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[54] ELECTRICAL COUPLING DEVICE AND ELECTRICAL CONNECTOR

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[52] **U.S. Cl.**.....**339/19,** 339/111, 339/174, 339/252 P, 339/263 R, 24/214

[51] **Int. Cl.**.....**H01r 31/08,** H01r 11/22

[58] **Field of Search**.....339/19, 22 B, 258 R, 263, 111, 339/174, 9, 252 P, 92, 46; 24/230, 213, 214; 180/9.5; 287/126

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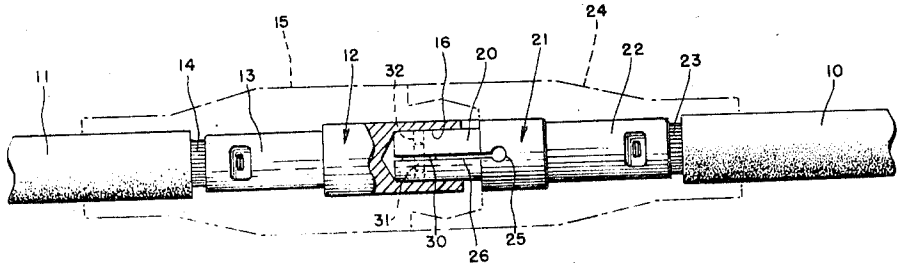
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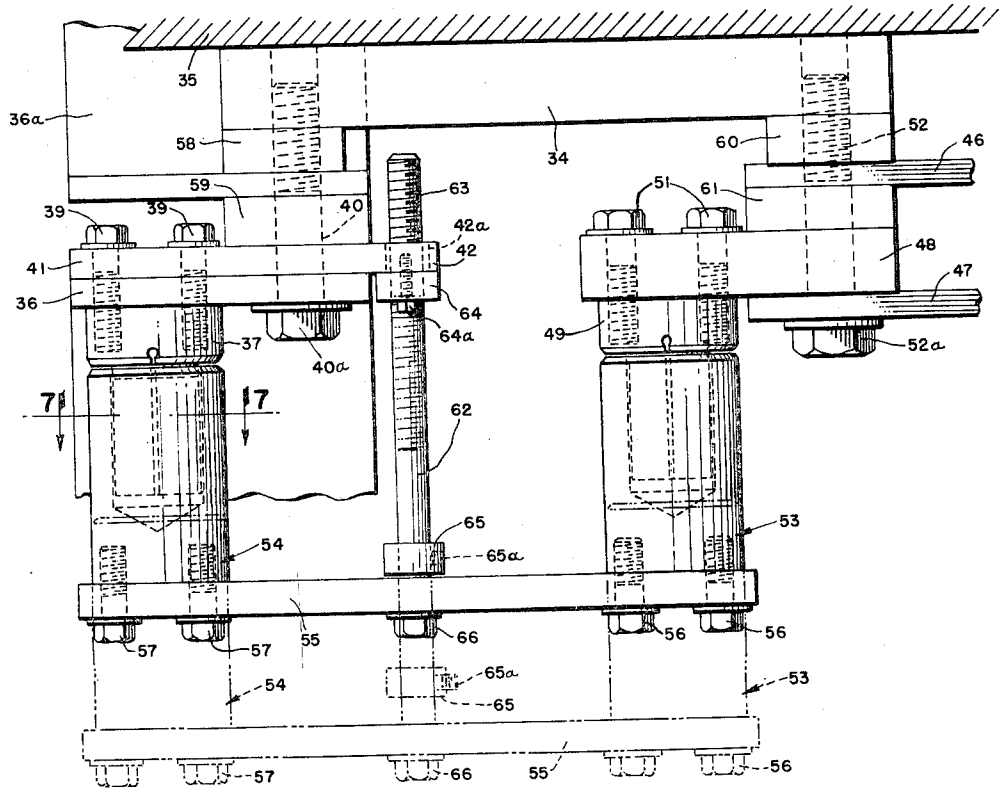
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[57] **ABSTRACT**

An electrical coupling device is provided for bringing various electrical members into electrical connection and also for disconnecting them, the device utilizing electrical connector components in which the manner of connection and disconnection is push-pull, good electrical contact being obtained in the connector components by means of an outward force exerted by a Belleville washer, manipulatable means being provided to bring electrical connector components into and out of engagement.

