Nov. 29, 1960 G. WERNER 2,962,688

PLUG-IN CABLE CONNECTOR

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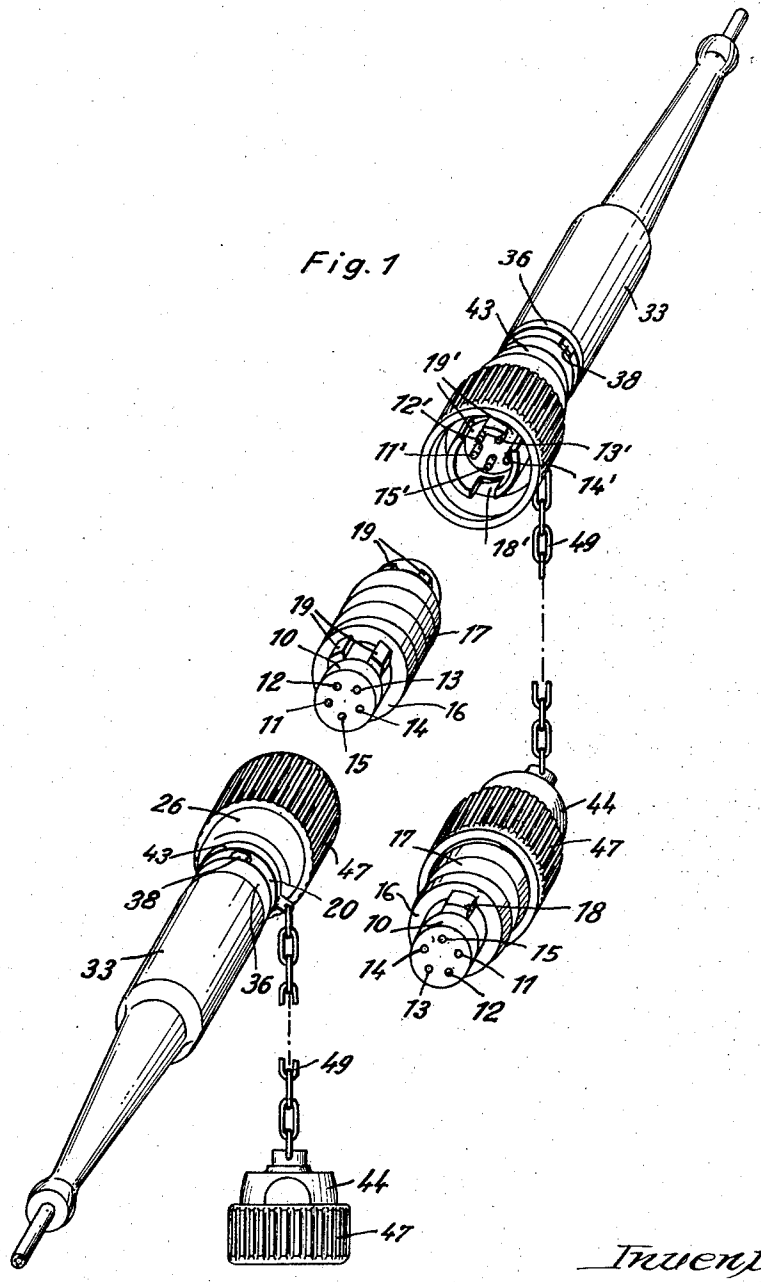
Fig. 1



