# United States Patent

[11] **3,576,937**


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[54] **UNDERGROUND RIGID CONNECTOR HOUSING SEAL**
**4 Claims, 7 Drawing Figs.**


[52] **U.S. Cl.** ..... **174/92,** 174/72
[51] **Int. Cl.** ..... **H02g 15/08**
[50] **Field of Search** ..... 174/92, 93, 77, 71.72, 21; 339/94, 205, 211, 213



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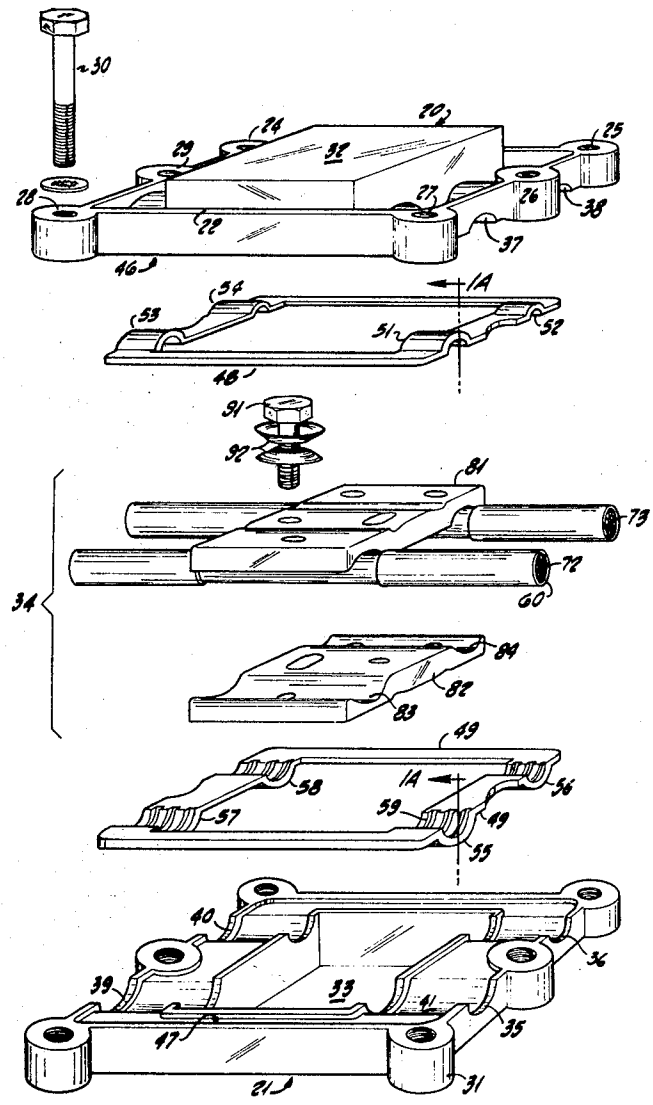
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**ABSTRACT:** An underground connector housing for large diameter power lines is enclosed within a split housing comprised of upper and lower Fiberglas reinforced plastic shells. These shells have entrance and exit ports for receiving the power cables which are connected together inside the housing. Gaskets seal the housing by following the contours of the mating surfaces on each shell of the Fiberglas housing. At the ports, the gaskets are increased slightly in thickness. Hence, the compression forces which occur when the two parts are bolted together, squeeze the gaskets together to force them to expand and fill all of the available space within the housing parts and around the cables.

