 downwardly in the cylindrical recess 70 to force the elastomer material into the mold cavity.

The various parts of the mold may be aligned by any suitable means, as for example by a plurality of aligning dowels 82 which are disposed in respective openings 84 through the various parts of the mold structure.

When the elastomer material is thus injected into the mold cavity, it will flow about the rings 22 and connecting links 30 of the positioning web 28, so that the stop rings 22 will be securely bonded to the elastomer material.

The pressure for injecting the elastomer material into the mold is on the order of between about 2000 p.s.i. and about 4000 p.s.i.

Removal of the insulation body 10 from the mold is effected by separation of the required mold parts, the core pin members 44 being withdrawn from the rear end of the insulation body, and the core pin members 62 being withdrawn from the forward end of the insulation body. The resiliency of the insulation body 10 will permit flexing of the insulation material in the region of the terminal-receiving bores 16 to permit this withdrawal of the core pin members, and by placing the stop ring members 22 at the juncture between the opposed core pin members 44 and 62, the substantially rigid rings 22 will not interfere with this withdrawal of the core pin members.

One of the characteristics of most elastomer materials is that they undergo a substantial amount of shrinkage when they cool. A typical example of this shrinkage is approximately 18 thousandths of an inch of shrinkage per inch of the part during cooling from the range of about 300° to 320° F. down to room temperature. By providing the thin, relatively weak connecting links or bridging members 30 between the stop rings 22 in the contact-positioning web 28, the stop rings 22 are permitted to shift slightly toward each other during the shrinkage of the elastomer material, so that the stop rings 22 in the final cooled part will be correctly aligned in their respective terminal-receiving bores 16. Thus, dur-

(8) Blend in the silicious material (HiSil 233), clay, and paraffine (cut into small pieces).

(9) Blend the zinc oxide in well.

(10) Next, the curing agent is milled in well. However, if the batch has become too hot before adding the curing agent, cut the batch off of the rolls and allow to cool before adding the curing agent and milling it in on the rolls. After the curing agent is milled in well, cut the batch off of the rolls, tighten the rolls, and then roll up the batch and pass it through the rolls endwise, doing this preferably from 6 to 8 times. Then, open the rolls and sheet the material off approximately ¼ inch thick.

The curing temperature of the mold is preferably between about 300° F. and 320° F. The molding time from injection of the material until removal of the completed insulator body from the mold is preferably from about 9 to about 12 minutes.

The completed elastomer insulator produced according to the above formula has the following physical properties:

Table II

Shore A hardness	81
Tensile strength (p.s.i.)	2320
Elongation percentage	565
Tear strength (Die B)	275
Mooney Scorch to 10 point rise at 250° F., minutes	9½
Plasticity	72

Although only a single formula has been set forth herein in detail for the preparation of the elastomer material comprising insulation body **10**, it will be apparent that those skilled in the art can, from the above example, readily produce the present insulators of various elastomer materials and with various hardnesses as may be required for different types of electrical connectors.

The insulation body **10** which is molded in the apparatus of FIGS. 1, 5 and 6 has a forward face **12** and a rearward face **14**, with a multiplicity of parallel terminal-receiving bores **16** extending axially through body **10** from the rearward face **14** to the forward face **12**. Each of the terminal-receiving bores **16** has at least one forwardly facing annular shoulder therein which is engageable by a rearwardly facing shoulder on a respective contact terminal when the contact terminal is inserted into the bore to position the terminal against rearward movement in the insulation body. In the particular insulation body **10** which is shown in the drawings, there is the forwardly facing shoulder **18** in the bore which serves this function. Although only one such forwardly facing shoulder is required in the bore for positioning the terminal against rearward movement, in the particular bore configuration shown in the drawings there is a second forwardly facing shoulder **20** in the bore which also assists in holding the contact terminal against rearward movement.

A multiplicity of substantially rigid stop rings **22** are molded into the insulation body **10** so as to be generally circumferentially positioned within the respective terminal-receiving bores **16**. Each of these substantially rigid stop rings **22** has an exposed, rearwardly facing annular shoulder **24** in its respective bore **16** which is engageable by a forwardly facing shoulder on the terminal member so as to limit forward positioning of the terminal member in the bore. The applicant's new method and structure for securing these rigid stop rings **22** in their operative positions in the respective terminal-receiving bores **16** comprise important parts of the present invention.

