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A. D. FORBES ET AL

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SEPARABLE CONNECTOR FOR ELECTRICAL APPARATUS

Filed July 24, 1943

2 Sheets-Sheet 1

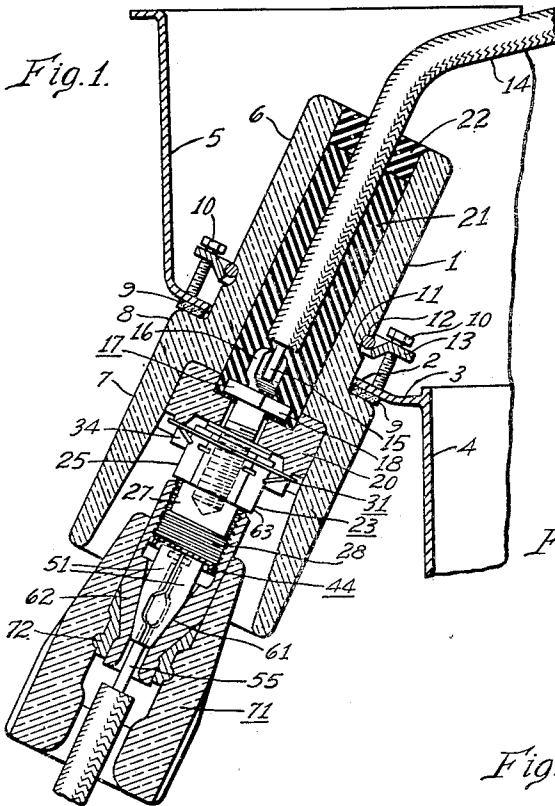


Fig. 1.

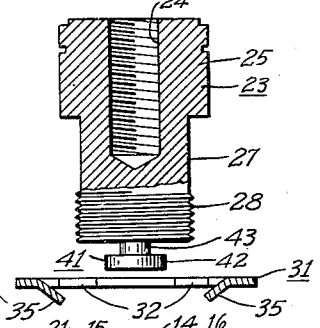
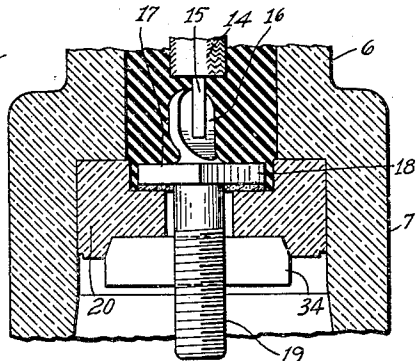


Fig. 2

Fig. 3.

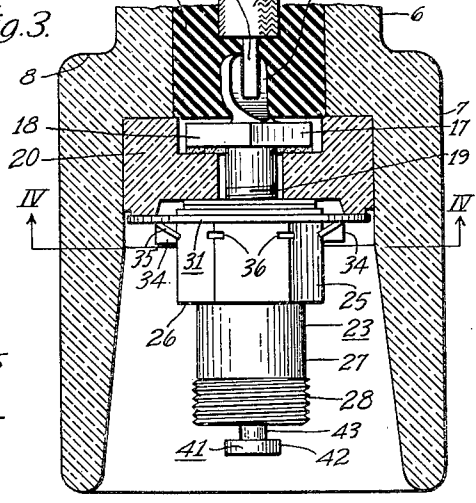
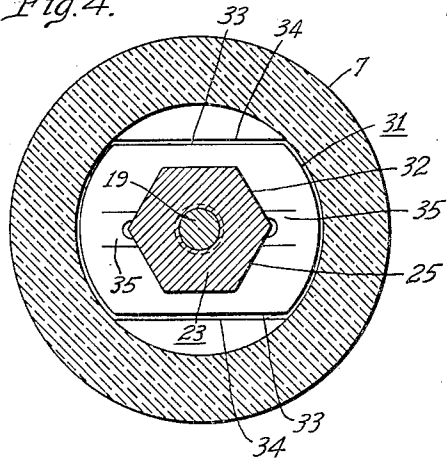


Fig. 4.



