Oct. 29, 1968 A. GREENBAUM 3,408,616

INSULATION PIERCING ELECTRICAL CONNECTORS

Filed April 21, 1966

4 Sheets-Sheet 1

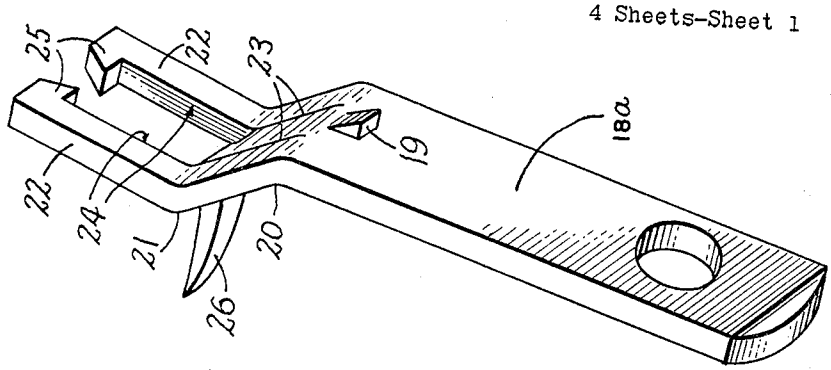
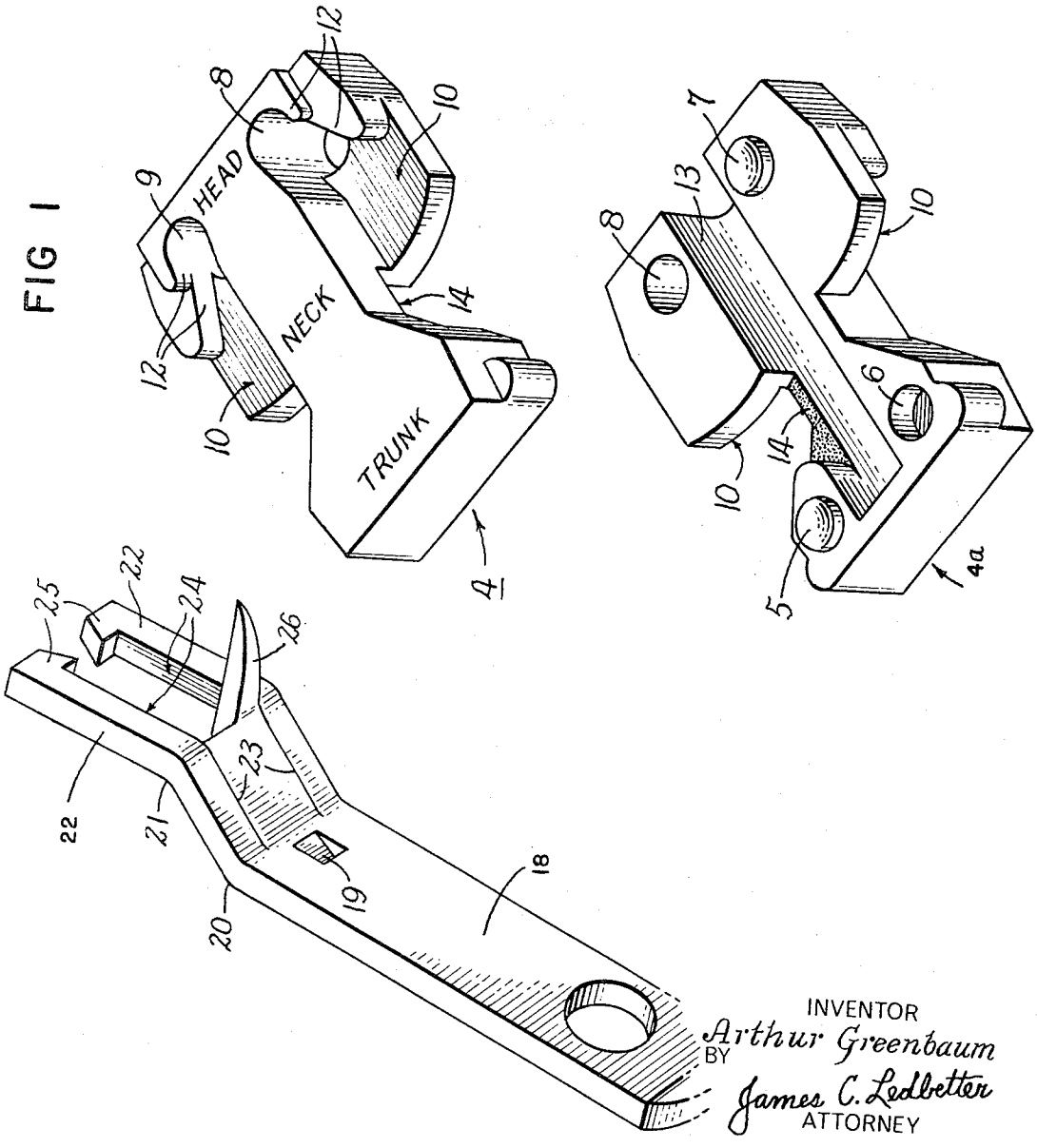