The stop rings **22** in the respective bores provide substantially rigid stop means against which the contact terminals will seat when they are pushed into their operative positions in the insulation body. The stop rings **22** thus provide reliable positioners for the contact terminals. The hardness of the rigid stop rings **22** causes an audible click noise to be heard when each contact terminal reaches its final position as defined by the respective rigid stop ring **22**, release of flexed or compressed resilient material of the insulation body when the contact terminal arrives at this final position helping to drive the contact against the shoulder of the stop ring **22**. In addition to this positive axial positioning of the contact terminals by the rigid stop rings **22**, the stop rings also assist in final contact stabltiy by limiting lateral shifting of the contact terminals in their respective bores.

Although the rigid stop rings **22** will normally be employed to arrest forward axial movement of contact terminals which have ben inserted into the insulation body bores from the rear, it will be apparent that the rigid stop rings **22** can also be employed to limit rearward movement of contact terminals of the forward entry type which are inserted from the forward ends of the bores.

The inside diameters of the rings **22** as they are finally molded into position in the insulation body **10** are slightly larger than complementary cylindrical wall portions of the respective contact terminals, and the ends of the passages which extend through the stop rings **22** are preferably radiused or chamfered so as to facilitate entry of the contact terminals therethrough.

Each of the terminal-receiving bores **16** of insulation body **10** is preferably provided with a constriction **26** in the rear portion of the insulation body which resiliently engages either the conductor from the contact or a rear portion of the contact itself for sealing purposes.

An important part of the present invention is the provision of a unitary contact-positioning web **28** comprising all of the substantially rigid stop rings **22** for the insulation body **10** and a plurality of connecting links or bridging members **30** between the stop rings **22** which fix the positions of the stop rings with respect to each other for insertion and positioning of the stop rings **22** in the mold. The connecting links or bridging members **30** are made considerably thinner and weaker than the bodies of the stop rings **22**, and a minimum number of these connecting links **30** is provided, so that the connecting links can break or shrink or bend when the molded insulation body shrinks as it cools after it is removed from the mold. The contact-positioning web **28** which is illustrated in FIGS. 2 and 3 and which is employed in the mold structure shown in FIGS. 1, 5 and 6 includes only four of the stop rings **22**, so as to simplify the drawings as they relate to the molding process. However, in many instances there will be a much larger number of the stop rings **22** formed in the contact-poitioning web **28**. For example, in the contact-positioning web **34** which is shown in plan view in FIG. 4, **55** of the stop rings **22** are provided.

The contact-positioning web **28** is preferably composed of a substantially rigid insulating material which has high dielectric characteristics. It is preferred to employ a material which has dielectric characteristics that are as good as, or better than, those of the elastomer material in the insulation body **10**. Presently preferred materials for the contact positioning web **28**, to which the present invention is not necessarily limited, are nylon, Lexan and Delrin (Lexan and Delrin being well-known proprietary compositions), these materials having a hardness within the region of from about 107 to about 120 Rockwell R. These presently preferred materials are thermoplastic materials, and with such material the web **28** can be produced by injection molding if desired. Thermosetting materials could also be employed for the web **28**.

Where the web **28** is made by injection molding, it is sometimes useful to retain some of the extra molded material which was in the feed channels of the mold as a support **32** for handling the web **28** during preparation of the web **28** for the process of molding insulation body **10**.

It is important that the substantially rigid stop rings **22** be bonded to the elastomer material of insulation body **10** during the process of molding the insulation body **10**, and in order to effect such a bond, it is preferable to treat the

ing shrinkage of the insulation body **10** as it cools, the thin connecting links **30** will bend or warp or break as required, and will not obstruct the required movement of the stop rings **22** with the shrinking insulation body. Accordingly, it is by means of the relatively thin and weak connecting links **30** that the contact positioning web **28** is permitted to be slipped freely over the ends of the core pin members **44** in the mold, accurately registering with these core pin members, while the substantially rigid stop rings **22** are properly aligned in their respective terminal-receiving bores **16** when the final part has cooled to room temperature.

The core pin members are preferably provided with hard surface finishes, as for example chrome plated finishes, so that the bonding agent employed on the stop rings **22** will not adhere to the core pins and thus cause damage when the core pin members are extracted after the insulation body **10** has been molded.

It is to be noted that the contact positioning web **28** provides an accurate check for the positioning of the core pins when it is placed in its operative position as shown in FIG. 5. If any of the core pin members **44** are bent out of alignment, the web **28** will not fit as it should.

