Dec. 26, 1967 F. G. BAC 3,360,764

ELECTRICAL CONNECTIONS

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Fig.1

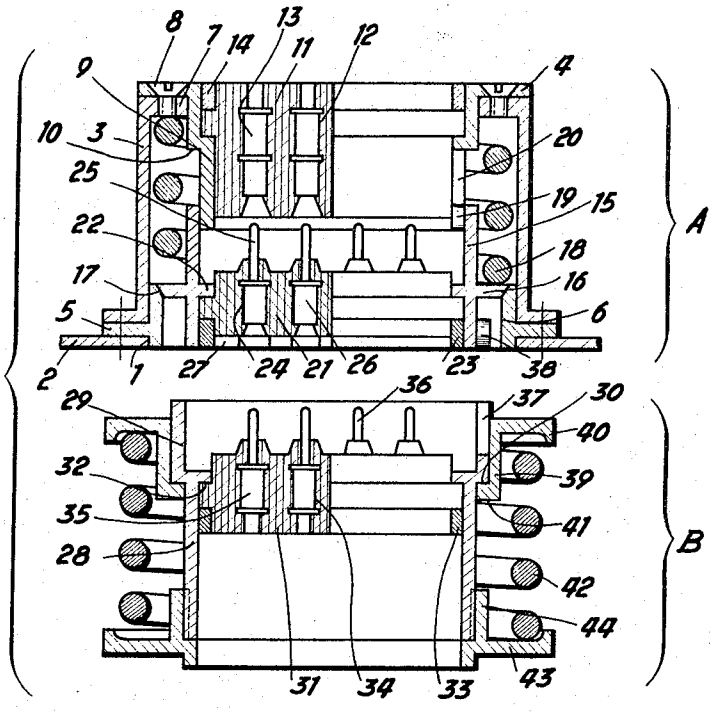
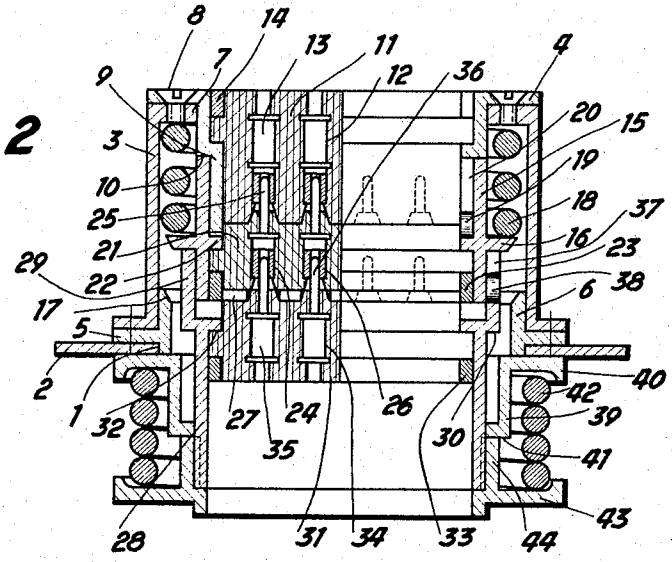


Fig.2



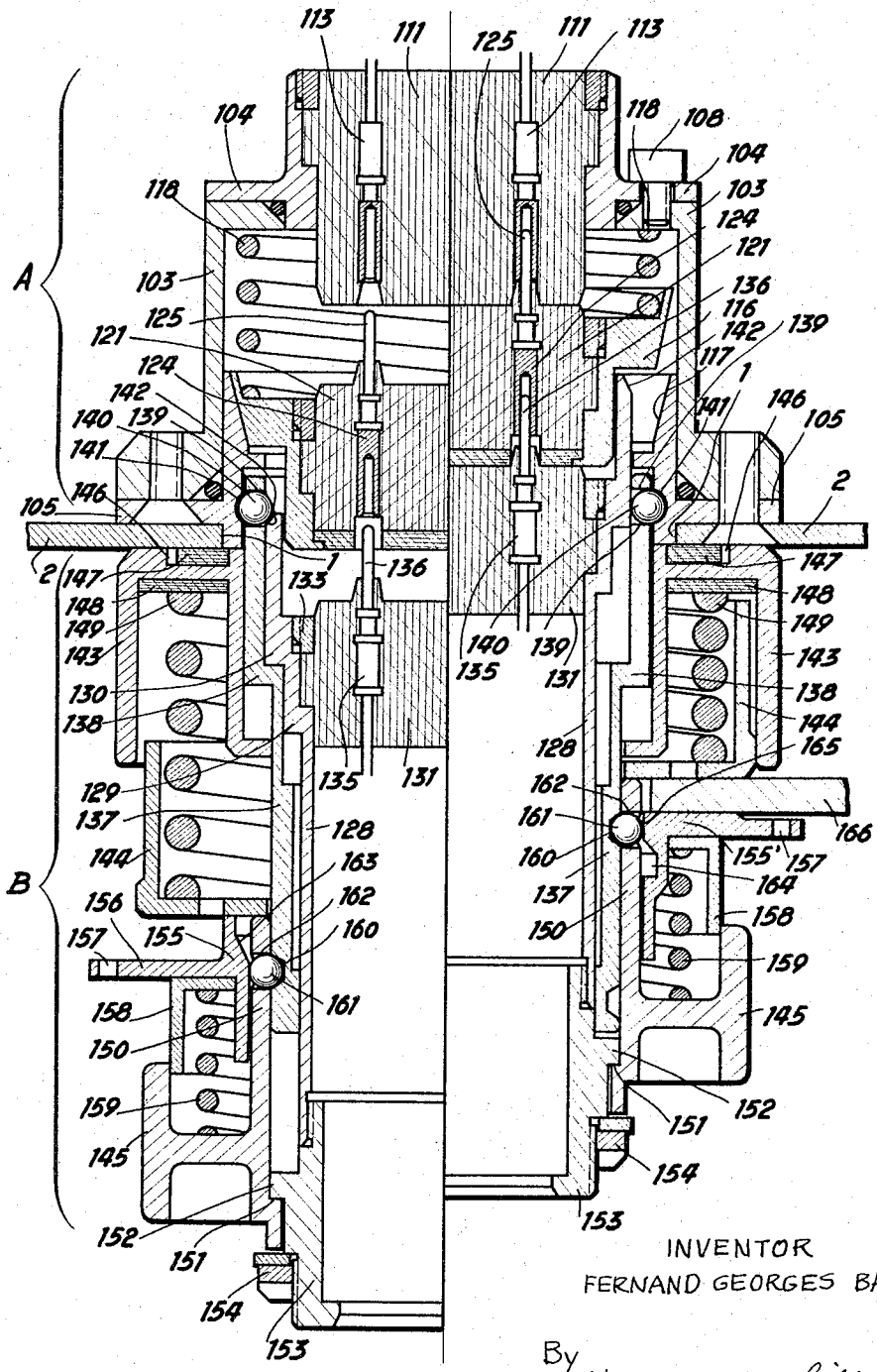
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ELECTRICAL CONNECTIONS

