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MAGNET CONTROLLED CONNECTORS

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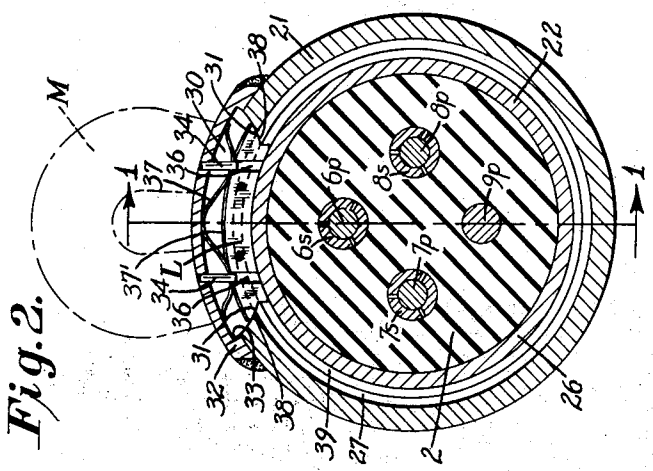


Fig. 2.

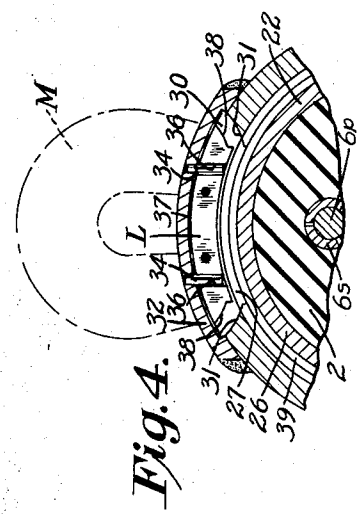


Fig. 4.

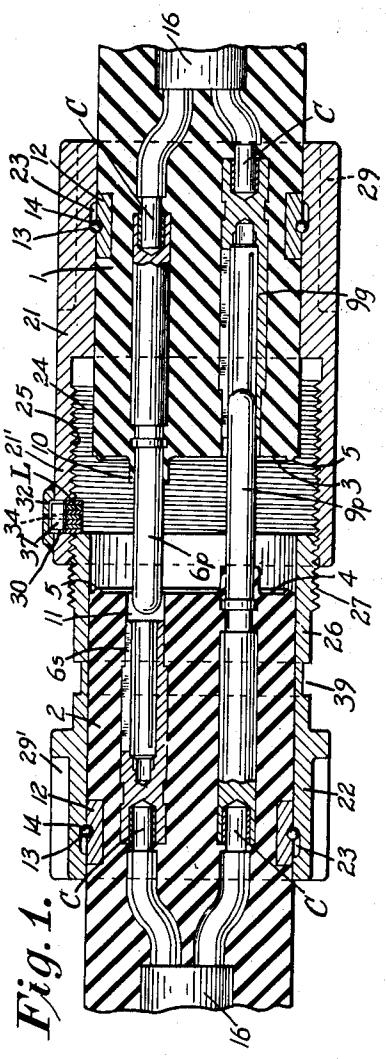


Fig. 1.

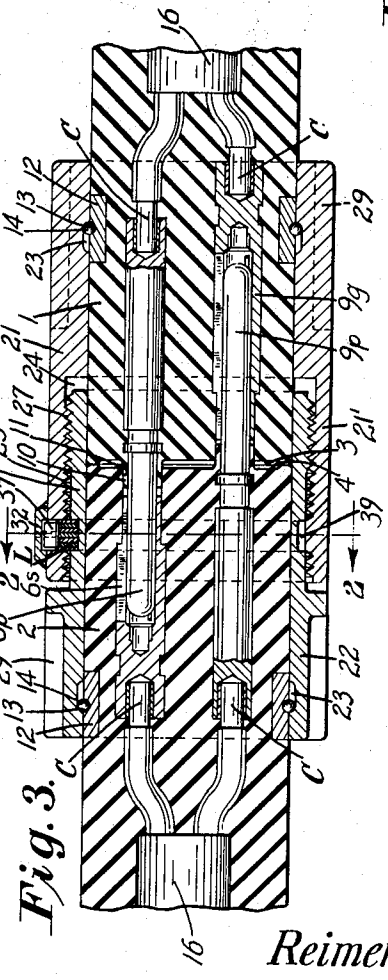


Fig. 3.