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SHEET 1 OF 2

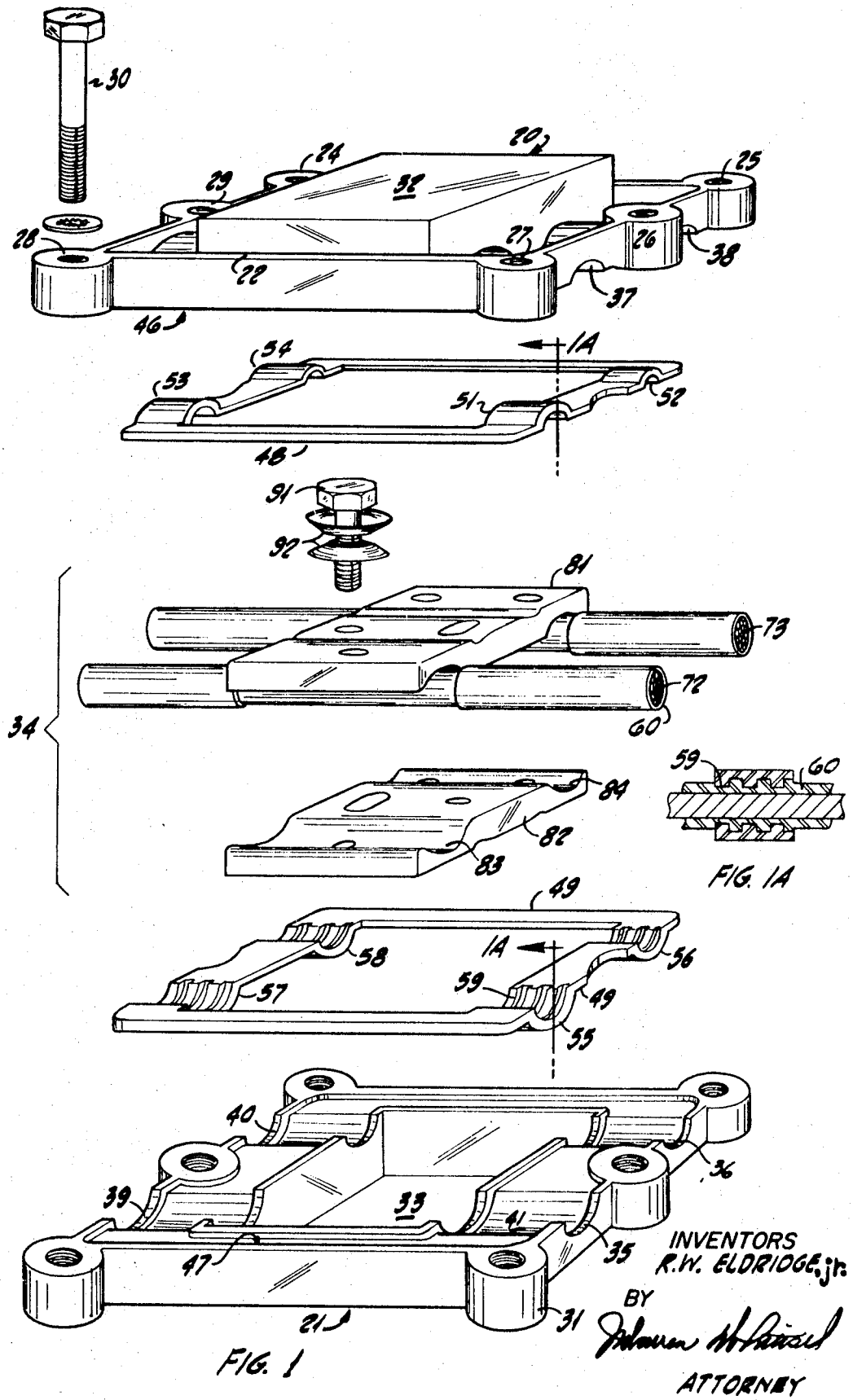



FIG. 1A

FIG. 1

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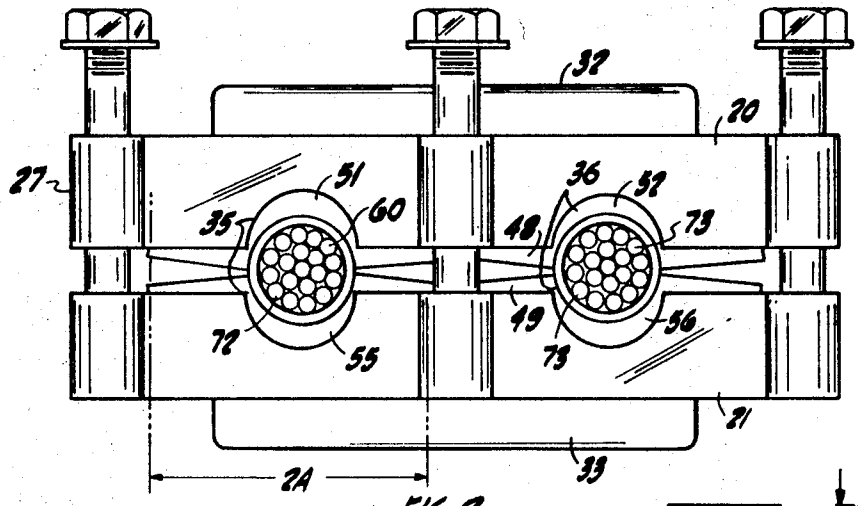



