A telecommunications connection block for connecting together first and second conductors, which comprises (i) a housing comprising (a) a hollow first part, and (b) a second part attached to the first part and which can be moved relative to the first part to open and close the housing; (ii) a switch within the housing, comprising (a) a first contact that can be connected to the first conductor, and (b) a second contact that can be connected to the second conductor, the parts and the contacts being so arranged that opening of the housing automatically opens the switch, and closing of the housing automatically closes the switch.
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ELECTRICAL CONNECTOR BLOCK

The present invention relates to an electrical connector, especially for use as part of a connector block, particularly for forming connections in a telephone or other telecommunications system.

A telecommunications system requires conductor connections between telephones or other subscriber equipment and the operating company's central office. The exact nature and arrangement of such connections will depend upon the system's architecture, and this varies from country to country and from operating company to operating company. Nonetheless, the following general points may be made. Each subscriber is connected to a central office by a dedicated pair of wires, generally of copper called a twisted pair, and central offices are connected to each by main cables. Although optical fibres have replaced much of the twisted pair copper, the latter is still common towards the subscriber end of the network, particularly the so called last-mile, or local loop, and in the distribution network. It is there that the connector will find most, although not exclusive, use.

A distribution cable containing, say, hundreds of pairs will leave a central office and, perhaps after branching one or more times, will terminate in a small number of drop wires leading to subscribers. The branches will also end in drop wires to subscribers. These connections between the cable and a number of drop wires occur at a distribution point. Also, cables may need to be joined together in a way that allows their conductor interconnections to be rearranged. That occurs at a cross-connection point. Distribution points and cross-connection points may occur in ground level cabinets or pedestals, on a pole or suspended from a wire etc.
Rather than have a large number of loose connectors at a distribution or cross-connection point, it is normal to provide a terminal block, or cross-connection block which can be used to connect a number of pairs, such as 3, 5, 10, 25 or 50. Terminal blocks will usually have incoming conductors permanently attached and outgoing conductors removable; and cross-connection blocks will usually have all conductors removable. The term "connector block" will be used herein generically.

Prior art terminal blocks in wide use comprise oblong blocks of insulating material having pairs of so-called binding posts passing through them. The binding posts extending from the base of the block are connected to the conductors of a distribution cable by, for example, wire wrapping. The conductors and the wire-wrapped posts are then potted in a curing composition making permanent connections. The binding posts also extend above the block, and end in a screw thread. Drop wires to subscribers are wrapped around these screw-thread posts, and a nut is screwed down over them to form a releasable connection.

US 4449777 (3M) discloses an electrical drop wire connector for facilitating the connection of drop wires to cables, which has spring compression reserve connection to both drop wire and cable. Test ports permit electrical testing, and easy access to the contact area for removal and replacement of drop wires is provided. The circuit can be broken to remove a drop wire by simply unscrewing screws which control the position of a driver cap. This patent, and others referred to are incorporated herein by reference.

GB 2176062 (Egerton) discloses a terminal block including at least one pair of main contacts, an earth contact and a surge arrester, the terminal block further comprising means operable automatically to connect the main contacts to earth when the surge arrester is removed.
US 4435034 (Northern Telecom) discloses a connector for connecting telephone lines, comprising a hollow body and a hollow cap, the cap fitting into the body to form an enclosure. When body and cap are pressed together the terminals make contact with conductive cores of the lines.

I have now designed a connector that better addresses the need for access to connectors whilst allowing them to be properly housed.

Thus the present invention provides a telecommunications connector block for connecting together first and second conductors, which comprises

(i) a housing comprising
   (a) a hollow first part, and
   (b) a second part attached to the first part and which can be moved relative to the first part to open and close the housing,

(ii) a switch within the housing, comprising
   (a) a first contact that can be connected to the first conductor, and
   (b) a second contact that can be connected to the second conductor,

the parts and the contacts being so arranged that opening of the housing automatically opens the switch, and closing of the housing automatically closes the switch.