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MAGNET CONTROLLED CONNECTORS

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11 Claims. (Cl. 339—86)

This invention relates to electrical cable connectors and finds particular utility in, though it is not confined in its broader aspects to, connectors of the so-called swivel coupling type.

A preferred form of electrical coupling, for use in mines, or in other places where rough service is likely to be encountered, is the swivel coupling. These, in a well known form, include molded rubber connectors provided with pin and socket elements adapted to be engaged with each other to establish circuits—one or more, dependent on the number of pin and socket elements. These connectors may desirably be provided with water seals of suitable form, such as molded in, annular ridge type seals, and are equipped with threaded metal collars, sleeves or couplings that prevent accidental disconnection and which, through relative rotation, may draw together or move apart the pin and socket elements. The pin and socket elements may be arranged on the cooperating connectors so that all of one kind are on one connector and all of the other kind are on the other connector, or some of each kind may be on each connector, and so, from time to time, herein the term "plug-socket" will be used to designate generically a connector element having only pin elements, having only socket elements, or having both types of elements thereon. It may also be noted that plug-socket contacts may be either of power, ground or pilot type depending upon the circuits of which they form parts. The metal collars, sleeves or couplings, desirably, in the present invention, of non-magnetic material, are supported for relative rotation, and either or both of a cooperating pair may be rotatively mounted on the connectors; and these sleeves may be supported in some cases by ball bearings arranged on metal collars at the periphery of one or both of the molded rubber connectors; and the sleeves respectively carry external and internal threads which may be readily engaged and disengaged by relative rotation, which rotation may be effected by hand or by a wrench, by reason of the free turning of at least one of the metal couplings surrounding the rubber connector bodies.

The current flowing in the power circuit or circuits established by such connectors is frequently substantial, and it is unsafe to have such circuits broken by the separation of the pin and socket elements from each other while there is current flowing in the conductors which are connected by such elements. Means has heretofore been provided for preventing such dangerous practice, such means consisting of a pilot circuit having pin and socket elements carried by the connectors and so positioned as to be separated before any of the main circuit (power) pin and socket elements are separated from each other, said pilot circuit pin and socket elements forming portions of a circuit which must be complete in order for a main line switch, or a control switch for the main circuits, to be closed. Such arrangements make it necessary to have the conductor cables contain at least two pilot circuit conductors and add to the complication of the

plugs proper, as well as making additional switch gear essential.

If unauthorized or promiscuous coupling and uncoupling of the connectors can be prevented, the entire pilot circuit can be eliminated. Accordingly, if control of the coupling and uncoupling of the connectors be effectively confined to an authorized person or persons, charged with the responsibility of shutting off the power from a cable before bringing together or separating the connectors, another line of attack on the problem is available, and the problem can be solved by providing suitable means for controlling coupling and uncoupling of these connectors operable only by devices which would be confined to the possession of and therefore utilizable only by such responsible persons, and which would be utilized by them only after the circuits in which the connector is included have had the power shut off.

The use of mechanical locks having keys is not a sound solution of the problem, both because of the complexity of the mechanism and the possibility of undesired duplication of keys. Also locks to which physical access would be necessary might become plugged with coal dust or the like. However, a magnetically controlled locking arrangement wholly housed within the coupling except for its control magnet, and the use of a control magnet carried by a responsible person or persons as above mentioned, produces a desirable control system, upon the assumption that a fool-proof apparatus would be unnecessary with foremen or the like of sufficient responsibility to be charged with the exclusive control of the connecting and disconnecting of the connectors mentioned.

