United States Patent [19]

Ganzert et al.

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[45] **Dec. 3, 1974**

[54] **CURRENT TRANSFORMER CONNECTOR**

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[73] Assignee: **Okzona Incorporated,** Asheville, N.C.

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[21] Appl. No.: **346,690**

[52] **U.S. Cl.** ..... **339/19,** 339/222, 339/255 R, 339/45 M

[51] **Int. Cl.** **H01r 31/08**

[58] **Field of Search** 339/19, 42, 45, 222, 253, 339/255

[56] **References Cited**

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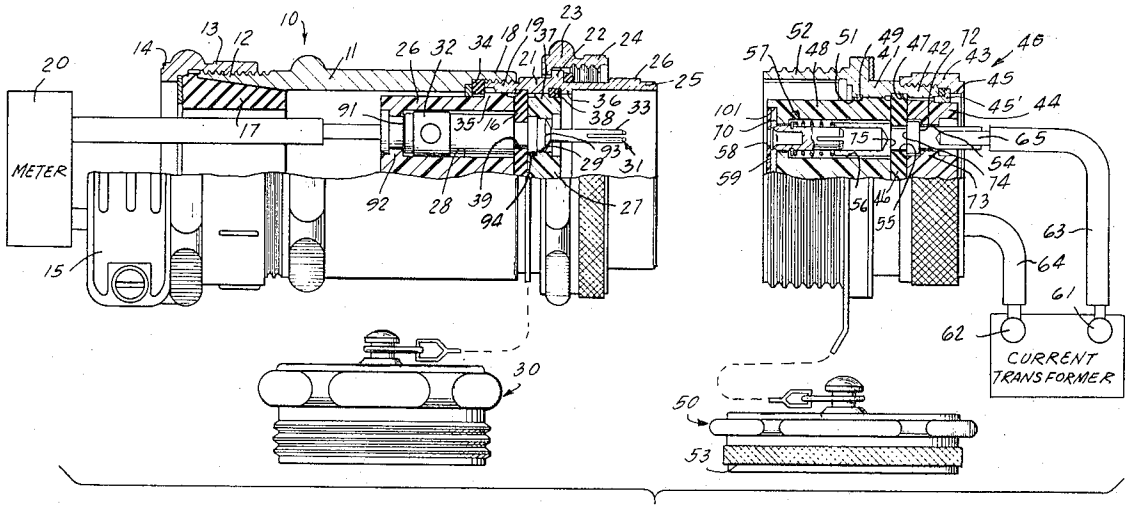
Attorney, Agent, or Firm—Hill, Gross, Simpson, Van Santen, Steadman, Chiara & Simpson

[57] **ABSTRACT**

Each contact of a connector receptacle is electrically connected to a separate lead from the secondary winding of a current transformer. In the disconnected condition, the socket contacts are shorted together by means of individual spring loaded actuators which make electrical contact with both the socket contact and a metal shorting plate which is common to all socket contact actuators. A measuring instrument or other device which is to be connected across the current transformer secondary is connected to the pin contacts of a complementary connector plug. When the connector plug is inserted into the receptacle, the pin contacts of the plug force the spring loaded actuators out of engagement with and away from the shorting plate thereby electrically isolating the socket contacts from each other. At the same time, the pin contacts engage the socket contacts, by means of the actuators, thereby establishing electrical continuity through the connector. The instrument is therefore electrically connected across the secondary winding of the current transformer. Upon disengagement of the connector, the socket contacts are automatically shorted together due to the spring loaded feature and the shorting plate, thus preventing the secondary winding of the current transformer from being accidentally in an open condition.

