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Poliak et al.

[11] **3,891,297**

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[54] **ELECTRICAL CONNECTOR FOR ATTACHMENT TO MULTI-CONDUCTOR CABLE**

[75] Inventors: **John M. Poliak**, East Meadow; **Juan M. Lopez**, New York, both of N.Y.

[73] Assignee: **Leviton Manufacturing Co., Inc.**, Little Neck, N.Y.

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[51] **Int. Cl.**[2] **H01R 7/06**

[58] **Field of Search** ..... 339/174, 273, 274, 270 R, 339/249 R, 249 A, 99 R

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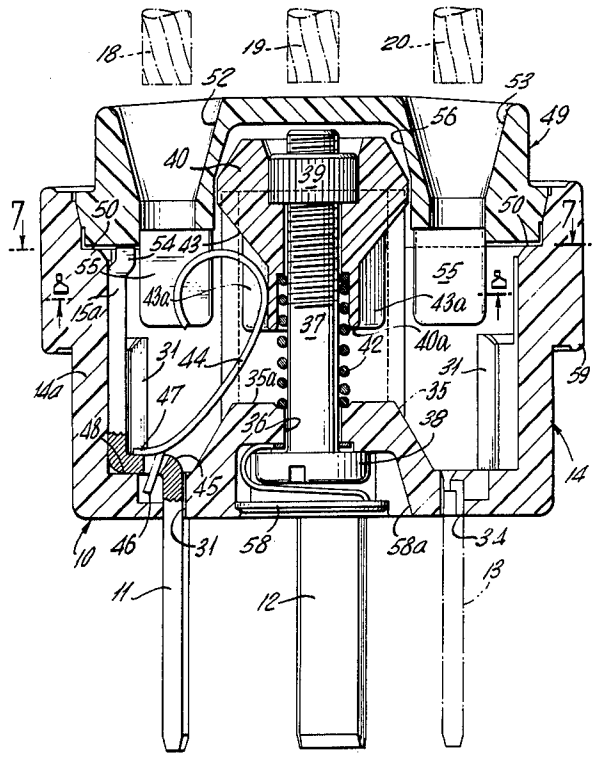
Primary Examiner—Roy Lake
Assistant Examiner—Mark S. Bicks
Attorney, Agent, or Firm—Hanse H. Hamilton

[57] **ABSTRACT**

The subject connector includes a hollow body having a plurality of angularly spaced contacts mounted therein. Each of the contacts has a terminal end for electrical connection to a bare end of one of the conductors of a multi-conductor cable. The hollow body is formed of insulating material and contains compartments which enclose the terminal ends of the spaced contacts. The contacts may carry either male blades or female contacts for engagement with mating contacts carried by an opposing connector.

A cap or cover closes a rear end of the hollow body and contains spaced funnel-shaped openings which receive and guide the bare ends of the respective contacts. The bare ends of the conductors are clamped in firm electrical contact with the terminal ends by means of a movable wiring insert. The insert carries cams which engage with and urge movable ends of leaf springs against the bare ends of the conductors and force the conductors against the terminal ends of the contacts in movement of the insert in one direction in the body. The wiring insert is moved in said one direction against a return spring by a screw which threadably engages with the insert and has a headed end accessible from a front face of the body. The clamping action for a number of conductors takes place simultaneously in response to turning the single screw in one direction. Release of the conductors is obtained by turning the screw in the opposite direction. The screw and the spring raise the insert to permit the ends of the conductors to be withdrawn from engagement with the terminal ends of the contacts.