When the concept of the invention is understood, it will be appreciated that the invention may be embodied in various forms and may in its broader aspects be incorporated in a push-pull connector with an automatic latch or lock which is magnetically releasable. It will further be apparent that in the preferred form of coupling above described, utilizing threaded metal collars or couplings, the locking means may be carried by the threaded metal couplings, or may simply be housed within the latter, though the former arrangement, due to its strength, will be preferable. In any event the armature to be moved by the magnet will be arranged close enough to the peripheral wall of the coupling structures so that it may be subjected effectively to the force, preferably the pull, of a magnet of suitable strength applied to the coupling externally. It must not be thought that in certain of its aspects the invention is confined to constructions in which pilot circuits are omitted, and it may very desirably include constructions in which ground connections are incorporated in the connectors. In either of such embodiments, the magnetic lock features will be employable to advantage, and it is not to be understood that connectors having only power plug-socket contacts, as distinguished from pilot and/or ground plug-socket contacts, alone come within its scope. The invention is also of value with explosion resistant constructions, as will later more fully appear. Magnetic repulsion, as well as magnetic retraction may be employed in suitable embodiments.

It will further be appreciated that the invention may be very advantageously incorporated in embodiments in which the plug-socket contacts—at least the power plug-socket contacts—may remain at least essentially separated from the ambient atmosphere until they are separated an adequate distance and have been separated for an adequate time to insure against the possibility of an arc or sparks causing an explosion of a surrounding explosive mixture, and not only may the housing provide as mentioned for explosion prevention during separation of the power con-

tacts but, as well, during the establishment by such contacts of circuit connections.

In a preferred embodiment of the invention, connector plug elements of non-conducting material may carry pin and socket elements which are mutually engageable to establish circuit connections. Non-magnetic coupling sleeve members, interlockingly connectible to each other to house the pin and socket elements and to effect drawing together of the plug elements, may be suitably mounted on the plug elements, at least one of said non-magnetic coupling sleeve members, and desirably both, being rotatably mounted upon the exterior of the associated plug elements, and at least one of said non-magnetic coupling sleeve members projecting longitudinally from its plug element sufficiently to receive the other of said plug elements within it for a substantial distance. The non-magnetic coupling sleeve members will be provided with suitable means for connecting them together upon appropriate relative rotation. Breech-block type constructions may be employed, or what is known as "fire hydrant" type threaded connections may be used. One of the non-magnetic coupling sleeves may carry, housed within it, but in a position to coact with the other coupling sleeve, a lock or latch member supported for movement between locking and unlocking positions radially of the other coupling sleeve member; and desirably the lock or latch member will be retractable fully within the sleeve which supports it, in such a manner that it may be held, when moved to and held in its retracted position, completely out of engagement with the other sleeve member during the making and the breaking of the connections between the sleeve members. Where one sleeve member is internally threaded and the other is externally threaded, the outer sleeve member may be formed with a recess closely receiving and guiding the lock or latch member. When the latter is retracted it will occupy a position wholly outside the major diameter of the threads of the externally threaded member. When the latch is in lowered or active position and connection is being initiated, the latch may engage the end of the externally threaded member and prevent, until it is withdrawn, the bringing together, beyond a predetermined point, of the coupling members. Thus it may prevent engagement of the power plug-socket contacts before such engagement is intended. The inner sleeve member may have a recess of relatively small arcuate extent into which the lock or latch member may be automatically moved when it attains to proper position and is not held in retracted position, but a dseirable arrangement consists in providing an appropriately located annular groove in a position for engagement by the lock or latch element when the coupling sleeves are fully screwed together and the contacts are in desired circuit-making relation to each other. The latch may desirably be made of magnetic material—or at least partially so—and may be supported for radial movement and may be preferably biased by a non-magnetic spring into projected position. The sleeve members will, as previously stated, desirably be made of non-magnetic material. It will thus be evident that when the parts are to be connected together or to be disconected, a magnet of suitable strength may be positioned against the outer wall—or a projection therefrom—of the sleeve member carrying the latch element, and may release such latch or lock element, as illustrated moving it out of engagement with the other sleeve member, thus allowing relative longitudinal movement between the sleeve members, and their separation. Suitable means for limiting the inward movement of the latch element will be provided for the purpose of preventing th elatch from moving to a position which would make difficult the coupling of the elements together. And the latch will be properly guided, not only to facilitate its movement, but to insure its effective locking action.