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Fig. 3



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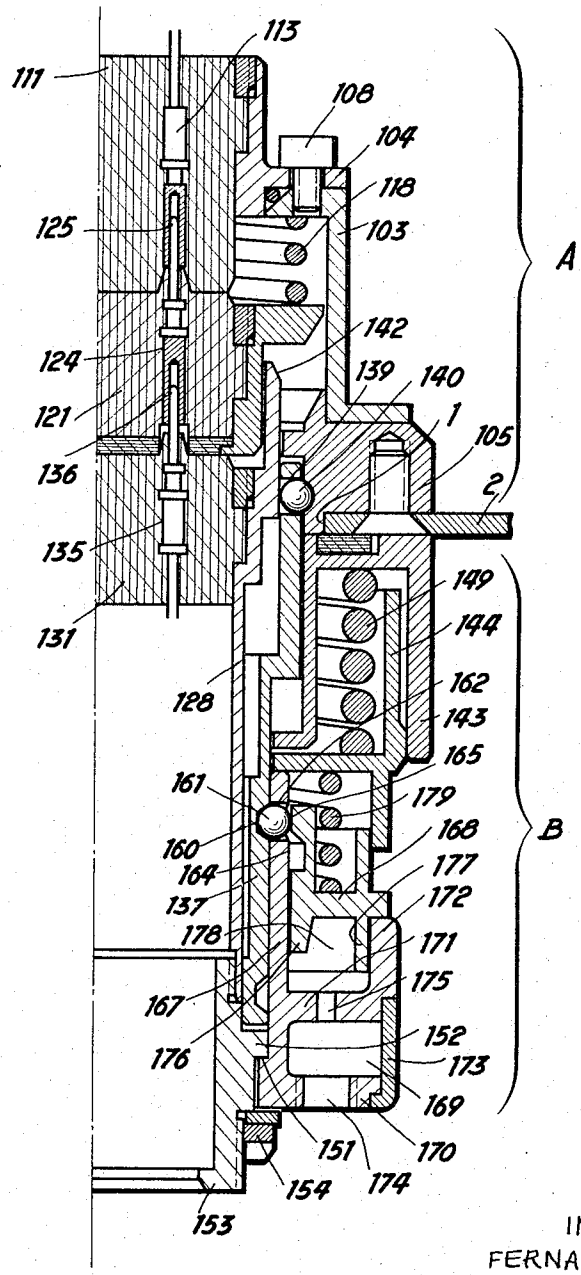
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Fig. 4



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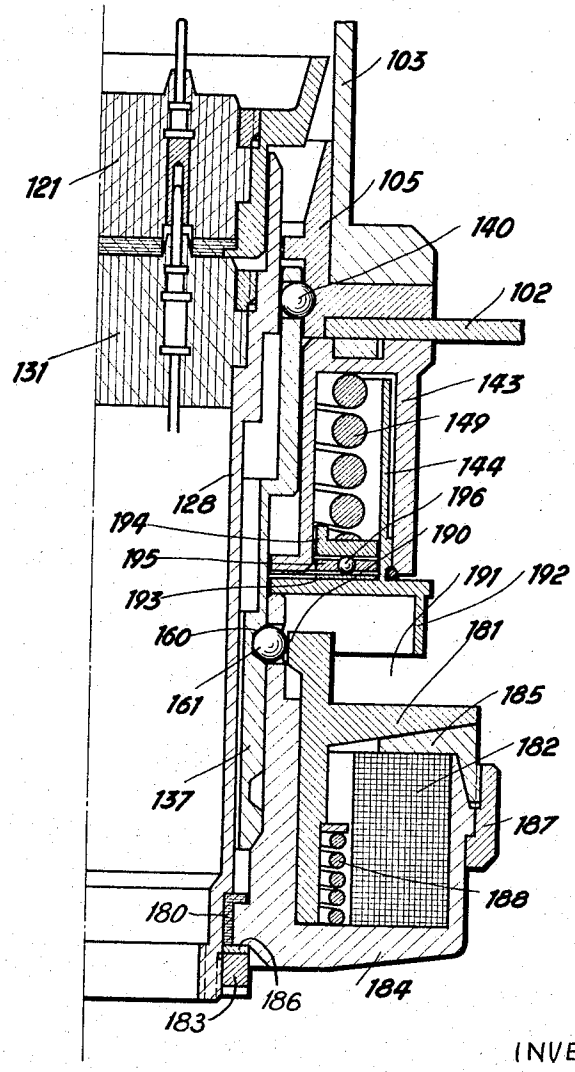
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Fig. 5



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Fig. 6

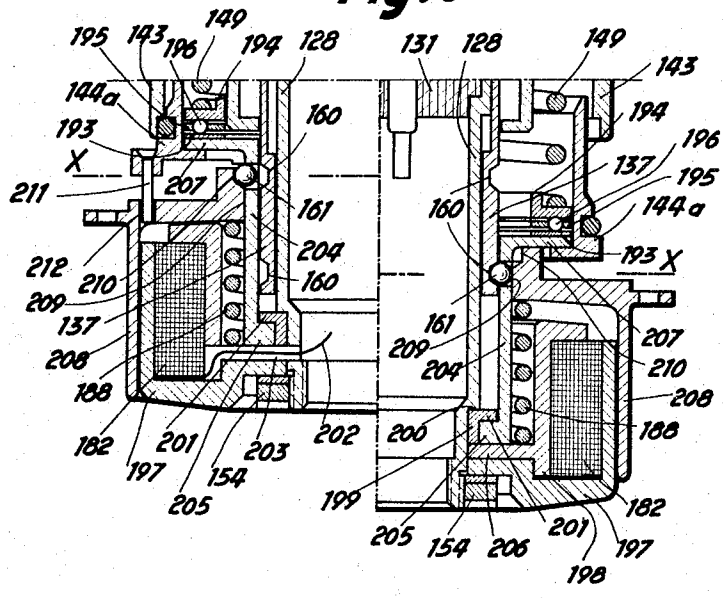
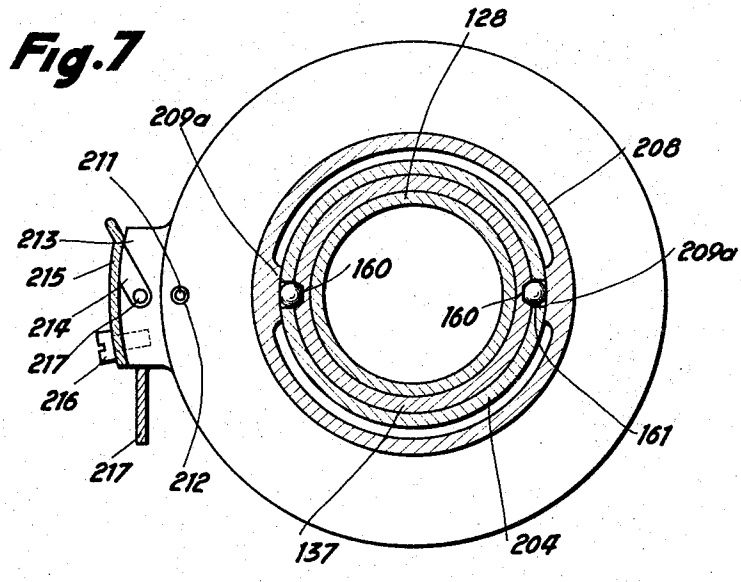


