United States Patent [19]

Curcic

[11] **3,778,747**

[45] **Dec. 11, 1973**

[54] **ELECTRICAL CONNECTOR**

[75] Inventor: **Simo Curcic,** Derby, England

[73] Assignee: **Coal Industry (Patents) Limited,** London, England

[22] Filed: **Apr. 13, 1971**

[21] Appl. No.: **133,622**

[30] **Foreign Application Priority Data**

Apr. 28, 1970 Great Britain 20,283/70

[52] **U.S. Cl.** ..... **339/45 M,** 339/90 R

[51] **Int. Cl.** **H01r 13/62**

[58] **Field of Search** 339/45, 46, 75, 90, 339/91; 285/358, 360, 361, 376, 396, 401, 402

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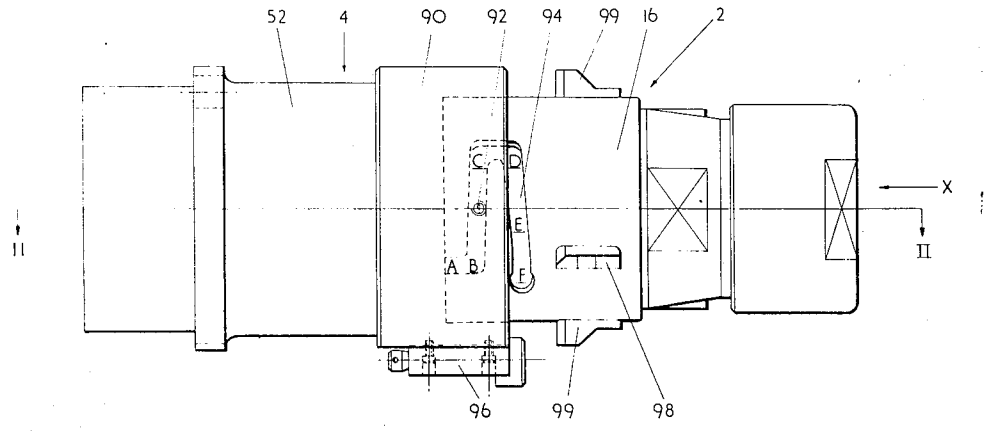
Primary Examiner—Marvin A. Champion
Assistant Examiner—Terrell P. Lewis
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

An electrical connector which has mating plug and socket parts which can be joined together by connecting means without causing relative rotation of the parts. Each part comprises main and auxiliary contacts and the connecting means includes a cam profile and cam follower which ensure that the auxiliary contacts of the two parts make after the main contacts make on assembly of the connector and break before the main contacts break on disassembly of the connector.

