Jan. 17, 1956 L. J. KAMM 2,731,611

ELECTRICAL CONNECTORS

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FIG. 1.

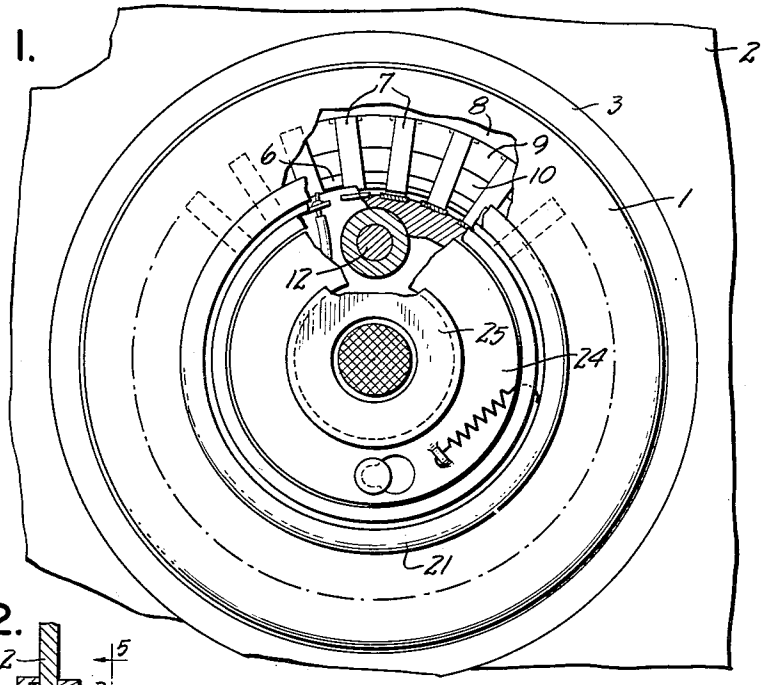


FIG. 2.

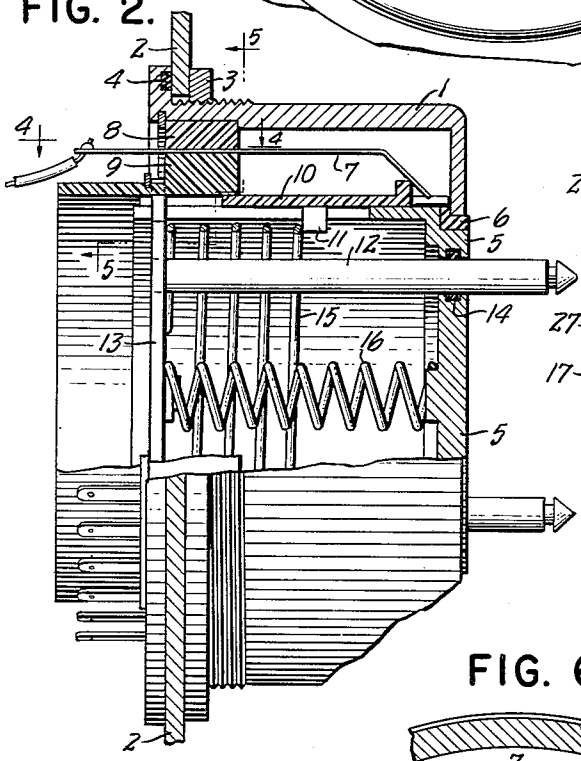


FIG. 3.

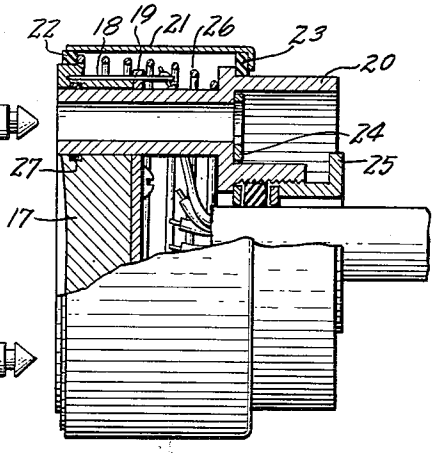


FIG. 6.

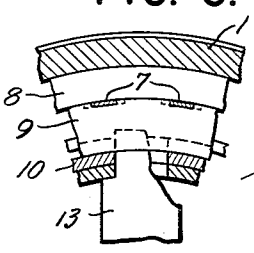
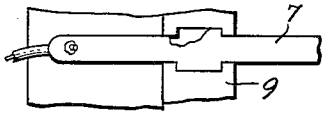


FIG. 5.



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FIG. 4.

