Dec. 6, 1960 R. U. CLARK 2,963,540

HIGH TORQUE RESISTANT ELECTRICAL TERMINALS

Filed Dec. 19, 1957

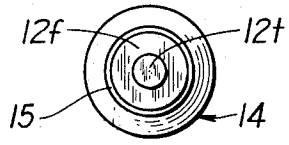


Fig. 2

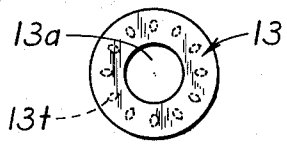


Fig. 7

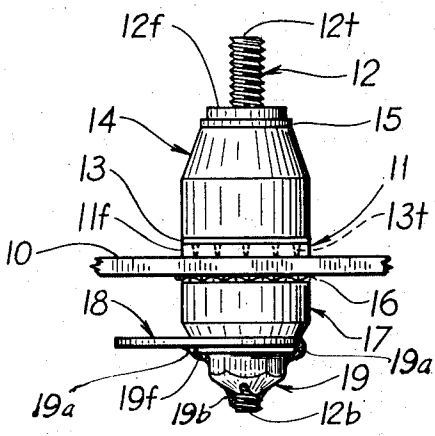


Fig. 1

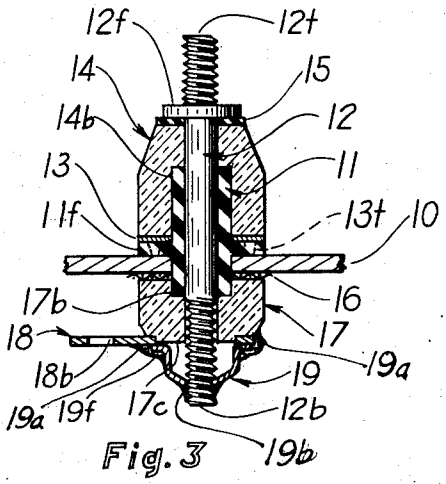


Fig. 3

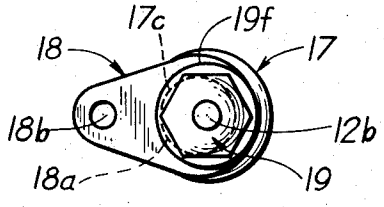


Fig. 4

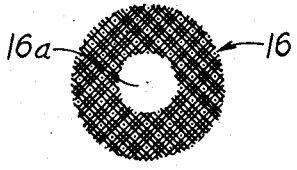


Fig. 6

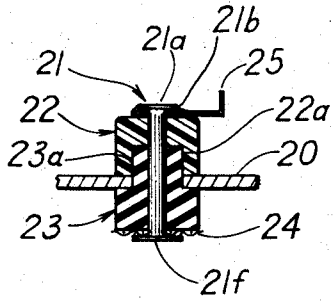


Fig. 8

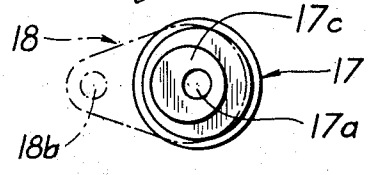


Fig. 5

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United States Patent Office

2,963,540

Patented Dec. 6, 1960

2,963,540

HIGH TORQUE RESISTANT ELECTRICAL TERMINALS

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Filed Dec. 19, 1957, Ser. No. 703,929

9 Claims. (Cl. 174—153)

This invention relates to improvements in hermetically sealed electrical terminals and more particularly to such terminals which offer high resistance to torque or turning forces which tend to loosen the terminal components.

In electrical terminal construction and usage it is customarily necessary to draw the terminal components up tightly to provide and insure an hermetic seal both between the components themselves and between the terminal and the edges of the opening in the panel. Frequently, after the terminal is drawn up tightly and a good seal provided, and the wires are soldered or attached to the lugs or other terminal connections, inadvertent pull or tension applied to the wire subjects the lug to a torsional or rotational force with the result that the terminal becomes twisted and loosened and the hermetic seal is destroyed.

A number of efforts have been made in prior terminals to provide some measure of torque resistance but none have satisfactorily withstood the rigid tests and service conditions required by certain of the more recent specifications and performance requirements of hermetically sealed terminals particularly for military components and equipment. These prior shortcomings have been satisfactorily overcome by my improved terminal construction in which relative rotation, twisting or turning of the components is prevented by a novel relationship and form of frictional washers combined with an eccentrically disposed lug soldered or locked to both the ceramic shell and the electrode components of the terminal.