10 Claims, 6 Drawing Figures



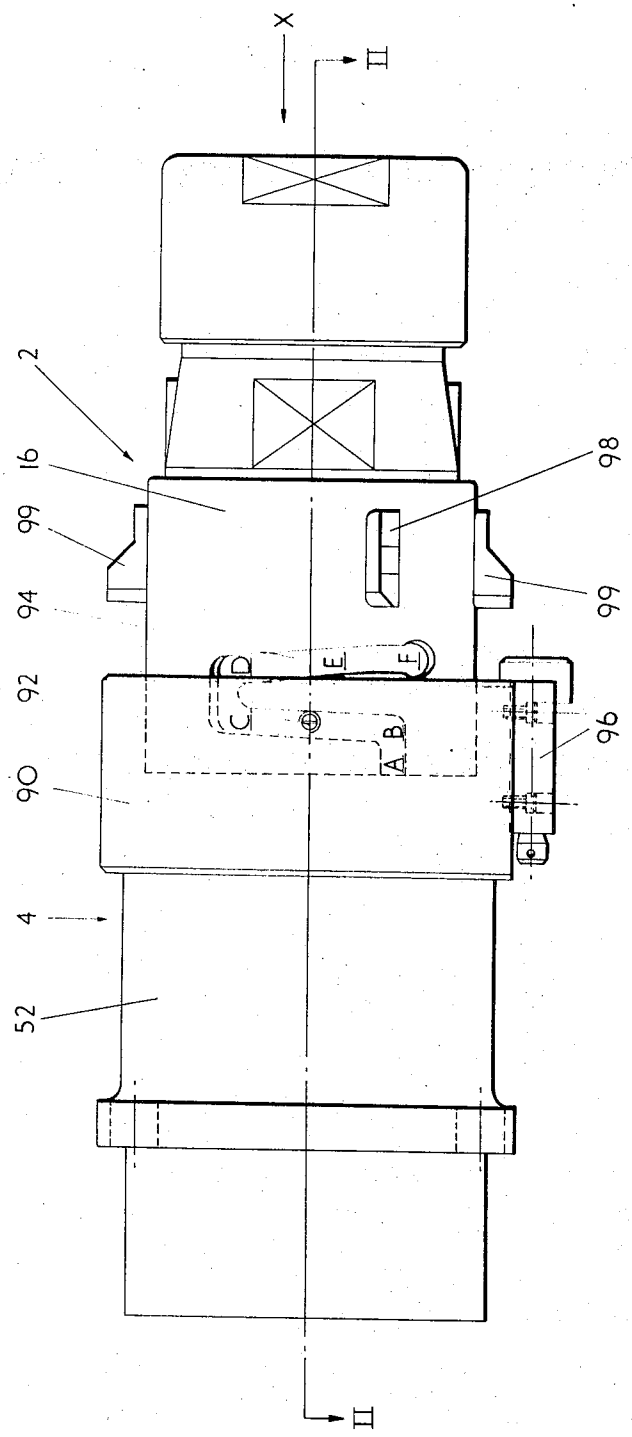


FIG. I.

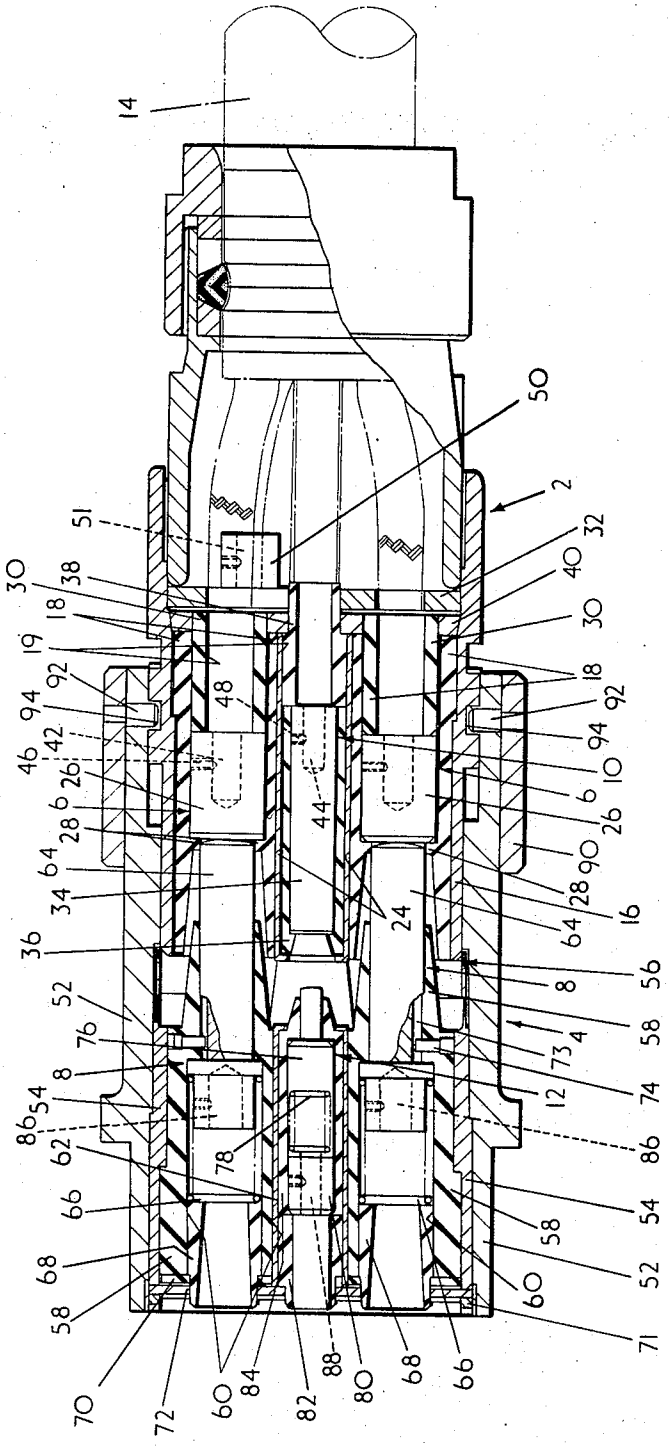

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FIG. 2.