From the foregoing general statement it will be appreciated that it is an object of my invention to provide an improved connector of the plug-socket type. It is another

object of the invention to provide an improved connector provided with a magnetically releasable lock. It is a further object of the invention to provide an improved safety magnet controlled lock for connectors, utilizing a portable magnet and having the lock structure thereof housed within the connector in such a manner as to be completely inaccessible so long as the connector parts are secured together. It is a further object of the invention to provide an improved threaded coupling of a type which shall require the bringing into cooperative relation with it of a magnetic force-providing device before the coupling can be released. It is still another object of the invention to provide an improved magnet controlled housing arrangement for connectors. It is yet a further object to provide an improved explosion resistant, magnet controlled housing arrangement for electric cable connectors. It is still a further object of the invention to provide an improved magnet controlled lock device for cable connectors. Still another object is to provide an improved threaded coupling of a type which shall require the bringing into cooperative relation with it of a magnetic force-producing device before the coupling can be screwed together. Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawing, in which for purposes of illustration one illustrative embodiment of the invention is shown.

Fig. 1 is a view partially in longitudinal axial section and with certain parts shown in elevation and others broken away, the section being taken on the plane of the line 1—1 of Fig. 2, and on a reduced scale,

Fig. 2 is a transverse section on the plane of the line 2—2 of Fig. 3, this view being on an enlarged scale,

Fig. 3 is a longitudinal section on the same plane as Fig. 1, the parts of the connector being shown in connected position, and locked together,

Fig. 4 is a fragmentary sectional view showing the lock in released position, the section being taken on the same plane as Fig. 2.

Referring to the drawings and initially particularly to Fig. 1, it will be observed that there is shown a pair of connector plug members **1** and **2**, each formed of a suitable dielectric material such as molded rubber and provided with mutually opposite faces **3** and **4**, having annular ridge type water seals **5**, **5**.

The connector plug members are shown as provided with four sets of plug-socket contacts: three power and one ground. The connector plug member **1** carries three power plug contacts 6_p, 7_p and 8_p, while the plug member **2** carries three power socket contacts 6_s, 7_s and 8_s. The connector plug member **2** carries a ground plug contact 9_p and the connector plug member **1** a ground socket contact 9_s. The ground plug contact 9_p is longer than the power plug contacts 6_p, 7_p and 8_p, and accordingly the ground circuit will be established before and broken after the power circuits. Projecting sleeve portions **10** formed on the connector plug member **1** surround each of the plug contacts, and recesses **11** are provided on the connector plug member **2** to receive these sleeve portions. These provide an additional sealing, and also improved centering for the connector plug members **1** and **2**. Each of the plug members **1**, **2**, is provided with an annular ball seat providing member **12**, each providing a circumferential groove **13** in which a series of bearing balls **14** are received and guided. The ball seat providing members are desirably metallic and they are desirably molded in position on the plugs. Suitable conductors are connected to the plug and socket elements, four of these being shown, and designated C. The plugs **1** and **2** are carried at the adjacent ends of cable sections **16**, being vulcanized, desirably, to the latter.