9 Claims, 4 Drawing Figures



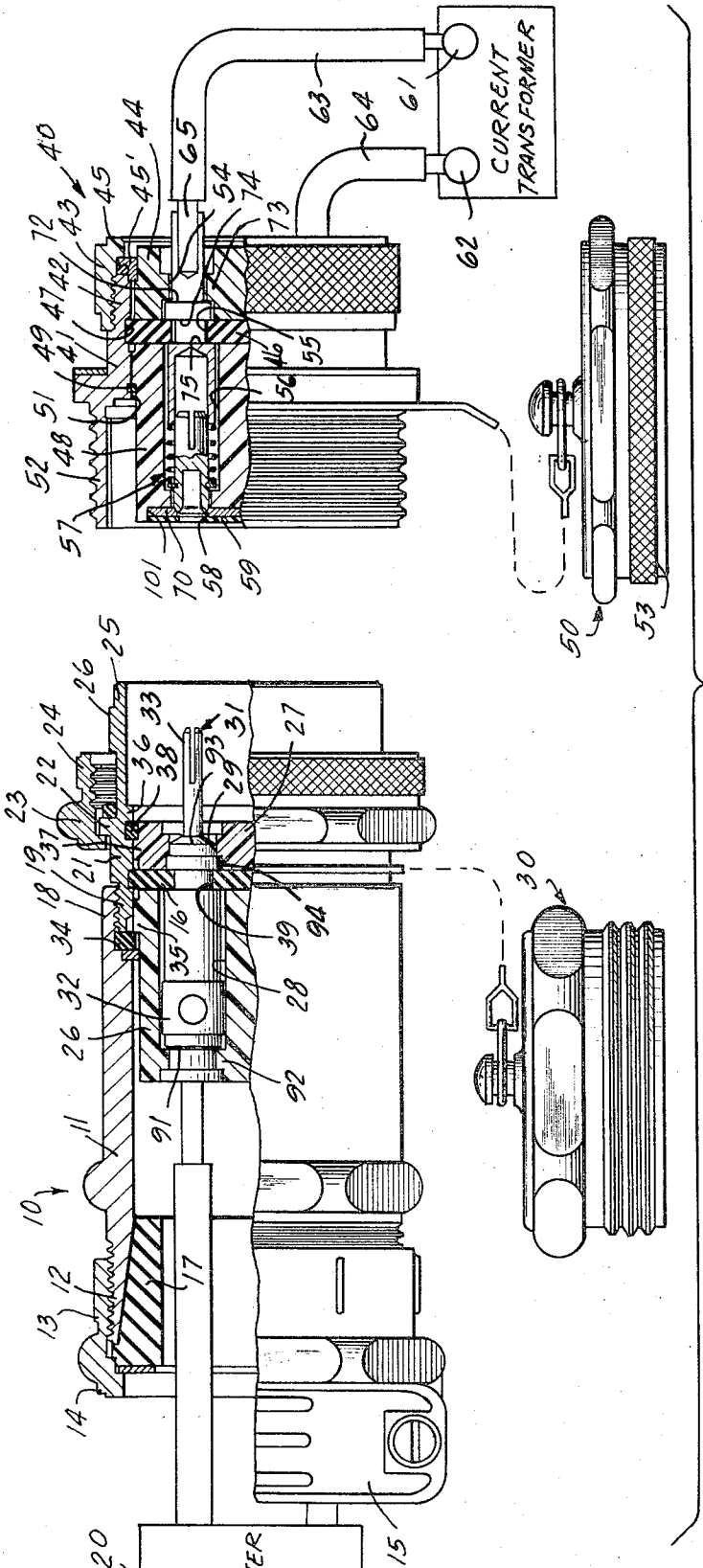


Fig. 1

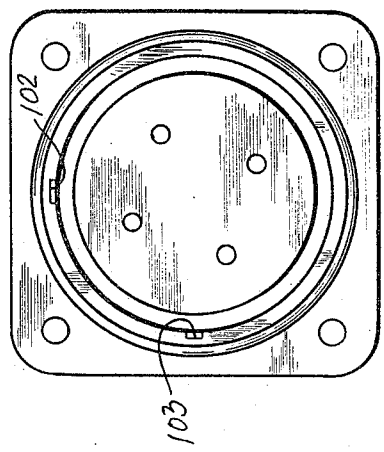


Fig. 2

Fig. 4

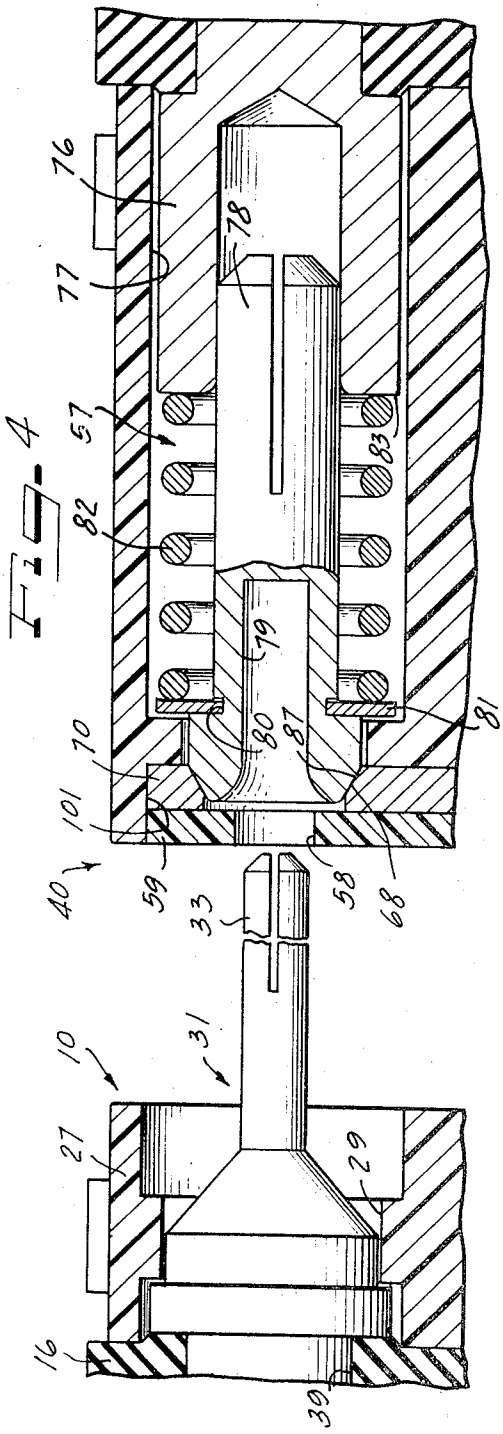

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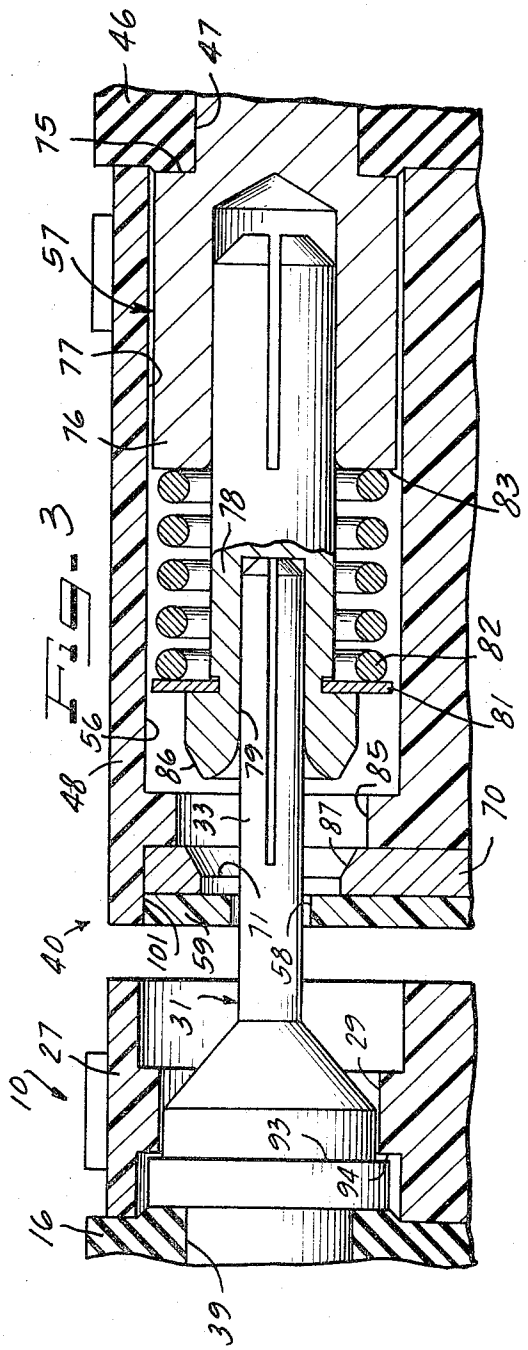
Fig. 3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CURRENT TRANSFORMER CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical connectors, and more particularly to an automatic self-shorting electrical connector part which may advantageously be employed for connecting and disconnecting the secondary winding of the current transformer to a measuring instrument or the like.

2. Description of the Prior Art

A current transformer, as is well known in the art, is a device which provides a current value at a secondary winding which is compatible with the current coils of a wattmeter or ammeter. The primary coil of the transformer is connected in series with the primary circuit load and has multiple terminals so that the correct ratio can be selected to produce a suitable secondary current.