9 Claims, 7 Drawing Figures





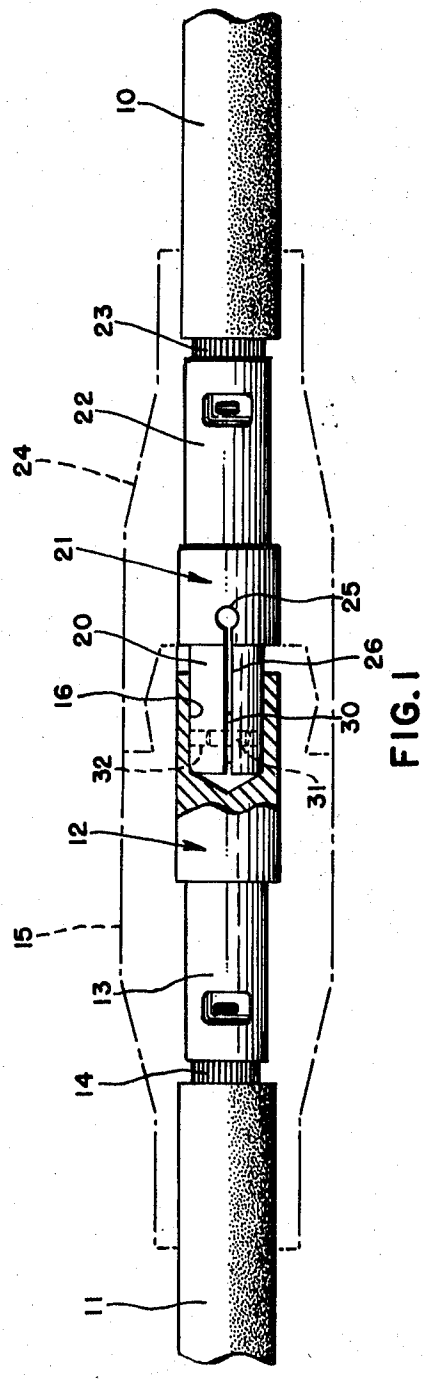


FIG. 1

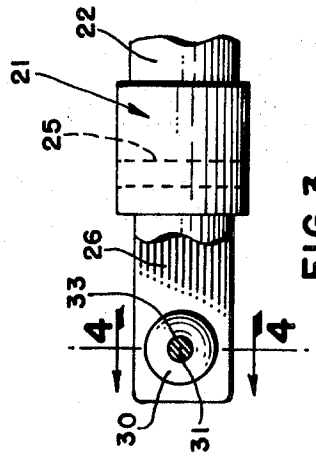


FIG. 3

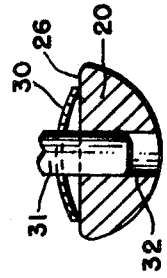