FIG 1



INVENTOR
Arthur Greenbaum
BY
James C. Ledbetter
ATTORNEY

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FIG 2

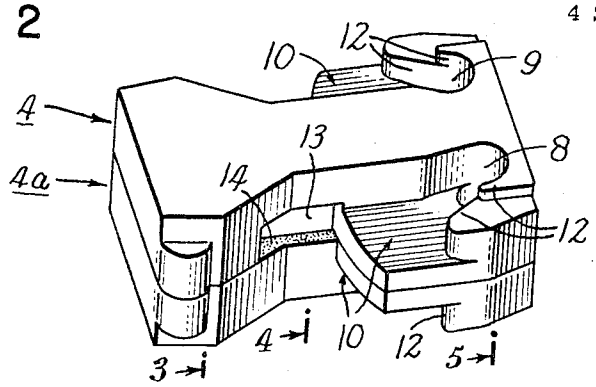

FIG 3

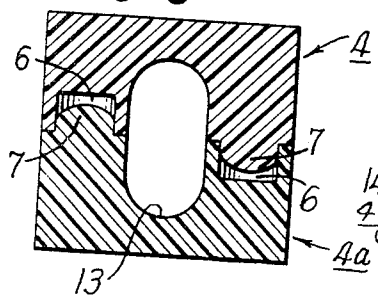

FIG 4

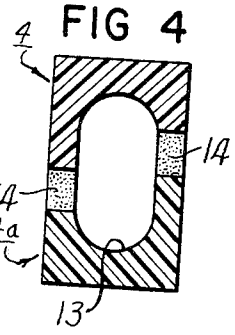

FIG 5

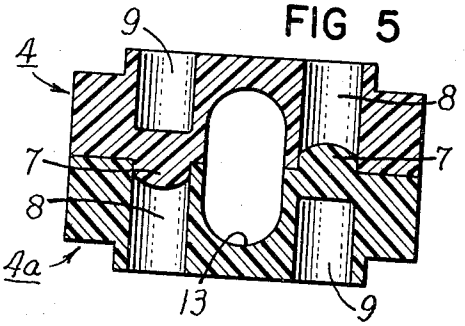

FIG 6A

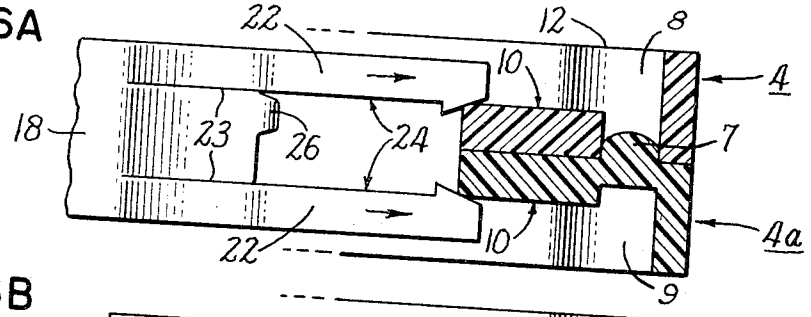

FIG 6B

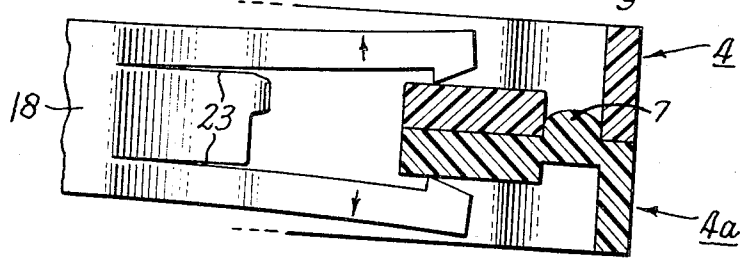

FIG 6C

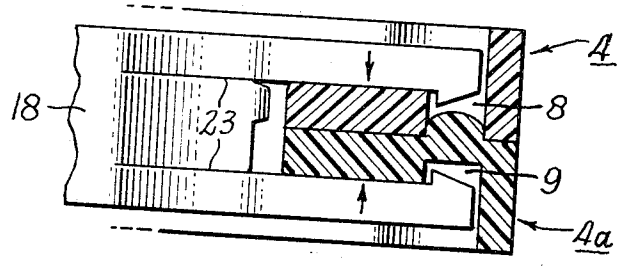

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FIG 7

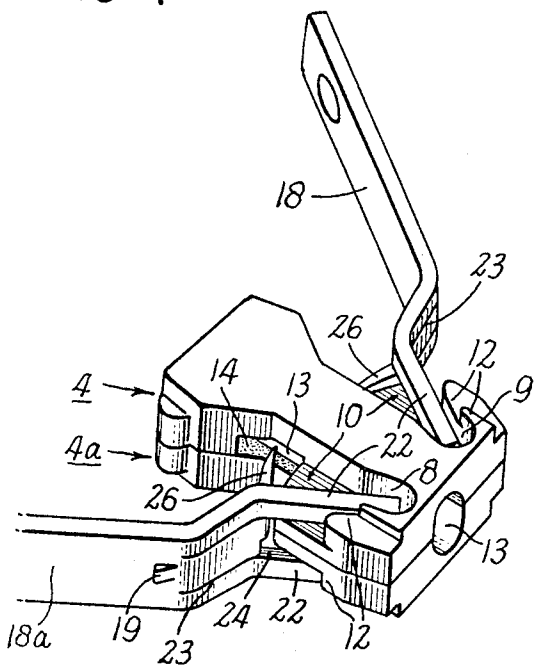

FIG 8

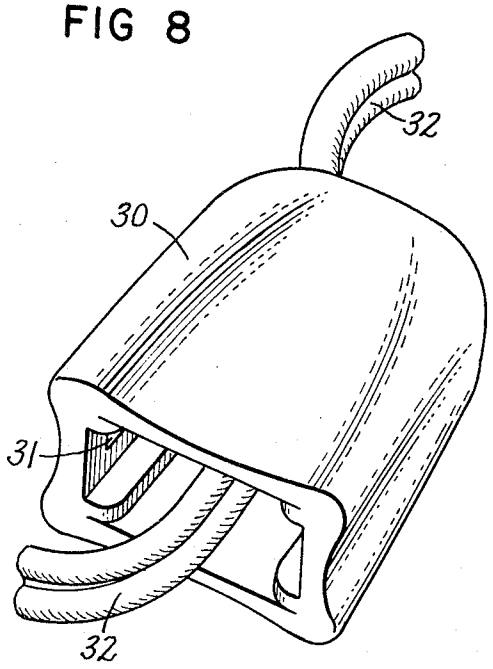

FIG 9

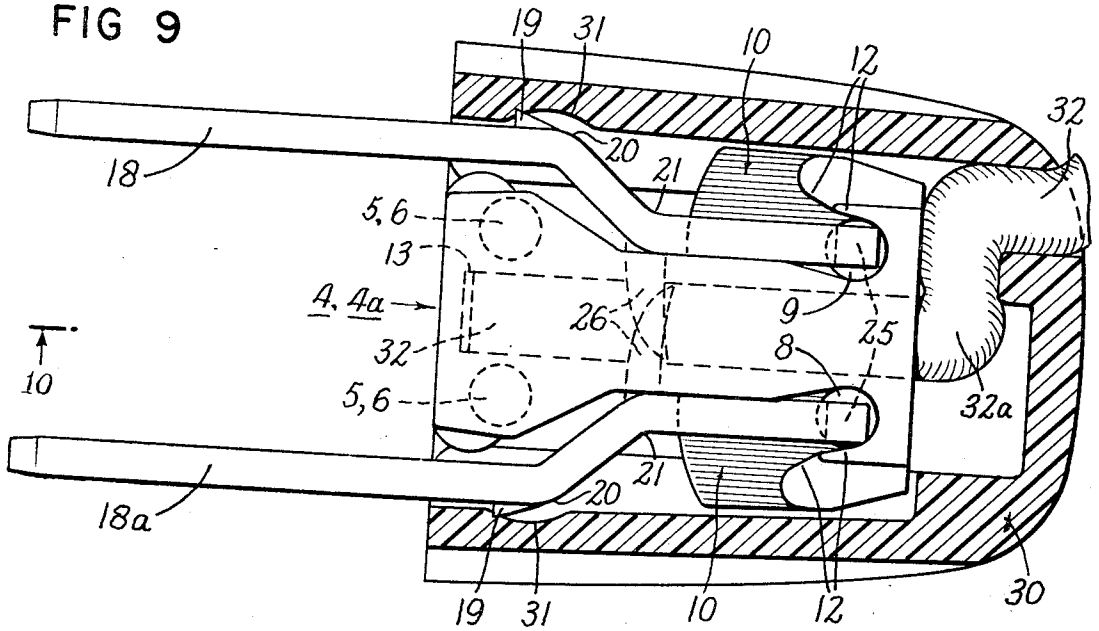

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FIG 10

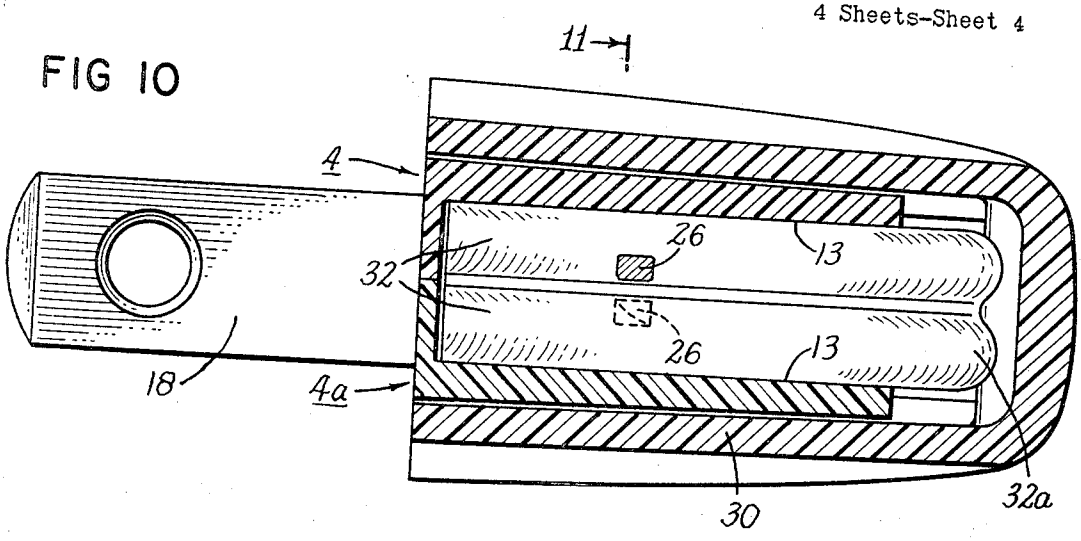
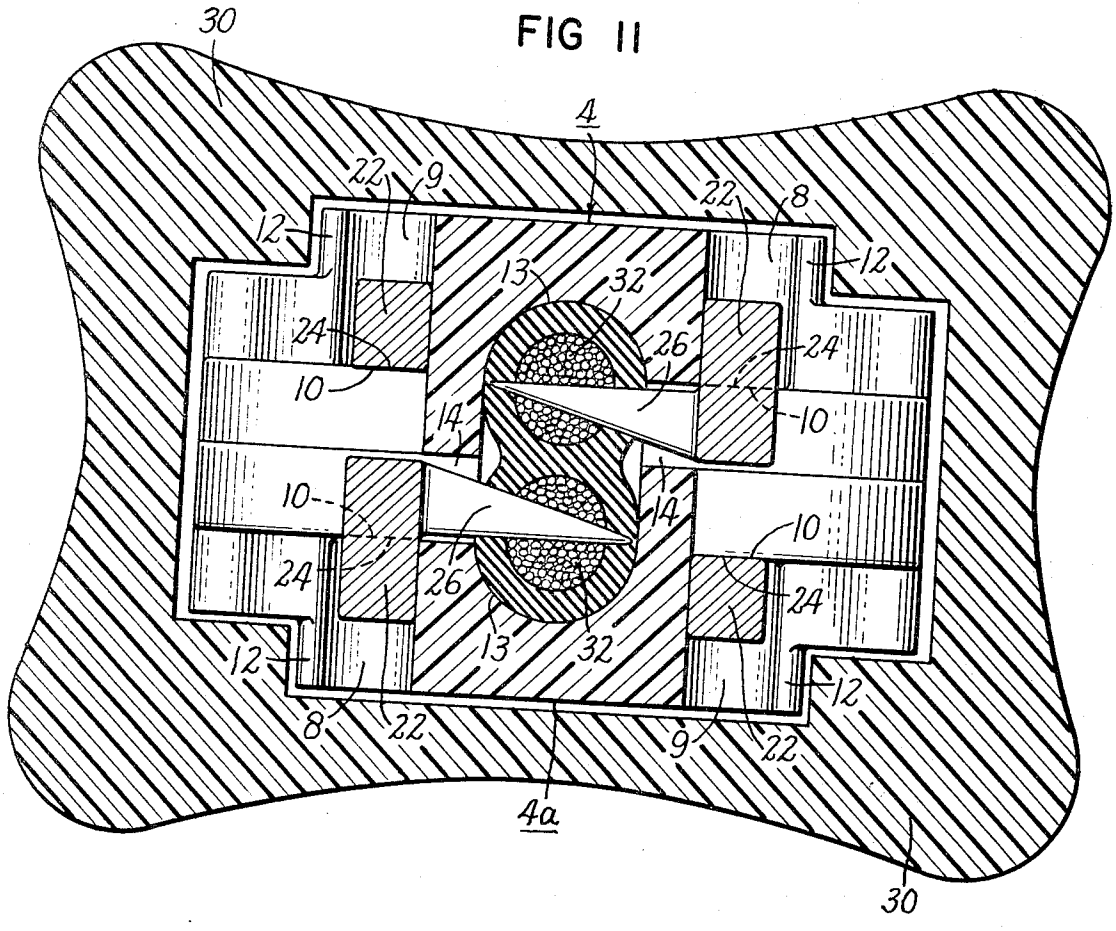


FIG 11