10 Claims, 9 Drawing Figures



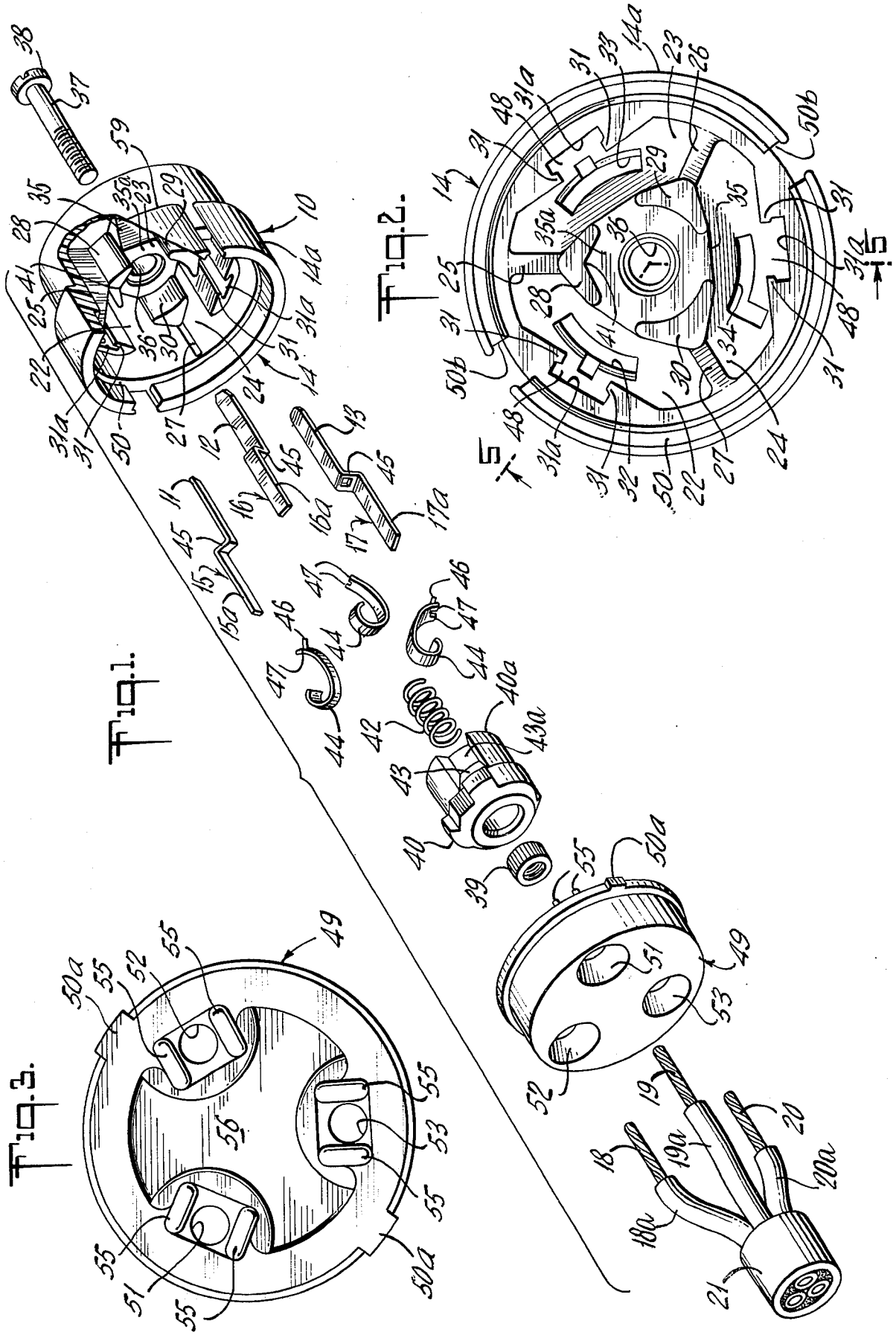


Fig. 1.
Fig. 2.
Fig. 3.

Fig. 7.

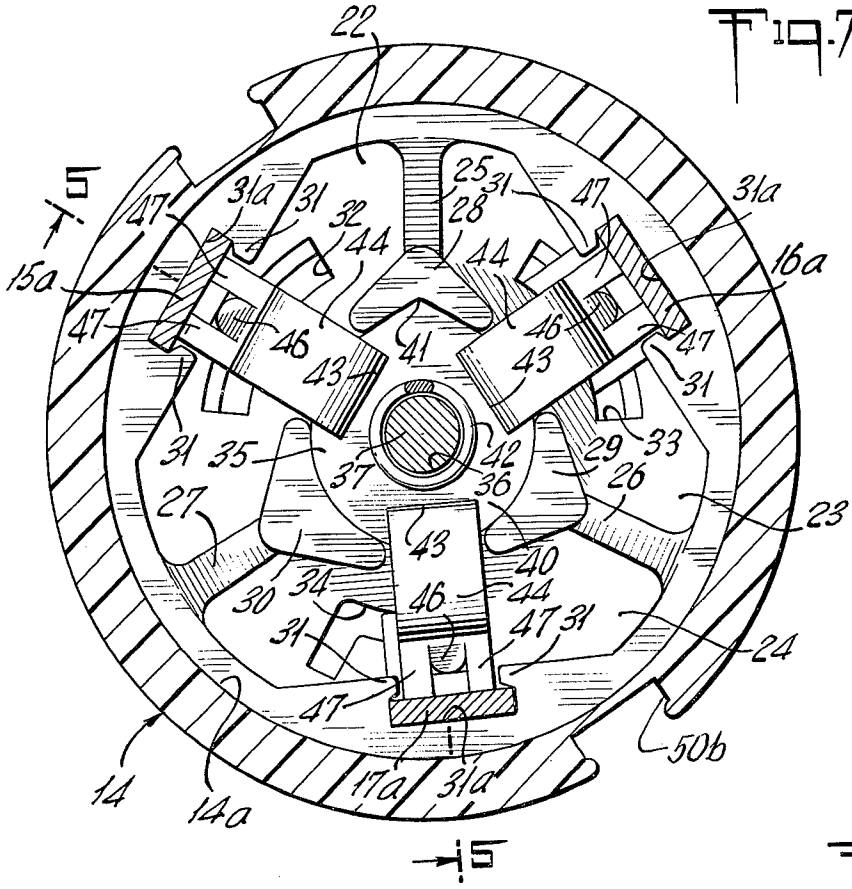


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Fig. 8.