FIG. 4

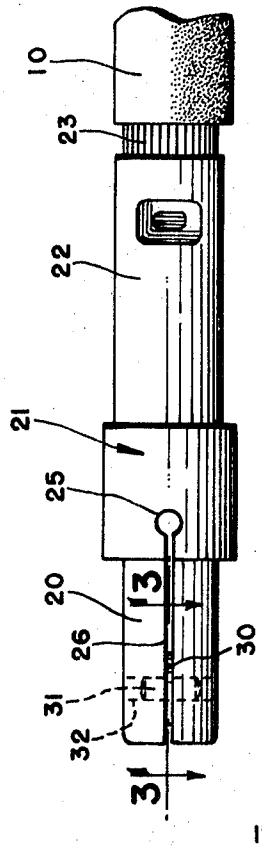


FIG. 2

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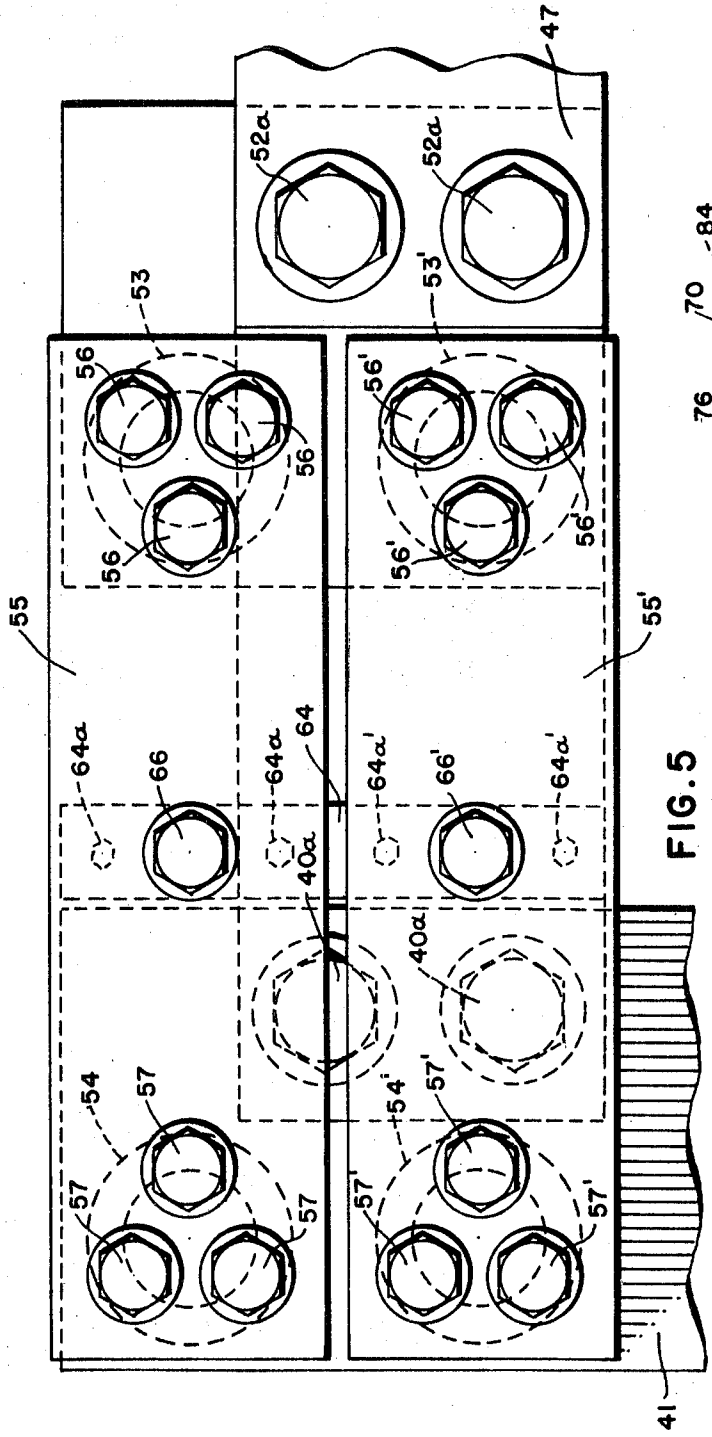