A disadvantage in the form of a shock hazard to both personnel and equipment arises, however, from the fact that dangerous voltages can be developed across a current transformer secondary winding, if the secondary winding is opened under load conditions. The conventional current transformer is provided with a shorting switch across the output terminal of its secondary winding. It is standard practice for operating personnel to short the secondary winding with the switch before disconnecting attached meters, or to short the circuit in another manner. This technique itself, however, has disadvantages, including: the possibility that the shorting switch may be inadvertently left open; and the current transformer may be remotely located or installed behind a panel such that the shorting switch is not readily accessible.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a current transformer connector which includes automatic fool-proof techniques for shorting the secondary winding of the current transformer when the load is removed.

According to the invention, the foregoing object is achieved by provision of a special connector receptacle (or plug) which is permanently connected across the secondary winding of a current transformer. In the "unloaded" condition, a short circuit is provided across the socket contacts in which the transformer secondary winding leads are terminated. Insertion of the plug connector automatically disengages the short circuit while simultaneously connecting the measuring instrument across the secondary winding of the current transformer.

The short circuit is provided by means of a shorting plate disposed near the forward end of the receptacle and a socket contact which includes an actuator for receiving a pin axially movable within the contact and spring loaded so as to be urged toward the metal shorting plate upon disengagement of the plug and receptacle. In the disengaged and engaged conditions of the receptacle the actuator is in electrical contact with the associated terminal of the secondary winding of the current transformer through the respective socket.

An electrical connector constructed in accordance with the present invention includes further features and advantages, such as: the receptacle portion of the connector can be permanently connected to the secondary winding of a current transformer thereby allowing various instruments to be easily connected to the transformer through the use of a mating plug connector; disengagement of a meter from the secondary winding circuit, by means of the mating current transformer connector elements provides an automatic short circuiting of the current transformer secondary winding and thereby eliminates the safety hazards to personnel and equipment; and the automatic shorting feature can be readily incorporated in receptacles for both single phase and polyphase applications.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention, its organization, construction and operation will be best understood from the following detailed description of a preferred embodiment of the invention taken in conjunction with the accompanying drawings, on which:

FIG. 1 is a combination schematic and circuit diagram of the connection of the secondary winding of a current transformer to an instrument by means of an electrical connector constructed in accordance with the principles of the present invention, particularly showing, in partial sectional elevation, a connector plug and a mating connector receptacle;

FIG. 2 is an end view of the connector receptable of FIG. 1 specifically showing two possible angular orientations of the plug with respect to the receptacle;

FIG. 3 is a detailed sectional elevational view of a pin of a connector and its associated socket in an engaged condition according to the invention; and

FIG. 4 is a sectional elevational view illustrating the same apparatus as FIG. 3 in a disengaged condition.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the invention is described herein with the receptacle connected to the secondary winding of a current transformer, it should be readily apparent that the plug could be so associated and the receptacle then connected to the instrument. It is also possible to provide a construction in which the two mating connector parts each have pins and sockets. Also, the invention is not necessarily limited to applications involving a current transformer, but may be employed in electrical connectors wherein it would be advantageous to provide electrical continuity between contacts upon disengagement of the associated contacts.

Referring to FIG. 1, a connector plug **10** is connected to a meter **20** or other instrument and is adapted for connection to the secondary winding of a current transformer **60** via a mating connector receptacle **40**. The plug **10** and the receptacle **40** may be provided with a respective protective cap **30, 50**, as is standard practice in the art.

The connector plug **10** comprises a generally cylindrical metal body **11** having a threaded portion **12** for engagement by a complementary threaded portion **13** of a nut **14** which also carries cable clamp apparatus **15** as well known in the art for strain relief purpose. A hollow resilient member **17**, such as rubber, may be employed to seal the plug and cable as the nut **14** is turned onto the body **11**.

At its forward end the body **11** includes a threaded portion **18** for engaging a complementary threaded

portion 19 of a hollow cylindrical metal body 21. The body 21 includes an annular flange 22 for limiting the forward movement of a coupling nut 23. The rearward movement of the coupling nut 23 is limited by the forward end of the threaded portion 18. The coupling nut 23 includes an internal thread which is complementary for the external thread of the protective cap 30 and, as will be seen below, for an engaging portion of the connector receptacle.