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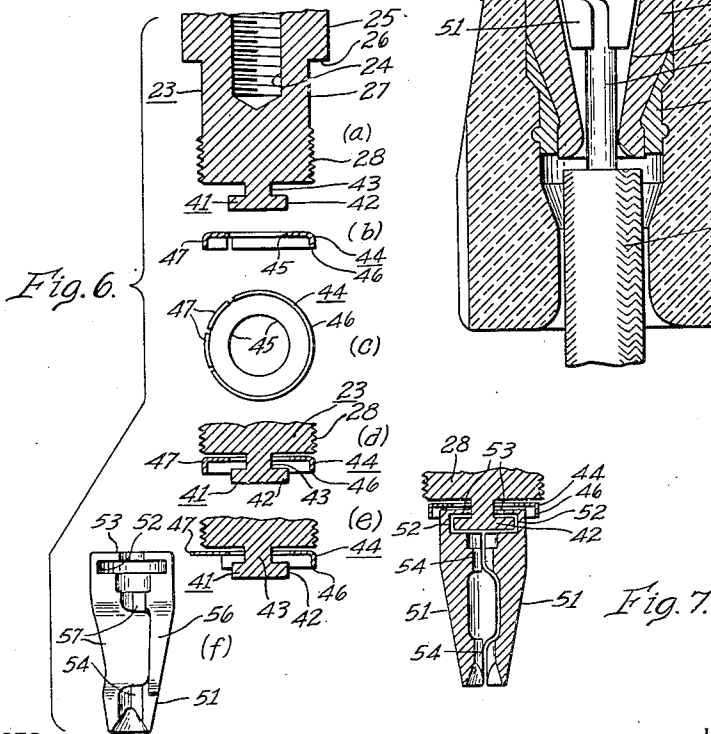
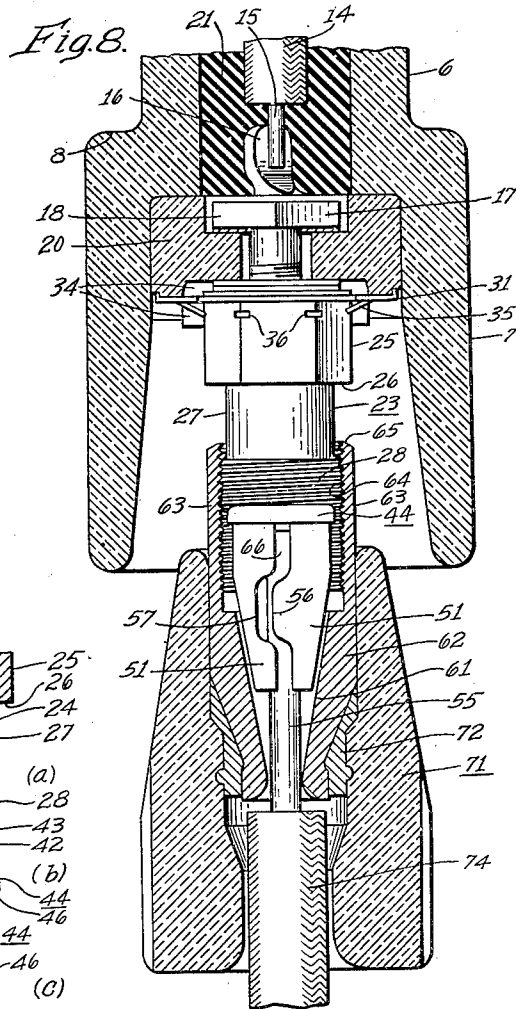
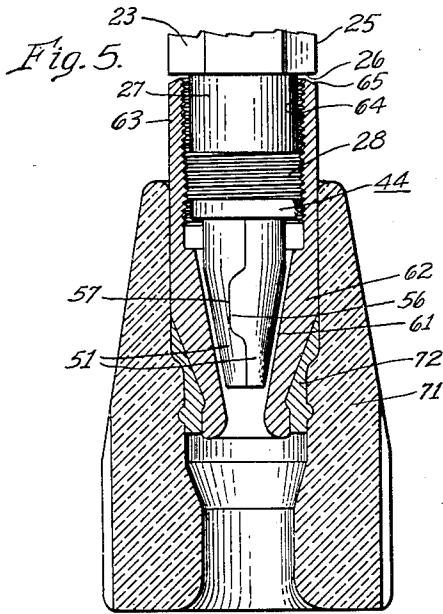
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2 Sheets-Sheet 2



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2,397,097

SEPARABLE CONNECTOR FOR ELECTRICAL APPARATUS

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Application July 24, 1943, Serial No. 495,982

7 Claims. (Cl. 173—328)

The invention relates to a separable connector bushing structure for electrical apparatus such as transformers, and particularly to bushing structures for electrical apparatus comprising means for connecting the apparatus to the conductors of an outside circuit. The invention may be used in bushing structures of electrical transformers for readily connecting the transformers to or disconnecting them from the electrical circuits supplied from the transformer, or to the circuit supplying energy to the transformer.