FIG. 5

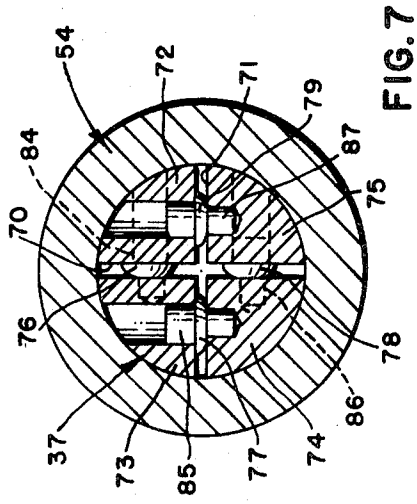


FIG. 7

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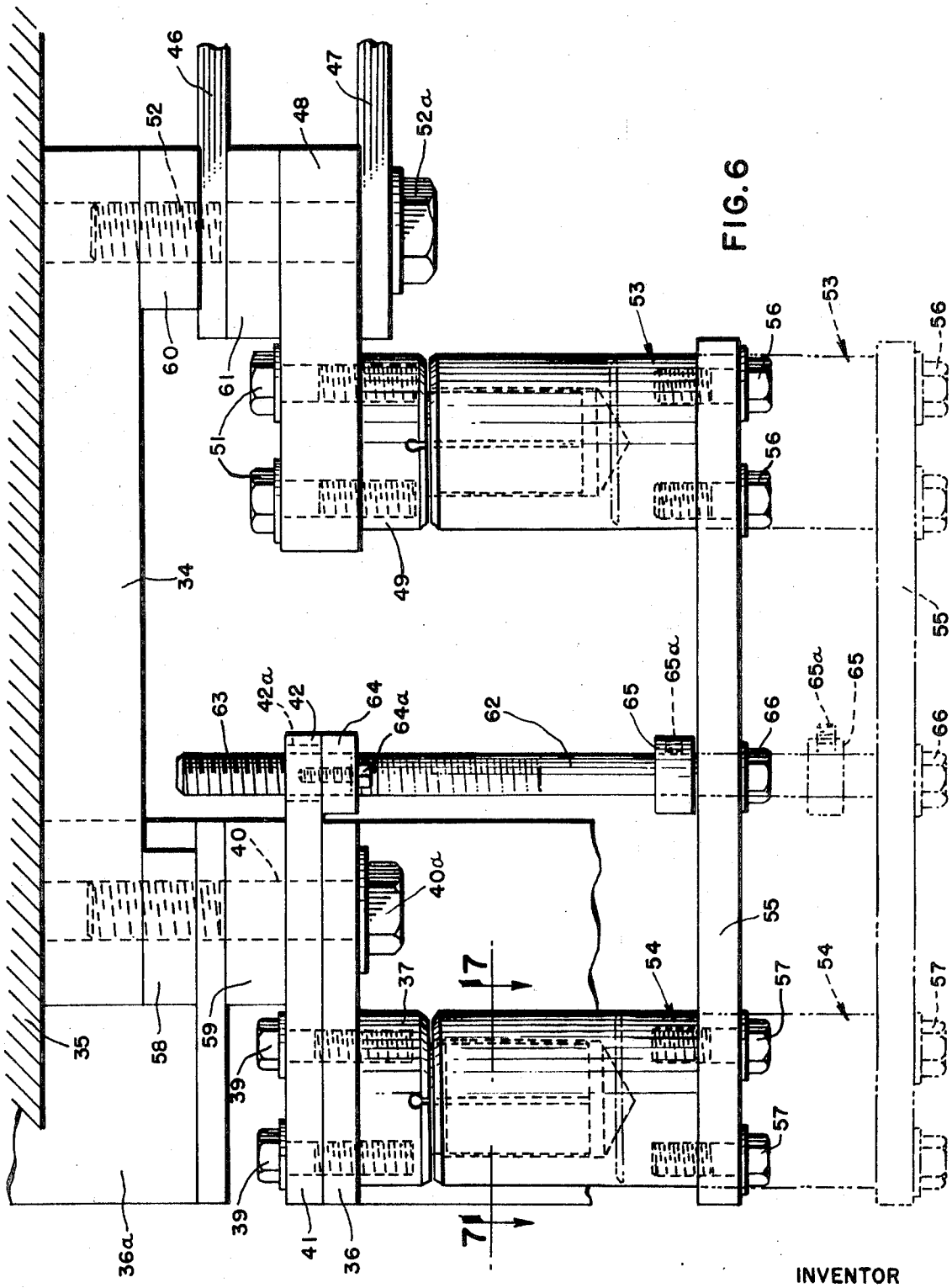