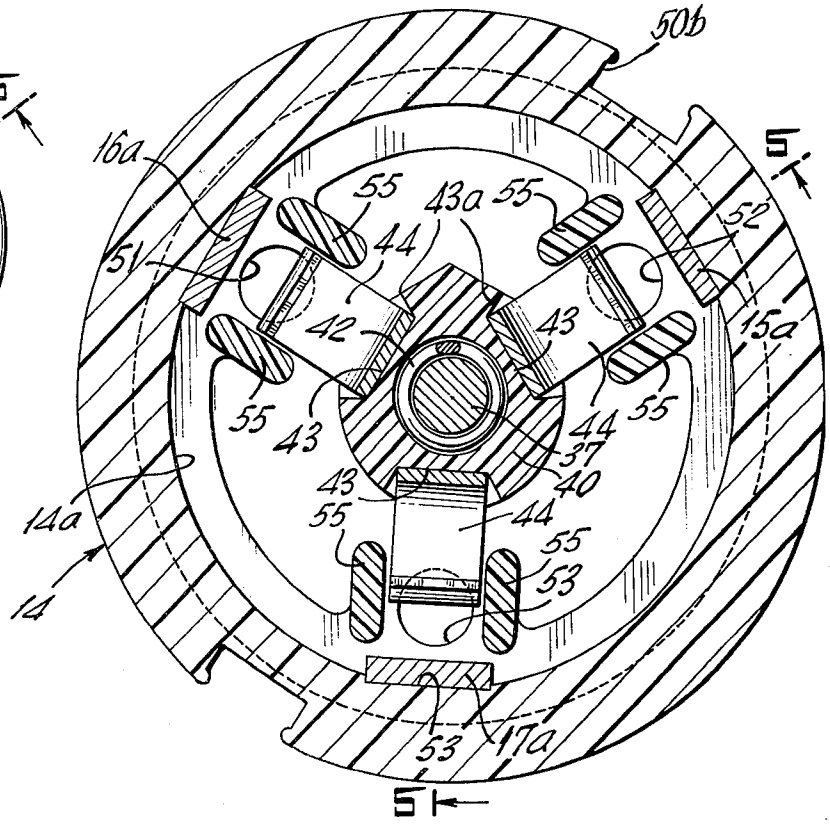
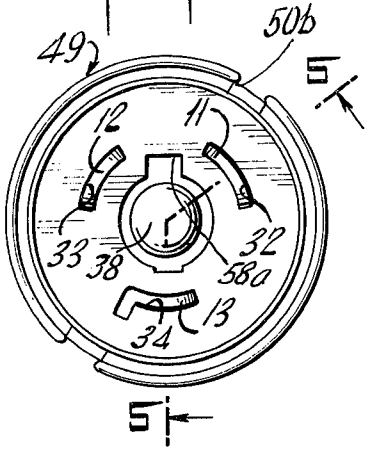


Fig. 4.