United States Patent Office 3,408,616 Patented Oct. 29, 1968

3,408,616

INSULATION PIERCING ELECTRICAL CONNECTORS

Arthur Greenbaum, Scarsdale, N.Y. (% Academy Electrical Products Corp., 3842 9th Ave., New York, N.Y. 10034)

Filed Apr. 21, 1966, Ser. No. 544,304
8 Claims. (Cl. 339—99)

ABSTRACT OF THE DISCLOSURE

This invention provides a new electrical connector of the insulation-piercing type, which automatically makes its connection with a flexible electrical conductor by probing the dielectric covering and pressure-impaling the wire strands thereof. Accordingly, the wire strands are not de-insulated, and a tool is not used, when attaching this type of electrical connector to an insulated flexible conductor cord.

Statement of invention

The invention is exemplified by an electrical male terminal commonly known as a cord plug, which is adapted to make a detachable plug-in connection with ordinary current supply outlet receptacles. Although presented as a terminal, the inventive principle herein is also applicable to splice and tap connectors. Thus, the invention may be used to improve all three known species of electrical connectors, i.e., terminals, taps, and splicers.

The present invention provides improvements over my old connector, of the cord plug type, as covered in my prior Patent 2,769,154, granted Oct. 30, 1956. The old connector is manufactured and sold under the trademark "Academy."

The purpose of this invention is to improve the construction and mode of operation of the old automatic "wiring-core" shown in FIG. 1 of my prior Patent 2,769,-154 and preliminarily described in column 2, lines 64 to 69 thereof.