The invention also provides an electrical connector, which comprises

(a) a first part having an electrical contact that is preferably resiliently deformable and means for locating an insulated conductor;

(b) a second part having a split-beam first insulation-
displacement connector that is preferably resiliently deformable,

the electrical contact preferably being electrically connected to a second insulation-displacement connector;

the first and second parts being moveable relative to one another to open and close a space between them, such that

on moving the first and second parts to close the first space the insulation-displacement connector makes electrical contact with

(i) an insulated conductor located in the means for locating, contact being made through insulation of the conductor and

(ii) said electrical contact, preferably by the contact and the first insulation-displacement connector being forced together causing one or both to be deformed against its resilience.

This connector (particularly the first part thereof) may have a socket, contacts of which are electrically-connected to the first insulation displacement connector and electrical contact. Also, a plug is preferably provided for the socket for provision of electrical protection such as overcurrent or overvoltage protection.

It may be desirable to test the electrical components of the connector with and also without breaking the circuit, and I therefore prefer that partial opening of the housing from a closed position retains the switch closed and allows access to the first and/or second contacts.

 Preferably the first and/or second contact is connected to, more preferably is integral with, an insulation-displacement connector, particularly of split-beam design.
The housing may be constructed in any suitable way, but the first and second parts are preferably hinged together. More preferably they are mutually integral, being joined by a living hinge. A third part may be provided, preferably pivotally connected to the first or second part. In a preferred embodiment the three parts have, in cross-section, a substantially Z-shaped configuration.

The connector block may comprise a plurality of housings, each allowing for a pair of connections, the block being capable of dealing with say 3, 5, 10, 25 or 50 pairs. The housings may be fixed to a casing which may have a grounding rail or other means to which each connector is grounded. The casing and/or each housing may contain a sealing material such as a gel for environmental protection.

Each housing may have a socket accessible from outside, contacts of which are electrically-connected to the first and second contacts of the switch. A plug may be provided for the socket, which plug provides electrical connection between the first and second contacts via an overcurrent protection device. Such a plug also or alternatively provides electrical protection between (a) the first and/or second contacts and (b) ground via an overvoltage protection device. The plug may break a direct electrical connection between the first and second contacts.

It will often be desirable to organize conductors to be joined by the connector, and the housing, or a casing supporting them may be provided with an organizer. An organizer may comprise one or more holes through an edge or other portion of one of the parts, particularly the second part.

The invention may additionally or alternatively provide one or more of the following.

An electrical connector having a housing, comprising:

(a) a first part,
(b) a second part pivotable about a first line to open and close a space between the first and second parts, and
(c) a third part pivotable about a second line of the first part optionally to open and close a space between the first and third parts.

A split-beam electrical connector, in which the beams at the split are bent between proximal and distal ends thereof.

A split-beam insulation displacement connector having a configuration such that insertion of a conductor therein causes torsion of at least one the beam.

A resilient electrical connector into which a conductor may be inserted thereby deforming the connector against its resilience, a mode of deformation of the connector varying with extent of insertion.

An electrical connector, comprising

(a) a housing comprising a first hollow part and a second part, that can be moved relative to the first part to open and close a space between the first and second parts,

(b) an electrical switch within the housing that is arranged such that a connection is made automatically on closing said space, optionally when a conductor is located at the first or second part; and

(c) a sealing material within the space that is substantially entirely enclosed when the space is closed.

An electrical connector which comprises
(a) a housing comprising
   (i) a first part, and
   (ii) a second part moveable with respect to the first part to open and close the housing;
(b) a first electrical contact carried by the first part;

(c) a second electrical contact or means for locating a conductor carried by the second part, such that when the housing is closed electrical contact is capable of being made between the first contact and either the second contact or the conductor;

(d) electrical ground;

(e) means for moving the first and second parts to close the housing, which means is in electrical contact with the electrical ground.

An electrical connector, which comprises
(a) a housing comprising a first part and a second part that can be moved relative to one another,
(b) an electrical protection device carried by the first part and being electrically-connectable to a first electrical contact that extends within the housing,
(c) a second electrical contact within the housing that has means for connection thereto of an electrical conductor, the first and second electrical contacts being arranged such that connection is made between them on closing the housing and connection between them is broken on opening the housing.