Each of the plug members **1** and **2** is surrounded by a coupling sleeve, the one associated with the plug member **1** being designated **21** and the one connected with the plug

member 2 being designated 22. These sleeves, or collars, are desirably of bronze, brass or other non-magnetic material. These have internal circular grooves 23 formed in them, these grooves being wider than the grooves 13 and cooperating with the rows of balls 14 and providing for a limited degree of free relative longitudinal movement of the sleeves 21 and 22 with respect to their associated plug members 1 and 2. The end portion 21' of the sleeve 21 is of reduced thickness, and thus there is provided an annular recess 24 in which the coupling portion of the coupling sleeve member 22 is receivable. The adjacent ends of the sleeve members 21 and 22 are each threaded. The end 21' of the sleeve 21, is internally threaded as at 25 for a substantial length from its free end. The outer end portion 26 of the coupling sleeve 22 is externally threaded as at 27, and the two sets of threads are adapted to draw the parts together and secure them in connected relation, and the threads may be readily connected and released because the coupling sleeves are freely rotatable on the connector plugs and have, to aid in turning them, indentations 29 and 29' spaced around their peripheries so that they may be easily grasped either manually or by wrench. The threaded connection is shown as of the fire hydrant type.

The coupling sleeve 21 has an opening 30 formed in it. This may desirably be formed by milling, and have shoulders 31 at its opposite ends. This opening is adapted to receive a lock element or latch member L. The latch member may be of solid or of laminated construction, in the latter case having its parts soldered or riveted together, or both. It is desirably made of magnetic material, and must be at least partially of such material, so that it may be attracted and drawn outwardly by a magnet applied to the exterior of the coupling. Latch member L is a fairly close fit, laterally, for the opening 30. A cover member 32, having a recess 33 to complement the opening 30, is suitably secured to the outside of the sleeve member 21, and guide pins 34 are provided for the purpose of guiding the latch member L, these being arranged to enter holes 36 in the latter. A wave spring 37, having its ends slotted to permit movement relative to the pins 34, lies between the cover member 32 and the top of the latch member, which may, in effect, be grooved as at 37' on its back or outer surface to cooperate with the spring. The spring is desirably of non-magnetic material, spring bronze being, for example, suitable for the purpose. The latch member L has ends 38 adapted to engage the shoulders 31 to limit inward movement of the latch member.

The sleeve 22 is provided with a circumferential groove 39 with which the latch member L may engage in the fully connected position of the parts shown in Figure 3. It will be noted that the latch member will engage the end of the portion 26 of the sleeve member 22 before the power contacts 6_P, 6_S, etc. can be engaged, and it will further be noted that the latch member, as shown in Figure 3, is adapted to engage in the annular groove 39 when the plug-socket contacts of the connector are fully mutually engaged. Thus it requires deliberate application of a magnet, such as the magnet illustrated in construction at M, in proximity to the lock member or latch L in order for the connector plug to have its parts connected so as to effect a power circuit, and also in order that the parts of the connector plug may be mutually released from each other. It will be noted that, as the parts are shown in the drawing, the latch or lock member L may engage the left-hand one of the threads 27 as the parts are being separated, if the magnet M be not maintained in position adjacent the lock member. However, after the latch has attained to a position in which it overlies the threads 27, completion of separation of the parts of the connector may be effected without the maintenance of the magnet in position, though this is a less desirable procedure. Since the magnet will be made of very considerable strength, as for example being made of "Alnico" or some similar alloy, the magnet will retain its position overlying the lock by its own strength, without the operator's holding it there. Thus no occasion for sliding the latch member over the threads exists. The mode of operation of othe embodiment of the invention illustrated will be readily understood. Let it be imagined that the coupling is in connection-establishing use and that it is desired to disconnect its parts from each other. This cannot be done by anyone not provided with a magnet of suitable strength. A trusted employee, who may be relied on to do his job correctly and infallibly, will open the circuit at such a point as to render the power conductors dead. He will then take a suitable magnet M, whether a permanent magnet, as is preferable, or a wound magnet, and bring its poles against the coupling sleeve in a position against the cover member 32. This will cause the latch member L to be raised out of engagement with the side wall of the groove 39, and it will then be possible to unscrew the coupling sleeve 21 from the coupling sleeve 22 and thus to separate the plug-socket elements from each other. It will be necessary, with the construction shown, that the latch be maintained in retracted position both until it has passed partially beyond the groove 39, and also, again, as it approaches the threads 27, until it has passed partially over these threads. Desirably the magnet will be continuously applied during disconnection of the coupling.