Two each of both old twin parts (the body part **11**, as well as the lever-type, plug-in, contact blade **3**, likewise two rivets, hence six parts), are required in the manufacture of the old "riveted wiring-core" (FIG. 1 in the patent). It is now improved and made "Rivetless," as shown in the accompanying drawings and briefed in the "first" and "second" summaries, the next two topics, as follows:

Old body part 11 changed to new body part 4

First, in implementing the aforesaid purposes, the molded plastic old body part **11** (FIG. 1 in the patent) is reformed to provide a new body part (two required), which is characterized by:

(1) Eliminating the two rivets that heretofore held the two old twin body half parts **11** together;

(2) Reforming the molded shape of the old body part **11**, to produce the new twin body half parts, numbered **4** and **4***a* herein;

(3) Providing improved centering means which positions (aligns) two of the new body parts (twins) in mating relation, preliminary to being clamped together without rivets, to form a new two-part rivetless body unit **4** and **4***a*;

(4) Providing two new pivot bearings at the rear end of the new body part; since two body parts (duplicates) are required to complete the new body unit as a whole, it follows that four new pivot bearings are provided;

(5) So arranging the aforesaid "centering means" in a unique manner that a simplified dual function is achieved, to-wit: serving as a centering (aligning) means per se, and also as pivot bearings;

(6) Also, forming two new arm-pockets on the new body part, at the rear end thereof, each arm-pocket being concentric with its respective pivot bearing; since two pivot bearings are molded into the body part and two of the latter are required, it follows that four arm-pockets are embodied in this new two-part body unit;

(7) Also, providing two new surface slide-bearings on the new body that coact with said two new pivot bearings; since a complete body unit has four pivot bearings, it follows that four surface slide-bearings are provided in said new two-part body.

The foregoing seven (7) features, specific to the new body part, provide a better mating relation when two thereof (twin parts) are placed together. Also, the omission of the two old rivets eliminates the strain and clinching pressure thereof and, moreover, saves the expense of maintenance and exactness in adjustment of the automatic riveting machines used in the manufacture of the old wiring-core (FIG. 1 in my prior patent).

Note that the two old rivets (now omitted), clause (1), are not numbered in my prior patent, but the two rivets are shown in the bottom left hand and at the top right hand corners of old FIG. 1 and are also shown in section in FIG. 9 and other views of my prior patent.

Old contact blade 3 changed to new contact blade 18

Second, in further implementing the aforesaid purpose, the die-formed old lever-type, plug-in, contact blade **3** (FIG. 1 in the patent), is reconstructed to provide a new contact blade **18** (two required), which is characterized by:

(1) Providing a new clamping yoke on the inner (rear) end of the old contact blade **3** to produce the new contact blade **18** herein, which cooperates with the new plastic body noted in the previous summary topic;

(2) Providing the clamping yoke with two parallel arms that clamp the twin body parts together; since there are two new contact blades (twins), it follows that there are four clamping arms which positively clamp the body parts together, thus effectively performing the function of the omitted rivets;

(3) Each parallel clamping arm is provided with a new pivot trunnion, hence four trunnions, that articulate in the pivot bearings of the new two-part body;

(4) Each parallel clamping arm, four arms, has an inner edge slide-bearing that rides on its respective surface slide-bearing of the two-part body. Accordingly, these eight slide-bearings (four on the two-part body and four on the two contact blades) serve a new function, that of guiding the two new articulated contact blades with such exactness that their two old pressure-impaling barbs (**9** in FIG. 1 of the patent) are precisely held to the planes of the respective wire strands of the two-wire conductor and, thereby, are assured of making pierced-pressure contact, at or near the center of the conductor strands.

The foregoing eleven new features, summarized in these two topics, now provide a new "rivetless wiring-core" of less parts, having a more exact and stable mode of pressure closing operation for the new twin lever-type contact blades. These several features simplify factory production, reduce the cost of manufacture, improve the automatic machine assembly, and enhance the utility of the connector.

Next, it is pointed out that the old piercing barb **9** and the old slide-on cap **22** (FIGS. 1 and 9 in the patent) are embodied in my new connector herein.

Significantly, the "first" and "second" summary topics include sixteen (16) "bearings means," as such, embodied in the four parts of this new wiring-core. Their structural coacting interrelation achieves the dual purposes of

(a) Permanently holding the four new wiring-core parts

together, without rivets, thereby solving the "rivet" problem; and

(b) Also, guiding the articulated twin barbs in their exact planes of closing movement which pierces, with certainty, at or close to the center of the wire strands of the conductor, thereby improving the mode of operation.

In general, this new wiring-core comprises one molded dielectric (plastic) body part and one die-formed lever-type plug-in, contact blade, hence two parts. However, since two of each part are required, my new wiring-core assembly comprises four parts. They are self-captive, i.e., hold each other together and cannot readily be taken apart, unless broken.

The new twin contact blades extend forwardly from the front end of the rivetless wiring-core, and my old dielectric slide-on cap is pushed onto its rear end and encloses the parts.

The drawings

The accompanying four sheets of drawings are made from a specimen adapted for production and enlarged for clarity on a scale somewhat more than three times actual size.

FIGS. 1 to 7 illustrate the new wiring-core; and FIGS. 8 to 11 show the connector made complete by mounting the old slide-on cap (of my prior patent) on the new wiring-core.

FIG. 1 (sheet 1) illustrates the four components in spaced-apart assembly alignment.

The next group of four views shows the molded twin body parts (noted centrally in FIG. 1) placed in face to face position, with a "centering means" of one twin disposed in the "centering means" of the other.

By "centering means" is meant an arrangement of two sockets and two bosses, in staggered relation, on the inner faces of the twin body parts which register and snugly interfit with each other to align and hold the twin body parts against sliding displacement, preparatory, to being clamped together.

FIG. 2 shows the molded twin body parts of FIG. 1 stacked together, thus a complete two-part body unit. The left hand portion (small end) is the front end and may be referred to as the "trunk." The central portion is the "neck." And the right hand end (large end) is the "head" constituting the rear portion of the wiring-core.

FIG. 3 is a transverse section on the line **3** at the front end of FIG. 2, showing the "trunk" centering means.