Fig. 7



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United States Patent Office 3,360,764 Patented Dec. 26, 1967

3,360,764

ELECTRICAL CONNECTIONS

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Filed Apr. 26, 1965, Ser. No. 450,725
Claims priority, application France, Apr. 24, 1964, 972,342
5 Claims. (Cl. 339—45)

ABSTRACT OF THE DISCLOSURE

This invention relates to a releasable electrical connector permitting abrupt release of electrical conductors connecting an integral device to an outside power supply which comprises a releasable movable part designed to be connected to an outside power supply and a fixed part secured to the integral device, said releasable movable part comprising a first series of movable electrical connecting means in electrical connection with said outside power supply, said fixed part comprising a movable dead face and a fixed connector block situated behind said movable dead face, said movable dead face comprising a second series of corresponding separable electrical connecting means designed to cooperate with said first series of electrical connecting means in said releasable movable part and a third series of separable electrical connecting means respectively connected electrically to said second series of separable electrical connecting means, said fixed connector block comprising a fourth series of electrical connecting means designed to cooperate with said third series of separable electrical connecting means and designed to be connected to conductors situated inside said integral device, means being provided to obtain a relative movement between said dead face and said fixed connector block and also to lock said releasable movable part to said fixed part when the various series of connecting means are in the position of reciprocal contact and to effect the abrupt separation of said releasable movable part from said fixed part, characterized in that said dead face of said fixed part is mounted for axial sliding in the latter, while said fixed connector block is fastened securely and sealingly in said fixed face, elastic means being provided to move said movable dead face away from said fixed connector block and effect the separation of the cooperating connecting means carried respectively by these two parts, said movable dead face being provided with stop means limiting its movement towards the outside of said integral device by cooperation with a fixed stop secured to said integral device, in order to limit the movement of said dead face in the opposite direction from said fixed connector block to a value at least sufficient to effect the separation of the respective connecting means of the aforesaid third and fourth series, said stop means on said movable dead face and said fixed stop secured to said integral device cooperating to provide a seal between the outside of said integral device and the space contained between said fixed connector block and said dead face.

It is known that in devices such as rockets or other similar missiles, before firing and while the device is situated on its firing apparatus or surface, certain internal parts of the device are connected to outside power or signal supplies by means of electric cables. When the rocket is fired, the connection between the outside cables and the internal parts must be abruptly broken in order to free the device completely.

This break is normally effected by means of releasable connectors comprising a fixed part sealingly fastened in the outer wall of the device and a releasable movable part which at the moment of the break must be able to be abruptly extracted or expelled.

At the beginning and during the flight of the device, the outer face of the fixed portion of a connector of this type, which generally comprises an insulating block in which connection parts are held, such as sockets intended to co-operate with corresponding pins carried by the releasable part, is subjected to intense heating action originating either from friction against the ambient atmospher or even from flames coming from the propellant, which is liable to damage said face of the fixed part and impair its tightness and the reciprocal insulation of the various connection parts which it supports.

In order to obviate this disadvantage it has been proposed that the outer face of the fixed part of such connectors should be composed of what my convention is called a "dead face," which on one side comprises electrical connection parts adapted to co-operate with those carried by the corresponding face of the releasable part, and on the other side connection parts adapted to co-operate with corresponding parts carried by an insulating block which up to the present time has been mounted for axial sliding in the rear portion of the fixed part of the connector, the last-mentioned connecting parts being connected to the electrical conductor disposed inside the rocket and means being provided to effect the separation of the abovementioned block from the dead face at the last moment on the release of the movable part of the connector. In this way only the dead face withstands any external deteriorating action, against which the inner block carrying the connections connected to the conductor situated in the rocket is protected, thus eliminating the risk of impairing the insulation of the connecting parts. The movability of said internal block nevertheless still entails problems of construction on the one hand, in respect of tightness which may be compromised in the event of serious damage to the dead face unless the latter has considerable thickness, and on the other hand with regard to the connections between the connecting parts disposed in said movable block and the internal conductors which connecting parts may be subjected to harmful bending stresses, while in addition a space must be provided behind the movable block to accommodate the end fastenings of these conductors when said block is withdrawn from the interior of the device. The present invention has as object a releasable connector of the dead face type, which makes it possible to obviate the above-mentioned disadvantages while providing all the advantages of previously known dead face connectors.

The releasable dead face connector according to the invention comprises in known manner a releasable movable part and a fixed part secured to the device on which the connector is used, said releasable part comprising a first series of electrical connecting means designed to cooperate with a second series of corresponding means carried by a dead face disposed in the fixed part, the last-mentioned connecting means being respectively connected electrically to a third series of separable electrical connecting means which are likewise carried by said dead face and are designed to co-operate with a fourth series of separable electrical connecting means which are carried by an internal insulating block situated behind said dead face and are designed to be connected to conductors situated inside the device, means being provided to obtain a relative movement between said dead face and said internal block and also to lock the releasable part of the connector to its fixed part when the various series of connecting means are in the position of reciprocal contact and to effect the abrupt separation of the releasable part from the fixed part.

It is characterised in that the dead face of the fixed part is mounted for axial sliding in the latter, while the internal block is fastened securely and sealingly in said fixed face, elastic means being provided to move said

movable dead face away from said internal block and effect the separation of the co-operating connecting means carried respectively by these two parts, said movable face being provided with stop means limiting its movement towards the outside of the device by co-operation with a fixed stop secured to said device, in order to limit the movement of the dead face in the opposite direction to said internal block to a value at least sufficient to effect the separation of the respective connecting means of the aforesaid third and fourth series.