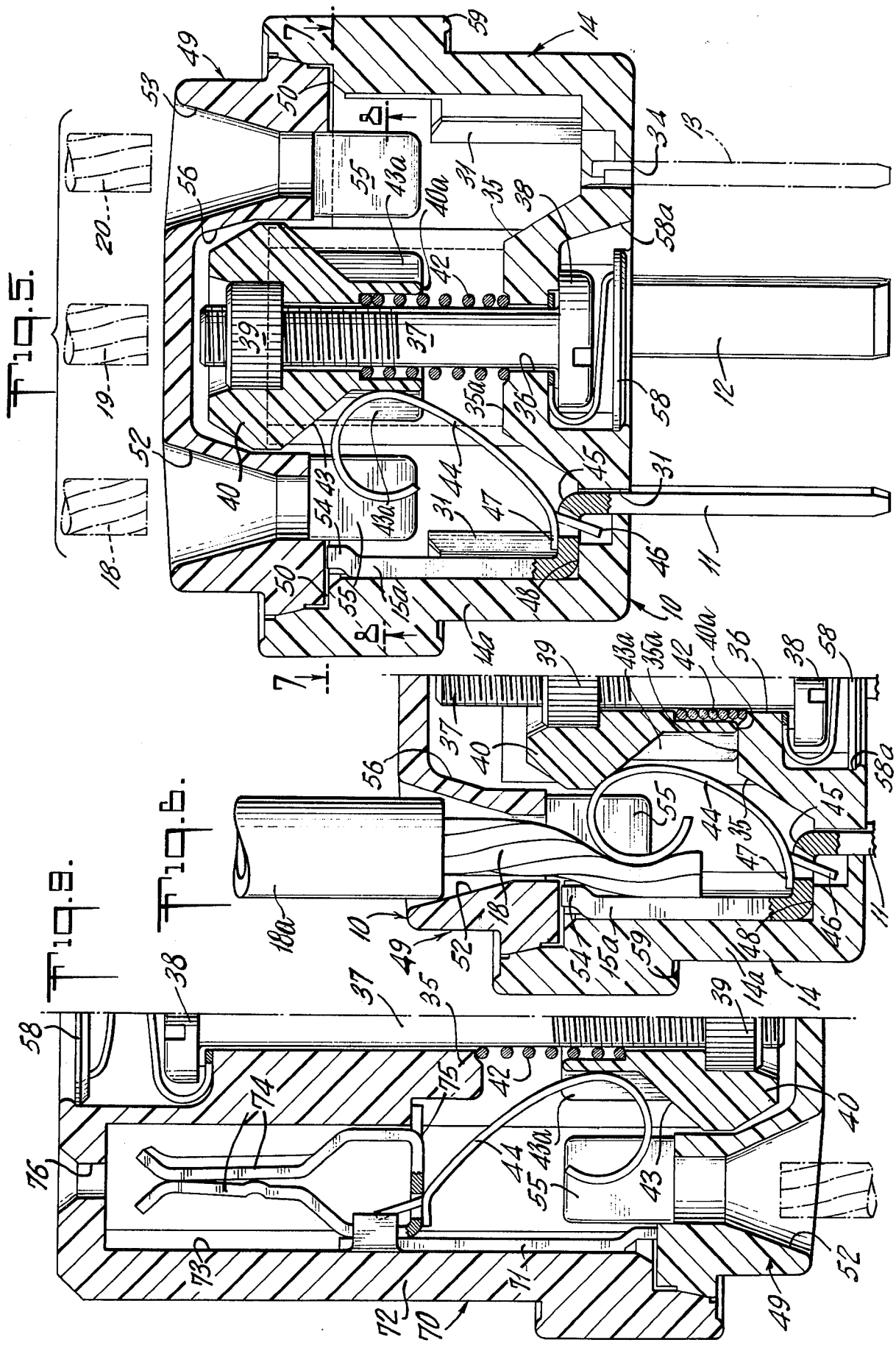


Fig. 5.
Fig. 6.
Fig. 9.

ELECTRICAL CONNECTOR FOR ATTACHMENT TO MULTI-CONDUCTOR CABLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to improvements in an electrical connector for simultaneously connecting several conductors of multi-conductor cables to contacts of the connector.

2. Description of the Prior Art

Generally, individual connections are made between contacts of an electrical connector and each of the conductors of a multi-conductor cable. Customarily, terminal screws or clamping devices are employed for this purpose. In the case of terminal screws, the screws are subject to stripping and the bare ends of the conductors must be looped around the screw to make good electrical connection. In the case of clamping devices, loops are not required, but in either case, it is frequently difficult and time-consuming to make the necessary connections to the conductors of a multi-conductor cable. This is particularly true where heavy or large size conductors are involved and the conductors are connected individually to the connector.

OBJECT AND SUMMARY OF THE INVENTION

An object of the present invention is to provide an electrical connector for attachment to a multi-conductor cable in which electrical connections between several conductors of the cable and contacts of the connector are made simultaneously in a simple and expeditious manner by turning a single screw. Another object is to avoid damage to the cable or its conductors.

A further object of the invention is to provide an electrical connector in which good electrical connections are established between spaced contacts of a connector and individual conductors of a multi-conductor cable in a trouble free and foolproof manner. Guess work in making the electrical connections is eliminated and there is no possibility of stripping terminal screws.

As shown in the illustrated embodiment, an insulating jacket on the cable is removed and exposes short lengths of the individual conductors on wires which are spread apart. Insulation is then stripped from ends of the wires exposing bare ends of the wire. The bare ends of the wires are then inserted through spaced openings in a cover or cap carried on a rear end of a hollow connector body. The openings position the bare ends of the wires so that they are located between terminals carried by spaced contacts in the body and movable ends of clamping members.

A wiring insert is movably mounted in the body and is shaped to engage with and urge the movable ends of the clamping members into engagement with the bare ends of the conductors and against the terminals in movement of the insert in one direction relative to the body. Under the influence of the insert, the free ends of the clamping members are forced against the bare ends of the wires and the wires are forced into good electrical contact with the terminals of the spaced contacts. The electrical connections are made simultaneously between the several conductors and the spaced contacts of the connector.