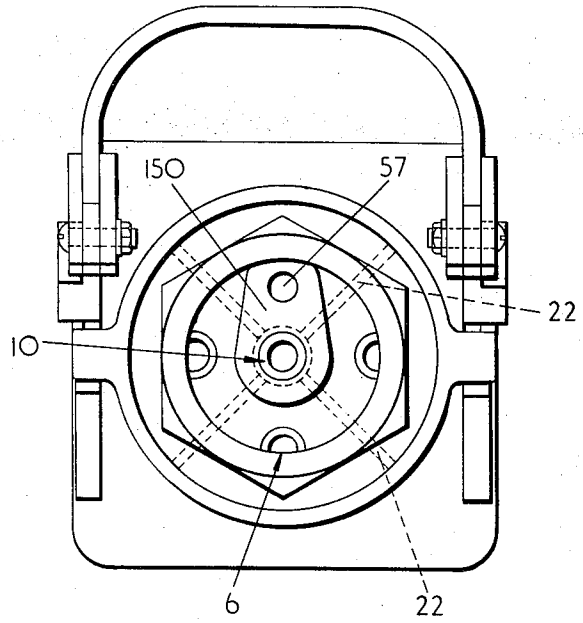

FIG. 6

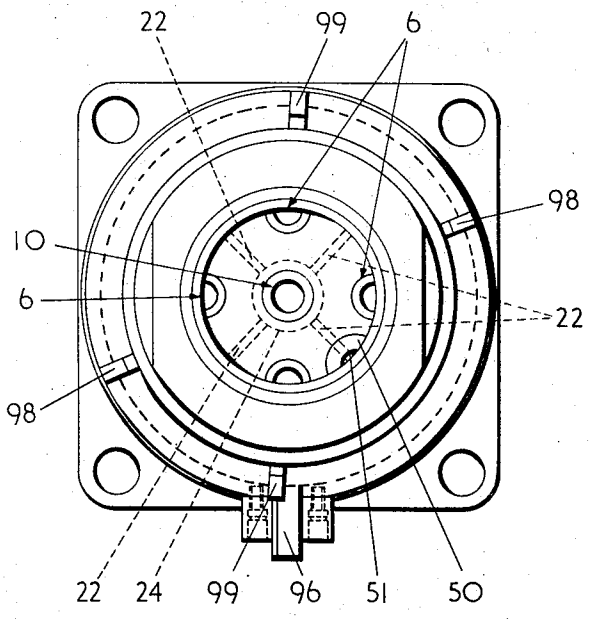

FIG. 3.