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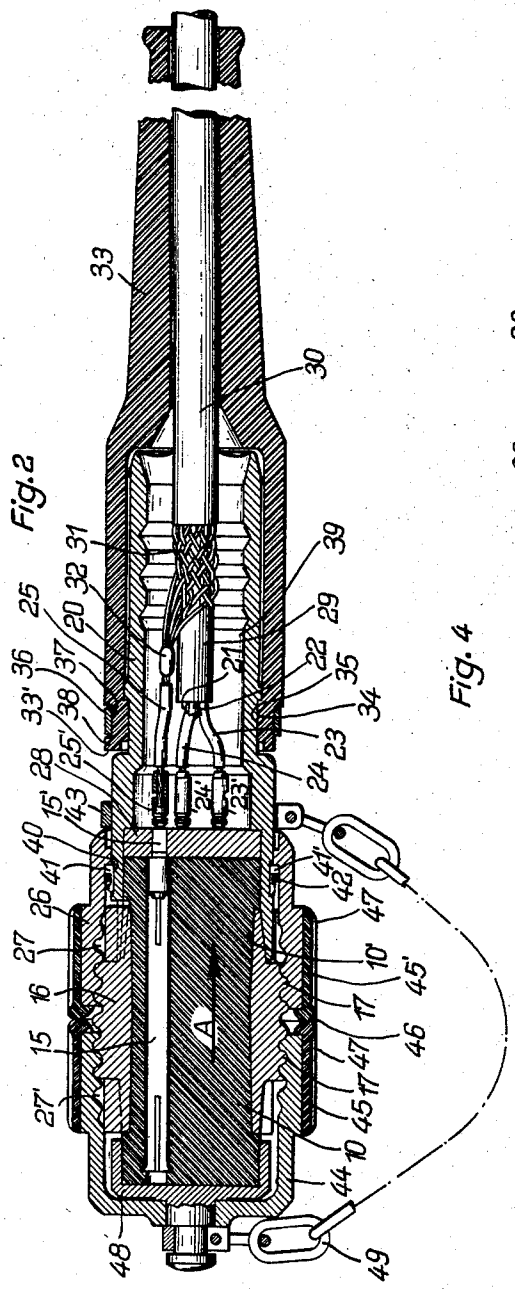

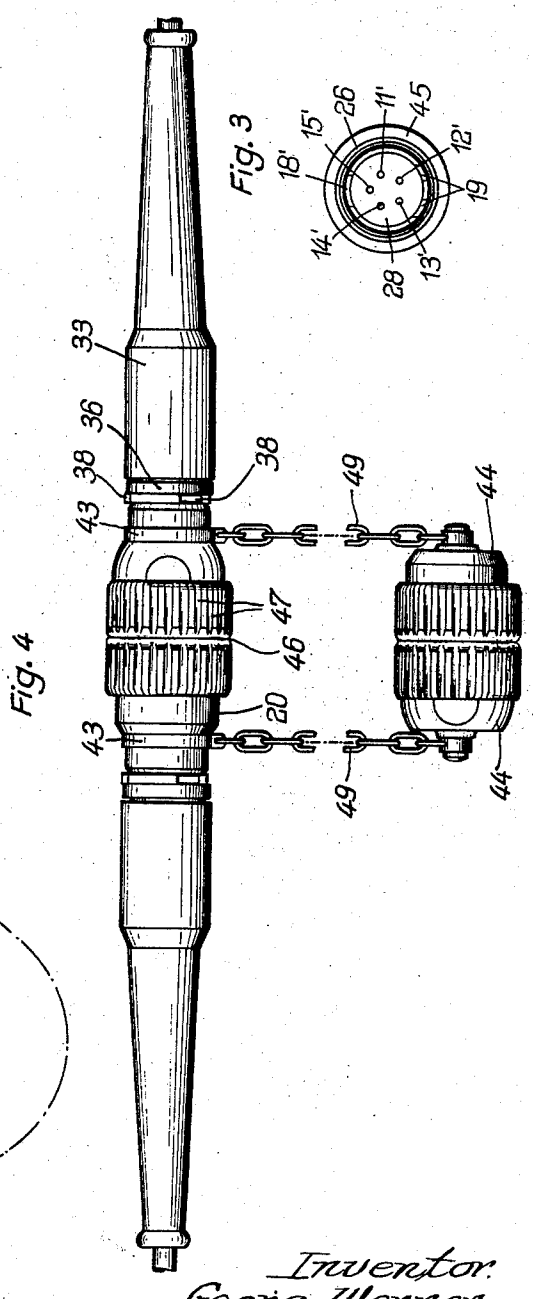

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United States Patent Office 2,962,688 Patented Nov. 29, 1960

2,962,688

PLUG-IN CABLE CONNECTOR

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Filed July 10, 1957, Ser. No. 671,063

Claims priority, application Germany May 31, 1957

2 Claims. (Cl. 339—89)

This invention is concerned with an easily operable plug-in connector for locally mobile communication cables having a plurality of conductors, comprising plugs having a plurality of contact pins and interconnected by a coupling member having a plurality of contact sleeves embedded therein.