Also, the contacts may carry either female contacts or male blades at their outer or mating ends as may be desired. Also, the mating ends of the contacts may be of various configurations as required. In the connector illustrated, the contacts are of a heavy duty locking type.

Other objects and advantages of the invention are set forth with particularity in the following description and the appended claims. The invention will be more clearly understood from the following description when read in connection with the accompanying drawings. However, it will be understood that various changes and modifications may be made in the illustrated embodiment by those skilled in the art without departing from the spirit or scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view in perspective schematically illustrating unassembled elements of an electrical connector embodying the present invention;

FIG. 2 is a top end view of a connector body for the connector illustrated in FIG. 1 and is drawn to an enlarged scale;

FIG. 3 is a bottom view of a cover for the connector body illustrated in FIG. 2 and is drawn to an enlarged scale;

FIG. 4 is a bottom view of the connector illustrated in FIG. 1 after assembly;

FIG. 5 is a side view in vertical section taken along line 5–5 of the assembled connector shown in FIG. 4 and is drawn to an enlarged scale;

FIG. 6 is a fragmentary side view in vertical section of a portion of the assembled connector shown in FIG. 5 with a bare end of a conductor installed therein;

FIG. 7 is a view in horizontal section taken along line 7—7 of FIG. 5;

FIG. 8 is a view in horizontal section taken along line 8—8 of FIG. 5; and

FIG. 9 is a fragmentary side view in vertical section of a connector similar to the connector illustrated in FIG. 5. but with a female contact.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally speaking, a multi-conductor cable has a number of conductors which are respectively connected to spaced contacts of a connector.

The contacts may carry male blades or female contacts for inter-connection with a mating contact in an opposing receptacle or plug. As noted, the insulation jacket is removed from a length of a cable at one end thereof. The conductors are spread apart and insulation is stripped from an end of each of the conductors to expose a bare end of the conductor wire. The bare ends of the several conductors are then inserted through spaced openings in a cover or cap which closes an open rear end of a hollow connector body. The spaced openings in the cover position the bare ends of the several conductors so that they enter between free ends of leaf springs and terminal portions of spaced contacts in the body for clamping engagement therewith.

The clamping and electrical connections to the bare ends of several conductor wires are effected simultaneously by means of a wiring insert which is movably supported in the connector body. Movement of the wiring insert relative to the body is caused by turning a single screw. The wiring insert carries cams which engage with and urge movable ends of the leaf springs outwardly in movement of the insert in one direction. The screw extends into the body from a front end thereof

and has a headed end which is accessible from the front of the connector body. The cam surfaces on the wiring insert engage with and force movable ends of the springs outwardly against the bare ends of the conductors and the spring, in turn, force the conductors against the terminal portions of the contacts to establish good electrical contact therewith.

A rear end of the connector body may be enclosed in an outer housing or shell (not shown) which receives the cable and provides a strain relief. However, the shell forms no part of the present invention. A suitable shell is described and claimed in U.S. Pat. No. 3,856,376 issued Dec. 24, 1974 to John M. Poliak, Milton J. Weitzman and Juan M. Lopez entitled "ELECTRICAL CONNECTOR" to which reference may be made, if necessary.

Referring now to the drawings in detail, there is a connector **10** in the form of a plug having spaced contacts **15, 16** and **17.** The contacts include male blades or prongs **11, 12** and **13** which extend through a suitably shaped openings in a front face of the plug for engagement with mating female contacts of an opposing connector or receptacle.

The particular connector illustrated is a three-wire heavy duty grounding type connector of the locking type in which mating connectors are turned relative to each other to prevent accidental separation of the connectors when in use. The configuration of the contacts illustrated conforms to established (NEMA) standards, but other configurations may be employed as desired. Also, the number of contacts may be increased if necessary, depending on the size of the connector body.

As shown, the connector **10** comprises a hollow body **14** of insulating material having a generally closed front end with upstanding side walls **14***a* which define an opening at a rear end of the body. The contacts **15, 16** and **17** are made of an electrically conductive material and are mounted in the hollow body **14** in angularly spaced relation to each other. The inner ends **15***a*, 16*a* and **17***a* of the contacts **15, 16** and **17** extend along the side walls **14***a* and serve as terminal portions for electrical connection to bare ends **18, 19** and **20** of insulated conductor wires **18***a*, 19*a* and **20***a* forming a multiconductor cable **21.**

When assembled, the terminal portions **15***a*, 16*a* and **17***a* of the contacts **15, 16** and **17** are enclosed within the hollow body **14** and are supported against an inner surface of the side walls **14***a* of the body **14** in chambers or compartments **22, 23** and **24.** The chambers **22, 23** and **24** are formed, in part, by inwardly extending radial partitions **25, 26** and **27** which terminate at vertical guide members **28, 29** and **30.**

The terminal portions **15***a*, 16*a* and **17***a* of each of the contacts **15, 16** and **17** are held against movement relative to the side wall **14***a* by means of grooves **31***a* and spaced lips **31** carried by the interior surface of the side walls **14***a* and extending along opposite sides of a lower portion of each of the terminal portions **15***a*, 16*a* and **17***a*.