The hollow cylindrical body 21 includes a forward end 25 which carries a key 26 on its outer surface to properly align the plug with the receptacle.

The plug 10 includes a disc 27 of insulating material, a disc 16 of resilient insulating material and a cylindrical body 26 of insulating material disposed within the hollow bodies 11 and 21 in a sandwich configuration. The insulating body 26 includes a peripheral flange 35 which abuts a shoulder 34 (via a seal) formed in the inner surface of the hollow cylindrical body 11 to limit rearward movement of the sandwich configuration. In order to limit forward movement of this structure, the hollow cylindrical body 21 includes an internal shoulder 36 which bears against a peripheral flange 37 of the insulating disc 27 via a seal 38.

The insulating disc 27, the flexible insulating disc 16 and the insulating body 26 include respective axially aligned openings 29, 39 and 28 for receiving a contact pin assembly 31. The contact pin assembly 31 includes a connection portion for connection to a wire which is to be extended to the instrument 20 and a contact pin portion 33 which is to be received in a complementary socket of the connector receptacle. The contact pin assembly 31 includes a shoulder 91 which is received against an internal flange 92 of the insulating block 26 to limit rearward movement of the contact pin assembly. The contact pin assembly 31 also includes a shoulder 93 which bears against an internal ridge or flange 94 of the insulating disc 27 to limit the forward movement. During assembly, the contact pin assemblies are disposed in the respective bores or openings 28, the resilient disc 16 is pressed into place whereby its openings 39 expand about the shoulder 93 and contract about the smaller diameter portion 95 of the contact pin assemblies, and the disc 27 is located so that the shoulder 93 contacts the flange 94. The bodies 11 and 21 are then engaged by means of their respective threaded portions 18 and 19 to clamp the insulating members and pin assemblies in place.

The connector receptacle 40 comprises a hollow generally cylindrical metal cylinder 41 having a rear threaded portion 42 for engaging a threaded nut 43. At the forward end of the body 41 is a threaded portion 52 for engaging a complementary threaded portion 53 of a protective cap 50, or the threaded portion 24 of the coupling nut 23 carried on the connector plug 10 as indicated above.

The connector receptacle includes an internal construction for mounting the individual sockets which is similar to that employed in the plug 10 for mounting the pin assemblies 31. This structure includes a sandwich construction of a insulating disc 44, a resilient insulating disc 46, and an insulating block 48. The insulating block 48 includes a shoulder 49 which, via a seal, bears against an internal annular flange 51 of the hollow body 41. The resilient insulating disc 46 bears against the rear end of the insulating block 48 and has its periphery disposed in an annular internal groove 47 of the body 41. The insulating disc 44 bears against the resilient insulating disc 46 and is clamped thereagainst by an annular internal ridge 45 of the nut 43 via a retaining ring 45'.

The connector receptacle 40 includes a plurality of socket assemblies 57 for receiving respective pin portions 33 of the pin assemblies 31 carried by the connector plug 10. As shown in FIG. 1, a socket assembly 57 comprises a rear terminal portion 65 for connection to a wire 63 which, in turn, is connected to one terminal 61 of a secondary winding of the current transformer 60. The other terminal 62 of the secondary winding is connected by way of a wire 64 to a respective socket assembly. The socket assembly 57 is disposed in a plurality of axially aligned openings 54, 55 and 56 of the respective insulating elements 44, 46 and 48. To limit forward movement of the internal structure of the receptacle 40, each pin assembly 57 is provided with an annular flange having a forward facing surface 74 which bears against the rear face of the resilient insulating disc 46. To restrict rearward movement of the socket assembly, the aforementioned flange has a rear facing surface 72 which is positioned to contact an annular ridge or flange 73 formed on the inner surface of the opening 54. In addition, the socket assembly 57 includes a shoulder 75 which contacts the forward facing surface of the insulating member 46. As in the previous case, the member 46 is stretched to receive the socket assembly therethrough and contracts about the narrowed portion between the surface 74 and the shoulder 75.

More detailed illustrations of the aforementioned pin and socket assemblies may be found by referring to FIGS. 3 and 4 which respectively illustrate the engaged and disengaged conditions of the connector plug 10 and the connector receptacle 40.

In FIG. 3, for example, the socket assembly 57 is seen to comprise a forward portion 76 having a bore 77 therein for receiving a member 78 in sliding electrical contact therewith. The member 78 includes a similar forward facing bore 79 for receiving the contact pin 33 of a respective pin assembly 31 in sliding engagement.

