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[54] **HEAVY DUTY CONNECTOR**

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[58] **Field of Search** ..... 200/50 B, 51.07, 51.08, 200/51.09; 339/45 B, 45 M, 75 R, 75 M, 91 R

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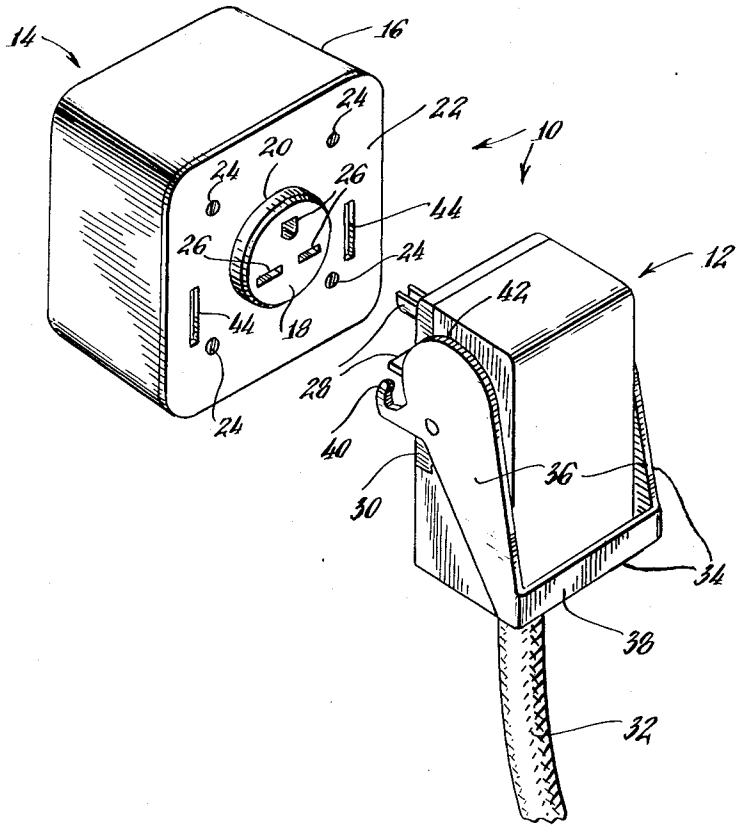
[57] **ABSTRACT**

Apparatus for facilitating engagement and disengagement in electrical connectors, particularly where large electrical loads are transmitted therethrough. A pivotal handle is disposed on the connector plug to protect the operator from electrical hazard and to maintain a relatively compact plug profile. Cooperation between the handle and the connector outlet creates a mechanical lock to preclude inadvertent disengagement and also achieves a relatively large mechanical advantage when disengagement is intended. Furthermore, this cooperation establishes an electrical interlock which interrupts power to the connector outlet whenever the mechanical lock ceases to exist.

2 Claims, 3 Drawing Figures



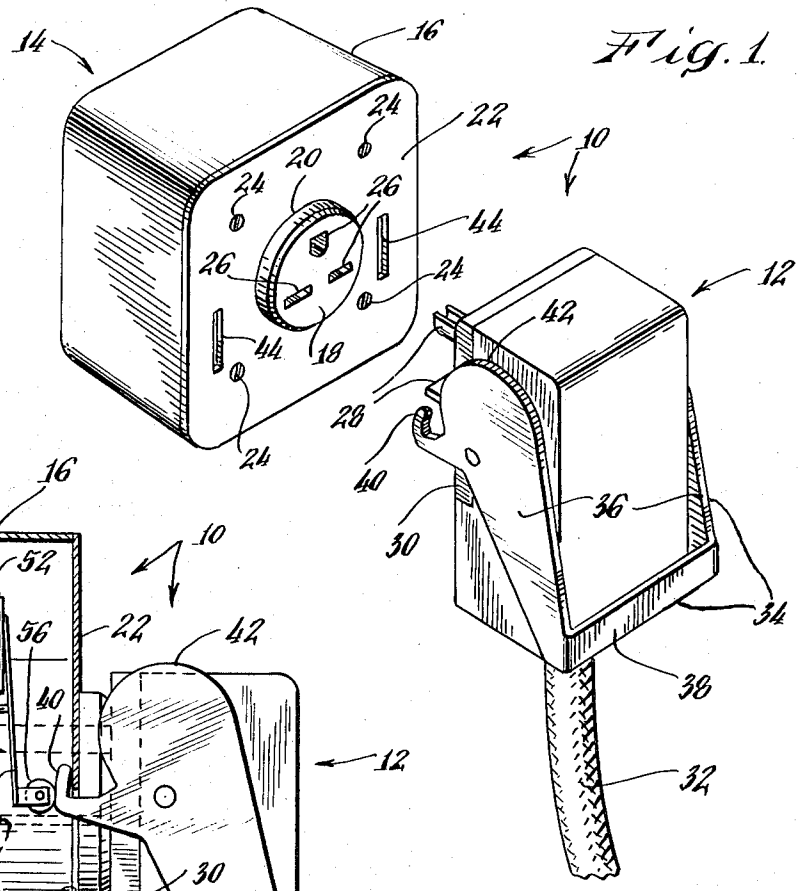


Fig. 1.