As shown, the front end of the body **14** contains spaced openings **32, 33** and **34** of appropriate configuration to receive the male blades **11, 12** and **13** carried by the contacts **15, 16** and **17.**

A central boss **35** extends inwardly or upwardly from the front face of the body **14** and contains a central bore **36** to receive an end of a threaded screw **37.** The screw **37** has a headed end **38** which is accessible from the front end of the body **14** so that the screw can be turned as desired by a screwdriver.

An upper end of the screw **37** threadably engages with a bushing **39** which is molded or pressed into a wiring insert **40** and the wiring insert is moved vertically relative to the body **14** as the screw turns. The wiring insert **40** is guided in such movement by the guides **28, 29** and **30** which also function to prevent rotation of the insert. As shown in FIG. **2,** the insert **40** is keyed to the upper guide **28,** as indicated at **41,** and has a bottom or lower end **40***a*. In its lowered position, as shown for example in FIG. **6,** the bottom or lower end **40***a* of the insert **40** engages with an upper face **35***a* of the boss **35** which acts as a stop and limits downward movement of the insert **40** as the screw **37** is turned in one direction (clockwise). A coil spring **42** which is interposed between the insert **40** and the boss **35,** urges the insert **40** upwardly when the screw **37** is turned in an opposite direction. The spring **42** also holds the screw head **38** in contact with the front face of the body **14.**

In the form illustrated, the wiring insert **40** carries three angularly spaced cams **43** which are positioned in opposing relation to curved free ends of spaced leaf springs **44.** The curved free ends of the springs **44** resiliently and compressibly engage with the bare ends **18,** 19 and **20** of the conductors under the influence of the insert **40.** The springs **44** are rockably mounted in the body with the free ends thereof in opposing relation to the terminals **15***a*, 16*a* and **17***a* of the contacts **15, 16** and **17** and being movable relative thereto.

The insert **40** also contains spaced channels **43***a* to receive and position the upper or free ends of the springs **44** during movement of the insert.

As shown, the leaf springs **44** are rockably supported on inwardly extending shoulders **45** of the contacts by means of tongues **46** formed from lower ends of the leaf springs **44.** Curved fingers **47** located on each side of the tongue **46** rest on an upper face of the shoulder **45** to support and return the leaf spring **44** to its open position when the insert **40** is moved upwardly.

The inwardly bent shoulder **45** of the contact rests on an inner ledge or projection **48** at a lower end of the side walls **14***a* of the body **14** and as shown in FIGS. **5** and **6,** the shoulder **45** carries one of the male blades **11, 12** and **13** which extend through the shaped openings in the front face of the body **14.**

The free or curved upper ends of the lead springs **44** are also held or confined against lateral movement in the body by opposing vertical sides of the positioning guides **28, 29** and **30** and downwardly extending fingers **55** carried by a cover **49.** The fingers **55** position the free ends of the springs **44** in opposing relation to the terminal portions **15***a*, 16*a* and **17***a* of the respective contacts **15, 16** and **17** and prevent misalignment of the wires as they are inserted.

The cover or cap **49** rests on a rim **50** surrounding an opening at the rear end (the upper end as shown in FIGS. **5** and **6**) of the body **14** and may be secured thereto by ultrasonic welding, cement or other suitable fastening means. In addition, the cover **49** may be keyed to the body **14** by means of ears **50***a* which fit into mating recesses **50***b* in the rim for assembly and alignment purposes.

The cover **49** contains spaced openings **51, 52** and **53** to receive the bare ends **18, 19** and **20** of the conductors of the cable **21** and guides them into positions be-

tween the curved free ends of the leaf springs **44** and an opposing face of the terminal portions **15***a*, 16*a* and **17***a* of each of the contacts **15, 16** and **17.** The openings **51, 52** and **53** have enlarged funnel-shaped upper ends to faciliate insertions of three conductor wires at the same time.

As shown in FIGS. **5** and **6,** upper ends **54** of the terminal portions **15***a*, **16***a* and **17***a* are inwardly offset to create a crimp or bend in the bare end of the conductor wire, as shown in FIG. **6.** The bend in the wire increases resistance to pulling the wire from engagement with the terminal portion of the contact. In addition, the faces of the terminal portions engaging with the bare ends of the conductors may contain serrations to provide greater pull resistance and better electrical contact with the bare ends of the conductors.