An electrical connector, which comprises
(a) a housing that has means for receiving an electrical protection device.
(b) a first electrical contact having means for connection to a first electrical conductor,
(c) a second electrical contact having means for connection to a second electrical conductor, and being capable of being in direct electrical contact with the first contact in the absence of the protection device;
(d) the protection device, which when received in the housing interposing an overcurrent protector between the first and second contacts.


The invention is further illustrated with reference to the accompanying drawings, in which

Figures 1A and 1B show two perspective views of an electrical connector of Z-shaped cross-section;
Figure 2 shows the connector of figure 1 in unfolded form;
Figure 3 shows several connectors positioned together to form a terminal block;
Figures 4 and 5 show ways in which connectors can be used to join conductors;
Figures 6A, 6B and 6C show the installation of a protection module into a connector;
Figure 7 shows a casing on which connectors may be mounted;
Figures 8, 9, 10 and 11 show other designs of connector;
Figure 12 shows a connector whose parts slide with respect to one another, and
Figures 13A and 13B show an insulation-displacement connector.

Figures 1A and 1B show an electrical connector 1, of substantially Z-shaped configuration in cross-section, and used to connect together electrical conductors such as telephone wires. Figure 1A is a view from above and figure 1B is a view from below. Since telephone lines employ pairs of conductors, the connector will in
general have one or more pairs of contacts etc. In the following discussion, however, connection of single wires will be referred to for simplicity.

The connector has a first part 2 and a second part 3 pivotable about its rear edge as drawn, thus allowing opening and closing of a space between them. A third part 4 is pivotable about a front edge of the first part 2, similarly to allow opening and closing of a space between them. In general, the first and/or second and/or third parts will be at least partially hollow. The spaces may contain first and second insulation-displacement or other connectors 5 and 7, carried preferably by the second and first parts 3 and 2. Such connectors obviate the need for conductors to be pre-stripped at their ends. One or more of the parts (preferably the first and third parts) has means for locating a conductor which may, for example, comprise a hole or recess 6A in an outer surface and/or a protrusion or other guide 6B within the space between the parts. The parts may pivot about hinges or other means 8 and 9. Living hinges, preferably integral with the parts 2, 3 and 4, are preferred.

The first insulation-displacement connector (IDC) is electrically connected to, and preferable is integral with, a first electrical contact 10. The first part 2 carries a second electrical contact, which is electrically connected to, and preferable integral with, the second IDC, 7.

When the first and second parts 2, 3 are closed by pivoting along line 8, the first and second electrical contacts 10, 11 are brought together. They therefore constitute a switch within the connector housing. The result is that the two IDCs 5, 7 become electrically connected, thereby joining any conductors carried by them. In this way the connection (say between central office and subscriber) may be made and broken, and if need be the connector may be open and closed without IDC connections being disturbed.
This electrical connection between the contacts 10, 11 may be direct, or it may require some further component such as an overcurrent protector between them. In this sense, the connection may be said to be "capable of being made" when the parts 2 and 3 are brought together.

The action of bringing together the first and second parts 2, 3 (or the first and third parts 2, 4) may also drive a conductor into the IDC 5 (or 7). This may require a significant force and means may be provided for moving the parts to close the housing of the connector. Such means may comprise a bolt that passes through the second (or third) part into a nut 12 in the first part 2. The terms "nut" and "bolt" are used herein in a broad sense to include any female/male connector where some turning motion is involved, and includes screws, cams and bayonet fixings. An alternative is an over-centre latch or other lever-action device.

The housing of the connector may have a cover 13 for enclosing an access point to the first and second contacts 10, 11, or other component within the housing. Such an access point may allow for testing of the contacts (for example to determine line voltage or continuity in both or either direction) or for addition of other electrical components. Other electrical components may comprise electrical protection such as the overcurrent protector mentioned above (in series between the contacts) and/or an overvoltage protector between one or both contacts and ground. A further use of the access point may be for tapping-off to further telephones, or other telecommunications equipment. Due to the various uses of the access point, it may be referred to as a "flexibility point", providing the connector with increased versatility.