Fig. 2.

Fig. 3.

HEAVY DUTY CONNECTOR

BACKGROUND OF THE INVENTION

The present invention relates to an electrical connector and especially a heavy duty connector comprised of a plug and an outlet combination which includes provisions for facilitating engagement and disengagement therebetween. Hitherto, plugs have been structured to comply with the particular requirements of various applications. Where the plug receives an electrical cable in line with the male contact blades the profile height it occupies above the outlet must include provisions for wiring terminals and a cable clamp. When such plugs are used in heavy duty applications where the cable connecting to the plug is quite large and inflexible, a very large cable bend radius is encountered in addition to the profile height of the plug. Therefore, in such applications the plug is usually adapted to receive the cable perpendicularly to the male contact blades and such plugs have become known as right angle plugs.

In heavy duty applications, a very tight fit exists between the male contacts on the plug and the female contacts in the outlet and therefore, a large force is required to effect engagement and disengagement therebetween. This large force coupled with the cable inflexibility previously mentioned, causes particular difficulties when right angle plugs are utilized. On engagement, a struggle is usually encountered in correcting any misalignment between the male contacts and the female contacts due to the inflexible nature of the cable and its orientation relative to the outlet. On disengagement any force applied to the cable only results in a turning moment which tends to bind the male contacts within the female contacts and therefore the total force must be applied to the plug in line with the male contact blades.

Engagement and disengagement of most right angle plugs can only be accomplished by gripping the plug directly to apply the necessary forces thereto. Any alignment struggle encountered during engagement presents a safety hazard in that the operator's hand or fingers may be burned by an electrical arc or may slip from the gripping surface to receive an electrical shock. During disengagement, superfluous forces must be applied perpendicular to the gripping surface in attaining a frictional force of sufficient magnitude to withdraw the male contacts from the female contacts.

Some right angle plugs are configured to provide a shield for protecting the operator's hand during engagement and a ledge to facilitate gripping during disengagement. However, these plugs fail to remove the operator's hands from the zone of electrical hazard and achieve no mechanical advantage on disengagement.

In other right angle plugs, a permanently fixed handle is provided away from the zone of electrical hazard, however, such handles result in a significant increase to the profile height and fail to translate the forces of engagement or disengagement without producing turning moments. Also the static nature of such handles precludes their cooperative use in developing a mechanical advantage to facilitate disengagement, or in accomplishing a mechanical lock to avoid inadvertent disengagement, or in actuating an electrical interlock to interrupt the power supplied to the outlet whenever the mechanical lock ceases to exist.

SUMMARY OF THE INVENTION

It is therefore, a general object of the present invention to provide a heavy duty electrical connector which minimizes and obviates the disadvantages of the prior art.

It is a specific object of the present invention to provide a heavy duty electrical connector which facilitates engagement and disengagement between the plug and the outlet while affording safety from electrical hazard to the operator.

It is a more specific object of the present invention to provide a heavy duty electrical connector having a plug on which a pivotal handle is accessibly disposed without significantly increasing the overall profile height of the plug.

It is another object of the present invention to provide a heavy duty electrical connector which utilizes a pivotal plug handle to develop a mechanical advantage during disengagement.

It is still another object of the present invention to provide a heavy duty electrical connector which utilizes a pivotal plug handle to achieve a mechanical lock for precluding inadvertent disengagement.

It is a further object of the present invention to provide a heavy duty electrical connector which utilizes a pivotal plug handle to actuate an electrical interlock for interrupting power to the outlet whenever a mechanical lock ceases to exist.

These objects are accomplished in one form according to the present invention by disposing a handle on the plug to pivot about an axis which perpendicularly intersects the axis along which the mating forces are centered. The handle has arms extending from the pivotal axis and each arm is specially configured about the pivotal axis to provide both a latch and a cam which pivot in unison with the handle. The outlet is adapted to effect a mechanical lock upon mating with the latch and provides a bearing surface against which the cam acts to disengage the plug. An electrical switch is disposed within the outlet and is tripped by a portion of the latch to energize the outlet in synchronism with attainment of the mechanical lock.