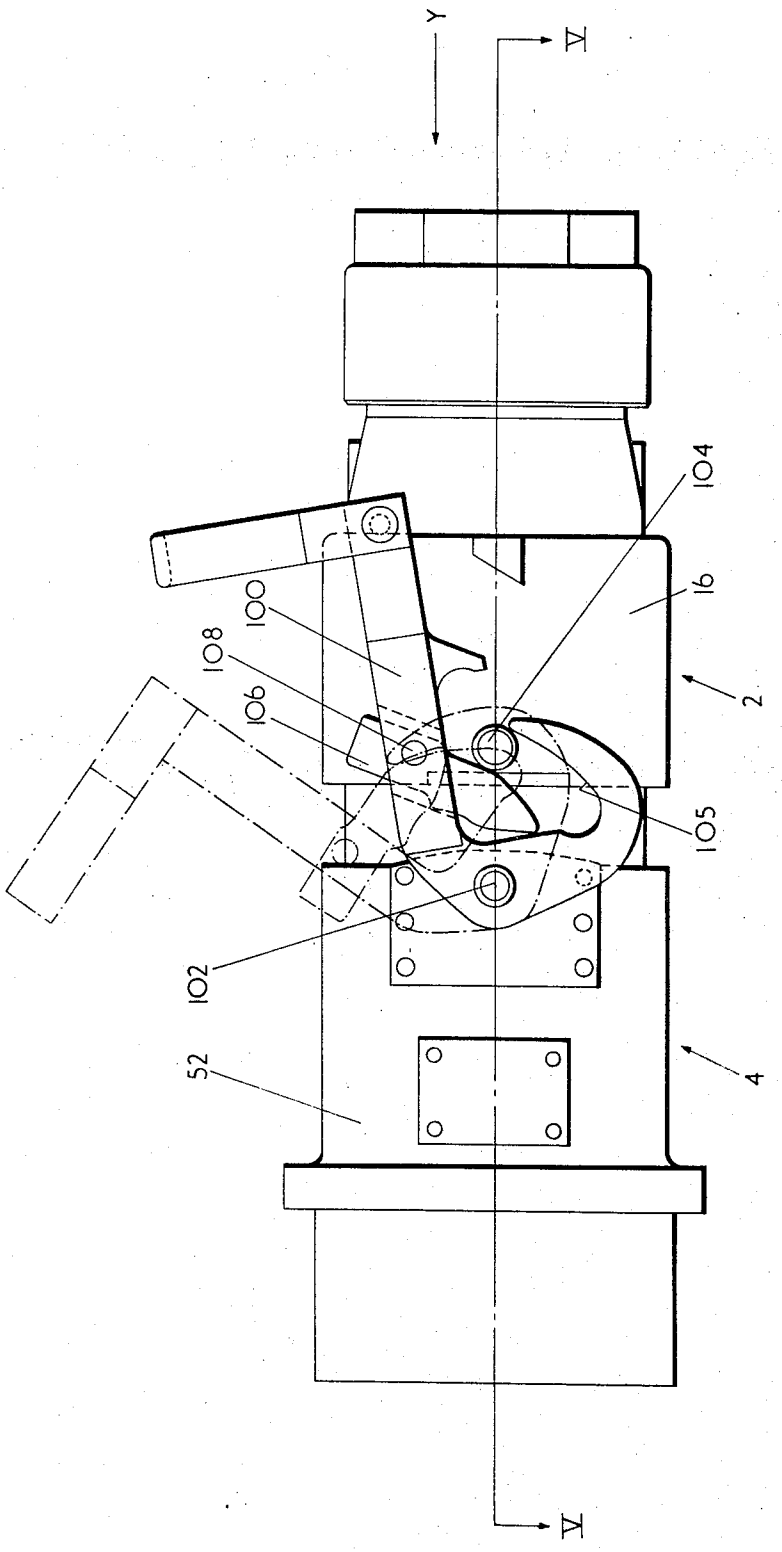

FIG. 4.