The access point is preferably environmentally-sealed to protect the contacts 10, 11 or other parts of the connector. Such sealing may be provided by a cover 13 and/or by a sealing material such as a gel, particularly one having the following properties: a cone penetration from 100 - 400, especially 150 - 350, particularly 250 - 350 (10^-1mm), an ultimate elongation of at
least 100%, particularly at least 300%, especially at least 500%, a maximum tensile strength of substantially 20 p.s.i., an elastic modulus of less than $10^7$, especially $10^6$, particularly $10^5$ dynes/cm$^2$, and a cohesive strength greater than its adhesive strength to components of the connector. Cone penetration is determined in accordance with ASTM D217-68, (cone weight 102.5g, shaft weight 47.5g), and elongation in accordance with ASTM D638-80.

The sealing material may be prepared by extending a polymeric material with a vegetable and/or mineral oil. The resulting material may be thermoplastic, or it may be formed by cross-linking the polymeric material. The polymeric material may comprise a block copolymer, for example one having crystalline end blocks and elastomeric centre blocks. An example is a styrene-ethylene butylene-styrene block copolymer, for example that known by the trade mark Kraton G1651. Such a material may be used with from 700 - 1200, particularly 900 - 1100 parts by weight of plasticizing oil to 100 parts of a block copolymer. Other gels can be made based on oil-extended polyurethanes or silicones.

The spaces between the parts are preferably at least partially filled with such a sealing material, preferably in sheet form. Means, such as a spring, is preferably provided for maintaining and optionally for putting the sealing material under compression.

A device, such as an electrical-protection device, that is applied at the access point is referred to herein in preferred embodiments as a "plug" and a part of the housing that receives it as a "socket". These terms are used in a broad sense with reference to the functions of the plug and socket and their relative sizes: whilst we prefer that the plug has male electrical contacts, and the socket female, the situation could be reversed. Also, the second (or other) part of the housing may have a recess within which the plug is at least partially received, but this is not necessary.
Where the plug is to provide overvoltage protection it will, in general, need to be electrically connected to ground. In this way, it can shunt any overvoltage caused for example by lightning or mains voltage cross away from equipment connected by the connector, and down to ground. The protection device will remain insulating at the normal operating voltages of the conductors, but will become conducting at the higher fault voltage. A ground connection may be provided within the connector housing and that may be in turn connected to some casing to which the connector is attached. A bolt that closes the part of the housing, and that mates with nut 12 may be in electrical contact with electrical ground. The protection plug may make contact with the head or other part of the bolt. A connector housing of slightly different design from that illustrated may then be preferred, so that the bolt and contacts 10, 11 are closer together and such that a plug and cover 13 cover both.

The IDCs 5,7 are shown as split beam connectors, and they are more fully illustrated in Figure 13. Their beams are bent at their split between proximal and distal ends. As a result when a conductor is inserted into a slit, the connector, which is preferably resilient, is deformed against its resilience, the mode of deformation varying with extent of insertion. Also, energy is stored over a large extent of beam. As a result an IDC of small absolute size, and especially of small size perpendicular to the plane of the conductors, is able to accept conductors over a large range of sizes.

The connector may be provided with strain relief for the conductors, and/or means for cutting the conductors to length especially on closing of the parts.

Figure 2 shows the connector 1 of figure 1 unfolded such that it lies substantially flat. Preferably the three parts 2, 3, 4 are integral with one another, the part being manufactured by moulding, for example injection moulding. Preferred materials
include polypropylene (useful for living hinges) and or various engineering plastics.

The third part 4 (or other part) may be provided with complementary joining means such as dove-tail protrusion 14 and recess 15 whereby a connector can be joined side-by-side to a similar connector.

Figure 3 shows several such connectors joined side-by-side. Bolts 16 are shown having been used to bring or maintain together various parts of the connectors, and optionally to provide ground connections.

Figures 4 and 5 show two ways in which the connectors 1 can be used to join conductors 17 and 18. The third part 4 acts as a base (hence the use of that part in figure 2 for interconnection of adjacent connectors) which may be secured to some casing etc. An insulated conductor from, for example, a telephone central office, is placed in some means for location 6 of the third part 4. This is shown in figure 4A. The third part 4 and first part 2 are then closed as indicated by the arrow, causing an IDC on the underside of the first part to cut through insulation of the conductor 17 and make electrical contact.