The cover **49** carries the spaced lugs or fingers **55** which extend downwardly from the cover on opposite sides of each of the openings **51, 52** and **53** and into the body on opposite sides of the upper ends of the leaf springs **44.** The lugs **55** insure that the bare ends of the conductors remain in alignment with the terminal portions **15***a*, 16*a* and **17***a* of the contacts and the free ends of the leaf springs as the wires are being inserted in the openings in the cover **49.**

An inner face of the cover **49** contains a recess **56** to receive an upper end of the screw **37** and the wiring insert **40** when the insert is in a raised position as shown in FIG. **5.**

In attaching the connector **10** to the cable **21,** the bare ends **18, 19** and **20** of the conductors are spread apart and are inserted through the spaced openings **51,** 52 and **53** in the cover **49** of the connector **10.** This positions the bare ends of the conductors between the terminal portion of each of the contacts and the free end of the leaf spring associated therewith.

The wiring insert **40** is then moved downwardly relative to the body by turning the screw **37** in one direction until the insert engages with the stop **35***a* in the body **14.** In this movement of the insert **40,** the cams **43** carried by the insert engage with and force the free curved ends of the leaf springs **44** outwardly and into engagement with the bare ends **18, 19** and **20** of the conductors. This forces the wires against the terminal portions **15***a*, 16*a* and **17***a* of the contacts **15, 16** and **17** and establishes good electrical contact therebetween. FIG. **6** shows the connector with a conductor wire installed and clamped in engagement with the contact.

The electrical connections to the contacts are made simultaneously to the several conductor wires of the cable by turning a single screw. This permits the electrical connections to be made rapidly and without forming loops in the ends of the conductor wires. There is no guesswork involved as the proper tightness is assured when the insert engages with its stop.

If desired, a removable plastic cap **58** may be fitted into a well **58***a* in the front face of the body **14** to enclose the head **38** of the screw **37.**

A rim **59** extends outwardly from and surrounds the upper or rear end of the connector body for engagement with an outer shell or cover (not shown) which fits over the rear end of the connector and engages with the exterior jacket of the cable to provide a strain relief if required. As mentioned above, an example of a suitable outer shell is described in co-pending application Ser. No. 248,030, but forms no part of the present invention and hence, is not described in detail.

FIG. **9** illustrates a connector **70** in the form of a receptacle having female contacts **71** in place of male contacts **15, 16** and **17.** As shown, the body **72** of the connector is elongated to form wells **73** at an outer end thereof to receive outer portions **74** of female contacts which are attached to and carried by a strut **75.** The strut **75** is formed as part of the contact and extends radially inwardly of the body to support the outer portions **74** of the female contacts. Ends of the outer portions of the female contacts **74** are aligned with openings **76** in the forward end of the connector body **72** to permit entry of the male prongs of the plug into engagement therewith.

Aside from this difference, the male and female connectors are the same and the same reference numerals have been used throughout the drawings to identify similar parts.

It will be understood, that while a preferred form of the invention has been illustrated and described herein, various changes and modifications may be made therein by persons skilled in the art, without departing from the spirit or scope of the present invention.

What is claimed is:

1. In an electrical connector for attachment to conductors of a multi-conductor cable, the improvement comprising:

a. a hollow connector body of insulating material;
b. said body having upstanding side walls defining a cavity;
c. a plurality of electrical contacts mounted in said cavity in spaced relation to each other;
d. each of said contacts having a terminal portion located within said cavity and extending lengthwise along one of said side walls of the body;
e. means for clamping bare ends of several conductors of a cable in electrical engagement with said terminal portions of said contacts;
f. said means including spaced clamping members rockably mounted within said connector body and having resilient and compressible free ends opposing wire-engaging faces of said terminal portions of the respect contacts;
g. a wiring insert mounted in said cavity for axial movement therein;
h. a plurality of spaced cams carried by said insert and engaging with each of said free ends of the clamping members;
i. said cam members being adapted to urge the free ends of the clamping members toward the wire-engaging faces and into compressive clamping engagement with the bare ends of the wires in movement of the insert in one direction relative to said body;
j. threaded means extending into said body and threadably engaging with said insert for moving said insert axially relative to said body; and
k. stop means located within said cavity for engaging with and limiting movement of the insert in said one direction.

2. An electrical connector as defined in claim **1,** which includes:

a. fixed guide members located within said cavity and engaging with said insert;
b. said guide members maintaining the cams on the insert in alignment with said clamping member in

axial movement of said insert relative to said body.