The stop carried by the dead face and the stop secured to the device, which co-operate with one another, are preferably shaped to provide a seal between the exterior of the device and the space contained between the internal block and the dead face.

The fixed part of the connector according to the invention may comprise a casing adapted to be sealingly fastened in an aperture provided in the wall of the device and opening on to the outside, a first insulating block carrying the aforesaid fourth series of separable connecting means, the axes of which are parallel to the longitudinal axis of the casing, said insulating block being fastened transversely securely and sealingly in said casing and forming the bottom of the latter, a second insulating block forming a dead face and carrying the aforesaid second and third series of separable connecting means, said second insulating block being fastened sealingly in a sleeve mounted for longitudinal sliding in said casing but secured against rotation in relation to the latter, said sleeve being provided on the outside with stop means co-operating with corresponding stop means provided in the casing to limit the movement of said sleeve towards the outside of the latter, and one or more springs bearing on the one hand against the bottom of the casing and on the other hand against said sleeve in order to urge the latter towards the outside of said casing, urging the aforesaid stop means against one another.

A free peripheral space may be provided between the side surface of the first block and the inside wall of the casing in order to permit the accommodation of the spring or springs acting on the socket carrying the second block, and either a single helicoidal spring engaging around said first block or a plurality of coil springs having a diameter smaller than the radial width of said peripheral space may be provided.

The aforesaid stop means limiting the movement of the sleeve carrying the dead face in relation to the casing may have the respective forms of a clack periphery and a valve seat periphery, thus making it possible to obtain a seal between the outside and the space contained between the dead face and the first block when said stop means are in the co-operating position.

Said first block may in turn be inserted in a socket fastened sealingly behind the casing, while the latter, as well as said blocks, sleeve, and socket, may have a circular cross-section.

The releasable part of the connector according to the invention may comprise a body which is designed to be able to engage in the casing of the fixed part and in which there is fastened an insulating block which on a front face, intended to be applied against said fixed part, carries the aforesaid first series of connecting means.

The means of locking the releasable part in relation to the fixed part, which are capable of rapid release, may be of any known type, for example working by mechanical traction, the relaxation of a spring, electromagnetically, pneumatically, or by pyrotechnic explosion.

In order to effect release by relaxation, a member forming a ring adapted to bear against a part secured to the outer face of the casing of the fixed part may be mounted slidably on said body, elastic means being disposed between said body and said member forming a ring, for the purpose of urging said member axially towards a stop limiting its movement in the direction of the front face of said body to a position such that the first series of connecting means is then disengaged from the second series of means carried by the fixed part, the total reciprocal movement of said member forming a ring and of said body being sufficient to permit the complete engagement of the releasable part in the fixed part, and means being provided to lock reciprocally said body and said member forming a ring against the action of said elastic means when the releasable part is entirely engaged in the fixed part, said locking means being arranged to free the body from the member forming a ring under the action of an external control.

In this case the means for locking the releasable part in relation to the fixed part are arranged to be unlocked by the reciprocal movement of said body and said member forming a ring.

Various examples of construction of the apparatus according to the invention are illustrated in the accompanying drawings, in which:

FIGURE 1 is a view in vertical section of the two separate elements of a connector according to the invention, illustrating the basic principle of the latter, the means of locking together the two parts when they are engaged one in the other and also the means for releasing the movable part not being illustrated;

FIGURE 2 is a similar view to that in FIGURE 1, showing the two parts engaged one in the other;

FIGURE 3 is a view in longitudinal section of a first example of practical construction of a connector according to the invention, the left-hand part of the figure illustrating the device immediately before engagement of the connections with one another, and the right-hand part showing the same device with an alternative form of construction of the means of disconnection in the position in which the electrical connections are completely engaged;

FIGURE 4 is a half-view in section of another embodiment in which the release is effected by the action of compressed air or of a pyrotechnic cap;

FIGURE 5 is a similar partial half-view of another embodiment in which the release is effected with the aid of an electromagnetic circuit;

FIGURE 6 is a partial view in longitudinal section of a modification of FIGURE 5, the right-hand half of the figure showing the operating device in the position in which the two parts of the connector are engaged, while the left-hand part shows the same device in the release position;

FIGURE 7 is a view in cross-section on the line X—X in FIGURE 6 of an additional modification of the latter.

As illustrated in FIGURES 1 and 2, the apparatus according to the invention comprises a fixed part A intended to be mounted in an aperture **1** provided in the outside wall **2** of the device, for example a rocket, to which the connector is intended to be fitted, and a movable part B.

The fixed part A comprises a casing **3** of cylindrical shape, closed at the rear by a cover **4** and fastened to the inside of the wall **2** of the device with the interposition of a flange **5** belonging to a ring **6** which is accommodated in the aperture **1** in said wall. The cover **4** rests on an annular rim **7** on the casing **3** to which it is fastened by means of screws **8**, and it is extended towards the interior of the part A by a socket **9** having a shoulder **10**. A block **11** of elastomer material, such as silicone rubber, is received in a completely fluid-tight manner in said socket **9**, and in said block there are provided spaces **12** intended to receive female connecting parts or sockets **13**. An annular ring **14** holds the block **11** inside the socket **9**, and for this purpose said annular ring may be screwed to the inside of said socket by means of co-operating screw threads (not illustrated). Because the block **11** is composed of elastomer material, after the moulding of said block with the corresponding spaces **12**, it is possible very easily to introduce into it the female parts **13** which in known manner are themselves provided with collars locking them inside the block, while said

female parts can, when desired, be subsequently extracted from the block for the purpose of replacement or after remaking the connection by crimping, in a manner known per se, to the corresponding conductor. The female parts can in fact be connected to the conductors by crimping before said parts are introduced into the block **11**, which simplifies manufacture and ensures a perfect electrical connection, without risk or breakage under the effect of external actions, such as vibrations, as is the case with welded connections.

A sleeve **15** is mounted slidably on the socket **9** and near its middle part has an external collar **16** the periphery **17** of which is machined in the shape of a truncated cone and is adapted to co-operate with the inside face of the ring **6**, which is machined in corresponding manner and against which it is applied by the action of a spring **18** housed inside the casing **3** and around the socket **9** and sleeve **15**, said spring bearing on the one hand against the edge **7** of the casing **3** and on the other hand against the collar **16**. It will be understood that instead of being cylindrical, the casing **3**, socket **9**, and sleeve **15** could have a polygonal, for example square, section, in which case the spring **18** could be replaced by other elastic means intended to lock the collar **16** against the inside face of the ring **6**, for example coil springs of a diameter smaller than the width of the space existing between the casing **3** and the sleeve **15** and disposed at the four apices of the square.