If the contact-positioning web **28** were composed of a thermosetting plastic material, the coating of bonding material could probably be eliminated. The thermosetting web **28** in this case would only be partially cured when formed, and would be in this partially cured condition when placed in position as shown in FIG. 5 ready for the molding of the insulation body **10**. Then, during the curing of the insulation body **10**, curing agents in the elastomer material would assist in completing the cure of the thermosetting material of the contact positioning web **28**.

In FIG. 8 a pin contact terminal is shown operatively positioned in one of the contact terminal-receiving bores **16** of insulation body **10**. This pin contact terminal **86** has a contacting portion **88** which projects forwardly from the forward face **12** of the insulation body, and has a forward enlarged portion **90** which presents a rearwardly facing shoulder that is engageable against the forwardly facing shoulder **18** in the bore **16** to secure the terminal **86** against rearward axial movement in the bore. The pin contact terminal **86** also includes an annular collar **92** which presents a forwardly facing shoulder that strikes the rearwardly facing shoulder **24** of stop ring **22** so as to limit forward positioning of the contact terminal **86** when terminal **86** is inserted into the bore **16** from the rear of the insulation body. Collar **92** also presents a rearwardly facing shoulder which will engage against the forwardly facing shoulder **20** to assist in preventing rearward axial movement of the terminal. The terminal **86** also includes a rear cup or sleeve portion **94** within which the exposed conductor of a wire **96** is secured, as by crimping, soldering, welding or the like, to effect electrical and mechanical connection.

FIG. 9 illustrates an insulation body **10*a*** having bores **16*a*** therethrough which receive respective socket contact terminals **86*a***, the socket contact terminals **86*a*** being inserted into the bores **16*a*** from the rearward face **14*a*** of the insulation body **10*a***.

Bores **16*a*** are the same in configuration as bores **16** of insulation body **10**, except for an elongated forward cavity portion **98** of each bore to the rear of the forward face **12*a***. Each socket contact terminal **86*a*** has a tubular forward contact portion **88*a*** within which an opposed forward contacting portion **88** of a pin contact terminal **86** will mate. The insulation body **10*a*** is molded in the same manner as insulation body **10**, and contact positioning web **28** with its substantially rigid stop rings **22** is molded into insulation body **10*a*** in a similar position as in insulation body **10** so as to cooperate with the socket contact terminal **86*a*** in the same manner as with the pin contact terminal **86**.

FIGS. 10 and 11 illustrate a modified insulation body **10*b*** having a plurality of bores **16*b*** therethrough which are adapted to receive pin contact terminals **86**. The insulation body **10*b*** is molded in the same manner as insulation body **10**, with a contact positioning web **28*b*** molded therein. However, the substantially rigid stop rings **22*b*** differ from stop rings **22** in that each of the stop rings **22*b*** has integrally formed therewith a plurality of forwardly, generally axially extending spring fingers **100**. The spring fingers **100** as illustrated in FIGS. 10 and 11 are three in number, and each includes a section **102** which inclines forwardly and radially inwardly, an offset portion **104** extending radially outwardly from the forward end of each of the inclined sections **102**, and a straight axial section **106** at its forward end. The offset portion **104** presents a forwardly facing shoulder **108**.

The operation of the structure shown in FIGS. 10 and 11 is as follows: When a pin contact terminal **86** is inserted into bore **16*b*** from the rear, the forward enlarged portion **90** will engage against the inclined sections **102** of the fingers **100**, camming the fingers radially outwardly so that the enlarged contact portion **90** can pass between the fingers to a point just forward of the forwardly facing finger shoulders **108**, which is the position of the enlarged contact portion **90** when the collar **92** of the contact strikes the rearwardly facing shoulder **24** of the substantially rigid stop ring **22*b***. This outward camming of the spring fingers **100** is permitted by virtue of the fact that the spring fingers are backed up by the resilient elastomer insulation body material, and when the enlarged contact portion **90** passes forwardly in front of the finger shoulders **108**, the fingers will snap back radially inwardly so that the shoulder **108** will then be behind the enlarged contact portion **90** to provide a positive stop means against withdrawal of the contact **86**.