Then a further insulated conductor 18 leading to, for example, a subscriber, is placed in means for location 6 on the upper surface of the first part 2. See Figure 3. The second part 3 is then closed as shown by the arrow, causing an IDC in the first part to make connection to conductor 18. When the second part is closed, the two IDCs make contact with each other, to connect together the conductors 17 and 18, as shown in figure 4C.

Figure 5 is similar except that in figure 5B means for location is provided at the lower surface of the second part 3, and an IDC is provided on the upper surface of the first part 2.

Figures 6A, 6B and 6C show three steps in the provision of an electrical protection device, or other plug, in a connector.
Figure 6A shows a connector 1 having a cover 13 that is shown closed. In figure 6B it is open and a plug 19 is about to be mated with socket 20. Figure 6C shows the plug, now inserted, covered by the cover which has been folded over it. The cover has a first surface 21 that is now vertical (as drawn) and a part 22 that is now horizontal and covers the top of the plug. In this way a cover 13 is provided that can seal socket 20 when empty, and also can seal plug 19. Thus, the connector can be used with full environmental sealing with or without the plug.

A casing 23 is illustrated in figure 7, within or on which are mounted a plurality of connectors 1. Two are shown but more, such as 10, 25 and 50 may be provided. The casing plus connectors may be positioned in or adjacent a cable splice case, or other housing such as a cross-connect cabinet or a pedestal, and it may be positioned at ground level, on a pole, suspended from a wire or attached to a wall etc. The casing 23 may provide a sealed housing or it may comprise merely a frame or other support.

The casing 23 illustrated has rails or guides 24 over which connectors 1 are positioned. The rails 24 may be electrically conductive and connected to ground, thus providing means for grounding some component within the connectors. The bolts 16 may mate with the rails 24. The casing may have a cover 25 and locating means 26 for the incoming or outgoing conductors. Sealing material 27 may seal the cover to the base.

Figures 8, 9, 10 and 11 show other designs of connectors, each having first, second and third parts 2, 3, and 4 that hinge together. The designs illustrated are for three pairs of conductors. Two IDCs 5 are provided for each pair (shown) above and (hidden) below the first part 2. A protection plug extends through socket 20 to connect together the contacts 28, optionally via an overcurrent protector and/or to connect either one of them to ground via an overvoltage protector. One of the contacts 28 is integral with the visible IDC 5, and the other extends through the plane of the first part and is integral with the hidden IDC.
Figure 9 shows a drop cable 29 containing three pairs of conductors 30, located in the third part, 4. When the third part 4 is folded over the first part 2, the conductors are driven into the IDCs 5. A single third part 4 provides for several (here three) pairs of connections.

An opposite side of such a connector is seen in figure 10. Individual second parts 3 are provided for each pair of connections. A ground plate 31 is shown below the base of the connector. A bolt for driving the parts together may be provided, and it may mate with the plate 31.

In figure 11 slabs or other sheets of a sealing material 33 are provided between the parts 2, 3 and 4 of the connector. The sheets 33 may be positioned between respective pairs of parts after the conductors have been positioned. Alternatively, the connector may be supplied with a sheet 33 preinstalled at one or more of the appropriate surfaces of the parts. The sealing material preferably substantially fills any space between the parts. Also, it preferably contacts all otherwise exposed connectors or other metal-work within the connector. In this way an excellent environmental seal can be achieved. In less damaging environments, a mere seam seal of sealing material may be sufficient, provided around or adjacent peripheries of the parts 2, 3 and 4. Each pair of parts is preferably re-openable, and if a suitable sealing material is used removal and reconnection of central office as well as subscriber conductors is possible. The sealing material preferably comprises a gel such as that mentioned above. Means, such as a spring, is preferably provided for maintaining, and optionally for putting, it under compression. An expansion cavity may be provided into which sealing material may pass on closing the parts and/or on insertion of a conductor.

Figure 12 shows a connector 1 having first, second and third parts 2, 3 and 4 that slide together, preferably telescopically, rather than pivotally. A connector may be provided that
combines at least some of the features of a pivoting design and at least some of the features of a sliding design.