On its inside surface near its inner edge, the collar **16** carries a stud **19** adapted to slide in a slot **20** provided along generatrices of the socket **9**, this arrangement providing the axial guiding of the sleeve **15** in relation to the socket **9** while preventing relative rotation of the two parts, in order to keep the sockets **13** permanently coinciding with the respective corresponding pins which will be described hereinbelow.

A block **21** of elastomer material, similar to the block **11** but of smaller thickness, is fastened in the sleeve **15** and held sealingly inside the sleeve **15** between an annular rib **22** provided on the inside surface of said sleeve and a retaining ring **23** similar to the ring **14**. Spaces **24** are provided in this block to receive connecting parts comprising, on the side of the face of the block **21** which is turned towards the block **11**, male parts or pins **25** and, on the opposite side, female parts or sockets **26** corresponding to the connecting parts **13** in the block **11**.

Finally, on the outer face of the block **21** a plate or grid **27** of insulating material resisting high temperature and optionally flameproof, such as mica, silicone glass, ceramic material, or the like, is fastened by any known means on the outer face of the block **21**, said grid having the apertures necessary for the passage of the male portion **36** of the connecting parts **35** of the movable part B. The block **21**, with its connecting parts **25**, **26** and its protective covering **27**, constitutes the "dead face" of the connection and provides a seal between the outer atmosphere and the space contained between the collar **16** and block **21**, on the one hand, and the inside parts, the edge **7**, the socket **9**, and the block **11** of the connector on the other hand.

The movable part B comprises a cylindrical body **28** (which could have any other cross-section corresponding to that of the sleeve **15**) having a slightly widened portion **29** the inside diameter of which is such that this portion can be engaged on the sleeve **15**, a shoulder **30** being formed on the outside of the body **28** at the point of connection to the widened portion **29**.

A block **31** similar to the blocks **11** and **21** is received sealingly in said body **28** and is held between a circular internal rib **32** provided in the body **28** in a position corresponding to the shoulder **30**, and a gripping ring **33** similar to the rings **14** and **23**. This block contains spaces **34** which receive male connecting parts **35** the pins **36** of which project on the outer face of the block **31** with the same distribution as the connecting parts **24**, **25** on the block **21**. A slot **37** provided along the generatrices of the widened portion **29** of the body **28** co-operates with a stud **38** carried by the outer surface of sleeve **15** in order to obtain coincidence between the pins **36** and the corresponding female connecting parts of the fixed part and also the axial guiding of the movable part B in relation to the part A, while preventing relative rotation of these two parts.

On the front of the body **28** there is slidably mounted a ring **39** provided with an outside collar **40** and an inside rim **41**, the latter co-operating with the shoulder **30** of the body **28**, against which it is applied by a helical spring **42** which bears on the one hand against the collar **40** and on the other hand against the collar **43** carried by a ring **44** screwed on the rear end of the body **28**. The latter is closed at the rear by any means known per se, such as a cover (not illustrated) permitting the passage of the conductors connected to the connecting parts **35**. The conductors may be connected to said parts by crimping under the same conditions as the connection in the conductors to the connecting parts **13** of the block **11**.

In order to obtain engagement of the movable part B and the fixed part A of the connector and to effect the connection between the external conductors connected to the parts **35** in the block **31** and the conductors inside the device and connected to the parts **13** in the block **11**, after having placed the slot **37** in the body **28** of the part B and the stud **38** in the sleeve **15** of part A opposite one another, it is sufficient to insert said part B into said part A. The collar **40** of the ring **39** of the body **28** is applied against the wall **2** of the device and then, as the insertion movement continues, the connecting pins **36** of part B are engaged in the female connecting parts **26**, the ring **39** being pushed back on the body **28** against the action of the spring **42** until the front edge of the widened portion **29** of the body **28** strikes against the collar **16** of the sleeve **15** of the part A. This sleeve **15**, together with the "dead face" assembly, is pushed back towards the interior of the part A and the male connecting parts or pins **25** of said dead face are engaged in the female parts **13** in the block **11**. The inner edge of the sleeve **15** finally abuts against the shoulder **10** of the socket **9**, and the position of complete insertion illustrated in FIGURE 2 is thus achieved. Rapid release connection means (not illustrated in FIGURES 1 and 2) hold the parts A and B in this inserted position against the action of the springs **18** and **42**, which are compressed during the previously described operation. When it is required to disconnect the parts A and B, the quick release means are operated and the dead face is pushed back towards the outside by the spring **18** until the peripheral surface **17** of the collar **16** of the sleeve comes into contact with the corresponding seat of the ring **6**, restoring the seal, while the body **28** is in turn projected violently towards the rear by the spring **42**, which effects the respective disconnection of the pins **25** and female parts **13** on the one hand, and of the pins **36** and female parts **26** on the other hand, as well as the complete separation of the parts A and B. The surface **17** of the collar **16** of the sleeve **15** is again applied under the action of the spring **18** against the corresponding seat provided on the inner edge of the ring **6**, thus providing the desired seal for the protection of the block **11** and of the connecting parts which it carries.

With the device as described above, when the two parts A and B of the connector are not engaged in one another, the dead face of the part A ensures the continuity of the wall **2** and is given every possible protection by the grid **27** of insulating material against possible damage resulting from external action, for example flames licking the outside wall of the device. In addition, as is generally the case with dead face connectors, the dead face provides effective protection of the inside portion of the connector, which is here constituted by the block **11** and its connecting parts **13**, against the same action.

Finally, and this is one of the fundamental advantages of the apparatus according to the invention, the fact that the dead face is movable makes it possible to avoid any difficulties which might occur, particularly with regard to the safety of the connection between the connecting parts **13** and the conductors which are connected thereto and the space receiving the corresponding end portions of said conductors, this protection being rendered perfectly effective because of the fluid-tight closure obtained through the co-operation of the peripheral surface **17** of the collar **16** and the seat provided in the ring **6**.

The means for reciprocal locking of the parts A and B and of rapid release of the part B may be constructed in any conventional manner, and in particular this locking may be obtained by means of a releasable barrel type joint or by means of skews, while the release may be effected for example either by mechanical traction or, as has been described above, by relaxation of a spring, controlled in particular by electro-magnetic means, or by pyrotechnic explosion.