Prior hermetic electric terminals of the type disclosed in applicant's Patent No. 2,447,489 which issued on August 24, 1948 with various improvements thereon such as in applicant's more recent Patent No. 2,774,812 which issued December 18, 1956, and his pending app. Ser. No. 422,315, filed April 12, 1954, now Patent Number 2,823,251 have adequately met the requirements of hermetically sealed terminals, as attested by their extensive use. It is very important, however, that for very high torque requirements, such as where external circuit connections are to be made to screw thread terminations, and where terminals are to be used in locations where they are not readily solderable (as in my above mentioned Patent No. 2,774,812) that a low cost hermetic seal be available. In most gasket type terminals where a resilient sealing member is used, such as in my earlier Patent No. 2,447,489, there is always considerable relaxing of the resilient member under heat conditions resulting chiefly in loss of braking resistance against twisting torque forces such as when connections are changed or disturbed at the external part of the terminal electrode.

To provide this desired increase to twisting torque the present invention provides improved means to retain the tightness of the terminal under repeated heat cycling, the improved means being in the form of a metallic annulus or washer having teeth or the like which protrude from the flat surface. These protrusions are proportioned physically such that, upon tightening of the terminal, they

will actually force themselves through the sealing gasket or flange portions, of the aforementioned types of terminals, at points in said gaskets where they will not seriously affect the sealing qualities. Actually when these protrusions are forced through the gasket and against the panel in which the terminal is mounted they not only serve to keep the terminal tight after heat cycling, but they also anchor the gasket or flange in place so as to prevent excessive flow or "pull-away" under heat and pressure. This is true in the case of seals using separate gasket type washers and also in types where the sealing gasket is in the form of a resilient flange integral with an insulating insert member of the terminal as in my Patent No. 2,447,489.

In addition to providing a member for the terminal assembly which will maintain the tightness of the assembly, particularly during heat cycling of the same, it is desirable to provide a device to cooperate with this tightness maintaining means which will give very high frictional braking qualities to the assembly. I have discovered that by employing a woven mesh network type of washer with impregnations or encrustations of grit-like material firmly bonded thereto that a very efficient braking action is obtained not only as between very hard surfaces such as metal and ceramic, but also between metal and a resilient material as well, such as between a rubber flange or gasket and a compressing eyelet therefore.

The foregoing combination of braking members has proven very satisfactory in providing very high torque resistance to the ceramic and rubber parts such as in the case of ceramic encased terminals disclosed in my Patent No. 2,447,489. In these and other type terminals I have discovered that further improved results are attained by additionally anchoring the electrode stud to the ceramic element. This further braking characteristic is obtained by incorporating in one of the encasing ceramic or like members an eccentric or offset hub portion, attaching a lug element with a tightly fitting hole engaging the hub and retaining the same in place with a suitable nut or other retaining means and soldering the lug to both the nut and to the electrode stud.

It is accordingly a major object of the present invention to provide an hermetic electric terminal which has relatively high torque resisting qualities. It is a further object to provide such a terminal in which relative rotation or turning is prevented both between the respective components of the terminal and between the terminal and the panel upon which it is mounted. A further object resides in the provision of a novel toothed metallic washer which bears against both a face of the panel and an intermediate resilient washer through which its teeth project. A still further object is directed to an improved insulating washer of woven plastic material coated with abrasive encrustations which provides a relatively high measure of torque resistance both between very hard surfaces such as a metal and a ceramic, but also between a resilient flange or gasket and a metal eyelet or washer.

Other objects and advantages of the present invention will become apparent to those skilled in the art after consideration of the following description taken in conjunction with the accompanying drawings, forming a part hereof, in which:

Fig. 1 is a side elevational view of a preferred form of my improved terminal mounted in a portion of a panel;

Fig. 2 is a top plan view of the terminal;

Fig. 3 is a cross-sectional view of the same;

Fig. 4 is a bottom view of the terminal;

Fig. 5 is a bottom view of the eccentric hub on the lower ceramic element;

Fig. 6 is a plan view of the improved woven mesh washer;

Fig. 7 is a plan view of the toothed lock washer; and

Fig. 8 is a cross-sectional view of a modified form of terminal utilizing the woven mesh washer.