FIG. 2

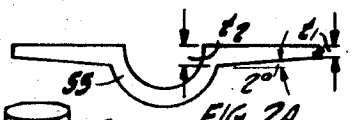



FIG. 2A

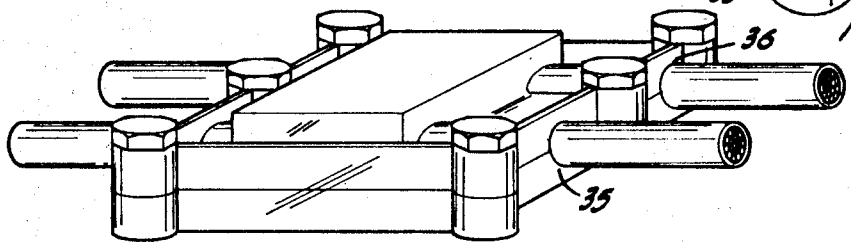



FIG. 3

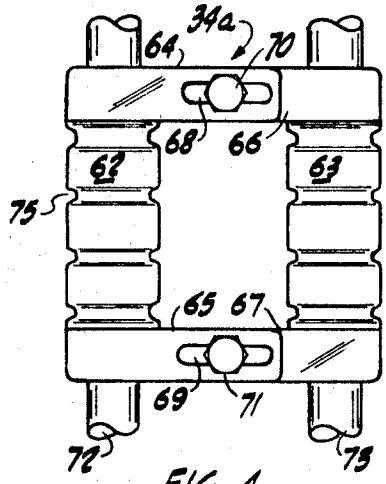



FIG. 4

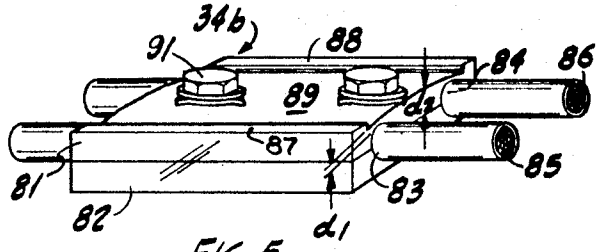



FIG. 5

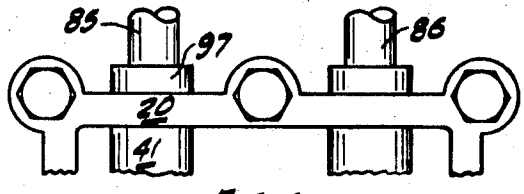



FIG. 6

# UNDERGROUND RIGID CONNECTOR HOUSING SEAL

This invention relates to underground connector housings and more particularly to moisture resistant connector housings for relatively large diameter, voltage lines.

Recent trends in residential building—and elsewhere—require elimination of unsightly pole lines. Among these lines are the insulated high power distribution lines which supply electricity to the houses—and other installations—in the area. Usually these lines include electrical conductors in the order three-eighth to one-half inch inch in diameter, which means that they cannot easily bend around a small radius.

The pole lines may be eliminated by the simple expedient of burying the lines in the ground with no protection other than the insulation originally fabricated on the wire when it is made. When it is necessary to make a connection to the line, the connector must also be adapted to a burial with no added protection. Among other things, this means that the connector should be resistant to entry of moisture even when the area is flooded. Preferably, the connector should provide means for making connections to and between conductors having a range of different wire sizes. There must not be any corrosion. The connector should be easily opened, repaired and reclosed.

Accordingly, an object of this invention is to provide new and improved underground connector housings. In particular an object is to provide for making connection to and between cables, wires, and busses of relatively large diameter, such as those used for electrical power lines. In this connection, an object is to preclude hazardous conditions when voltages are carried through neighborhood areas.

Another object of this invention is to provide water resistant buried connector housings. Here an object is to enable connections to be made quickly and easily to (or removed from) unbroken wires of large diameter while preserving the moisture proof integrity of such connections.