FIG. 4 is a transverse section through the "neck" on the line **4** of FIG. 2, showing a barb opening into the wire passage, one barb opening on each side of the two-part body.

FIG. 5 is a transverse section on the line **5** of FIG. 2 at the rear end through the "head," showing a coaxial unique arrangement of combined centering means and pivot bearings.

The next three are action views, three assembly steps, which demonstrate how a clamping yoke, its two arms, formed on the rear (inner) end of each articulated twin lever-type, contact blade, is mounted on the two mated twin body parts to permanently clamp them together.

FIG. 6A shows the first assembly step. The two parallel clamping arms are being started into clamping and articulated position onto the aforesaid surface slide-bearings of the two-part body. The horizontal arrows on the arms show the direction of force applied (either manually or by an assemblying machine), that pushes them into final position; and

FIG. 6B shows the two clamping yoke arms elastically stressed apart "edgewise" in the direction of the arrows (without exceeding their elastic limits), and they are sliding rearwardly on the surface slide-bearings of the two-part body; while finally

FIG. 6C shows that the two yoke clamping arms have reached their final position and have spring snapped their pivot trunnions into the two pivot bearings of the mated body parts, for irremovably clamping them together. Thus, rivets are not required in the assembly of the completed wiring core.

Note that the preceding three views show the method of clampingly mounting one twin contact blade on the new two-part body, and that the other twin contact blade is mounted in the same way. In manufacture, both contact blades may be pushed into final articulated clamping position at one time by an automatic assembling machine.

FIG. 7 shows the completed assembly of my new "rivetless" wiring-core, which may now be compared to the old "riveted" wiring-core (FIG. 1 in my prior patent). The contact blades are open in readiness to receive the blunt end of a two stranded-wire, insulation-covered, flexible conductor cord.

FIG. 8 shows my old slide-on cap, with the conductor cord inserted through it. The end of the wire, protruding through the cap, is about to be inserted into the new wiring-core shown in FIG. 7. Thereupon, the twin lever-type contact blades are closed by thumb-and-forefinger pressure. The old slide-on cap is then pushed onto the wiring-core and snubs the conductor cord for strain relief, as in the next view.

FIG. 9 is a lengthwise section of the complete connector, looking down on the edges of the twin lever-type contact blades. The old slide-on cap is in section, the new wiring-core in elevation, and the flexible conductor cord is snubbed in place.

FIG. 10 is a lengthwise section on line **10** of FIG. 9, looking sidewise at the flat surface of one of the contact blades.

FIG. 11 is a greatly enlarged transverse section on line **11** of FIG. 10 through the neck of the mated body parts. This view shows the exactness with which the aforesaid slide-bearings serve to precisely guide the two articulated contact barbs into pressure-piercing electrical connection with the respective insulation-covered wire strands of a two-wire conductor.

The foregoing specification discloses the invention, but a brief detailed description is next made by further references to the part numbers and legends on the drawings.

New body part 4 and its duplicate body 4a

In the drawings, the new body part **4** is molded of hard dielectric plastic, with an enlarged rear end (the head), also a reduced size central portion (a neck), and front end portion (a trunk). Its mate or twin part **4a** is identical. Accordingly, the part numbers are the same on the two body halves, except for **4a** on one of the twins for identification in this description.

A centering boss **5** and a centering socket **6** are molded on and in the inner face of the trunk, i.e., the front smaller end of the body parts **4** and **4a**. It is seen that if the two inner faces are placed together (FIGS. 2 and 3), that the boss **5** of part **4** snugly fits into the socket **6** of part **4a**. Thus **5** and **6** constitute a "centering means" for aligning the twin body parts at their front ends, thereby preventing relative sliding displacement between the two body halves **4** and **4a**, which form a complete two-part body unit.

The head (enlarged rear end) is likewise provided with centering means for aligning the mated twin body parts **4** and **4a**, and significantly, also for serving as pivot bearings which swingably mount the twin lever-type contact blades (as in FIG. 7). Thus, the centering means in the head (next paragraph) perform two functions, whereas the boss **5** and socket **6** in the trunk (previous paragraph) perform one function.

Accordingly, a boss **7** (FIG. 5) is molded on the inner face of the head of the body part **4** and snugly fits into the inner end of a "thru-hole" **8**. The outer end of this thru-hole **8** provides a pivot bearing. Also, a pivot bearing recess **9** is molded in the outer face of the body **4**, coaxially with the boss **7**.

Note, therefore, that the boss **7** and the inner end, only, of the thru-hole **8** constitute the centering means for the

two head portions (rear ends) of the twin bodies **4** and **4***a*. It is noteworthy that the thru-hole **8** serves both as a centering means and as a pivot bearing.

Significantly, the outer end, only, of the thru-hole **8** (FIGS. 5, 6A, B, C) and the entire portion of bearing recess **9** constitute companion pivot bearings, in which the twin contact blades are articulated (note FIG. 6C), as explained in the next topic.

Further, it is observed that the bosses **5** and **7**, at opposite ends of the body **4**, are spaced in staggered relation to the lengthwise axis thereof. And this is also true of the socket **6** and the thru-hole **8**. This staggered arrangement is best observed in FIG. 1.

The next feature, in the head portion of the body **4**, comprises two flat surface slide-bearings **10**, symmetrically formed on each side and of less thickness than the neck, also extending outward and forward from the thru-hole pivot bearing **8** and the recess bearing **9**. These two slide-bearings **10** are surface shaded for identity.