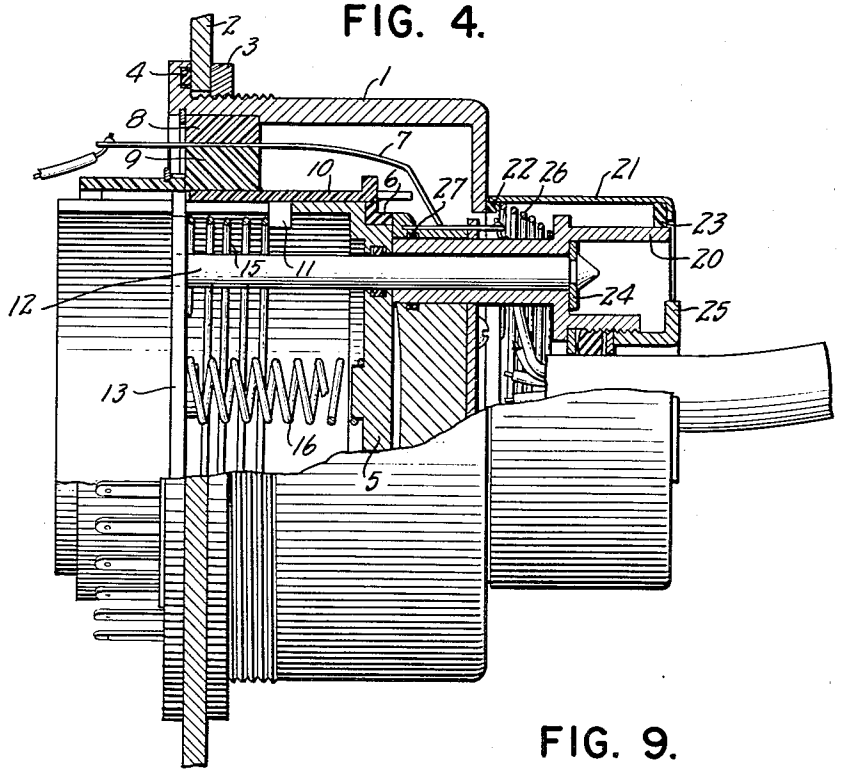


FIG. 9.

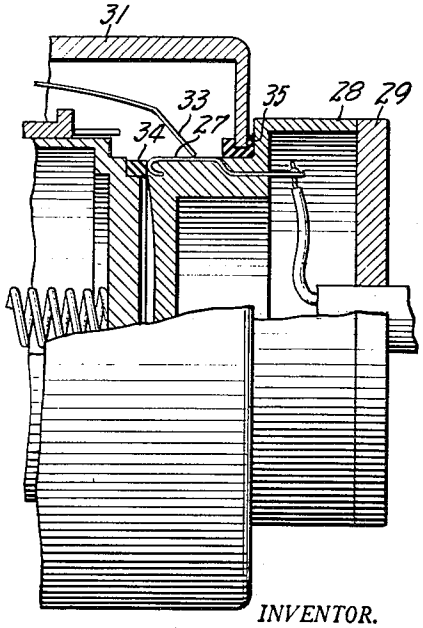


FIG. 7.

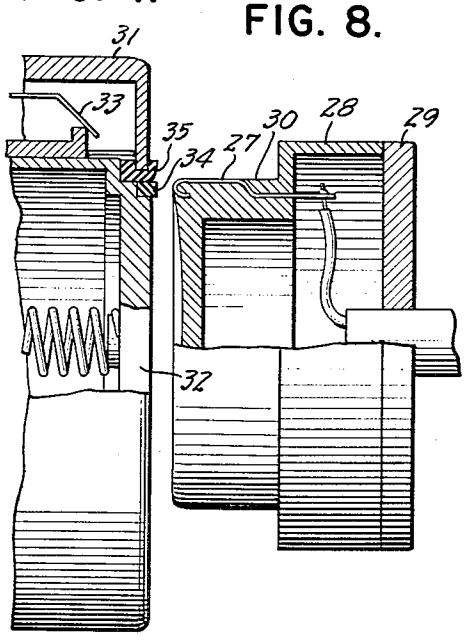


FIG. 8.

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ELECTRICAL CONNECTORS

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6 Claims. (Cl. 339—94)

This invention relates to electrical connectors.

Electrical connectors, particularly those exposed to conditions of moisture, dirt, and rough handling for outdoor service, may malfunction from the following general causes: short circuiting of contacts or leakage between contacts due to entrance of moisture or dirt; contact clogging, failure to close, or high contact resistance due to inclusion of dirt or to corrosion from entrance of moisture; short circuiting or failure to close properly due to mechanical injury; and exposure of contacts to short circuit or shock hazards.