For the coupling to be reconnected, it is necessary that the magnet hold the latch retracted within the socket at least until the latch has passed over the first of the threads 27 at the end of the sleeve 22, for otherwise, as is apparent in Figure 1, it will obstruct the screwing together of the sleeves in such a manner as to prevent the power plug and socket elements 6_P, 6_S etc. from engaging with each other.

It will be evident that by the use of the structure described, neither the connection nor the disconnection of the coupling will be possible without the retraction of the latch member or lock by a magnet, as above described. By confining the possession of suitable magnets to duly responsible personnel, a very safe system can be assured At the same time additional equipment and expense and the additional complication of pilot controlled safety switches may be avoided. It will be evident that the construction is strong, fully protected from accidental injury, durable and effective; and that the complete enclosure of the latch fully safeguards the latter from tampering while the parts are connected together.

This application is a continuation of my application Serial No. 125,758, filed November 5, 1949, and now abandoned.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What is claimed as new is:

1. In a coupling plug, in combination, connector elements of non-conducting material, power contact elements carried by said connector elements and mutually engageable to establish electrical circuit connections, non-magnetic coupling sleeves freely rotatable relative to said connector elements and releasably interlockingly connected to each other housing and preventing separation of said contact elements and of said connector elements, lock means for preventing the release of one of said sleeves from the other, said lock means including a lock element housed within one of said sleeves and operable by pull exerted thereon by a magnet external to said sleeves to release the same, the other of said sleeves having a circumferential groove for receiving said lock element when said sleeves are in position to be locked together.

2. In a coupling plug, in combination, connector elements of non-conducting material, power contact elements

carried by said connector elements and mutually engageable to establish electrical circuit connections, non-magnetic coupling sleeves freely rotatable relative to said connector elements and releasably interlockingly connected to each other housing and preventing separation of said contact elements and of said connector elements, lock means for preventing the release of one of said sleeves from the other when they are connected and their connection when they are released, said lock means including a lock and stop element housed within one of said sleeves and operable by pull exerted thereon by a magnet external to said sleeves to release the same.

3. In a coupling plug, in combination, connector elements of non-conducting material, power contact elements carried by said connector elements and mutually engageable to establish electrical circuit connections, non-magnetic coupling sleeves freely rotatable relative to said connector elements and releasably threadedly interlockingly connected to each other housing and preventing separation of said contact elements and of said connector elements, lock means for preventing the release of one of said sleeves from the other, said lock means including a lock element housed within one of said sleeves and traversing the threaded portion thereof and operable by pull exerted thereon by a magnet external to said sleeves to release said lock means.

4. In a coupling plug, in combination, connector elements of non-conducting material, power contact elements carried by said connector elements and mutually engageable to establish electrical circuit connections, non-magnetic coupling sleeves freely rotatable relative to said connector elements and overlappingly and releasably interlockingly connected to each other housing and preventing separation of said contact elements of said connector elements, lock means for preventing the release of one of said sleeves from the other, said lock means including a lock element housed within one of said sleeves at least near the portion thereof having maximum overlap with the other sleeve in their fully connected relation and operable by pull exerted thereon by a magnet external to said sleeves to release said lock means.