It will be noted from FIG. 10 that the forwardly facing shoulders **108** of the spring fingers **100** are generally disposed in a radial plane, and with this construction the fingers **100** will normally have to be flexed radially outwardly by a suitable tool inserted into bore **16*b*** from the forward end of the insulation body in order to remove the contact terminal rearwardly out of the bore.

The structure shown in FIG. 12 is similar to that of FIGS. 10 and 11, with similar parts designated by reference character "*c*" instead of "*b*". However, the shoulders **108*c*** on the spring fingers **100*c*** in FIG. 12 differ from the corresponding shoulders **108** in FIG. 10 by being inclined forwardly and radially outwardly so that upon the application of a predetermined amount of rearward force to the contact terminal, the terminal will cam the fingers **100*c*** radially outwardly for removal of the terminal from the bore without requiring the use of a front entry tool.

While the instant invention has been shown and described herein in what are conceived to be the most practical and preferred embodiments, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims.

I claim:

1. An electrical connector insulator which comprises a body of resilient insulation material having a plurality of parallel contact terminal-receiving bores extending entirely therethrough, and a contact-positioning web composed of insulation material bonded within said body said contact-positioning web comprising a plurality of annular substantially rigid stop members and a plurality of bridging members, said stop members presenting stop shoulders in the respective bores intermediate the ends of the bores which are engageable against opposed shoulders on respective contact terminals inserted in said bores to limit axial movement of the contact terminals in one direction in the bores.

2. An electrical connector insulator as defined in claim

1, wherein said bridging members are substantially weaker than said stop members.

3. An electrical connector insulator as defined in claim 1, wherein said stop members and bridging members are substantially coplanar in a plane disposed at right angles to the axes of said bores.

4. An electrical connector insulator which comprises a body of insulation material having a forward face and a rearward face and having a plurality of parallel contact terminal-receiving bores extending therethrough from said rearward face to said forward face, and a contact positioning web composed of insulation material bonded within said body, said contact positioning web including a plurality of substantially rigid stop rings and a plurality of bridging members connecting said rings, said stop rings presenting rearwardly facing annular shoulders in the respective bores intermediate the ends of the bores which are engageable against forwardly facing opposed shoulders on a plurality of contact terminals to limit forward positioning of the contact terminals upon insertion of the terminals into the respective bores from the rear of the insulation body, each of said stop rings having a plurality of integral spring fingers extending forwardly and radially inwardly therefrom, each spring finger having a shoulder thereon which faces forwardly in the bore, said spring fingers being cammed radially outwardly by a projection on each contact terminal and then springing radially inwardly behind the projection on the terminal to limit rearward movement of the terminal when the terminal is moved forwardly into its forwardmost position.

5. An electrical connector insulator which comprises a body of resilient insulation material having a forward face and a rearward face and having a plurality of parallel contact terminal-receiving bores extending therethrough from said rearward face to said forward face, and a contact-positioning web composed of insulation material bonded within said body intermediate the faces of said body and disposed in a general plane transverse of the axes of the bore, said web including a plurality of stop rings having substantially greater rigidity than the material of the body and a plurality of bridging members connecting said rings, said rings being disposed in circumscribing relationship with the respective bores and presenting annular shoulders in the respective bores intermediate the ends of the bores which are engageable against opposed shoulders on a plurality of contact terminals to block movement and limit the positioning of the contact terminals upon insertion of the contact terminals into the respective bores of the insulation body.

6. An electrical connector insulator as defined in claim 5 wherein the stop rings are closely spaced in a symmetrical pattern.

7. In an electrical connector which comprises a body of resilient insulation material having a forward face and a rearward face and having a plurality of parallel contact terminal-receiving bores extending therethrough from said rearward face to said forward face, a unitary contact-positioning web bonded within said body intermediate the faces of said body during the formation of the body and disposed in a general plane transverse of the axes of the bore, said web being entirely composed of insulation material of substantially greater rigidity than the material of the body and comprising a plurality of stop rings closely spaced in a pattern corresponding to the transverse pattern of the bores, said rings being in circumscribing relationship with the respective bores and presenting annular shoulders in the respective bores intermediate the ends of the bores which are engageable against opposed shoulders on a plurality of contact terminals to block movement and limit the positioning of the contact terminals upon insertion of the latter into the respective bores, said web including bridging elements initially interconnecting said stop rings and retaining the same in said pattern during formation of the body, and said bridging elements being deformable or shearable under stresses tending to change relative transverse positioning of stop rings during formation of the body.

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