A conductor 17 from a telephone central office etc passes through a locating means 6 such as a hole in a wall of the first part 2. When part 4 is slid in the direction of the arrow into, over or otherwise with respect to part 2 the conductor 17 is driven into IDC 7.

A subscriber drop wire 18 is located in means 6 of the first part 2 and is likewise driven into IDC 5 by sliding the part 3 into, over or otherwise with respect to part 2. Contacts 10 and 11, which are connected to (and preferably integral with) IDCs 5 and 7, are themselves connected together by plug 19 on insertion thereof into socket 20. As mentioned in connection with the designs above, plug 19 may connect contacts 10, 11 via an overcurrent protector and/or may connect either of them to ground via an overvoltage protector.

A bent IDC 5 is shown in figure 13A. The IDC is of the split-beam type having beams 34 and a slot 35 between them. The IDC preferably comprises a phosphor-bronze or beryllium-copper alloy. In particular, IDCs (especially those for incoming wires from a central office) comprise a 0.5 to 0.75 hard phosphor-bronze C51000 or C51900 which are nominally Cu-Sn5 and Cu-Sn6. Such materials have good elasticity without excessive stress-relaxation. IDCs for drop wires to subscribers, which may be re-entered more often, may have more stringent requirements of elasticity, ductility (allowing sharp bends) and hardness. The material preferably has a yield stress of at least 300, especially 350 MPa, and is preferably hard enough to deform bronze and steel wires. If its conductivity is not sufficient, it may be plated. The drop IDC preferably comprises Cu-Sn8 C52100 hard, Cu-Sn10 52400 hard, Cu-Sn5 C5100 hard or Cu-Sn6 C51900 hard. In general, we prefer a modulus of 90000 - 140000, especially about 110000 MPa, and a tensile strength of greater than 400 especially 450 MPa. The ductility preferably allows the material to be bent at a radius of the material thickness, or greater than 5%. Hardness
is preferably at least 70, especially 72 Rockwell B. An example of a beryllium-copper alloy is C17200, which may require hardening by heat treatment. A spinoidal alloy such as Cu-Ni-Sn C72700 may be suitable. The beams 34 at the split 35 are bent between a distal end and a proximal end thereof. Thus, the slit extends as it were around the bend. Preferably the beams have a substantially planar first part 36 distal of the bend and a substantially planar second part 37 proximal of the bend. The slit may terminate at a cut away portion 38 to avoid stress concentration. The IDC is shown mounted on a support 39. On insertion of conductor 17 into the slit 35 as shown by arrow A the initial deformation of the beams will be predominantly as shown by arrows B. This involves torsion of the proximal parts 37 as shown. As the conductor advances in the slot 35 between the distal parts 36 the mode of deformation will vary to become predominantly bending of the proximal parts 37 as shown by the arrows C.

The length D of the second part is preferably 10-20, particularly 12-16, especially about 14 mm, and that (E) of the whole horizontal part is preferably 25-30 mm. The width F of the IDC is preferably 5-10, especially about 8 mm, the slit being preferably 2.5 - 4.5 mm at the second part and sharpened edges of the beams preferably substantially touching one another at the distal part 36. The length G of the distal part is preferably 6 - 14, especially 8 - 12, particularly about 10 mm. Preferably, the length D is from 1.2 - 1.6, particularly about 1.4 times the length G. The material thickness of the IDC will typically be from 0.8 - 1.2, especially about 1 mm.

Figure 13B is an end view of an IDC of the type shown in figure 13A. Here, however, the IDC is provided with stop means 40 which may be part of a support 39 or a connector housing. Stop means 40 serves to limit free deformation of the IDC. Thus, for larger conductors some deformation of stop means 40 will additionally be required, thus increasing the force exerted by the IDC on the larger conductors.
For the avoidance of doubt it is noted that the invention provides an improved connector, IDC, connection block and method of connection. Any of the connectors, IDCs, contacts, housing or casing designs or protector designs may be selected.
CLAIMS

1. A telecommunications connector block for connecting together first and second conductors, which comprises

   (i) a housing comprising

       (a) a hollow first part, and
       (b) a second part attached to the first part and which can be moved relative to the first part to open and close the housing,

   (ii) a switch within the housing, comprising

       (a) a first contact that can be connected to the first conductor, and
       (b) a second contact that can be connected to the second conductor,

   the parts and the contacts being so arranged that opening of the housing automatically opens the switch, and closing of the housing automatically closes the switch.