In the example illustrated in FIGURE 3, the fundamental parts of the apparatus described above are found once again, namely the fixed part A intended to be mounted in an aperture provided in the outer wall **2** of a device, for example a rocket, to which the connector is fitted, and the movable part B.

The fixed part A comprises the same elements as those described above, particularly with reference to FIGURES 1 and 2, these parts being designated by the same references increased by 100.

The movable part B in turn comprises a cylindrical body **128** which has two successive shoulders **129** and **130** and in the interior of which there is sealingly fastened a block **131** similar to the blocks **111** and **121** of the fixed part and held between the shoulder **129** of the body **128** and a ring **133** screwed in the latter, said block receiving the male connecting parts **135**, the pins **136** of which project on the outer face in order to co-operate with the connecting pieces **124** in the block **121** constituting the dead face of the fixed part.

On the body **128** there is slidably mounted a sleeve **137** having a shoulder **138** which strikes against the shoulder **130** on the body **128**. In the position in which the shoulders **130** and **138** reciprocally abut, the sleeve **137** projects beyond the inner end of the body **128** and near its free edge it has holes **139** each of which contains a ball **140** which, when the sleeve **137** is engaged in the flange **105** of the fixed part A, can be engaged in an annular groove **141** provided in said flange under the thrust of the sleeve **128**, the end edge of which is for this purpose chamfered at **142**.

The other three rings **143**, **144**, and **145** are mounted slidably one behind the other on the socket **137**. On its front face the ring **143** has a circular groove **146** in which a packing **147** is disposed. This ring forms a bowl against the bottom of which a spring **149** bears through the medium of a washer **148**, the other end of the spring bearing against the bottom of the bowl constituted by the ring **144**. The ring **145** bears a skirt **150** on the rear face of the ring **144**, said skirt also having a shoulder **151** held against a collar **152** provided on the outer periphery of a plug **153** screwed into the rear end of the body **128** by a ring **154**, which in turn is screwed on the plug **153**.

On the ring **145**, which is free to rotate in relation to the sleeve **137** and the plug **153**, there is also slidably mounted a fourth ring **155** provided with a collar **156** in which holes **157** are pierced which enable a release cable, not illustrated, to be attached. A cup **158** bears against the rear face of the collar **156** and is urged away from the ring **145** by a spring **159**.

In the outer wall of the sleeve **137** there is provided at least one helicoidal slot **160** in which a ball **161** engages which is housed in a corresponding opening **162** provided in the skirt **150** of the ring **145**, when said ball is pushed back towards the interior by the ring **155**, which for this purpose is provided with an internal conical bearing surface **163**.

Means, not illustrated, such as keys or studs, co-operating with corresponding slots, as in the examples illustrated in FIGURES 1 and 2, are provided for the purpose of securing the body **128** against rotation in the sleeve **137** and to fix the position of interengagement of the connecting parts, such as **136** and **124**, **125** and **113**, carried respectively by the blocks **131**, **121**, and **111**.

The apparatus thus constituted operates in the following manner:

Before engagement of the movable part B in the fixed part A, the parts engage the position illustrated on the left in FIGURE 3. In order to engage together the two parts of the connection, the sleeve **137** of the movable part is first engaged in the skirt **150** of the fixed part in order to obtain the position of engagement illustrated by the left-hand part of FIGURE 3. The ring **145** is then turned, which has the effect that, under the action of the balls **161** which move in the corresponding helicoidal slots **160**, the body **128** of the movable part is caused to penetrate into the fixed part. The chamfer **142** situated on the front edge of the body **128** pushes the balls **140** into the groove **141**, thus locking the sleeve **137** in relation to the fixed part. The rotary movement of the ring **145** and consequently the movement of penetration of the body **128** are continued, so that the electrical connecting parts penetrate into one another, the movable block **121** being pushed towards the interior of the casing **103** against the action of the spring **118** until the position illustrated in the right-hand part of FIGURE 3 is reached.

When it is desired to release the movable part of the connector, the ring **155** is drawn axially towards the rear by means of the release cables. The ring **155** withdraws against the action of the spring **159** and thus frees the balls **161**. Under the action of the spring **149** the rings **144** and **145** are pushed towards the rear, the balls **161** escaping from the corresponding slots **160**, and the ring **145** with the body **128** being then free to move towards the rear in relation to the sleeve **137** under the action of the spring **159**. When the shoulder **130** of the body **128** comes into contact again with the shoulder **138** of the sleeve **137**, the balls **140** are freed and therefore escape from the groove **141**, enabling the whole of the movable part to be definitely pushed back under the action of the spring **149**.

As illustrated in the right-hand part of FIGURE 3, the ring **155'** is slightly modified in the sense that instead of having a conical bearing surface **163** directed in the forward direction like the ring **155** shown in the left-hand part, it has an internal peripheral groove **164** providing a heel **165** in front of the ring. Before the movable part is engaged with the fixed part, the ring **155'** is pushed backwards against the action of the spring **159** and held in that position by a fork **166** which is engaged, between said ring **155'** and the ring **144**, so that the heel **165** holds the balls **161** in the corresponding helicoidal slots **160**.

The cables passed into the apertures **157** in the ring **155'** are utilised to compress the spring **159** and permit the engagement of the fork **166**. For the purpose of release the fork **166** is extracted laterally, the ring **155'** is pushed forwards by the spring **159**, and the balls **161** are free to penetrate into the groove **164**, escaping from the corresponding helicoidal slots **160**, while the ejection of the movable part B can be effected as described above.

In the case of connections having to be separated a short time after the firing of the device with which they are associated, the fork may be connected to a fixed point on the ground, by a connection such as a cable of the necessary length to ensure that the fork will be pulled out at the desired moment after the firing of the device.

In the example illustrated in FIGURE 4, the same elements are found once again for the fixed part A, and are designated by the same references as in FIGURE 3, and similarly in the movable part B the body **128** with its block **131** and its rear plug **153**, the sleeve **137** with its helicoidal

slots 160 with which the balls 167 co-operate. The rings 145 and 155 however are replaced respectively by rings 167 and 168 of a slightly different shape.