Referring now to Figs. 1, 2 and 3, the numeral **10** represents a panel, wall or enclosure for a component through which it is desired to lead or bring an electrical conductor in an hermetically sealed relationship. An opening is provided in the panel **10** within which the flanged resilient insulating insert **11** is engaged with its flange **11***f* in contact with the upper or outer face of the panel. In order to insure high resistance to relative rotation between the engaging faces of the panel **10** and the flange **11***f* there is engaged with the upper face of the flange **11***f* the improved toothed washer **13**. The latter is preferably formed of metal in the shape of an annulus or washer as shown in detail in Fig. 7 with a central opening **13***a* and a plurality of sharply pointed teeth or protrusions **13***t* extending from its lower face and are adapted to penetrate the flange **11***f* as shown in Fig. 3 and as described further hereinafter.

An upper or outer ceramic shell **14** having a central bore to receive the shank of an electrode or stud **12** has an enlarged bore portion **14***b* which is engaged with the upper portion of the insert **11** with the lower face of the rigid ceramic insulating shell **14** engaging the upper face of the toothed washer **13**. The electrode stud **12** may be threaded at its upper and lower terminals **12***t* and **12***b* respectively and is preferably provided with an integral flange **12***f* adjacent its upper threaded end **12***t*. A gasket washer **15**, preferably formed from "Mylar" film, made by Dupont, is placed against the upper face of the rigid ceramic insulating shell **14** and is held thereagainst by the flange **12***f* of the electrode **12** when its shank is inserted through the openings in the washer **15**, the ceramic **14** and the insert **11**. The gasket washer **15** is preferably coated on both sides with approximately ten thousandths thickness of Neoprene, or some other synthetic elastomer of similar properties, in a durometer of from 60 to 85 on the Shore A scale to provide a good seal between the ceramic shell **14** and the flange **12***f*.

The woven mesh or "grit-cloth" washer **16**, having a central opening **16***a*, shown in Fig. 6 is slipped over the lower portion of the insert **11** and placed against the lower face of the panel **10**. The washer **16** is preferably made from material having a resin impregnated oil-proof woven base mesh of approximately 24 to 28 to the inch and preferably coated with a grit or abrasive such as aluminum oxide of about 150 mesh. The base mesh of this material is woven from a synthetic fibre such as Rayon or the like with a phenolic binder which is stable in most oils and water. For special high temperature operation in oil, I prefer to coat the improved "grit-cloth" washers with a very thin coat of fluoro-carbon type rubber which can be dipped or sprayed on and cured at as low a temperature as possible.

The lower or inner rigid ceramic insulating shell **17** is then placed into position up the lower threaded shank **12** of the electrode stud, with its enlarged bore **17***b* engaging the lower portion of the insert **11**, and with its upper face engaging the lower face of the "grit-cloth" washer **16**. On the lower end of the ceramic shell **17**, as more particularly shown in Figs. 3 and 5, there is integrally formed an eccentric or offset boss portion **17***c* which is off-center with respect to the main axis of the ceramic shell which passes through the bore **17***a* for the electrode stud **12**. The boss **17***c* is engaged by the closely fitting hole **18***a* in the metal lug **18** which has a further and smaller hole **18***b* adapted for the attachment of a wire as by soldering, or otherwise connected thereto. The lug **18** is held in place on the boss **17***c* by a blind type nut a "pal-nut" or spring cap-nut **19** having a flange **19***f* which bears against the lower face of the lug **18**. While the elements **14** and **17** have been described as of ceramic material they may be of other rigid material having high insulating properties, and **17** may be metalized at each end.

After the components of the terminal are assembled together as shown in Figs. 1 and 3, the nut **19** is tightened upon the threads **12***b* thereby compressing each of the terminal components disposed between the electrode flange **12***f* and the flange **19***f* of the nut **19**. As the several components are tightened, and the electrode **12** tensioned, the prongs or teeth **13***t* on the washer **13** force their way through the resilient insert flange **11***f* and dig into the upper face of the panel **10**. At the same time as the flange **11***f* is compressed between the washer **13** and the panel **10**, the remainder of the insert **11** is compressed between the ceramic shells **14** and **17**, and the stud **12**, the washer **15** is compressed between the flange **12***f* and the upper ceramic shell **14**, and the "grit-cloth" washer **16** is similarly compressed between the bottom face of the panel **10** and the upper face of the lower ceramic shell **17**. The nut **19** is tightened such that the prongs **13***t* actually impinge solidly upon the upper face of panel **10**, the pressure obtained by tightening the nut **19** clamps and compresses the entire terminal assembly firmly into the panel **10**, and the insert **11** is compressed into the bores **14***b* and **17***b* of the ceramic shells **14** and **17**; and the insert **11** is held in sealing relation in the panel **10**.