Yet another object of the invention is to provide for the low-cost manufacture of the inventive connector housings. Thus, an object is to use readily available materials and to manufacture them on general purpose machine tools.

In keeping with one aspect of the invention, these and other objects, are accomplished by a connector enclosed within a split housing. More particularly, the housing comprises shell-like upper and lower Fiberglas reinforced plastic parts having entrance and exit ports for receiving the power cables which are connected together inside the housing. Gaskets seal the housing by following the contours of the mating surfaces on each shell or part of the Fiberglas housing. At the ports, the gaskets are increased slightly in thickness. Hence, the compression forces which occur when the two parts are bolted together, squeeze the gaskets together and force them to expand and fill all of the available space within the housing parts and around the cables.

The above mentioned and other features and objects of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded view of the inventive connector;

FIG. 1A is a cross section of a fragment of FIG. 1 taken along line 1A, thereof, to show a moisture seal at an entrance port;

FIG. 2 is an end view of the housing of FIG. 1 showing an increased gasket thickness near the entrance-exit ports in the housing;

FIG. 2A is a fragmentary, end view, of a gasket appearing in the area 2A of FIG. 2;

FIG. 3 is a perspective view of the connector housing in its closed and operative condition;

FIG. 4 is a plan view of a compression connector utilized in one embodiment of the inventive connector;

FIG. 5 is a perspective view of another embodiment of a connector used in the invention and



FIG. 6 is a fragmentary view of a second embodiment of the waterproof housing used in the invention and featuring a cable guide to preclude unwanted cable bending at the point where a moisture seal is formed.

The inventive connector comprises upper and lower housing shells or halves **20, 21** made of any suitable, dimensionally stable, and noncorrosive material (such as glass filled acetal material). In one embodiment of the invention, these housing shells are molded. Suitable ribs or struts may also be molded into the housing (as at **22**), and elsewhere—not shown to increase its strength and rigidity. Any number of lugs may be provided on the two housing shells to facilitate assembly. For example, the drawing shows six lugs **24—29**, each adapted to receive a bolt, such as **30**, which also is made of a noncorrosive material, such as a silicon-bronze alloy, for example. The corresponding lugs (such as **31**) on the other housing shell may be threaded to receive and secure the end of the bolts **30**, and thereby reduce hardware and requirements.

Each of the housing shells includes a well **32, 33** for receiving an electrical connector **34**. These wells communicate with the exterior of the housing via entrance-exit ports **35—40** which are formed when cutout sections **35, 36** closed upon corresponding cutout sections **37, 38** and when corresponding cutout sections (not visible in FIG. 1) close on cutout sections **39, 40**. The communicating passage includes rather long tunnel sections, as at **41**, designed to hold and stabilize the cables passing through them.

Each of the housing shells or halves **20, 21** includes a somewhat troughlike recessed area **46, 47** for receiving individually associated gaskets **48, 49**. The trough **46** is not visible in FIG. 1, but it is on the underside of shell **20**. The trough recesses **46, 47** and gaskets **48, 49** have complementary contours so that they fit together when the gaskets are laid in the recesses, and the shells **20, 21** are bolted together. However, the lateral (as viewed in FIG. 1) dimensions of each gasket **48, 49** are such that it fills only about 75 percent of the corresponding lateral or horizontal dimensions of each trough or recess **46, 47**. But, the combined vertical dimensions of the two recess is less, by a corresponding volume amount than the vertical dimensions of the two gaskets. Thus, when the two shells **20, 21** of the housing are bolted together, there is a vertical compression for squeezing the gaskets outwardly in a horizontal direction. The gaskets **48, 49** are made of a flexible material which does not compress; hence, the vertical forces exerted by the two housing shells coming together causes the gaskets to be squeezed laterally to completely fill the troughlike recesses **46, 47**. This way, a good seal is provided even after the cover shells warp or creep slightly. The gaskets **48, 49** should be made of a material having good quality, noncompressible characteristics, such as EPDM rubber, which retains its elastic characteristics and dimensional stability over long years of use.