FIG. 6

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ELECTRICAL COUPLING DEVICE AND ELECTRICAL CONNECTOR

This invention relates to electrical connectors and more particularly to such connectors for use in interconnecting electrical cable ends, or alternatively for interconnecting an electrical cable end with a fixed mating connector.

In the creation of electrical connectors for the indicated use, certain criteria must be met. It is important that following interconnection of mating connectors the connection itself present resistance in the electrical line which is as small as possible. Otherwise stated, the mating connectors must be as efficient as possible in the transmission of electrical power. Deleterious to this end are any gaps between contact surfaces in mating connectors because such gaps serve as causes of resistance and make for inefficiency in the interconnection of connectors. A second criterion is that mating connectors remain interconnected so long as it is desired that power pass through the interconnection, while yet being reasonably easily disconnected when so desired.

In the prior art connectors are known which meet both of these criteria by employing cam action which depends upon mutual rotation of mating connectors, conductor surfaces being forced into close proximity on mutual rotation of the mating connector, while the active member causing the movement into close proximity serves also as a means for inhibiting separation of mating connectors until counter rotation takes place. While such connectors are satisfactory and meet both criteria heretofore stated, certain applications do not permit mutual rotation of mating connectors. Among such applications is that where the material of the connectors will seize or otherwise not tolerate rotation. Such a result occurs, for example, when the connector material is copper.

Accordingly, it is the primary objective of the present invention to meet the criteria set out in mating connectors where mutual rotation is not desirable or permissible, but instead mate upon a straight line push-pull manner of engagement and disengagement. Where interengagement is straight line in manner, reflection will indicate to the thoughtful person that the two criteria set forth above are mutually inconsistent. Close contact between conductive walls bespeaks tight fit between mating members, while friction which will normally result from such tight fit will create difficulty in separation of mating connectors when it is desired to break contact. The present invention meets the challenge of providing mating connectors which mate upon a straight line movement, which upon interengagement give efficient transmission of electrical power, and at the same time admit of reasonable ease in separation of mating connectors when it is desired to separate them. This is achieved by dividing the male contact of mating connectors into a plurality of segments with the various segments normally being in effect spring-loaded outwardly. This scheme provides a male connector which while being able to contract for engagement with a female connector, will yet following engagement be in intimate contact with the conductive surfaces in the female. In order to achieve the spring load effect, Belleville washers are employed disposed between segments of the male contact. A supplemental object of the present invention is to provide connectors which may be fabricated without overly elaborate manufacturing operations, so that economy in the production of connectors is possible.

How these and many other objects are to be implemented will become clear through a consideration of the accompanying drawings wherein:

FIG. 1 shows a side view of male and female connectors embodying the present invention in electrically engaged relationship,

FIG. 2 is a side view of a male connector constructed according to the present invention,

FIG. 3 is a section at 3—3 of FIG. 2,

FIG. 4 is a section at 4—4 of FIG. 3,

FIG. 5 is a front view of a structure embodying an application of the present invention,

FIG. 6 is a plan view, partly schematic, of the structure shown in FIG. 5, and

FIG. 7 is a section at 7—7 of FIG. 6.

In the drawings, FIGS. 1–4 show for illustrative purposes an assembly of male and female connectors for releasably bringing into contact two electrical cable ends 10 and 11. A female connector 12 is shown having a crimp tube 13 as an integral part thereof, such crimp tube receiving therein the conductive strands 14 of cable end 11. Crimp tube 13 is of deformable copper, and after such conductive strands are inserted therein, a crimping device is applied to deform such crimp tube 13 into the conductors and thereby retain them in place in contact with female connector 12. An insulating sleeve 15 is shown in phantom disposed about female connector 12 to protect such connector as well as any bare portions of conductors 14 within cable and 11 from accidental contact by users.