After the nut **19** has been tightened to the desired extent solder is applied at **19***a* between the flange **19***f* of the nut **19** and the lug **18**. The adjacent areas of the ceramic shell **17** may also preferably be metallized, such as more particularly disclosed in my co-pending App. Ser. No. 422,315 filed April 12, 1954, now Patent Number 2,823,251, in order that the solder band **19***a* may adhere and bond therewith also. The nut **19** is also preferably soldered to the threads **12***b* of the electrode **12** by the solder seal **19***b* as shown in Figs. 1 and 3. When the terminal assembly is completed as shown in these figures, the nut **19**, the lug **18** and the stud **12** are securely soldered together and it will be obvious that the electrode stud **12** will be locked against turning in respect to the lower ceramic **17** since the lug **18**, which is soldered to the nut **19** and the stud **12**, cannot rotate or move around on the eccentric ceramic hub **17***c*. The lower ceramic shell **17** being thus locked to the stud **12**, would normally tend to turn or rotate if the stud **12** were turned, as for instance might be the case where a lead-holding nut is applied to the threaded portion **12***t* at the upper end of the electrode **12**. This turning tendency is accordingly arrested and prevented by the improved terminal disclosed by the relatively high braking action of the grit-cloth washer **16** which is compressed between—and prevents relative movement between—the ceramic shell **17** and the panel **10** as shown in Figs. 1 and 3. This braking action will be maintained by the tension created in the stud **12** by its being bolted up tightly and by the pronged washer **13**, of Fig. 7, shown in position in Figs. 1 and 3, biting through the soft rubber flange **11***f* and into the panel **10**. It will be understood from the foregoing description that the entire terminal assembly is firmly locked against rotation since once it is set up and tightened there is not element in the assembly which can give or relax to a sufficient extent to lower the assembly tension or impair the great braking or torsion restraint.

While the terminal assembly of Figs. 1 and 3 represents a preferred embodiment of my improved terminal construction, the improvements are not restricted thereto. In certain terminal constructions it may be preferable to make the lug **18** and the nut **19** integral, or in one-piece, or to pre-fasten these two elements, and assemble the terminal prior to soldering the lower stud thread by turning the stud in the "threading-on" direction. Inasmuch as the spring type nut **19** can be tightened by being pushed up axially the one-piece nut and lug can also be assembled on the eccentric boss of the shell **17** without the necessity of being rotated. In lieu of the "pal-nut" **19**, I may prefer to use suitable nuts of other types, or a lock washer and threaded nut, or a lock washer and a lock nut, but where a single nut is used I

prefer to solder the same to both the lug and the stud. I may also prefer to eliminate the toothed washer **13** by providing the upper ceramic shell **14** with downwardly extending integral projections to bite through the rubber flange **11***f*. These projections would be part of the ceramic piece and would be formed on its lower face where it engages the top surface of the flange **11***f*.

Fig. 8 shows a modified form of terminal embodying my improved torque resisting "grit-cloth" washer. The numeral **20** represents a panel having an opening therein through which the inner or male resilient insert is inserted and engaged by the upper or female insert **22** the internal bore **22***a* of which engages the projecting portion **23***a* of the inner male insert. The insert **22** is preferably of Teflon (tetrafluoroethylene) or the like and the insert **23** is preferably formed from Neoprene or similar material. The length of the projection **22***a* and the recess **23***a* are such that as they are fully nested or telescoped the components tightly engage the opposite faces of the panel **20**. The insert components are secured to the panel by the tubular or hollow eyelet **21** having an upset head **21***a*, which also retains and is soldered to the attachment lug **25**, at **21***b*, and the flange **21***f* which compresses the "grit-cloth" washer **24** (similar to that shown in Fig. 6) against the lower face of the insert **23**. The "grit-cloth" washer **24** prevents rotation of the eyelet **21** and its flange **21***f* from rotating with respect to the insert **23** and sufficient friction is developed between the components **22** and **23** and the panel **20** to prevent relative rotation therebetween.