Many designs and inventions have been made to prevent such malfunction. One type consists of removable closures which are unscrewed or hinged open prior to engaging the contacts. These have the disadvantages of exposing the contacts for a time just before engagement and just after disengagement in many designs of being subject to not being replaced after disengagement because of negligence, and of exposing the contacts to mechanical short circuit or shock hazards during engaging and disengaging. Other types produce tightly sealed connections when the connectors are engaged, but have exposed contacts when they are disengaged. Another type uses butt contacts which are easily cleaned before engagement to prevent clogging of deep recesses, but which are still exposed to moisture and dirt when open to moisture inclusion during engagement.

With the foregoing and other considerations in view it is the purpose of the present invention to provide an electrical connector whose contacts are continually protected from outside conditions when disengaged, during engagement, and after engagement.

It is a further object of this invention to provide a connector which may be immersed in water when disengaged, during engagement, and after engagement, without the contacts getting wet.

It is a further object of this invention to provide a connector which guards the contacts against mechanical injury at any time.

It is a further object of this invention to provide a connector which prevents the user from receiving a shock at any time.

The invention accordingly comprises an article of manufacture possessing the features, properties, and the relation of elements which will be exemplified in the articles hereinafter described and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a partly sectional front view of a connector embodying the invention;

Fig. 2 is a partly sectional side view of the female part of the connector of Fig. 1;

Fig. 3 is a partly sectional side view of the male part of the connector of Fig. 1;

Fig. 4 is a partly sectional side view of the male and female parts of Figs. 2 and 3 shown in engaged relationship;

Fig. 5 is a fragmentary view on the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary sectional view on the line 6—6 of Fig. 2;

Fig. 7 is a fragmentary view of the female part of an alternative form of connector embodying the invention;

Fig. 8 is a fragmentary partly sectional side view of the corresponding male part;

Fig. 9 is a fragmentary partly sectional side view of the male and female parts of Figs. 5 and 6 shown in engaged relationship.

In the form of construction exemplified in Figs. 1–6 there is illustrated a socket consisting of housing **1** shown mounted to equipment panel **2** by means of ring nut **3** and sealed to **2** by O ring **4**. Cylindrical closure **5** slides axially within housing **1** and is sealed to housing **1** by rubber seal **6** under the influence of compression spring **16**. Contacts **7** are springs biased radially inward and are mounted between insulating rings **8** and **9**. A coaxial insulating spring lifter **10** slides between closure **5** and spring mounting ring **9**. Lug **11** projects through a slot in the closure **5** and receives the pressure of spring **15** holding the ends of fingers formed integrally with the spring lifter **10** against the inner surface of the housing and causing contact springs **7** to be lifted outwardly. Alinement and locking pins **12** are supported by plate **13** and project thru closure **5**. Pins **12** are sealed to closure **5** by O rings **14**.

When closure **5** is moved inward it moves alone for a short distance, and then picks up lug **11** on lifter **10** and continues its inward motion with **10**. As lifter **10** moves inward contact springs **7** are permitted to deflect radially inward against the male contacts which have been inserted.

The plug shown in Figure 3 comprises plug body **17** in which are mounted male contacts **18** retained by insulating plate **19**. The plug body is enclosed by back member **20** and sealing sleeve **21**. Sleeve **21** is sealed to back member **20** by rubber seal **23** so as to allow sliding of **21** on **20** and is sealed to plug body **17** by a seal **22**. Spring **26** normally holds the sleeve in the forward position shown in which the male contacts are in a sealed and enclosed space.

When the plug is placed against the socket, pins **12** aline the tubular holes in back member **20** and as the plug is pressed into the socket, pins **12** pass thru those holes and thru the holes in latch plate **24**. Latch plate **24** has a spring tending to rotate it so that the sides of its key-hole slots engage the grooves in pins **12** and retain those pins, thus holding the connector assembled.

When the plug is first placed against the socket, a seal is established between plug body **17** and socket closure **5** by means of rubber seal **6**. This seals off any moisture or dirt which may be included between the faces of **17** and **5**. After the plug has moved a short distance into the socket, the sleeve **21** of the plug is sealed against the body **1** of the socket by means of seal **22**. Thus when plug **17** is pushed out of its enclosure and into the inner space of socket **1** all contacts are sealed against outside conditions.

Figure 4 shows the plug fully introduced into the socket with both seals in effect and with the socket contacts released to press against the plug contacts.

When the plug is withdrawn from the socket the reverse sequence occurs. The latch-plate is released by any suitable means, as by a screwdriver blade inserted in its containing-groove.

As the plug is moved out of the socket, the seal **22** is broken after the seal **6** becomes effective, and both the plug and socket enclosures are sealed before the plug and socket are separated. Thus the entire unit and each

of its halves is sealed from the outside conditions, before, during and after coupling.

The male cable is shown sealed to the plug by a conventional stuffing gland.

To wire the plug, the sleeve and back plate are removed, thus exposing the terminals and contacts.

In both the plug and socket all terminals are arranged in a ring where they are easily available for wiring and inspection and maintenance, and all contacts are removable individually for maintenance.