Plug-in connectors for cables are known, comprising two plugs having similarly constructed contact elements which are conductively interconnected by means of an auxiliary intermediate member. Such intermediate member will be hereinafter referred to as coupling member. In these known structures, the plug casings may contain the contact pins and the coupling member may contain the contact sleeves or, vice versa, the plug casings may contain the contact sleeves, and the coupling member may be provided with the contact pins. In order to avoid dropping of the coupling member upon disconnection of the structure, there is provided a coarse thread, bayonet lock or the like, for connecting the coupling member with the contact elements of one of the plugs.

A known advantageous structure provides a coupling member or element made of soft rubberlike material comprising radially resilient contacts either upon the outside or within an interior bore.

In accordance with another proposal, the coupling element may be provided with bushings for engagement with the two plug casings, such bushings providing for a sealing-off of the contact space when the coupling member is clamped under pressure in coupled condition between the ends of the plug casings. In the case of plural contact plugs, each contact of the couplng member may be surrounded by an annular bushing for sealing it off.

In accordance with a further proposal, the coupling member may be provided with a coarse thread, bayonet lock or the like, for establishing connection with the two plugs. In such structure, the coupling member assumes in addition to establishing electrically conductive connections, the function of securing the mechanical connection between the two plugs. Both ends of the coupling member are provided with suitable threads which become effective responsive to slight rotation of the two plugs. However, detrimental torsion of the resilient cable will have to be tolerated in such structure. The sealing off of the interior of the coupling is to be effected by auxiliary elastic sealing beads at the end surfaces of the plugs, but such beads may be easily damaged and, therefore, do not reliably protect the contacts against moisture and dirt. The object of the invention is to provide a plug-in connector or coupling for locally mobile communication cables or the like, which meet several important requirements and exhibits considerable advantages over and above known plug-in connectors.

One requirement calls for constructing the plug-in connector so that it may be considered virtually immune to damage and, if inadvertently dirtied, that it can be easily and reliably cleaned with simple means.

The invention applies the thought of providing a coupling member comprising all sensitive parts such, for example, as resilient contacts, the sealing rubber parts and exteriorly positioned parts of the mechanical coupling. Accordingly, upon operating failure of any one of these parts, it will be merely necessary to insert another spare coupling member.

The invention contemplates in similar manner to make also the bushings upon the plug housings for the mechanical coupling of the coupling element, exchangeable, so that substitute spare parts may be used within wide limits and put in simple manner in place of the parts found defective.

An important requirement has to do with obtaining, in the coupling of the plugs by way of the coupling element, always the correct interconnection of the conductors, and to avoid bending stresses affecting the contact pins incident to the rotation of the parts required for securing the connection. The mechanical coupling of the coupling element is to be operatively effective only after the correct through-connection of the conductors is secured. In addition, the sealing off of the conductive contacts is to be effected by the coupling element.

According to the invention, the coupling element, made of a soft rubberlike material having a plurality of contact sleeves embedded therein, is contained within a metallic casing or a casing made of suitable insulating material. The casing carries on the outside the mechanical coupling parts for securing the position of the interior coupling parts in both plug housings and also elements such as clamping means, or the connection of the bushings, rotatably and exchangeably arranged upon the plug housings, with the casing of the coupling element.

The entire coupling element is advantageously constructed so that the inner portion, made of rubber or the like, protrudes beyond the ends of the corresponding casing, the smooth end surfaces of the inner portion pressing in coupled condition against smooth contact pin plates of the two plug housings, thereby effecting sealing of the contacts.

The invention also provides contact sleeves within the interior coupling part, which are wholly or partially slotted, and therefore resilient, thereby providing for increase of the pressure exerted upon the ends of the coupling member and consequently a self-cleaning feature for the contact surfaces.

The structure of the mechanical coupling elements disposed on the outside of the coupling member is considered important. Protrusions and recesses serve thereby as mechanical coupling members for securing the correct position of the entire coupling element, engaging respectively cooperating recesses and protrusions or keys in bushing means of the plug housings, and permitting the longitudinal motion of the coupling element relative to the plug housings only after proper mutual alignment.