Like the ring 145, the ring 167 has apertures 162 receiving the balls 161 and a shoulder 151 held against the collar 152 of the plug 153 by the ring 154 screwed on the latter, said ring 167 being by this means mounted rotatably on said plug. This ring however forms a chamber 169 limited at the rear by a collar 170, at the front by a partition 171 extended towards the front by a skirt 172, and at the side by a cap 173 hermetically sealing said chamber. The rear collar 170 is pierced by tapped holes 174 in each of which there may be screwed either a pyrotechnic cap of construction known per se, or a tube for connection to a compressed air supply. The partition 171 is in turn pierced with apertures 175 which establish communication between the chamber 169 and the space contained between the ring 167 and the skirt 172, in which space there are engaged two concentric skirts 176 and 177 extending the ring 168 towards the rear and sliding with light friction respectively against the ring 167 and its skirt 172 so as to form an expansion chamber 178. A spring 179 urges the rings 144 and 168 apart. Like the ring 155', the ring 168 has an internal annular groove 164 and a heel 165 effecting the reciprocal disengagement and engagement of the balls 161 and helicoidal slots 160.

The coupling of the movable part B and the fixed part A having been effected as described previously, the movable part B is released by explosion of the caps screwed in the holes 174 or by the introduction of compressed air through said holes.

The expansion of the explosion gases from these caps, or the increase in air pressure in the chambers 169 and 178 pushes the ring 168 against the action of the spring 179, which enables the balls 161 previously held by the heel 165 to escape into the groove 164. The ring 167, the plug 153, and the body 128 are then, as previously, pushed towards the rear by the spring 149 which, under the conditions already described in connection with FIGURE 3, effects the release of the movable part B. The arrangements illustrated in FIGURES 5 and 6 are of the magnetic release type.

In the example illustrated in FIGURE 5, the ring 155 or 155' illustrated in FIGURE 3, or the ring 168 illustrated in FIGURE 4, is replaced by a ring acting as movable core of an electromagnet constituted by a coil 182 held between a ring 184, replacing the ring 145 of FIGURES 3 and 4, and an annular pole piece 185 fastened on said ring 184 by a retaining ring 187. The ring 184 is in turn held, in such a manner as to be able to rotate without longitudinal movement in relation to the body 128, between a ring 180 having a collar and engaged on said body 128 and a ring 183 screwed on the front part of said sleeve, which is provided with a screw thread for that purpose, with the interposition of a washer 186.

The core ring 181 is urged forwards by a spring 188 and it has an annular heel 190 which, as is illustrated, holds the balls 161 engaged in the corresponding helicoidal slots 160 when said ring 181 is in the end rear position, the spring 188 being compressed, and frees them when the ring 181 is in the front end position.

When the movable part of the connector is engaged with the fixed part, and as long as these two parts have to be engaged, the coil 182 is permanently fed in order to maintain the core ring 181 in its rear position, in which the balls 161 are held engaged in the slot 160, which permits the interengagement of the two parts of the connector under the conditions already described. The interruption of the feeding of the coil 182, either with the aid of a switch placed in the supply circuit of said coil, and not illustrated, or by the withdrawal of the wires of said circuit, frees the core ring 181 which is pushed forwards, enabling the balls 161 to be disengaged in order to effect the release in the manner likewise already described. If desired, it is possible in this case to provide in the gap 191, which exists between a skirt 192 formed at the rear of the ring 144 and the core ring 181 when the latter is in the armed position, a locking fork similar to the fork 166 illustrated in FIGURE 3 and adapted to be operated in the same manner, so that said ring 181 is held in its rear end position even after the breaking of the current feeding the coil 182, said fork providing a mechanical safety device for the apparatus as long as it remains engaged in said gap 191. It will be noted that in the example illustrated in FIGURE 5 the bottom of the bowl formed by the ring 144 bears against the spring 149 through the medium of a ball bearing comprising a bearing track 193 integral with the ring 144, a bearing crown 194 against which bears the corresponding end of the spring 149, and between said track and said crown a cage 195 holding balls 196. This bearing facilitates the rotation of the ring 184 in relation to the assembly which is formed by the sleeves 128 and 137 and by the ring 143 and which is fixed in rotation when the movable and fixed parts of the connector are reciprocally engaged.

In the embodiment which has just been described above, on the engagement of the movable part of the connector with the fixed part, under the effect of the rotation of the ring 184 which effects the displacement of the balls 161 in the corresponding helicoidal slots 160, the coil 182 is itself rotationally driven with said ring 184. Difficulties result in the arrangement of the electrical conductors supplying current to the coil, and which must be able to rotate with the latter and which risk being damaged during this movement.

This disadvantage is obviated in the apparatus illustrated in FIGURE 6 and in which, as an additional alternative, the release of the movable part of the connector is effected by the passage of a current through the coil 182 and not, as was the case with the arrangement illustrated in FIGURE 5, by interruption of the current feeding said coil.

In FIGURE 6 there are illustrated only the parts of the apparatus which directly concern the release by the action of the coil, and the remainder of the apparatus may be identical to that illustrated in the previous figures. The right-hand part of the figure shows these parts in the position which they occupy at the moment when the movable part is about to be engaged with the fixed part, the balls 161 being held engaged in the corresponding slots 160. The left-hand part of FIGURE 6 on the other hand illustrates these same parts in the position which they occupy at the moment of the release when the balls 161 have just been freed in order to permit the relative displacement of the body 128, with the parts which are axially solid therewith, and of the socket 137.

In this apparatus there are therefore found once again the body 128, the socket 137 with the helicoidal slot 160, the balls 161 co-operating with the latter, the spring 149 tending to push the body 128 towards the rear, and the parts which are axially solid therewith, and also the ball bearing 193–194–195–196, through the medium of which said spring 149 bears on the last-mentioned parts.

The coil 182 is here supported between an outer bowl 197 replacing the ring 184 in FIGURE 5, and an internal sleeve 198, said bowl 197 and said sleeve 198 being gripped between the threaded ring 154 which is screwed on the end of the body 128 and a collar 199 bearing a shoulder 200 of said body 128 and having a square-shaped cross-section with a flange 201. The assembly formed by the bowl 197, the inner sleeve 198, and the coil 182 is thus secured against rotation in relation to the body 128 and the conductors 202 supplying said coil can pass to the interior of the body 128 through a radial slot 203 cut in the sleeve 198.

The balls 161 are carried by a ring 204 having an internal collar 205, which is engaged with light friction between the flange 201 of the collar 199 and the inner fabric of the sleeve 198, which is gripped between the ring 154 and said collar 199. This ring 204 is thus mounted

for free rotation about the body **128** but is locked axially in relation to the latter, and it is provided with an outer flange **207** which bears on the race **193** of the ball bearing **193–196** and is integral with the ring **144***a* protecting the spring **149** and penetrating into the ring **143**.