The member 78 is hereinafter termed an "actuator," as will be readily apparent from the following discussion, and is seen to further comprise an annular groove 80 which seats an annular ring 81. The groove 80 is adjacent a radially extending shoulder 100 which provides support for the ring 81 as the ring 81 is employed as a spring retaining element which holds a spring 82 against a forward end of the contact member 76. In the position illustrated in the drawing, the actuator 78 has moved toward the right to store energy in the spring 82 so that as the pin contact 83 is withdrawn for disengagement of the plug and receptacle, the spring 82 will urge the actuator 78 toward the forward end of the receptacle, toward the left in FIG. 3.

The actuator 78 is provided with a conical surface 86 which complements a conical surface 87 of a metal plate 70. The metal plate 70 is common to all actuators of a receptacle so that when a disengagement operation is effected the secondary winding of the current transformer 60 is shorted. The metal shorting plate 70 is disposed in an annular cavity 101 at the forward end of the insulating block 48 and is covered with an insulating disc 59. Access for the pin 33 to the actuator 78 is provided by means of respective aligned apertures 58

and 71 in the insulating disc 59 and the metal shorting plate 70, respectively.

When the pin 33 is fully withdrawn from the actuator 78, the complemental surfaces 86 and 87 mate as is illustrated in detail in FIG. 4 to provide the aforementioned shorting feature.

The structure discussed thus far is applicable to two pin-socket assemblies. For slightly more versatility, a plurality of pairs of pin-socket assemblies may be provided for more versatility in mating the plug and receptacle by associating pairs of contacts and providing keyways to associate proper pairs of elements as is shown with the keyways 102 and 103 in FIG. 2, either of which may receive the same key, such as the key 26. There is no concern, however, over the unused pairs of elements and a common shorting plate will still suffice.

Although we have described our invention by reference to a particular illustrative embodiment thereof, many changes and modifications of the invention may become apparent to those skilled in the art without departing from the spirit and scope of the invention. We therefore intend to include within the patent warranted hereon all such changes and modifications as may reasonably and properly be included within the scope of our contribution to the art.

We claim:

1. In an electrical connector of the type wherein an electrical circuit is continued over at least two conductor paths through engaged contacts of mated connector parts, the improvement therein comprising:

means for automatically shorting the conductor paths by shorting the contacts of one of said connector parts upon disengagement of said connector parts, said means including

an electrically conductive element mounted in said one connector part adjacent each of the contacts thereof;

an electrically conductive shorting actuator movably mounted in each of said contacts of said one connector part and moved away from said conductive element by the corresponding contact of the other connector part upon mating of the connector parts; and

bias means for each of said actuators mounted to urge said actuators into electrical contact with said conductive element upon disengagement of the connector parts, each of said contacts of said one connector part including a hollow portion and each of said actuators including a first portion slidably mounted within and electrically contacting said hollow portion of a respective contact and a second portion having a bore for receiving and releasably engaging the corresponding contact of the other connector part and said bias means including a spring retainer carried on each said actuator and a respective bias spring mounted between said spring retainer and the part which includes the hollow portion of the respective contact.

2. In an electrical connector of the type wherein an electrical circuit is continued over at least two conductor paths through engaged contacts of mated connector parts, the improvement therein comprising:

means for automatically shorting the conductor paths by shorting the contacts of one of said connector parts upon disengagement of said connector parts, said means including

an electrically conductive element mounted in said one connector part adjacent each of the contacts thereof;

an electrically conductive shorting actuator movably mounted in each of said contacts of said one connector part and moved away from said conductive element by the corresponding contact of the other connector part upon mating of the connector parts; and

bias means for each of said actuators mounted to urge said actuators into electrical contact with said conductive element upon disengagement of the connector parts, each of said bias means including a spring mounted to urge the respective actuator toward said conductive element, each of said actuators includes a circumferential groove and a ring mounted in said groove, the respective spring bearing against said ring and the respective contact.