3. An electrical connector for simultaneous electrical attachment of bare ends of several conductors of a multi-conductor cable to a plurality of spaced contacts, the combination which comprises:

a. a hollow body of insulating material;
b. said body having upstanding side walls defining a cavity having a closed front end and an open rear end;
c. a plurality of electrical contacts supported in spaced relation to each other within said cavity;
d. each of said contacts including a terminal portion extending lengthwise along an inner face of said upstanding side walls of the cavity;
e. spring members rockably supported within said cavity and having compressible movable ends opposing wire-engaging faces of said terminal portions of the respective contacts;
f. each of said movable ends being positioned in opposing relation to one of the wire-engaging faces of said terminal portions and being adapted to resiliently and compressibly clamp a bare end of a conductor wire in electrical engagement therewith;
g. a wiring insert of insulating material supported for axially movement within said cavity;
h. a plurality of spaced cams carried by said insert;
i. said cams engaging with and forcing said movable ends of the spring members toward said opposing wire-engaging faces in movement of the insert in one direction relative to said body;
j. a threaded member extending into the body and engaging with said insert;
k. said member having an end accessible from outside the body for moving said wiring insert relative to said body; and
l. stop means in the body for engaging with and positively limiting the movement of said insert in said one direction.

4. An electrical connector as defined in claim 3, which includes:

a. a cover plate seated on upper edges of said side walls of the body and extending over the rear end of the cavity in the body;
b. said cover plate containing spaced entrances aligned with the terminal portions of each of the contacts and the spring members associated therewith;
c. said entrances permitting introduction of the bare ends of the individual conductor wires between the wire-engaging faces of said terminal portions and the movable ends of the spring members associated therewith.

5. An electrical connector as defined in claim 4, which includes:

a. guard lugs carried by and extending downwardly from said cover on opposite sides of each of said entrances;
b. said guard lugs restricting entrance of a wire from another entrance.

6. An electrical connector as defined in claim 3, which includes:

a. fixed guide members carried by the body and extending lengthwise thereof in said cavity;
b. said guide members engaging with and holding said insert against rotation relative to the body in movement of the insert relative to the body.

7. In an electrical connector for simultaneous attachment to a number of individual conductor wires of a multi-conductor cable, the improvement comprising:

a. a hollow insulating body having upstanding side walls defining a cavity therein and having front and rear ends;
b. a plurality of angularly spaced electrical contacts mounted within said cavity;
c. each of said contacts having a terminal portion extending rearwardly along an interior face of said side walls;
d. means for resiliently and compressibly clamping bare ends of individual conductor wires against opposing wire-engaging faces of each of said terminal portions;
e. said clamping means comprising curved leaf springs rockably mounted in the cavity within the body and having compressible free ends opposing said wire-engaging faces of the terminal portions;
f. said ends and opposing faces defining spaces for receiving the bare ends of the conductor wires therebetween;
g. a cover extending over said cavity and enclosing the rear end of said body;
h. said cover containing spaced entrances aligned with said spaces between the wire-engaging faces of the terminal portions and the clamping springs;
i. movable means located within the body for engaging with and simultaneously forcing all of said compressible ends into resilient clamping engagement with said bare ends of the conductor wires;
j. said means including an insert supported within the cavity for axial movement relative to said body;
k. said insert carrying a plurality of spaced cams, each of which engages with the compressible end of one of the springs in movement of the insert relative to said body.

8. An electrical connector for attaching individual conductors of a multiconductor cable to electrical contacts of the connector, which comprises:

a. a hollow body of insulating material having upstanding side walls defining a cavity;
b. a plurality of electrical contacts mounted within said cavity in spaced relation to each other;
c. each of said contacts including a terminal portion supported in and extending rearwardly along an interior face of said cavity;
d. spring clamping members rockably mounted within said cavity and having compressible free ends opposing wire-engaging faces of each of said terminal portions;
e. said compressible free ends and the wire-engaging faces of the terminal portions defining spaces adapted to receive bare ends of conductor wires therebetween;
f. a cover extending over a rear end of the body;
g. said cover containing spaced entrance passageways aligned with each of the wire-engaging faces and the associated spring member;
h. said entrance passageways permitting introduction of the bare ends of conductor wires into clamping position between the wire-engaging faces of the terminal portions of the respective contacts and the compressible ends of the clamping members;
i. an axially movable wiring insert centrally located within said body;

j. spaced cams carried by said insert and engaging with said compressible ends of the clamping members;

k. said cams being shaped to engage with and urge said compressible ends of the clamping members toward the opposing wire-engaging faces of the terminal portions of the contacts in movement of said insert in one direction relative to said body; and

l. an adjustment screw extending into said body thereof and threadably engaging with said wiring insert;

m. said screw having a headed end accessible from an exterior of said body.

9. An electrical connector as defined in claim **8,** which includes:

a. return spring tongues formed on each of the rockable clamping members at pivoted ends thereof;

b. said tongues urging said free ends of the clamping members away from the wire-engaging faces of the terminal portions upon movement of the insert in an opposite direction.

10. An electrical connector as defined in claim **9,** which includes:

a. guide means carried by the body within the cavity for engaging with and guiding said insert in axial movement thereof relative to the body.

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