The twin surface slide-bearings **10** are formed on the plane of the longitudinal axis of the body **4**. When the twin bodies **4** and **4***a* are mated together (FIGS. 2 and 11), it is seen that the complete two-part body provides four surface slide-bearings **10** (shaded), and that they are precisely parallel (FIG. 11). These four slide bearings coact with articulating contact blades, described in the next topic.

Two arm-pockets **12** are formed on the outer surface of the head, one concentric with the thru-hole bearing **8**, and the other concentric with the bearing recess **9**. Each arm-pocket **12** extends upward from its surface slide-bearing **10** and has a top surface flush with the outer face of the body **4**. The arm pockets are formed with a space which opens toward its surface slide-bearing **10** and is adapted in depth to receive and hold one of the clamping arms of the twin lever-type, plug-in contact blades, later described.

A wire channel **13** opens at the center of the rear end (the head) of the two-part body **4** and **4***a*. See FIGS. 1 and 7. This wire channel extends lengthwise to the front end, where it has a dead stop (trunk end), against which the blunt end of an insulation-covered wire comes to rest when inserted into the wiring-core. One half of the wire channel perimeter **13** is formed in the body **4** and the full perimeter is made when the twin bodies **4** and **4***a* are mated together.

A notch **14** is molded in one side of the neck of the body **4** and extends into the wire channel **13**. This notch **14** is stippled in FIGS. 1, 2, and 4, for identification. When the twin bodies **4** and **4***a* are mated, this notch **14** is provided in each side of the neck. It thus forms twin openings **14**, one on each side, for entry of twin piercing barbs die-formed on the articulated contact blade **18**, next described.

New contact blade 18 and its duplicate blade 18a with the new body unit 4, 4a

A metallic lever-type plug-in contact blade **18** embodies features noted in the "second" summary topic. Two contact blades **18** are required, hence twins; and the second blade is numbered **18***a* for this description.

The contact blade **18** is die-formed of brass. It possesses a limited degree of elasticity for momentary "edgewise" flexure of their yoke clamping arms, when being mounted on the body unit **4**, **4***a*. This feature is noted in FIGS. 6A, B, C and the description of these three views in The Drawings topic.

Furthermore, a limited degree of "slidewise" flexure is also essential for the articulated twin contact blades **18** and **18***a* of the wiring-core when attaching and piercing a conductor cord and latching the cover cap into position for enclosing the parts.

The front end **18** is conventional, the same as the old contact blade numbered **3** (FIG. 1 in my prior patent). Thus, the front ends **18** and **18***a* of the twin contact

blades are adapted to make plug-in disconnect contact with ordinary current supply outlet receptacles in the usual way. A conventional detent latch **19** is formed at the rear part of the straight end portion **18** for gripping a slide-on cap, as later noted.

The rear end of the contact blade **18** is die-formed with an inward bend **20** and a return bend **21**. This brings the rear ends of the twin blades **18** and **18***a* in parallel and contiguous with the neck of the body parts **4** and **4***a*. This arrangement permits the rear ends of the twin blades to be mounted for articulation within the depth of the arm-pockets **12** (FIGS. 7 and 9).

Twin parallel clamping yoke arms **22** are die-formed at the rear end, and each arm is continued by a slit **23** forward to the inward bend **20**. These two arm slits **23** increase the "edgewise" resiliency of the two clamping yoke arms **22**, during their momentary spreading, when being permanently mounted on the two-part body **4** and **4***a*. This momentary resilient edgewise spread is demonstrated in FIGS. 6A, B and C and in the respective descriptions of these three action views.

It is significant that the two clamping arms **22** perform the function of a spring clamp for permanently fastening together the twin bodies **4** and **4***a*. Moreover, this spring clamping action distributes the gripping pressure along the entire length of the arms and onto the entire length of the slide-bearings **10**. This is pointedly superior to other fastening means, such as "rivets" which localize the pressure against delicate plastic body parts, as in my prior patent.

The two arms **22** have inner parallel edge surfaces which may be referred to as edge slide-bearings **24**. These inner parallel edges **24** are surface shaded for identification and relate them to the shading on the surface slide-bearings **10** of body parts **4** and **4***a*. This arrangement adapts the twin clamping arms **22** to slide (ride) bearingly against surface slide-bearings **10** on the body units **4** and **4***a*.

It is important to observe that the twin body **4**, **4***a* has four surface slide-bearings **10**, and that the twin yoke clamping arms **22** have four edge slide-bearings **24**. Thus, it follows that the complete wiring-core (FIG. 7) has eight slide-bearing surfaces, which precisely guide the articulation of the two contact blades **18** and **18***a* in an exact plane, with a very minimum of edge-wise wobble or play. This novel feature is important in the mode of operation of pivot trunnions and a piercing contact barb die-formed on the contact blade **18**, as next described.

A bearing journal or pivot trunnion **25** is provided on the inner end of each clamping yoke arm **22**, thus two trunnions. Each trunnion **25** is inwardly beveled as shown and terminates in a straight edge shoulder perpendicular to the shaded edge slide-bearing **24**. The two trunnions **25** are identical, coaxial, and perpendicular to the lengthwise axis of the contact blade **18**, and have a loose fit in their respective pivot bearings **8** and **9**. The trunnions **25** merely hold the contact blades **18** and **18***a* in place, whereas the exactness of the plane of articulation is achieved by the novel slide-bearing surfaces.