5. In a coupling plug, in combination, connector elements of non-conducting material, power contact elements carried by said connector elements and mutually engageable to establish electrical circuit connections, non-magnetic coupling sleeves freely rotatable relative to said connector elements and each having a threaded portion and releasably threadedly interlockingly connected to each other housing and preventing separation of said contact elements and of said connector elements, lock means for preventing the release of one of said sleeves from the other, said lock means including a lock element housed within one of said sleeves at least near the most advanced extremity of its threaded portion and lockingly engageable with the other of said sleeves to the rear of its threaded portion and operable by pull exerted thereon by a magnet external to said sleeves to release said lock means.

6. In a plug-socket connector, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectable with a power plug-socket contact on the other body, housing means for at least the mutually adjacent ends of said bodies comprising screw collars one on each of said bodies, said screw collars relatively rotatable to effect engagement and disengagement between the power plug-socket contacts on said bodies and freely rotatable relative to the latter, and means precluding inadvertent separative movement between said screw collars including a magnetically releasable latch carried by the one of said collars which is the outer one when said collars are engaged, said latch being disposed inwardly of the outer periphery of said collar which carries it.

7. In a plug-socket connector, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectable with a power plug-socket contact on the other body, housing means for at least the mutually adjacent ends of said bodies comprising screw collars one on each of said bodies and freely rotatable relative to the latter, said screw collars coacting on relative rotation to effect relative longitudinal movement between the plug-socket contacts on said bodies, and means for preventing non-deliberate connection of said screw collars including a magnetically releasable latch carried by one of said collars positioned to permit a limited connection of said collars while precluding, until said latch is released, engagement of said contacts.

8. In a plug-socket connector, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectable with a power plug-socket contact on the other body, housing means for at least the mutually adjacent ends of said bodies comprising screw collars one on each of said bodies and freely rotatable relative to the latter and each having a free end, said screw collars coacting on relative rotation to effect engagement and disengagement between the power plug-socket contacts on said bodies, and means precluding inadvertent separative movement between said screw collars including a magnetically releasable latch carried by one of said collars near its free end, the other of said collars recessed, to receive said latch, externally at a point further from its free end than is the threaded portion thereof.

9. In a plug-socket connection, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectable with a power plug-socket contact on the other body, means associated with said bodies cooperating to provide a chamber within which separation or engagement of said power plug-socket contacts may be effected, said chamber providing means comprising screw collars relatively rotatable to effect separation and engagement between the power plug-socket contacts on said bodies and freely rotatable relative to said bodies, and means, including a magnetically releasable latch carried by one of said collars and releasable to permit relative movement between said screw collars to effect engagement between said power plug-socket contacts, for precluding, unless released, relative movement between said screw collars, in a direction to effect engagement between said power plug-socket contacts, sufficient to effect engagement between said power plug-socket contacts.

10. In a plug-socket connector, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectible with a power plug-socket contact on the other body, housing means for at least the mutually adjacent ends of said bodies comprising screw collars, one on each of said bodies, said screw collars mounted on said bodies for rotation relative to the latter and operative on relative rotation with respect to each other to effect engagement and disengagement between the power plug-socket contacts, and means precluding inadvertent rotative movement between said screw collars including a magnetically releasable latch carried by one of said collars and guided for movement radially of the latter and disposed inwardly of the outer periphery of the housing means constituted by said screw collars and movable magnetically to a position in which the collar which carries it is rotatable relative to the other collar.

11. In a plug-socket connector, in combination, a pair of insulating bodies each carrying one or more power plug-socket contacts connectible with a power plug-socket contact on the other body, housing means for at least the mutually adjacent ends of said bodies comprising screw collars, one on each of said bodies, said screw collars mounted on said bodies for rotation relative to the latter and operative on relative rotation with respect to each other to effect relative axial movement between the power plug-socket contacts, and means precluding inad-

verent separative movement between said screw collars including a magnetically releasable latch disposed inwardly of the outer periphery of one of said screw collars and guided for movement radially of the latter and movable under the action of a magnet applied to the exterior of said collar radially outwardly to a position in which it may be rotated with said collar and the collar may be rotated relative to the other collar to effect their mutual separation.

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