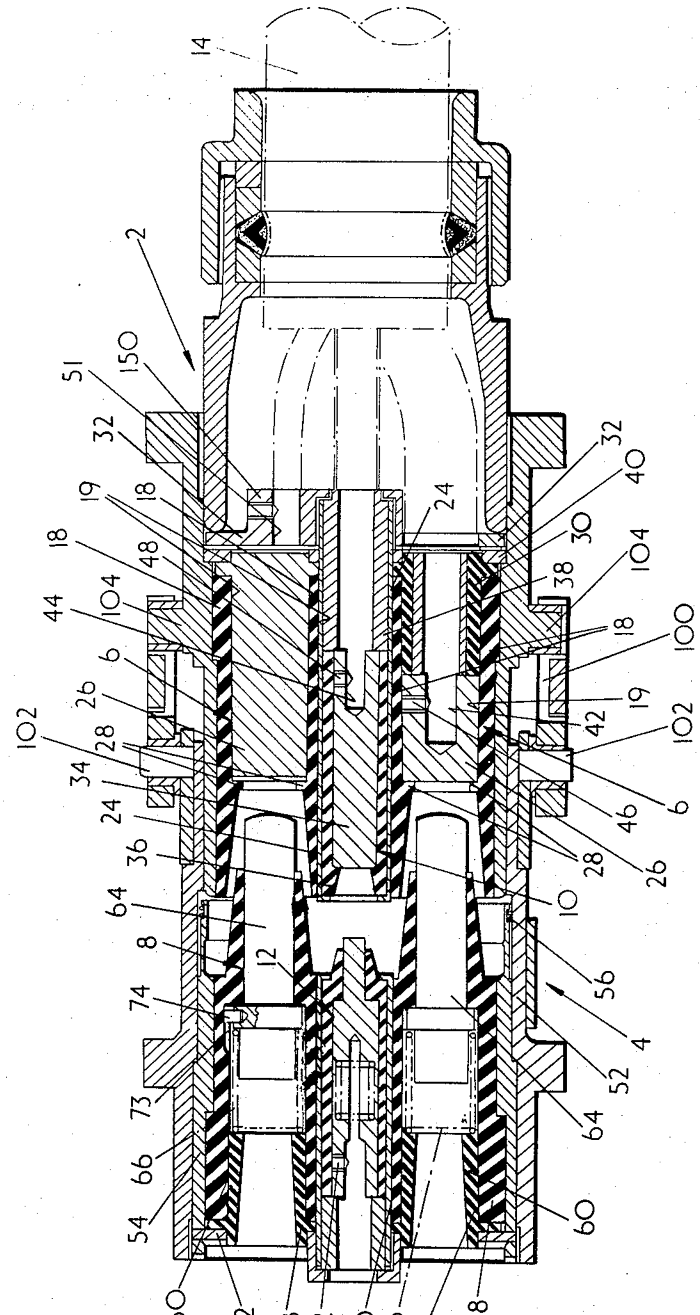
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FIG. 5

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

In coal mines, it is generally necessary to take stringent precautions to ensure that no sparking occurs at a nature liable to ignite the atmosphere of the mine, and this is particularly necessary where electricity is used underground. In a well-known electrical connector for use, for example, in connecting a trailing cable to the control panel, immediately prior to contact being made between the power contacts, a flameproof enclosure surrounding the contacts is established. For the establishment of a flameproof enclosure, this known connector includes a screw-drive device which can be manually operated to draw and accurately guide the plug part of the connector with little clearance into a relatively long sleeve forming the socket part of the connector. However such a connector is subject to the following disadvantages: the screw-drive device in practice is liable to damage sufficiently to impair its operation; the space required to accommodate the drive device and to allow its manual operation, inevitably creates difficulties in the design of mining machines which are to operate in restricted spaces; and an undue amount of time is taken in inserting and withdrawing the plug part.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved electrical connector which overcomes the above recited disadvantages and which comprises a plug part and a socket part, said parts being capable of assembly and disassembly without the need for relative rotation of the parts, and connecting means for said parts; each part including a main contact and an auxiliary contact arranged to mate with a corresponding contact in the other part and the auxiliary contacts being adapted, on assembly of the parts, to make contact after the main contacts make contact and, on disassembly of the parts, to break contacts before the main contacts break contact, wherein the connecting means controls the mating of the said contacts and includes means for introducing a time delay between the operation of the auxiliary and main contacts of the said parts.

It is also an object of the invention to provide a cam profile and cam follower in the connecting means. It is also an object to provide a freely rotatable ring on one of the parts and a slot in this ring or on the other part in which the cam follower, in the form of a pin, can engage.

A further object is to provide as an alternative a pivotally mounted cam profile mechanism on one of the parts engaging with a cam follower pin on the other part.

Yet another object is to provide latching means for holding parts of the connector together on assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

By way of example only, two embodiments of the invention will be described with reference to the accompanying drawings in which:

FIG. 1 shows one embodiment of an electrical connector in a partly assembled position;

FIG. 2 shows a sectional view taken along line II—II on FIG. 1;

FIG. 3 shows an end view taken in the direction of arrow X on FIG. 1;

FIG. 4 shows a second embodiment of an electrical connector in a partly assembled position.