Disposed within recess 16 of female connector 12 is contact portion 20 of male connector 21. Male connector 21 also has a crimp tube 22 integral therewith within which conductive strands 23 of cable 10 are received, crimp tube 22 being deformed following insertion of conductive strands therein to retain such strands in contact with male connector 21. A protective insulating sleeve 24, shown in phantom, is disposed about male connector 21 and any exposed portion of conductors 23 to prevent contact by operators therewith.

What is here contemplated is a push-pull male and female connector arrangement whereby the male contact portion 20 is firmly held within the recess 16 of female connector 12 when it is desired that the male and female connectors be in contact. When not so desired, such connectors may be separated simply by pulling them apart. Their reengagement may be in like manner simply achieved by pushing the contact portion of male connector 21 into recess 16 of female connector 12.

Ready, releasable, manual interengagement is possible consistently with firm electrical connection when engaged by reason of the now to be described expedient. Male connector 21 is drilled through to provide hole 25. Contact portion 20 is bifurcated into two segments by slit 26 which opens into hole 25 as well as into the free end of contact portion 20. A Belleville washer 30 is disposed within slit 26. Washer 30 is held in place by means of a fixing stud 31 which is driven into passage 32 formed in contact portion 20. Fixing stud 31 is retained within passage 32 by friction, and such fixing stud 31 passes through aperture 33 in Belleville washer 30 whereby such washer is held in position within slit 26. The Belleville washer is a well-known type of metal washer which may be described as truncated conical in configuration. Such washers have an aperture therethrough such as 33 and are of resilient metal.

By means of disposition of such a washer within slit 26 in contact portion 20, the two halves of such contact portion are normally urged outwardly from each other and a normal diameter in said contact portion is provided.

The diameter of recess 16 is slightly smaller than such normal diameter of contact portion 20. When contact portion 20 is then presented at recess 16, the rounded edges at the free end of contact portion 20 will engage walls of recess 16 and a force compressing the two halves of contact portion 20 against the outward force of Belleville washer 30 will be exerted. The two halves will be forced together until the diameter of the combined halves of contact portion 20 is such that contact portion 20 may slide into recess 16. While the contact portion is in place within recess 16 the compressed Belleville washer 30 will continue to exert an outward force, thereby assuring a firm contact between the external surface of contact portion 20 and the internal surface of recess 16.

The connectors described herein are especially useful where it is desired that the connectors be made out of unalloyed copper or other soft material for purposes of minimizing connector size for a given electrical load. Such connectors will seize if a connector construction requiring rotation is employed, and a very short connector life will result. The present connector construction, not requiring rotation, is much more suitable for such applications. I have also found that a coating of silver or other conductive soft metal if applied to the connectors here provided, acts as a lubricant and serves to extend

the life of the connectors on repeated cycles of engagement and disengagement.

Further illustrations FIGS. 5, 6 and 7 illustrate an application for releasable electrical interconnection in the railroad engine field where the present invention has been found particularly useful. The useful railroad engine of our time utilizes a plurality of traction motors to drive the engine wheels, and a generator carried within the engine drives the traction motors. Normal practice with railroads is from time to time to disconnect the means for conveying electrical power from the generator to the motors, so that the generator may be tested as to the adequacy with which it is functioning. The flow of power between motor and generator is reestablished following the test.