BRIEF DESCRIPTION OF THE DRAWING

The manner in which these and other objects of the invention are achieved will be best understood by reference to the following description, the appended claims, and the attached drawing wherein:

FIG. 1 is a perspective view of a connector into which the improvements of this invention have been incorporated and illustrating the plug and the outlet in a disengaged arrangement;

FIG. 2 is a side elevational view thereof with the plug and the outlet in a fully engaged arrangement and having portions cut away to illustrate the cooperation existing between the plug, the handle, and the outlet, and

FIG. 3 is a side elevational view thereof with the plug and outlet in an intermediate arrangement to illustrate the correlated motion of the cam and the latch on the handle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawing, a heavy duty electrical connector **10** incorporating the improvements of this invention is illustrated in FIGS. 1 – 3. As illustrated in

FIG. 1, the connector 10 generally consists of a plug 12 and an outlet 14 which mate along a common axis to effect an electrical connection between a power source (not shown) and an electrical apparatus (not shown).

The outlet 14 is contained in an outlet box 16 wherein a female contact holder 18 is mounted by any suitable means such as screws (not shown). The female contact holder 18 passes through an opening 20 in a cover plate 22 which is secured by screws 24 to the outlet 14. Female contacts (not shown) are disposed within slots 26 of the female contact holder 18 and are connected to a source of electrical power within the outlet 14 by any suitable means, such as wires (not shown).

Male contact blades 28 extend from a male contact holder 30 which is secured to the plug 12 by any suitable means, such as screws (not shown). Terminal means (not shown) are disposed on each blade 28 within the plug 12 for securing to the conductors of an electrical cable 32 which enters into the plug 12 perpendicularly to the blades 28. The blades 28 slidably engage through the slots 26 and into the female contacts of the outlet 14 to effect the electrical connection which is sustained through contact forces directed perpendicularly across the blades 28 by the female contacts.

A handle 34 is pivotally secured across the plug 12 and is utilized to effect both engagement and disengagement between the plug 12 and the outlet 14. The pivotal axis of the handle extends through the plug 12 and intersects perpendicularly with a transfer axis which is disposed parallel to the common axis. Forces applied along the transfer axis are distributed over the plug 12 to result in balanced turning moments about any axis in a plane perpendicular to the common axis. On the handle 34, arms 36 extend perpendicularly from the pivotal axis at each side of the plug 12 and a gripping bar 38 interconnects the arms 36 across the plug 12. About the pivotal axis, each arm 36 is configured to have both a latch 40 and a cam 42. Where desirable, a single latch 40 and a single cam 42 can be utilized to simplify fabrication of the handle 34. In such an arrangement, the latch 40 and cam 42 may be disposed on the same arm 36 or separately on different arms 36. A slot 44 is disposed in the cover plate 22 of the outlet 14 to receive each latch 40 upon engagement between the plug 12 and the outlet 14.

Full engagement of the plug 12 into the outlet 14 is shown in FIG. 2 where the outlet box 16 is secured to a bulkhead 46 by any suitable means, such as screws 48. The latches 40 rotate in direct response to the pivotal motion of the handle 34 and during engagement, cooperate with the outlet 14 to develop a mechanical lock between the plug 12 and the outlet 14. This cooperation consists of the latches 40 being rotated into the slots 44 and disposed behind the cover plate 22. The gripping bar 38 is compatibly configured to lie flat against the plug 12 in the fully engaged arrangement and has a portion overhanging the plug 12 to present a gripping lip 50.

An electrical switch 52 is disposed within the outlet box 16 and is operative through a spring biased push button 54 to make or break an electrical contact (not shown). The switch 52 is precisely located to cooperate with the handle 34 in establishing an electrical interlock which interrupts the power supplied to the outlet 14 whenever the mechanical lock ceases to exist due to rotation of the latches 40 from behind the cover plate 22. Any cooperating means can be utilized between the switch 52 and the handle 34, such as actuating the push button 54 through a roller 56 and a pivot link 58 combination with either latch 40. This cooperating means is inaccessibly located within the outlet 14 and can only be reached through one of the slots 44 in the cover plate 22, so as to make unintended operation of the electrical interlock most difficult. The contact of the switch 52 can be utilized in any electrical circuit means to interrupt the power supplied to the outlet 14, such as to wire the outlet 14 directly through the contact.