An impaling or piercing contact barb **26** is die-formed in the crotch of the yoke clamping arms **22**. It is the same as the barbs **9** and **30** in my prior patent. But its plane of movement is improved, i.e., rendered more exact and constant by reason of the guided control of the articulated contact blades **18** and **18***a* performed by the eight surface slide-bearings **10** and **24**.

The complete connector

FIGS. **7** and **8** are referred to (also the remaining views) for final assembly of my old cap **30** and a flexible two-wire stranded conductor cord **32**; and other known features are noted which cooperate with my new "rivetless wiring-core" (FIG. 7).

Observe that the twin lever contact blades **18** and **18***a* are open (FIG. 7), and that the arm-pockets **12** stop

the blades in full open position. The insulation-covered conductor cord **32** is now inserted through the rear end of the cap **30**. The end of wire **32** which protrudes through the open end of the cap is next inserted all the way into the wire channel **13** of the wiring-core and the contact blades **18** and **18***a* are then manually closed. The yoke arms **22** stop against the neck of the body when the twin blades are closed.

The twin barbs **26** on the contact blades pass through their respective openings **14** in the neck of the two-part body **4** and **4***a* and pierce the two-wire insulation, thus making a pressure-spreading contact with the respective wire strands (FIG. 11). Note that the twin bars pierce the wire strands at or close to center thereof. Hence, maximum current transmission is achieved.

Next, the front open end of my old cap **30** is pushed onto the rear end of the wiring-core (FIG. 7), and the two oppositely located latching shoulders **31** inside the cap catch against the detent latches **19** (FIG. 9) on the contact blades **18** and **18***a*, thereby securing the cap **30** in place. The sidewise spring flexure, from the bends **20** along the length of the twin blades, act to detent latch the cap in place at **19** and **31**. To remove the cap, the front ends of the blades are manually pressed toward each other for releasing the detent latch.

Observe that the four yoke arms **22** are disposed down in the arm-pockets **12** and below the outer surfaces of the twin body. Hence, the inner surfaces of the cap **30** make a close slide-on fit with the wiring core body without engaging the yoke arms. The old cap **30** also snubs the flexible wire cord at **32***a* for strain relief (FIGS. 9 and 10), in a manner similar to my prior patent.

It is readily appreciated that this new "rivetless wiring-core" contributes to economy in manufacture and achieves increased utility of the electrical connector.

What is claimed is:

1. An electrical connector comprising a body formed of twin body parts defining a channel therebetween to receive a two-wire conductor cord and two contact blades swingably mounted on said body, each of said body parts having a head, a neck and a trunk, centering means on the inner faces of said body parts, which interfit when said body parts are placed together in mated relation, thus maintaining said twin heads, necks and trunks in alignment, twin surface slide-bearings provided at the head ends of said twin body parts and pivot bearings molded in said head ends and being adjacent said surface slide-bearings; each of said contact blades being provided with parallel yoke spaced apart clamping arms on its rear end, a pivot trunnion on the rear end of each clamping arm, and a piercing barb provided in the crotch of the yoke clamping arms, the spaced apart clamping arms embracing the mated twin body parts, thereby clamping them together, and the pivot trunnions being disposed in the pivot bearings, thus mounting the twin contact blades for articulation upon said body, the inner edges of the clamping arms being parallel with each other, thus constituting edge slide-bearings which swingably ride on said surface slide-bearings of the body to precisely guide the twin contact blades with their twin barbs in their fixed planes into barb openings through opposite sides of the neck of the body and into piercing contact with the strands of a two-wire conductor cord adapted to be inserted within said channel.

2. The electrical connector of claim **1**, in which the pivot trunnions of the twin contact blades, disposed in the pivot bearings of the body, merely retain said contact blades in articulating position, while the coaction of the edge slide-bearings of the blades and the surface slide-bearings of the body perform the double function of positively clamping the twin body parts together, as well as confining the movement of each piercing barb to a constant and fixed plane aligned toward the center of the strands of a two-wire conductor cord adapted to be inserted within the wire channel.

3. The electrical connector of claim **1**, wherein said centering means comprise, on the inner face of each body part, a boss and a socket in the trunk, and a boss and a socket in the head, said bosses being disposed in staggered relation on opposite sides of said channel and likewise said sockets being disposed in staggered relation on opposite sides of said channel.

4. The electrical connector of claim **1**, having eight slide-bearing means, four on the clamping arms of the contact blades, and four on the twin body parts, for precisely guiding said twin piercing barbs in a fixed plane toward the center of the strands of a two-wire stranded conductor adapted to be inserted in the wire channel.

5. The electrical connector of claim **1** wherein each body part has a through-hole, the inner end of which constitutes a socket that receives a boss, and the outer end of which constitutes a pivot bearing which receives a said pivot trunnion on the end of an arm of a contact blade.

6. The electrical connector of claim **1** wherein each pivot bearing is partially surrounded by an arm-pocket, on the outer surface of the body, which opens toward its respective slide-bearing and has a depth that receives its respective arm down thereinto below the plane of the outer surface of the head, neck and trunk.

7. The electrical connector of claim **1**, in which the pivot trunnions are tapered to facilitate mounting said contact blades on the body.

8. The electrical connector of claim **1**, in which said piercing barb is carried in the crotch of the spaced apart clamping arms and each inner edge of each arm is extended forwardly beyond the crotch in the form of parallel slits, to facilitate edgewise momentary spreading of the arms when mounting said contact blade on the body.

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MARVIN A. CHAMPION, *Primary Examiner.*

J. H. McGLYNN, *Assistant Examiner.*