FIG. 5 shows a sectional view taken along line V—V on FIG. 4; and

FIG. 6 shows an end view taken in the direction of arrow y on FIG. 4.

Referring firstly to FIGS. 1, 2 and 3 of the drawings, the first embodiment of the connector comprises a plug part 2 and a socket part 4 capable of being assembled rectilinearly and each having four main power contacts 6, 8 respectively and a pilot auxiliary contact 10, 12 respectively.

Such a connector would be used, for example, to connect a trailing cable 14 having four power cores supplying power to a coal-cutting machine to a control panel, the panel being installed in a roadway leading to the coal face on which the machine is operating. Such a mining machine would generally require a three-phase power supply over three of the cores, the fourth power core enabling the supply power to the machine to be reversed by disassembling the connector and rotating the plug part 2 through 180° before reassembling the connector. Such an arrangement enables the power supply to be reversed without the requirement of additional contacts in the control panel. Thus the control panel can be made compact.

The plug part 2 which is adapted to be secured to one end of the trailing cable 14 as shown in FIG. 2 comprises a cylindrical casing 16 within which is a moulded body of dielectric material having five bores 19, which accommodate the contacts 6, 10 and four slots (not shown), which accommodate a cruciform metal screen assembly. The assembly comprises four flat vanes 22 radiating from a central tube 24 and shields the contacts 6, 10 from one another.

Each power contact 6 comprises a metal element 26 secured between a shoulder 28 formed in one of the bores 19 and an insulating bush 30 which is held in position by an end plate 32.

The pilot contact 10 comprises a metal element 34 mounted within an insulating sleeve 36 located in the tube 24 of the screen assembly. The element 34 is secured in position by an insulating bush 38 held in position by an earthing ring 40 which is in turn held in position by an end plate 32.

Each element 26, 34 has a blind bore 42, 44 respectively within which the associated core from the trailing cable 14 can be secured by set screws 46, 48 or any other convenient means, such as crimping.

A metallic braid sleeve around each of the power cores from the trailing cable 14 is clamped between the bush 30 and the end plate 32.

An earthing terminal 50, secured on the end plate 32 has a bore 51 within which an earth core from the trailing cable 14 can be secured.

The socket part 4 is adapted to be secured to the control panel and comprises a cylindrical casing 52 within which is a "scraping earth" metal sleeve 54 having a plurality of longitudinal slots formed in one end and around which a spring 56 is wound. The plug part 2 is slidable within one end of the casing 52 and within the slotted portion of the sleeve 54 so as to form a flameproof enclosure and effective earth contact. Within the sleeve 54 is a moulded body of dielectric material which has five bores 60 for accommodating the

contacts 8,12 and four slots (not shown) for accommodating a cruciform metal screen assembly shielding the contacts 8, 12 from one another. The assembly comprises four flat vanes (not shown) radiating from a central tube 62, which is located in a central bore of the part.

Each power contact 8 comprises a metal pin 64 urged into a position as shown in FIG. 2 by a spring 66 which abuts an insulating bush 68 held in position by a retaining plate 70, an end plate 72 and a retaining screwed ring 71. Each pin 64 has a cranked slot 73 extending along the pin 64 engaged by a set screw 74 made of insulating material, so that, when the pin 64 is pushed into the socket part 4 against the action of the spring 66, the pin 64 is rotated. This facilitates the cleaning of the abutting end surfaces of the pin 64 and of the element 26.

The pilot contact 12 comprises a short pin 76 which is abutted by a spring 78 held in position by a metal bush 80 which in turn abuts an insulating bush 82 contacting the end plate 72. The pilot contact 12 is mounted within an insulating sleeve 84 within the tube 62 of the screen assembly.

Power and pilot leads (not shown) are fed from the control panel to the associated pin 64 or bush 80 which have bores 86, 88 into which the leads can be secured by set screws or other means such as crimping.

The connector also comprises quick release means for holding the plug part 2 and, the socket part 4 when assembled together, the means being in the form of a ring 90 rotatably mounted on the end of the socket casing 52 and having two opposed inwardly-directed pins 92 each of which can engage one of two tortuous path slots 94 provided on the outside of the plug casing 16. The pins 92 act as cam followers and the slots 94 define a cam profile. A spring loaded cath 96 is mounted on the ring 90 as to engage keys 98, 99 secured onto the casing 16 when the plug part 2 is fully in the socket part 4.