The cams 42 rotate in direct response to the pivotal motion of the handle 34 and have an increasing eccentricity for counterclockwise rotation of the handle 34. On disengagement, each cam 42 cooperates with the outlet 14 to develop separating forces between the plug 12 and the outlet 14, as illustrated in FIG. 3. Because the mechanical lock precludes separation between the plug 12 and the outlet 14, this cooperation does not occur until the latches 40 have been rotated from behind the cover plate 22. 97

In use the handle 34 on the plug 12 operates to facilitate both engagement and disengagement between the plug 12 and the outlet 14. On engagement, the operator grips the handle 34 around the gripping bar 38 which pivots to a location well removed from the zone of electrical hazard. After aligning the blades 28 with the slots 26, a force to effect engagement between the male contact blades 28 and the female contacts is then applied along the transfer axis of the plug 12. As engagement proceeds, the cams 42 on the handle 34 bear on the cover plate 22 of the outlet 14, as illustrated in FIG. 3. Thereafter, engagement is continued while rotating the handle clockwise to maintain a clearance between the cams 42 and the cover plate 22, as illustrated in FIG. 2. Engagement is completed when the latches 40 on the handle 34 have been directed into the slots 44 of the cover plate 22 and the handle 34 is rotated flat against the plug 12 with no separation existing between the plug 12 and the outlet 14. During the final stages of engagement, the roller 56 interfaces with one of the latches 40 to trip the switch 52 and thereby actuate the power supplied to the outlet 14. Due to the compatible configuration existing therebetween, the gripping bar 38 of the handle 34 lies flat against the plug 12 in the fully engaged arrangement and therefore, the overall profile of the plug 12 is not significantly affected by the addition of the handle 34. Also, the mechanical lock created by the disposition of the latches 40 behind the cover plate 22 precludes any disengagement until the handle 34 is rotated sufficiently in a counterclockwise direction.

On disengagement, the operator pulls against the gripping lip 50 of the handle 34 which thereby causes the handle 34 to rotate in a counterclockwise direction and results in departure of the latches 40 from the slots 44. During this departure, the roller 56 on the switch 52 ceases to interface with the one latch 40 and therefore the spring bias on the push button 54 trips the switch 52 to electrically deactuate the outlet 14. After an initial rotation of the handle 34, the gripping bar 38 is grasped to facilitate rotation of the handle 34. The counterclockwise rotation of the handle 34 is continued with the cams 42 coming to bear against the cover plate 22, as illustrated in FIG. 3, to force a separation

between the plug **12** and the outlet **14.** Rotation of the handle **34** continues until the arms **36** of the handle **34** are aligned parallel with the transfer axis, at which point the eccentricity of the cams **42** achieves a maximum. Disengagement is then completed without any further rotation of the handle **34,** by pulling the gripping bar **38** along the transfer axis with sufficient force to accomplish complete separation. During the complete disengagement sequence, the operator's hand is at all times removed from the zone of electrical hazard. Initial disengagement is accomplished through the cams **42** which cooperate with the arms **36** to achieve a mechanical advantage. In magnitude the mechanical advantage is equal to the length of a single arm **36** from the pivotal axis, divided by the eccentricity of a single cam **42** from the pivotal axis. Because the electrical connection is effected through contact forces perpendicularly across the blade **28,** the disengaging force is greatest during the initial separation of the plug **12** from the outlet **14,** and therefore, the mechanical advantage is utilized during the most difficult phase of disengagement.

Those skilled in the art should readily appreciate that the heavy duty connector embodied by this invention provides the operator with safety while facilitating both engagement and disengagement between the plug and the outlet. Also, the handle utilized does not significantly affect the overall profile of the plug and yet is readily accessible for disengagement during which it achieves a considerable mechanical advantage. Furthermore, the handle cooperates with the outlet to establish both a mechanical lock and an electrical interlock, with the latter operating to interrupt the power supplied to the outlet when the former ceases to exist.

It should be understood that the present disclosure has been made only by way of example and that numerous changes in details of construction and the combination or arrangement of parts may be resorted to without departing from the true spirit and scope of the invention and therefore, the present disclosure should be construed as illustrative rather than limiting. What we claim is:

1. In an electrical connector apparatus comprising:

an outlet including female contacts and an electrical switch;

a plug including male contacts, said plug and said outlet mating along a common axis with said male contacts slidably engaging said female contacts to effect the electrical connection; and

a pivotal handle securing to said plug about a pivotal axis perpendicular to said common axis, said handle including a latch and an arm, said latch being pivotal about said pivotal axis to cooperate with said outlet and said electrical switch in establishing a mechanical lock and an electrical interlock between said plug and said outlet, said electrical interlock interrupting electrical power to said outlet whenever said mechanical lock ceases to exist.

2. The apparatus of claim **1** wherein said plug has a transfer axis parallel to said common axis and forces applied along said transfer axis are distributed over said plug to result in balanced turning moments about any axis in a plane perpendicular to said common axis, said pivotal axis being perpendicular to said transfer axis; said handle includes a gripping bar extending across said plug, said gripping bar being configured to lie flat against said plug and having no significant affect on the overall profile height of said plug; a portion of said gripping bar overhangs said plug, said portion establishing a gripping lip to facilitate the use of said handle during disengagement; said arm includes a cam, said cam being rotatable about said pivotal axis to bear against said outlet in developing separating forces between said plug and said outlet.

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