3. In an electrical connector of the type wherein an electrical circuit is continued over at least two conductor paths through engaged contacts of mated connector parts, the improvement therein comprising:

means for automatically shorting the conductor paths by shorting the contacts of one of said connector parts upon disengagement of said connector parts, said means including

an electrically conductive element mounted in said one connector part adjacent each of the contacts thereof;

an electrically conductive shorting actuator movably mounted in each of said contacts of said one connector part and moved away from said conductive element by the corresponding contact of the other connector part upon mating of the connector parts; and

bias means for each of said actuators mounted to urge said actuators into electrical contact with said conductive element upon disengagement of the connector parts, each of said contacts of said one part including a hollow portion, and each of said actuators including a first portion slidably mounted within and in electrical contact with said hollow portion of a respective contact and a second portion for releasably engaging the corresponding contact of the other connector part.

4. The improvement in an electrical connector according to claim 3, wherein each of said second portions of said actuators includes a bore for receiving the respective contacts of the other connector part in releasable engagement.

5. An electrical connector part for engagement with another connector part which has a plurality of pin contacts, comprising:

a hollow body having front and rear ends;

a plurality of socket contacts for receiving and releasably engaging respective ones of the pin contacts of the other connector parts;

first insulating means mounting said socket contacts within said body in a spaced relationship and having a front end with a cavity therein;

a conductive element mounted in the cavity in said front end of said first insulating means adjacent said socket contacts;

second insulating means mounted within the cavity of said front end of said first insulating means forward of said conductive element, said conductive element and said second insulating means having aligned apertures therein for permitting access therethrough for engagement between the pin contacts and said socket contacts;

an electrically conductive actuator included in each of said socket contacts and movable away from and toward said conductive element in response to engagement and disengagement, respectively, between the contacts of the connector parts; and

means biasing each of said actuators toward said conductive element for automatically shorting said socket contacts upon disengagement of the connector parts, each of said socket contacts including a hollow portion and each of said actuators including a first portion slidably mounted within and electrically contacting said hollow portion of a respective socket contact and a second portion having a bore for receiving and releasably engaging the corresponding pin contact of the other connector part, and said bias means including a spring retainer carried on each of said actuators and a respective bias spring mounted between said spring retainer and the hollow portion of the respective socket contact.

6. An electrical connector part as claimed in claim **5**, wherein each of said actuators includes a circumferential groove and a ring mounted in said groove, the respective spring bearing against said ring and the respective socket contact.

7. An electrical connector part for engagement with another connector part which has a plurality of pin contacts, comprising:

a hollow body having front and rear ends;

a plurality of socket contacts for receiving and releasably engaging respective ones of the pin contacts of the other connector parts;

first insulating means mounting said socket contacts within said body in a spaced relationship and having a front end with a cavity therein;

a conductive element mounted in the cavity in said front end of said first insulating means adjacent said socket contacts;

second insulating means mounted within the cavity of said front end of said first insulating means forward of said conductive element, said conductive element and said second insulating means having aligned apertures therein for permitting access therethrough for engagement between the pin contacts and said socket contacts;

an electrically conductive actuator included in each of said socket contacts and movable away from and toward said conductive element in response to engagement and disengagement, respectively, between the contacts of the connector parts; and

means biasing each of said actuators toward said conductive element for automatically shorting said socket contacts upon disengagement of the connector parts, each of said socket contacts including a hollow portion, and each of said actuators including a first portion slidably mounted within and in electrical contact with said hollow portion of a respective socket contact and a second portion for releasably engaging the corresponding pin contact of the other connector part.

8. An electrical connector part as claimed in claim **7**, wherein each of said second portions of said actuators includes a bore for receiving the respective pin contact of the other connector part in releasable engagement.

9. An electrical connector comprising:

a connector plug including pin contacts for connection to a first circuit,

a connector receptacle including socket contacts for connection to a second circuit,

said plug and said receptacle including means for mating said plug and said receptacle with said pin contacts received by said socket contacts to electrically connect said first and second circuits, and

means in said connector receptacle for short circuiting said socket contacts in response to withdrawal of said pin contacts from said socket contacts upon disengagement of said plug and receptacle, each of said socket contacts comprising a hollow portion, a generally cylindrical conductive member slidably received in said hollow portion and having a hollow portion for receiving the corresponding pin contact, and a spring having two ends, one of said ends bearing against said socket contact comprising said hollow portion, said conductive member including a spring retainer bearing against the other end of said spring.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,851,944 Dated December 3, 1974

Inventor(s) Albert E. Ganzert et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 1, column 1, line 8, after "[73] Assignee:" correct the attempted spelling of --Akzona--.

Signed and sealed this 18th day of February 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

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