Each of the arched sections **51—58** includes a number of small ribs (such as **59**) which may be about one thirty-second of an inch wide, one thirty-second of an inch deep, and separated by one thirty-second of an inch. Hence, when these arches are joined together by a closure of the box, the polyethylene insulation **60** on an associated cable tends to cold-flow into the ribs. This cold flow automatically makes a custom formed water-resistant gasket between the housing gaskets **48, 49** and the cable insulation **60**.

In keeping with an aspect of the invention, the entrance and exit ports **35—40** are further sealed by incrementally increasing the thickness of the gaskets near the ports. This aspect of the invention is best seen in FIG. **2**, which is an end view of the housing of FIG. **1**, showing the parts after assembly and before the bolts are tightened. By an inspection of FIG. **2** (and its enlarged fragment FIG. 2A), it should become apparent that the gasket is thickest in the area nearest the port. Hence, the gasket has been drawn in an exaggerated manner to have a thickness $t_1$ in the peripheral area and a thickness $t_2$ at the edge of the arch forming half an entrance port. The gasket thickness increases uniformly per unit length, as shown by

about a 2° incline in exemplary construction. However, this is not a critical matter; the increase could be in the order of 1° to 7° per unit length. As seen in FIG. 2, the thickness of both gaskets 48 and 49 increases in a similar manner adjacent to each port. Hence, when the two shells 20, 21 are clamped together by tightening the bolts, the gasket material is squeezed fore and aft into any openings remaining in the two ports.

When the bolts are tightened sufficiently, the two housing shells 20, 21 come together as shown in FIG. 3, to provide a tight, complete, water resistant housing.

The invention contemplates a use of either of two connectors 34*a*, 34*b*, as shown in FIGS. 4 and 5; however, this aspect of the invention is not overly critical; other connectors could also be used. In either case, the design is such that various kinds of splices may be made, depending upon the users needs, and public utility regulatory agency requirements. For example, some public utility rules and regulations require all connections to include crimped connections. Other public utility rules and regulations allow connectors to be bolted together. A need to make a splice without cutting a cable may also be a factor to consider.

The embodiment of FIG. 4 shows a connector 34*a* in the form of two hollow cylindrical sleeves 62, 63, each having a pair of tabs 64—67 thereon. These tabs contain elongated slots 68, 69 for receiving bolts 70, 71. To avoid binding at the ports, the bolts 70, 71 may be loosened and the sleeves 62, 63 may be slipped sideways, by sliding the tabs 64—67, against each other. To make a connection, the ends of cable wires such as 72, 73 are inserted into the sleeves 62, 63. Then, any well known means are used to crimp the sleeves in a number of places, such as 75, to capture the cable wire and make an electrical connection. The electrical interconnection between the two cable wires 72, 73 is completed via a bridge formed by the tabs 64—67.

In the embodiment of FIG. 5, the connector 34*b* has upper and lower halves 81, 82. Each half includes two channels 83, 84 for receiving electrical cable conductors 85, 86. The outer edges of the halves 81, 82 have stiffening ribs 87, 88 for giving mechanical stability and strength. The central section 89 has reduced vertical dimensions $d_1$ near its edges and thicker dimensions $d_2$ near its center. Thus, when the bolts (such as 91) are tightened, the center section flexes slightly to clamp the cable wires 85, 86 under spring tension. The bolts 91 are held by any suitable lock washers or similar means such as Belleville spring washers 92. Again, the electrical circuit between the cables is completed through the metal of parts 81, 82.

An advantage of the structure of FIG. 5 is that connections may be made to at least one of the conductors 85, 86 without cutting it. Hence, there is no increase of resistance at this point in the main power line. The connector would carry the tap load and not the main current. However, this is not intended to restrict the connector to only tap currents.

One of the problems which is likely to be encountered relates to the cable conductors which are too large to bend around a small radius. For example, the cable conductors of FIGS. 1, 2 could be in the order of three-eighth to one-half inch in diameter. If either of the cables 72, 73 is pulled off at an angle, it bends inside the arches 51—57 (FIG. 1) of the gaskets 48, 49. This loosens the waterproof seal around the cables and allows entry of moisture, which cannot be tolerated.