The connector is assembled as follows. With the plug part 2 correctly aligned with the socket part 4 the ring 90 is rotated until the pins 92 are adjacent the entry A of the slots 94. The plug part 2 is then slid into the socket part 4 until the pins 92 reach the bend B of the slots 94. The power contacts 6 and 8 are now in abutting engagement within a flameproof enclosure. The ring 90 is then rotated until the pins 92 reach the end C of the slots 94 when the plug 2 is slid further into the socket 4 until the pins 92 reach the bend D of the slots 94. At this stage the catch 96 engages the first key 98 but because the catch is suitably inclined when the ring 90 is rotated the catch 96 slides by the key 98. As the portion of the slots 94 now being engaged by the pins 92 is inclined to the longitudinal axis of the connector further rotation of the ring 90 causes the plug part 2 to slide further into the socket part 4 until, when the pins 92 reach the point E of the slots 94, the pilot contacts 10 and 12 abut each other. This results in power being fed to the power contacts 6,8. The ring 90 is finally rotated until the pins 92 reach the enlarged end portion F of the slots 94 with the catch 96 fast against the second key 99.

During assembly of the connector, the pins 92 must be correctly engaged within the slots 94, otherwise it would be impossible to assemble the connector.

When the plug part 2 is assembled with the socket part 4, the screen assemblies, which are earthed through with the plate 72 and the ring 40, ensure that even if the insulation is damaged in any way, there cannot be a phase-to-phase short-circuit within the connector.

The connector is disassembled by momentarily depressing the catch 96 and rotating the ring 90. When the pin 92 reaches the point E the pilot contacts 10, 12 disengage, which causes operation of the relay in the control panel to remove the power from the power contacts 6,8. The operation of the relay is not instantaneous and, as it is essential that the power must be removed before the power contacts 6,8 are disengaged, it is necessary to delay further disassembly of the connector until the relay has operated. This is achieved by requiring the pins 92 to be traversed along the slots 94 from the point E (where the pilot contacts 10, 12 disengage) to a point adjacent the entry A (where the power contacts 6,8 disengage), and by requiring the catch 96 to be depressed in order that the catch 96 may pass the key 98.

In order that the connector may be assembled when the plug part 2 is rotated through 180° to facilitate reversal of the power supply, the two pins 92 and the two slots are diametrically opposed. Also two sets of keys 98 and 99 are provided. Two diametrically opposed catches 96 may be provided.

Referring now to FIGS. 4, 5 and 6 of the drawings, the second embodiment of the connector comprises a similar plug part 2 and socket part 4 to those described with reference to the first embodiment and where applicable similar reference numerals have been used. Again the connector has four power contacts 6, 8 with parts 2, 4 respectively to facilitate reversal of a three phase power supply.

In the second embodiment of the connector, the springs 66 abutting the power contact pins 64 of socket part 4 are replaced by stronger springs than are necessary in the first embodiment which ensure that the plug part 2 can slide within the socket part 4 sufficiently for the pilot contacts 10, 12 to engage only as a result of operation of the quick release means.

In the second embodiment, the quick release means are in the form of a cam mechanism 100 pivotally mounted at 102 on the socket part 4 and simultaneously engageable with two opposed cam follower pins 104 on the plug part 2.

The second embodiment of the connector is assembled as follows. With the plug part 2 correctly aligned with the socket part 4 and with cam mechanism 100 as indicated by the full lines in FIG. 4, the plug part 2 is slid into the socket part 4 until the power contacts 6 and 8 engage. At this stage the pins 104 have entered the mouths of the cam mechanism 100 and the plug part 2 is within the socket part 4 sufficiently to provide a flameproof enclosure. The cam mechanism 100 is then pivoted into the position indicated by the broken lines in FIG. 4, so that movement of the pins 104 which engage the inner cam profile faces 105 of the cam mechanism 100 causes the plug part 2 to be drawn further into the socket part 4 against the action of the strong springs 66. At this stage the pilot contacts 10 and 12 have not engaged. Each of the mouths of the cam mechanism 100 is then closed by a gate 106 pivotally mounted on the cam mechanism 100 at 108. The gates 106 are independent of each other and require separate actions to open or close them.