The face of plug body **17** or closure **5** is made slightly concave. If mud or moisture droplets should accumulate on either part it may be wiped off roughly by hand and when the initial seal is made between plug body **17** and rubber seal **6** the mud or moisture is retained sealed in the concavity so that none may drip into the contact chamber after engagement.

The female contacts **7** are shown as flat springs. They may be made in a number of alternate forms, such as: flat springs with noble metal edges, known commercially as "edge-lay," and other known or suitable type.

Wiring terminals are shown of any suitable type.

The alinement and latching system using pins **12** and latch plate **24** may be modified without affecting the basic sealing functions of the other parts.

In the embodiment shown of Figs. 1–4, the female connector Fig. 1 is mounted in the wall **2** of an equipment while the male connector Fig. 2 is mounted at the end of a cable. It is possible to modify housing so that the female may be connected to the end of a cable and to modify back member **20** so that it may be mounted on an equipment. Furthermore, both contacts **7** and **18** are held in their supports **8—9** and **17—19** respectively by a system of fitted notches, but it will be apparent that they may be mounted in any of a variety of other ways.

In the embodiment of Figs. 7–9 the female connector, Fig. 7, is similar to that of Fig. 1 except that the seal **35** is fixed to the enclosure **31** instead of to the closure **32**. However, the male, Fig. 5 is unsealed. This is satisfactory for certain applications such as the power plug on a portable device.

The plug consists of a body **28** of insulating material in which are embedded contacts **27**. A closure **29** covers the wiring space and is sealed to the body and the cable in conventional ways not detailed in the drawing.

When the plug is inserted into the socket it pushes closure **32** out of the way in front and is wiped clean and dry by seal **35** before contacts **27** are engaged by contacts **33**. When the parts are fully engaged seal **26** rests on insulating surface **30** so that no conducting part is exposed when the connector is engaged.

Seal **34** on closure **32** serves to seal off the dirt and moisture on the faces of closure **32** and plug body **28**.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. An electrical connector comprising a socket having a plurality of contacts, insulating means supporting said contacts, a housing enclosing said contacts and having a fixed opening, a moveable closure, means for urging said closure toward said opening, and openable moisture-sealing means between said closure and said opening; and a plug having a supporting body, and a second plurality of contacts disposed on said body to mate with the first-mentioned plurality of contacts, a portion of said body

and of each of said second plurality of contacts being proportioned to enter said fixed opening; and moisture-sealing means for uniting said plug and said socket during entrance of said body into said opening.

2. An electrical connector as in claim 1 wherein there is provided a concavity disposed between said closure and said body, and openable moisture-sealing means surrounding said concavity, whereby substances adherent to said closure and said body are sealed from said contacts.

3. An electrical connector as in claim 1 wherein there are provided contact-lifting means engaging said first-mentioned plurality of contacts, means for urging said contact-lifting means to lift said contacts, and means for displacing said contact-lifting means during entrance of said body into said fixed opening, whereby said first-mentioned plurality of contacts are prevented from touching parts other than said second plurality of contacts.

4. An electrical connector comprising a socket and a plug; said socket comprising a plurality of contacts, insulating means supporting said contacts, a housing enclosing said contacts and having a fixed opening, a closure formed to substantially fit said opening, means for slidably guiding said closure towards said opening, a spring urging said closure towards said opening, and openable moisture-sealing means between said closure and said opening; and said plug comprising a body supporting a second plurality of contacts disposed to mate with the first-mentioned plurality of contacts, a portion of said body being proportioned to enter said fixed opening and to displace said closure while entering said fixed opening; and openable moisture-sealing means for uniting said plug and said housing during entrance of said plug into said fixed opening.

5. An electrical connector comprising a socket having a plurality of contacts, insulating means supporting said contacts, a housing enclosing said contacts, said housing having a fixed opening, a movable closure, means for urging said closure towards said opening, and sealing means between said closure and said opening; a plug comprising a supporting body, a moveable enclosure, and a second plurality of contacts disposed on said body to mate with the first-mentioned plurality of contacts, a portion of said body being proportioned to enter said fixed opening, a second sealing means sealing said second plurality of contacts within said enclosure when said body is outside of said fixed opening; and a third sealing means disposed to seal said enclosure to said housing and having an opening for the passage of said portion of said body and said second plurality of contacts; said housing, said third sealing means, and said enclosure enclosing said fixed opening and said plug body, and said second plurality of contacts being substantially smaller than said opening in said third sealing means whereby said second plurality of contacts do not rub against said third sealing means.

6. An electrical connector as in claim 5 wherein there is provided a concavity disposed between said closure and said body, and moisture-sealing means surrounding said concavity, whereby substances adherent to said closure and said body are sealed from said contacts.

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