Neither traction motors nor generator are shown in the drawings because such showing is unnecessary for a description of the present invention. A mounting bar **34** of nonconductive material is affixed by bolts or other known means to a bulkhead **35** or like fixed surface in a railroad engine. Bus bar **36** is electrically tapped by a cable attached thereto (not shown) for power for such traction motors. Male connector **37** is secured to bus bar **36** by means of bolts **39**. Bolt **40** having hexagonal head **40***a* then holds the assembly consisting of bus bar **36** and male connector **37** mounted upon mounting bar **34**. A second bus bar **36***a* to service additional traction motors is also held in relation to mounting bar **34** by bolt **40**. Additional conductive plate **41** is present in order to bear a portion of the electrical load from male connector **37**, which eventually flows to bus bars **36** and **36***a*. It will be observed that plate **41** on one side has a projection **42** extending beyond bus bar **34** at one side in FIG. **6** for a purpose hereafter to be described.

Bus bar **48** is associated with the positive side of a generator, and a male connector **49** is mounted upon such bus bar **48** by means of bolts **51**. Bolt **52** having a hexagonal head **52***a* then secures bus bar **48** to which male connector **49** has been assembled to mounting bar **40**. Bolt **52** also holds conductive taps **46** and **47** which lead to the generator, in contact with bus bar **48**.

In normal operation of the here posited railroad engine, electrical connection between the positive side of the generator by means of male connector **49** which is in electrical contact with such positive side, and the traction motor through its male connector **37**, is necessary. It is contemplated that this be accomplished by means of the present invention, by utilizing a shunt assembly, in the present embodiment consisting of two female connectors **53** and **54** for respective engagement with male connectors **49** and **37**. Female connectors **53** and **54** are bolted to a shunt bar **55** by means of bolts **56** and **57** respectively.

In order that male connectors **49** and **37** receive female connectors **53** and **54** in accordance with the present apparatus, it is desirable that such male connectors extend the same distance from mounting bar **34**. This is accomplished by utilizing the spacers **58** and **59** on the traction motor side, and **60** and **61** on the generator side. Spacers **59** and **61** are of conductive material, while those at **58** and **60** need not be.

This assembly consisting of shunt bar **55** and the female connectors **53** and **54** secured thereto is held in operative position by means of bolt or rod **62** which is threaded at one end **63**, there passing through a hole **42***a* in projection **42** of bus bar **41**, bolt **62** clearing the walls of hole **42***a*. Threads **63** of rod **62** do not thread into the material of plate **41** because the material of such bolt, preferably steel, might bind upon rotation within the conductive material of plate **41** which may be of copper. Instead such threads **63** are threaded into internal threads tapped into steel strip **64** which is secured to projection **42** by means of bolts **64***a*. A thrust collar **65** is secured by means of setscrew **65***a* to bolt **62** on one side of shunt bar **55**, while hexagonal head **66** is integral with bolt **62**. Thus manipulation of head **66** (and hence bolt **62**) in one direction will cause engagement of female connectors **53** and **54** with male connectors **49** and **37** respectively, and this is the condition shown in solid lines in FIG. **6** of the drawings. When manipulation of head **66** for movement toward engagement as shown in solid lines is desired, head **66** will be rotated by a wrench or other suitable tool applied thereto, and during rotation such head will bear against shunt bar **55**.

When, on the other hand, it is desired to disengage such female connectors from such male connectors head **66** (and hence bolt **62**) is rotated in the opposite direction, following which the shunt bar **55** and female connector **53** and **54** assembly will assume the position out of contact with the male connectors, such alternative position being shown in broken lines in FIG. **6**. When head **66** is rotated in such opposite direction for the purpose of disengaging to the broken line position shown, it is thrust collar **65** which bears against shunt bar **55**.

FIG. **7** is a section taken at **7—7** in FIG. **6** and shows the employment of an alternative male connector according to the present invention to that seen in FIGS. **1–4**. Two slits **70** and **71** divide male connector **37** into four segments **72–75**. Belleville washers **76–79** are disposed within slits **70** and **71** between each pair of segments in the group **72–75**. Fixing studs **84–87**, each of which passes through the aperture in the Belleville washer, are driven into passages in the various segments within which the studs are then retained by friction. The studs and hence the Belleville washers are thus retained in place. It will be understood that male connector **49** is identical in construction to that just described for male connector **37** and therefore further description is not necessary.