When both the gates **106** are closed the cam mechanism **100** is pivoted back into a position similar to that indicated by the full lines in FIG. **4**. The pins **104** engage the inner cam surfaces of the gates **106** causing the plug part **2** to be fully drawn into the socket part **4** and causing the pilot contacts **10** and **12** to engage which results in power being fed to the power contacts **6,8.**

The second embodiment of the connector is disassembled by firstly pivoting the cam mechanism **100** to the position indicated by the broken lines in FIG. **4.** This allows the plug part **2** to be pushed out of the socket part **4** by the action of the springs **66** a sufficient distance for the pilot contacts **10** and **12** to disengage. This results in the operation of the relay in the control panel which removes the power from the power contacts **6** and **8.** The gates **106** must then be individually opened and the cam mechanism **100** returned to the position as indicated by the full line in FIG. **4** before the connector can be further disassembled allowing the power contacts **6, 8** to disengage. The individual opening of the gates **106** and the pivoting of the cam mechanism **100** ensures there is a delay sufficient to allow the relay to operate to remove power from the power contacts **6,8.**

Although the embodiments described above provide for reversing of the phase by disassembly and reassembly in the alternate position, the invention is also applicable to connectors not adapted for phase-reversal.

I claim:

1. An electrical connector comprising:

a. a plug part having a first main contact and a first auxiliary contact;

b. a socket part having a second main contact and second auxiliary contact, said plug and socket parts being assembled and disassembled without the need for relative rotation of said parts; and

c. means for connecting said parts, said connecting means including delay means for introducing a time delay between operation of said auxiliary contacts and operation of said main contacts, said auxiliary contacts and said main contacts being connected to said plug and said socket such that on assembly of said parts the first and second main contacts mate before the first and second auxiliary contacts mate whereas on disassembly of said parts the first and second auxiliary contacts break before the first and second main contacts break.

2. An electrical connector according to claim **1** wherein said connecting means comprises a cam profile and a cam follower, said cam profile being associated with one of said parts and said cam follower being associated with the other of said parts.

3. An electrical connector according to claim **2** wherein said connecting means comprises a ring member rotatably mounted about said other part; a pin connected to said ring, said pin comprising said cam follower; and a slot formed on said one part, said slot comprising said cam profile.

4. An electrical connector according to claim **2** wherein said connecting means comprises a ring rotatably mounted on said other part; a pin, connected to said ring, said pin comprising said cam follower; and a slot, formed internally of said ring, said slot comprising said cam profile.

5. An electrical connector according to claim **2** wherein said connecting means comprises a member pivotally mounted on said one part, said member comprising said cam profile; and a pin projecting from said other part, said pin comprising said cam follower.

6. An electrical connector according to claim **1** further including spring biasing means connected to each said contact for urging each said contact in the longitudinal direction of said parts, said spring biasing means connected to said main contact having a greater force than said spring biasing means connected to said auxiliary contact.

7. An electrical connector according to claim **4,** wherein the slot is in the form of a tortuous path.

8. An electrical connector according to claim **1** and including latching means, the latching means being adapted to hold said parts in assembly.

9. An electrical connector according to claim **1** and including, in respect of each part, a centrally mounted auxiliary contact and four main contacts, the main contacts being equally radially spaced around the auxiliary contact.

10. An electrical connector comprising a plug part and a socket part, said parts being capable of assembly and disassembly without the need for relative rotation of the parts, and connecting means for said parts; a main contact and an auxiliary contact in each of said parts; delay means in the connecting means adapted to introduce a time delay between operation of the auxiliary and main contacts of the said parts whereby on assembly of the connector the main contacts are arranged to mate before the auxiliary contacts mate, and the auxiliary contacts are arranged on disassembly to break before the main contacts break; and in which spring biasing means are provided in respect of each contact for urging said contact in the longitudinal direction of said parts, the spring biasing means of the main contact being of a greater force than the spring biasing means of the auxiliary contact.

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