On the ring **204** there is slidably mounted a bowl ring **208** the skirt of which slides on the outer surface of the bowl **197** and which serves the same purpose as the moveable core ring **181** of the device illustrated in FIGURE 5. For this purpose, said ring **208** has a heel **209** which, when it is held apart from the electromagnet by the spring **188**, holds the balls **161** in their position of penetration into the helicoidal slot **160**, and a widened out part **210** into which the balls **161** can penetrate on escaping from the slots **160**. The ring **208** is associated in rotation with the assembly formed by the rings **204** and **144***a* by means of at least one pin **211** fastened in the ring **144***a* and engaging in a hole **212** provided in the ring **208**, the length of the pin **211** being sufficiently great to maintain the association in rotation of the rings **144***a* and **208** in all the positions of the latter.

It will easily be understood that in order to effect the penetration of the movable part of the connector into its fixed part, when the parts occupy the position illustrated on the right-hand side of FIGURE 6 and the coil **182** is not supplied with current, after having engaged said movable and fixed parts with one another it is sufficient to turn the assembly constituted by the rings **208**, **204** and **144***a* in relation to the body **128**. The balls **161** are then displaced in the corresponding helicoidal slots **160** in order to effect, as previously described the penetration of the movable part of the connector into the fixed part. In order to effect the release, current is supplied to the coil **182** through conductors, such as **202**. The ring **208** is drawn towards the rear in order to assume the position illustrated on the left-hand side of the figure, to which position the balls **161** can escape from the slots **160**, which permits the relative displacement of the sleeve **137** with the parts carried by it in relation to the body **128**, and consequently permits the release of the movable part under the action of the spring **149** under the conditions previously described.

An additional alternative construction of the apparatus thus constituted, permitting mechanical operation of the release, is illustrated in FIGURE 7.

In accordance with this alternative, the annular heel **209** of the ring **208** is replaced by two heels **209***a* occupying only an arc of a circle of slight length. In addition, the ring **208** carries a side lug **213** in which there is provided an oblique slot **214** closed by an elastic foot **215** forming a spring and held on the flange **213** by a screw **216**. A traction cable **217** is engaged in this slot. In the normal situation, the relative angular position of the rings **208** and **204** is such that the heels **209***a* of the ring **208** are opposite spaces provided in the ring **204** to receive the balls **161** and hold said balls in the corresponding slots **160** when the coil **182** is not supplied with current, the connection between the rings **204** and **208** being effected as described above by the pin **211** which penetrates into the hole **212** provided for this purpose in the ring **208**. In addition, the relative position of the movable part of the connector and of its fixed part when one part is engaged in the other is so arranged that the bottom of the slot **214** provided in the flange **213** of the ring **208** will be substantially in the horizontal plane of the general axis of the apparatus. Finally, the pin **212** is made of a sufficiently strong metal to associate the ring **208** in rotation with the ring **144***a* when the movable part of the connector is driven into its fixed part, but nevertheless sufficiently fragile or ductile to be able to be sheared under the action of a shearing force greater than that to which said pin is subjected during the process of mutually engaging the parts of the connector.

If it is desired to effect the release by mechanical means instead of by electromagnetic means, it is sufficient to apply to the cable **217** a sufficiently violent vertical pull to effect the shearing of the pin **211**. The ring **208** is then rotated in relation to the ring **204**, the balls **160** escape from the heels **209***a* and can therefore be released from the helicoidal slots **160**. The elasticity of the foot **215** enables the engagement and disengagement of the cable **217** to be effected easily.

I claim:

1. A releasable electrical connector permitting abrupt release of electrical conductors connecting an integral device to an outside power supply which comprises a releasable movable part designed to be connected to an outside power supply and a fixed part secured to the integral device, said releasable movable part comprising a first series of movable electrical connecting means in electrical connection with said outside power supply, said fixed part comprising a movable dead face and a fixed connector block situated behind said movable dead face, said movable dead face comprising a second series of corresponding separable electrical connecting means designed to cooperate with said first series of electrical connecting means in said releasable movable part and a third series of separable electrical connecting means respectively connected electrically to said second series of separable electrical connecting means, said fixed connector block comprising a fourth series of electrical connecting means designed to cooperate with said third series of separable electrical connecting means and designed to be connected to conductors situated inside said integral device, means being provided to obtain a relative movement between said dead face and said fixed connector block and also to lock said releasable movable part to said fixed part when the various series of connecting means are in the position of reciprocal contact and to effect the abrupt separation of said releasable movable part from said fixed part, characterized in that said dead face of said fixed part is mounted for axial sliding in the latter, while said fixed connector block is fastened securely and sealingly in said fixed face, elastic means being provided to move said movable dead face away from said fixed connector block and effect the separation of the cooperating connecting means carried respectively by these two parts, said movable dead face being provided with stop means limiting its movement towards the outside of said integral device by cooperation with a fixed stop secured to said integral device, in order to limit the movement of said dead face in the opposite direction from said fixed connector block to a value at least sufficient to effect the separation of the respective connecting means of the aforesaid third and fourth series, said stop means on said movable dead face and said fixed stop secured to said integral device cooperating to provide a seal between the outside of said integral device and the space contained betwen said fixed connector block and said dead face.

2. A connector according to claim **1** characterised in that said fixed part of said connector comprises a casing adapted to be fastened sealingly to an aperture provided in the wall of said integral device and opening towards the outside, said fixed connector block comprising a first insulating block carrying the aforesaid fourth series of electrical connecting means, the axes of which are parallel to the longitudinal axis of said casing, said first insulating block being fastened transversely, securely and sealingly in said casing and forming the bottom of said casing, said movable dead face comprising a second insulating block carrying the said second and third series of separable electrical connecting means in respective electrical connection, said second insulating block fastened sealingly in a sleeve mounted for longitudinal sliding in said casing but secured against rotation in relation to said casing, said sleeve being provided externally with stop means cooperating with corresponding fixed stop means in said casing in order to limit the movement of said sleeve towards the outside of said casing and to

provide a seal, and at least one spring bearing against the bottom of said casing and against said sleeve urging said sleeve towards the outside of said casing and the aforesaid stop means against one another.

3. A connector according to claim 2, characterised in that a free peripheral space is provided between the side surface of said first insulating block and the inside wall of the casing in order to permit the accommodation of said at least one spring acting on said sleeve carrying said second insulating block.

4. A connector according to claim 2, characterised in that said stop means limiting the movement of said sleeve in relation to the casing have the respective forms of a clack periphery and a valve seat periphery, thus making it possible to provide a seal between the outside and the space contained between said second insulating block and said first insulating block when said stop means are in the cooperating position.

5. A connector according to claim 2, characterised in

that said first insulating block is in turn inserted into a socket fastened sealingly to the rear of the casing, the latter, as well as said blocks, sleeve, and socket, having a circular cross-section.

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