Other forms and modifications of the present improved terminals which occur to those skilled in the art after reading the foregoing description are intended to come within the scope and spirit of the present invention as more particularly set forth in the appended claims, in which I claim:

1. In a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel and having a flange bearing upon a face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode and a metallic washer having toothed portions disposed between one of said rigid insulating elements and said insert flange adapted when compressed by said terminal compressing means to force said toothed portions of said washer through said insert flange against said panel face to impart torque resistance to said terminal with respect to said panel.

2. In a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel and having a flange bearing upon a face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode, a metallic washer having toothed portions disposed between one of said rigid insulating elements and said insert flange adapted when compressed by said terminal compressing means to force said toothed portions of said washer through said insert flange against said panel face to impart torque resistance to said terminal with respect to said panel and an annular washer having abrasive impregnations disposed between the other said rigid insulating element and the opposite face of said panel.

3. A torque resistant hermetically sealed electrical terminal of the type called for by claim 2 characterized by said annular washer being formed from a woven synthetic fibre having a phenolic binder.

4. In combination, in a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel and having a flange bearing upon the face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode, a metallic washer having toothed portions on one face and disposed between one of said rigid insulating elements and said insert flange and adapted when compressed by said terminal compressing means to force said toothed portions of said washer through said insert flange and against said panel face to impart torque resistance to said terminal in respect to said panel, and an annular washer having abrasive impregnations disposed between the other said rigid insulating element and the face of the panel, said other rigid insulating element having an external eccentric boss portion in a plane perpendicular to the said electrode stud, and one of said terminal's compressive means being locked to said stud and to said eccentric boss portion.

5. In a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel, an elastomeric gasket encircling said insert and bearing upon a face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, the said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode and a metallic washer having toothed portions disposed between one of said rigid insulating elements and said encircling elastomeric gasket and adapted when compressed by said terminal compressing means to force said toothed portions of said washer through said encircling elastomeric gasket and against said panel face to impart torque resistance to said terminal with respect to said panel.

6. In combination in a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel and having a flange bearing upon the face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode, a metallic washer having toothed portions disposed between one of said rigid insulating elements and said insert flange and adapted when compressed by said terminal compressing means to force said toothed portions of said washer through said insert flange against said panel face to impart torque resistance to said terminal with respect to said panel, an annular washer having abrasive impregnations disposed between the other said rigid insulating element and the opposite face of said panel, said other rigid insulating element having an eccentric boss section in a plane perpendicular to the electrode stud and a conductive member made fast to said stud and to said boss.

7. In a torque resistant hermetically sealed electrical terminal for an opening in a panel, an insulating insert extending through the opening in the panel, insulating flange means encircling said insert and bearing upon a face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode, one of said rigid insulating elements having toothed portions disposed against said insulating flange means adapted when compressed by said terminal compressing means to force said toothed portions of said rigid insulating element through said in-

sulating flange means against said panel face to impart torque resistance to said terminal in respect to said panel.

8. In combination in a torque resistant hermetically sealed electrical terminal for an opening in a panel, a resilient insulating insert extending through the opening in the panel and having encircling flange means bearing upon the face of the panel, rigid insulating elements enclosing and bearing against the opposite ends of said insert, an electrode stud passing axially through said insert, said rigid insulating elements and said panel opening and having terminal compressing means disposed adjacent the opposite ends of said electrode, one of said rigid insulating elements having toothed portions disposed against said flange means adapted when compressed by said terminal compressing means to force said toothed portions of said rigid insulating element through said insert flange means against said panel face to impart torque resistance to said terminal with respect to said panel, an annular washer having abrasive impregnations disposed between the other said rigid insulating element and the opposite face of said panel, said other rigid insulating element having an eccentric boss section in a plane perpendicular to the electrode stud and anchorage of said stud to said boss solidly achieved by one of said terminal compressing means.

9. In a torque resistant hermetically sealed electric terminal for an opening in a panel, a resilient insulating element having a passage extending axially therethrough and having a portion bearing upon a face of the panel, a first rigid insulating element having spaced projecting

portions bearing upon said resilient element portion, a second rigid insulating member bearing against the opposite face of the panel, an electrode stud passing axially through said rigid and resilient elements and through said panel opening, said electrode stud having terminal compressing means adjacent its ends adapted when compressed to force said spaced projecting portions of said first rigid element through said resilient element against said panel face whereby said spaced bearing points between the first rigid element and said panel face form a tightly compressed assembly of rigid elements which prevents relaxation of the assembly tension to maintain high torque resistance and the hermetic sealing properites of the terminal.

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