The structure of the mechanical coupling means for operatively connecting the coupling element with the respectively cooperating bushing parts will depend upon the construction of the latter, that is, it will depend upon the mode of the coupling decided upon. A coupling by thread means is preferred. The casing of the coupling element is in such a case provided with an outer thread and the cooperating bushing parts are provided with corresponding inner threads. These latter parts extend over and longitudinally beyond the contact pins, protecting such pins in uncoupled condition against contact with conductive parts of the entire coupling element as well as against contact with conductive parts of the other plug. The longitudinal displacement of the bushing parts is limited so as to protect the rim of the plug housing and the contact pins even with the bushing parts moved back.

The foregoing and other objects and features will appear from the description of an embodiment of the in-

vention which will be rendered below with reference to the accompanying drawings.

Fig. 1 shows a perspective exploded view including the two plugs which are to be coupled by means of an intermediate coupling element as well as a closure cap and a spare coupling element;

Fig. 2 is a part sectional view through one of the plugs connected with a coupling element which is closed by a closure cap;

Fig. 3 is an end view of parts of the coupling element as seen when looking in the direction of the arrow A in Fig. 2; and

Fig. 4 shows the entire plug-in connector in coupled condition including the closure caps and a spare coupling element attached thereto.

The coupling element according to the invention comprises an inner coupling member **10** made of rubber or the like, which is fixedly disposed within a metallic casing **16**. The member **10** may be vulcanized to the casing; in order to secure it in its fixed position, the member **10** may be provided with recesses **10'** formed therein. Contact sleeves **11, 12, 13, 14** are embedded within the member **10** for the through-connection of the conductors, and contact bushing **15** for the insulated through-connection of the shielding of the cable length to be interconnected. The contact bushings are provided, for part of their length, with longitudinal slots formed therein, for the purpose of making them resilient. The ends of the bushings are somewhat peened over to secure them in position.

The casing **16** of the coupling element carries centrally thereof a thread **17**; longitudinally extending protrusions or keys are provided at the ends of the casing, two keys **19** being disposed at each end diametrically opposite a key **18**.

In Fig. 1, the spare coupling element contained in the closure cap and depending from the chain **49** is shown displaced by 180° relative to the coupling element shown between the two plugs, to illustrate the protrusion or key **18**. The keys **18** and **19** and the thread **17** constitute the mechanical coupling members for securing the inner coupling element in positive predetermined position in both plug housings and for properly connecting with the casing of the coupling element the bushings which are arranged rotatably and exchangeably upon the plug housings.

The plug comprises essentially the plug housing **20** and the bushing **26** which is rotatable thereon and has an inner thread **27** corresponding to the thread **17**. Within the housing **20** is disposed a contact plate **28** carrying contact pins **11'** to **15'** for coupling cooperation with the contact sleeves **11** to **15** carried by the coupling element. The contact pins are connected with soldering sleeves **21'** to **25'** which are in turn connected with four conductors **21, 22, 23, 24** of the cable **30** and with a conductor **25**, respectively, conductor **25** being connected with the cable shield **31**. Only the soldering sleeves **23'** to **25'** are visible in Fig. 2. The insulated conductor **25** is conductively connected with the shielding **31** by solder **32** at a point between the inner cable sheath **29** and the outer sheath of the cable **30**. The tubular plug housing **20** is provided with an annular groove **35** (Fig. 2) for seating an enlargement **34** carried by a rubber-like tubular part **33** embracing the cable for a portion near the end thereof and forming a handle and at the same time protecting the cable incident to bending thereof. The enlargement **34** is held in place within the annular groove **35** by means of an annular retaining ring **36** engaging a groove **37** formed in the member **33**. Three keys **38** (Figs. 1, 2 and **4**) formed on and projecting resiliently from the handle and protecting member **33** hold the retainer ring **36** against sliding off while at the same time allowing, due to being resilient, removal of the ring **36** so as to permit moving the handle-protecting member **33** along the cable for exposing the plug housing. Longitudinally extending grooves or ribs may be provided upon the outside of the plug housing **20** for keying cooperation with corresponding ribs or grooves inside the handle and cable protecting member **33** to hold the member against angular displacement. The inner space **39** of the plug housing **20** is suitably filled with a moldable resin.