2. A connector block according to claim 1, in which partial opening of the housing from a closed position retains the switch closed and allows access to the first and/or second contacts.

3. A connector block according to claim 2, in which the first and/or second contact is connected to an insulation-displacement connector.

4. A connector block according to claim 3, in which the first and/or second contact is integral with an insulation-displacement connector.

5. A connector block according to any preceding claim, in which the first and second parts are hinged together.

6. A connector block according to any preceding claim, which
additionally comprises a casing, to which a plurality of said housings and switches is fixed.

7. A connector block according to any preceding claim in which the housing has a socket accessible from outside, contacts of which are electrically-connected to the first and second contacts of the switch.

8. A connector block according to claim 7, which additionally comprises a plug for the socket which plug provides electrical connection between the first and second contacts via an overcurrent protector.

9. A connector block according to claim 7 or 8, which additionally comprises a plug for the socket, which plug provides electrical connection between (a) the first and/or second contacts and (b) ground via an overvoltage protector.

10. A connector block according to claim 8, in which the plug breaks a direct electrical connection between the first and second contacts.

11. A connector block according to any preceding claim, in which the housing contains a sealing material.

12. An electrical connector, which comprises

(a) a first part having an electrical contact and means for locating an insulated conductor;
(b) a second part having a split-beam first insulation-displacement connector,

the first and second parts being moveable relative to one another to open and close a space between them, such that on moving the first and second parts to close the space the insulation-displacement connector makes electrical contact with
(i) an insulated conductor located in the means for locating, contact being made through insulation of the conductor and

(ii) said electrical contact.

13. An electrical connector according to claim 12, in which the means for locating the conductor comprises a hole through an edge portion of the second part.

14. An electrical connector according to claim 12 or 13, in which the first and second parts are pivotally connected to one another.

15. An electrical connector according to claim 12, 13 or 14, in which the electrical contact is electrically connected to a second insulation displacement connector.

16. An electrical connector according to any of claims 12 - 15, in which the first insulation-displacement connector and/or said electrical contact is resiliently deformable, and on moving the first and second parts together the first insulation-displacement connector and said electrical contact are forced together causing one or both to be deformed against its resilience.

17. An electrical connector according to any of claims 12 - 16, which has a socket, contacts of which are electrically-connected to the insulation-displacement connector and electrical contact.

18. An electrical connector according to claim 17, which additionally comprises a plug for the socket, which plug provides electrical connection between the insulation-displacement connector and the contact via an overcurrent protector.
19. An electrical connector according to claim 17, which additionally comprises a plug for the socket, which plug provides electrical-connection between (a) the insulation-displacement connector and/or the contact and (b) ground via an overvoltage protector.

20. An electrical connector according to claim 17, 18 or 19, in which the socket is provided by said first part.

21. An electrical connector according to any of claims 12 - 19, in which the space contains a sealing material.

22. A connector block which comprises a plurality of connectors according to any of claims 12 - 21, and optionally a connector block casing.
# INTERNATIONAL SEARCH REPORT

## I. CLASSIFICATION OF SUBJECT MATTER
(If several classification symbols apply, indicate all)*

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H01R4/24; H01R13/703; H01R13/713; H01R9/26

## II. FIELDS SEARCHED

### Minimum Documentation Searched

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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched*4

## III. DOCUMENTS CONSIDERED TO BE RELEVANT

### Category

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<th>Category</th>
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<td>GB,A,2 176 062 (A.G. EGERTON LIMITED) 10 December 1986 see page 1, line 16 - line 110; figure 1</td>
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* Special categories of cited documents: 10

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- **O** document referring to an oral disclosure, use, exhibition or other means
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- **X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- **Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to person skilled in the art

- **A** document member of the same patent family

## IV. CERTIFICATION

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International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

KOHLER J.W. Janet W. Kohler

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Form PCT/ISA/10 (second sheet) (January 1989)
ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9200207
SA 56184

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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For more details about this annex: see Official Journal of the European Patent Office, No. 12/82.