To avoid these problems of a loosened seal, the tunnel sections 41 formed in shells 20, 21 may be provided with added length cable guides which extend outwardly some distance in front of the housing, as shown at 97, FIG. 6. Hence, if pulled, or bent at an angle, the cables 85, 86 bend —if at all—inside these cable guides or tunnel extensions 97 where there are no moisture resistant seals. Further back, at the point recessed inside housing 20, where the seal is located, the cable wire is thus stabilized against physical movement, and the seal remains water resistant. Hence, within reason, the seal is not damaged by any amount of pulling, bending, or twisting because all resulting movement of the electrical cables occurs within the tunnel extension 97.

The connector is used in the following manner. The insulation on the main cable 60 is stripped in the area selected to receive the connector 34. The tap cable 73 is also stripped and inserted into the connector 34. As many as two taps may be accommodated at either side of the connector. Bolts, such as 91, having Belleville spring washers 92, are tightened so that the two connector halves 81, 82 make a good electrical and mechanical connection to the cable. The gaskets 48, 49 are placed in the connector covers 20, 21,—either dry or together with a sealant of any known kind. The connector 34, with the attached cables, is inserted into wells 32, 33 the gaskets 48, 49 are placed in face to face relationship, and the covers are pulled together by bolts such as 30. The cover compresses the gasket until the shells 20, 21 touch each other.

An alternative to a field application of a wet sealant is to apply a precoating in the factory. One way of doing this is to coat the gaskets and then cover the coating with a backing paper which may be removed in the field. Another way is to treat the face of the gasket with silicone globules which break to release a sealant when the covers are bolted into place. These globules are commercially available products.

Thus, the invention provides lower cost, simpler housings, well adapted for fast, molded, mass production. There is no need to cut the power line or waterproof the connector in the field. Since there is reduced resistance, less wattage is dissipated and less heat is generated. Moreover, high impact plastic can be used to reduce damage by rocks or stone cast on the housing during direct burial. The housing can withstand great external pressure (in the order of 30—50 lbs. per square inch) at abnormal temperatures (−30° C. to +90° C.) for extended periods of time. The cover guides prevent the cable from being sharply bent and the moisture seal from being broken. Contrast these advantages with the prior art wherein high cost housings had a design which required the power cable to be cut before it could be enclosed in the housings. This caused electrical resistance and mechanical weakness at the resulting joint. Hence, the connections failed responsive to mechanical working, passage of time, and normal temperature changes.

While the principles of the invention have been described above in connection with specific apparatus and applications, it is to be understood that this description is made only by way of example and not as a limitation on the scope of the invention.

I claim:

A moisture-sealed underground rigid connector housing comprising upper and lower shells with troughlike recessed areas completely surrounding the mating edges of said shells, said shells having ports for giving electrical power cables an entrance and exit to the inside of said housing and a substantially noncompressible gasket means individually associated with each of said shells, each of said gasket means having dimensions in a lateral direction which are less than the dimensions of said recessed area and vertical dimensions which are greater than the combined depths of said recessed areas on said upper and lower shells, whereby a closure of said shells on each other squeeze said gasket means outwardly in said lateral direction, each of said gasket means arching over said entrance and exit ports, said gasket means being thicker in areas near said ports than in areas removed from said ports, wherein said thicker gasket means overfills said recessed areas near said ports thereby forcing the gasket material out said ports, and rib means in said gasket means where it arches around said ports.

2. A connector housing as claimed in claim 1, wherein said rib means comprise a plurality of parallel ribs positioned to sealingly contact cables within said ports.

3. A housing as claimed in claim 1, wherein said rib means comprise a plurality of arcuate ribs in each of said port arches.

4. A moisture sealing, rigid connector housing for underground use, comprising upper and lower shells adapted to be joined together, raised wall members within each of said shells defining a continuous recess completely surrounding the central portion of said housing, each of said shells having ports

within said wall member for providing an entrance into the central portion of said housing for electrical cables, and at least one endless, noncompressible gasket member resting within each recess positioned to bear against the gasket member of the adjoining shell, each of said gasket members arched within said cable ports to bear against such cables on joinder of said shells to one another, the width of each gasket member being substantially less than the width of said recess and the height of each of said gasket members being greater than the depth of said recess, wherein said gasket members are fabricated of material substantially resistant to compression and having elastic qualities to deform outwardly into said recess on joining together tightly of said shells, and wherein there are a plurality of arcuate ribs extending from said gasket member within each of said arched portions to sealingly contact the cables on joinder of the shells and gasket members.