The bushing **26** is connected with the plug housing by shoulders **41** and **41'** engaging an annular groove **40**. The shoulders are made in the form of semi-rings which are held by a resilient wire retainer **42**. The shoulder ring thus formed determines the displacement of the bushing in the direction of the plug housing. The displacement of the bushing in the direction of the cable is limited by the key projections **38** at the end **33'** of the handle and cable protecting member **33** and by an intermediate ring **43** which is longitudinally movable. The end of the handle and cable protecting member facing the plug housing has a larger diameter than the enlarged end of the plug housing which contains the contact pins and is connected with the bushing **26**. The recesses **18'** and **19'** are formed in the end wall of the plug housing, such recesses receiving the keys **18, 19** upon coupling the parts together.

The end or closure cap **44** serves in engagement with the coupling element the purpose of providing a watertight closure for the end of the connector. The cap **44** is constructed in similar manner as the bushing **26**, having identical outer dimensions and also carrying an inner thread **27'** corresponding to the inner thread **27** carried by the bushing. The bushing **26** and also the closure cap **44** are provided with sleeves **45'** and **45**, respectively, made of soft rubberlike material. In assembled condition, with the threaded parts tightened, the facing ends of these sleeves **45'** and **45** will be pressed together along the joining line **46**, thus sealing and protecting the interiorly disposed coupling element against ingress of moisture, dirt or other damaging matter. The sleeves **45'** and **45** have ribs **47** formed thereon to provide for firm grip. The closure cap **44** contains a potlike member **48** which embraces the end of the soft rubber body **10** to prevent outward displacement thereof responsive to pressure exerted thereon. The closure cap **44** is fastened to the plug ring **43** by a chain **49** and thus protected against inadvertent loss.

Upon insertion of the coupling element into the connector, the keys **18** and **19** will enter the recesses **18', 19'** in the plug housing, thus allowing relative longitudinal motion of the parts and securing the required position of the cooperating contact members and therewith proper through-connection of the conductors of the mobile cable portions to be interconnected. The length of the keys is such, that the contact pins come into engagement with the contact sleeves only after the keys **18, 19** on the coupling element are in proper cooperative position with respect to the key recesses in the wall of the plug housing. The width of the key parts is such, that the coupling element can easily be placed into correct angular position by slight rotation thereof, even when the coupling operation is effected in the dark. The keys upon the coupling element may also serve the purpose of marking the position of the contact sleeve for the through-connection of the cable shielding. As is apparent from Fig. 1, the position of key **18** coincides with that of the contact sleeve **15** for the cable shielding.

Upon effecting the coupling between two cable portions, the end surfaces of the soft rubber body **10** will be pressed against the smooth plates carrying the contact pins, responsive to tightening of the threaded bushings carried by the respective plug housings, thereby sealing the contact elements with respect to one another and also with respect to the housing parts. The axial pressure exerted upon the end surfaces of the interior coupling element also produces radial pressure effective to the longitudinally slotted contact sleeves, thereby increasing the contact pressure exerted thereby on the contact pins. The bushings extend so far beyond the contact pins that conductive parts of the coupling element and of the other plug cannot touch the pins in uncoupled condition of the

parts. The retracting motion of the bushings is likewise limited so as to protect the contact pins at all times.

To provide for the placement of locally mobile cable portions or lengths, each plug housing is shipped with a coupling element and a closure or end cap, as illustrated in Fig. 2. In case two cable lengths or portions are to be interconnected, the end caps of both plug housings connected to the respective cable lengths are removed, whereupon the coupling element associated with one of the plug housings is likewise removed. The remaining coupling element is utilized for interconnecting the cable portions, resulting in the assembled connector structure shown in Fig. 4, the removed coupling element being disposed within the caps **44** chained to the interconnected connector structure by chains **49** and serving as a spare coupling element. All parts serving current conducting purposes are in this manner effectively protected against contamination.