In order to complete the description of the utility of the present invention as applied to railroad engine testing, following removal of female connector **53** from male connector **49**, whereby electrical interconnection of generator and traction motor is broken, a separate test conductor terminating in a female connector of the same construction as described for female connector **53** is engaged with male connector **49**. A generator may thereby be operated, its electrical output being led to a test board where its ability to function to acceptable standards is verified. Following the test procedure, such test lead is removed and by means of the shunt bar and male connector assembly heretofore described, the motive power of the railroad engine may very quickly be returned to its normal running state.

It should be noted that the present invention is useful for interengaging other electrical means than traction motors and generators. Therefore, it will be appreciated that while I have described a specific application of this invention, other applications and embodiments entailing changes and modification in nonessential aspects of the invention can be made, and such applications and modifications can still fall within the ambit of my invention.

I claim:

1. An electrical coupling device comprising

at least two first electrical connectors mounted in fixed position, each of said electrical connectors being in electrical contact with an electrical means,

a shunt assembly comprising

a conductive shunt bar,

a mating electrical connector for each of said first electrical connectors, each said mating electrical connector being mounted upon and in electrical contact with said shunt bar and being capable of interengaging with one of said first electrical connectors, said first electrical connectors and said mating electrical connector for each thereof comprising pairs of male and female connector means, and

control means for said shunt assembly capable of moving said shunt assembly in a first direction so that each of said first electrical connectors is simultaneously engaged by a said mating electrical connector, and also capable of moving said shunt assembly in a second direction so that disengagement of said first electrical connectors and said mating electrical connectors will occur.

2. An electrical coupling device as claimed in claim 1 wherein at least one of said electrical connectors comprises a male connector having a contact portion and an external surface on said contact portion, and pressure means within said contact portion for exerting a force urging said external surface on said contact portion outwardly.

3. An electrical coupling device as claimed in claim 2 wherein said pressure means comprises

a slit in said contact portion dividing said contact portion into a plurality of segments,

a Belleville washer within said slit,

and means for retaining said Belleville washer within said slit,

whereby said Belleville washer exerts said force urging said external surface on said control portion outwardly.

4. An electrical coupling device as claimed in claim 3 wherein said control means comprises

fixed means disposed in fixed relationship to said first electrical connectors, and

manipulation means in engagement both with said fixed means and said shunt assembly, operation of said manipulable means being capable of moving said shunt assembly in said first and second direction.

5. An electrical coupling device as claimed in claim 4 wherein

said fixed means comprises an internally threaded member and

said manipulable means comprises

bolt means in said shunt bar, freely rotatable therein, said bolt means having a threaded end in engagement with said internally threaded member, and

head and thrust collar means fixedly mounted on said bolt means on opposite sides of said shunt bar, said head bearing on said shunt bar when movement of said shunt assembly in said first direction is desired, and said thrust collar bearing on said shunt bar when movement of said shunt assembly in said second direction is desired.

6. An electrical connector for use with a mating connector having an internal recess, comprising

a male connector having a contact portion and an external surface on said contact portion,

a slit in said contact portion dividing said contact portion into a plurality of segments,

a Belleville washer within said slit, and

retaining means for retaining said Belleville washer within said slit.

7. An electrical connector as claimed in claim 6 wherein said Belleville washer has an aperture therethrough and said retaining means comprises a stud passing through said aperture, said stud being frictionally fixed within at least one of said segments.

8. An electrical connector as claimed in claim 6 wherein said male connector is normally oversize relative to said internal recess in said mating connector, said contact portion being capable of contracting against the outward force of said Belleville washer to a size which will fit into said internal recess, whereby said contact portion while disposed within said internal recess will have its external surface urged outwardly into intimate contact with said internal recess.

9. An electrical connector as claimed in claim 8 wherein a coating of silver is applied to said external surface of said contact portion.

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