The coupling elements, properly designed as to dimensions in accordance with the purposes to be served, may also be used for housing devices such as Pupin coils, amplifiers, for example, transistor amplifiers, or other desired switching elements. For example, one of the coupling elements of the two plug housings to be coupled together, may contain Pupin coils, thus providing for the interconnection of two cable lengths selective use of a normal coupling element and one containing Pupin coils. The unused coupling element will then be disposed in protected manner within the closure caps **44** shown in Fig. 4.

The invention is not limited to the illustrated embodiment. For example, the mechanical coupling of the plug housings with a coupling element may be effected by other means, for example, suitable claw, jaw, cam or grip means. Suitable guide means for determining the proper cooperative position of the coupling element with respect to the plug housings may be used in place of the keys **18**, **19** and cooperating recesses **18'** and **19'**. The displacement of the bushing **20** in the direction of the cable may be limited by other means, for example, by a limiter ring placed into an annular recess of the casing. The outer diameter of the handle and cable protecting member may in such a case be substantially equal to or smaller than the diameter of the casing.

In order to protect the coupling element against inadvertent loss, it may be secured by a chain or the like to the cable plug or to the cable in the manner shown in connection with the closure caps. The inner thread **17** may for this purpose carry an annular groove formed therein for receiving a fastening or retainer ring for the chain.

Changes may made within the scope and spirit of the appended claims.

I claim:

1. A plug-in cable connector for coupling two locally mobile cable portions each having a plurality of conductors with the conductors thereof disposed in conductive continuity, comprising a plug for each cable portion, each plug comprising a tubular housing member, a contact plate disposed within each said housing member and a plurality of contact pins carried thereby which are to be respectively connected with conductors of the corresponding cable portion, bushing means rotatably and exchangeably disposed on each said housing member, a coupling element for plug-in cooperation with said plugs, said coupling element comprising a casing made of relatively solid material, a coupling member made of relatively soft rubberlike material fixedly disposed within said casing, contact sleeves embedded in said coupling member for cooperation with said contact pins of said plugs, a closure cap for each plug assembled with a coupling element to seal the corresponding operating parts in uncoupled condition thereof, the structure of said closure cap corresponding substantially to that of said bushing means, and a potlike member disposed in said closure cap for embracing one end of the coupling element assembled with the corresponding plug in uncoupled condition thereof, said potlike member remaining angularly stationary responsive to actuation of said cap to place it in sealing position relative to said operating parts.

2. A plug-in cable connector for coupling two locally mobile cable portions each having a plurality of conductors with the conductors thereof disposed in conductive continunity, comprising a plug for each cable portion, each plug comprising a tubular housing member, a contact plate disposed within each said housing member and a plurality of contact pins carried thereby which are to be respectively connected with conductors of the corresponding cable portion, bushing means rotatably and exchangeably disposed on each said housing member, a coupling element for plug-in cooperation with said plugs, said coupling element comprising a casing made of relatively solid material, a coupling member made of relatively soft rubberlike material fixedly disposed within said casing and extending axially therebeyond, and contact sleeves embedded in said coupling member for cooperation with said contact pins of said plugs, said soft-material coupling member extending at each end thereof beyond said solid-material casing of said coupling element and also beyond said contact sleeves embedded therein, the opposite ends of said coupling member pressing in coupled condition of said connector against the contact plates of the respective plugs to form a seal for the contact pins and contact sleeves which are conductively interconnected at the opposite end of said coupling element, said soft-material coupling member having an annular groove formed therein for receiving said casing in fixed engagement therewith, and rubberlike jacket means carried by said bushing means, the inner ends of said jacket means abutting in pressure engagement in operatively connected condition of said connector to seal said coupling element against ingress of foreign matter and to protect it from damage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,195,343	Sayre	Mar. 26, 1940
2,265,341	Borchert	Dec. 9, 1941
2,379,942	Webber	July 10, 1945
2,449,983	Devol	Sept. 28, 1948
2,563,712	Frei et al.	Aug. 7, 1951
2,830,282	Swan et al.	Apr. 8, 1958

FOREIGN PATENTS

332,251	Italy	Nov. 27, 1935
551,253	Great Britain	Feb. 15, 1943
967,302	France	Mar. 22, 1950