The connector includes a main tubular member formed of insulating material, such as porcelain, extending through an opening in the casing and through which the conducting parts forming the path of the electric circuit extend. One feature of the invention is the manner in which a retainer nut is fastened to a stud connected to the apparatus conductor within the casing, the nut being held against rotation to prevent unintended separation of the retainer nut from the stud.

Another feature of the invention is the provision of clamping jaws for engaging the electric circuit conductor and the means for attaching the jaws to the retainer nut.

A third feature of the invention is the provision of a tapered nut for tightening the jaws and its cooperative relation to the retainer nut and the other parts of the connector assembly. When the tapered nut is screwed to its final position to close the jaws and to tighten the connection between the jaws and the electrical conductor its upper thread is jammed or bent inwardly. The jammed thread causes the tapered nut when unscrewed from its closed position a predetermined amount sufficient to separate the jaws from the circuit conductor to jam against the external threads on the lower end of the retainer nut so that further unscrewing of the nut becomes more difficult. Any additional movement of the nut after the end thread has jammed is unnecessary to the normal operation of the connector in connecting or disconnecting electrical conductors thereto.

Other objects and advantages of the invention will be apparent from the following description of a preferred embodiment thereof, reference being made to the accompanying drawings in which:

Figure 1 is a sectional view of the separable connector in place upon a transformer casing,

Fig. 2 is a sectional exploded view of separate parts of the assembly used in the upper portion of the connector,

Fig. 3 is a view partly in section of the parts of the assembly shown in Fig. 2 in their assembled relation,

Fig. 4 is a sectional view taken along the line IV—IV of Fig. 3,

Fig. 5 is a view partly in section of the lower portion of the separable connector,

Fig. 6 is a series of views of parts comprising the lower portion of the separable connector,

Fig. 7 is a sectional view of the assembled parts shown in Fig. 6, and

Fig. 8 is a sectional view of the entire assembly with the parts comprising the lower portion of the assembly in position to permit separation of the jaws so as to connect or disconnect the line conductor to or from the connector assembly.

Referring to the drawings, and particularly to Fig. 1 thereof, a main insulating tubular member 1, which may be of porcelain or other suitable material, is provided extending through an opening 2 in an overhanging portion 3 of a casing having a side wall 4 and an upper widened top side portion 5. The upper portion 6 of the member 1 is of smaller diameter than the lower bell-shaped portion 7 and extends within the opening in the casing, the shoulder 8 formed at the junction between the portions 6 and 7 engages a gasket 9 between the shoulder 8 and the tank well. A groove 11 is provided about the narrowed portion 6 at a point within the casing to accommodate a coil spring 12 whose ends are fastened together and which may be snapped therein. A set of screws 10 are provided in the flange 13, the screws bearing against the surface of the tank portion 3 and forcing the flange upward against the spring 12, which force is transmitted through the member 6 to the gasket 9. An apparatus lead 14 shown as an insulated cable is provided extending a greater portion of the way through the narrowed portion 6 of the insulating member and having a bare end 15 welded to the upper portion 16 of a stud 17 having a rectangular middle section 18 and a lower screw threaded end 19. An insert 20 of insulating material such as porcelain, or the like is shown which fits into the upper part of the interior of the bell-shaped portion 7. As shown in Fig. 1, the upper end 16 of the stud and a portion of the cable 14 is surrounded by insulating compound 21 and by an insulating cement 22 at the upper end of the portion 6 of the insulating member, thus holding the conductor 14 rigidly within the passageway extending through the main insulating member 1. The inner end of the conductor or

cable 14 is connected to the transformer or other electrical apparatus within the casing 4.

A retainer nut 23 is provided having a screw threaded bore 24 extending downwardly from its upper end for coupling it to the screw threaded portion 19 of the stud 17 thus holding the stud 17 and the retainer nut 23 tightly against opposite sides of the insulating insert 20. Washers may be provided between the surfaces of the insert 20 and the metal stud and retainer nut 23 if desired. The upper end 25 of the retainer nut 23 is shown hexagonal in shape, and a shoulder 26 is provided between the hexagonal portion and a middle portion 27. The lower portion 28 is provided with screw threads of a diameter larger than the diameter of the intermediate portion 27 so as to allow a tapered nut to be screw threadedly attached to the lower portion 28 and to pass over the undercut intermediate portion 27 without engaging it. After the stud 17 and the retainer nut 23 has been screwed into position, a lock washer 31 having a hexagonal opening 22 therein adapted to fit the hexagonal portion 25 of the retainer nut is slipped upwardly about the retainer nut. The lock washer 31 is provided with two flat outer edges 33 that are adapted to fit between shoulders 34 on the upper inner surfaces of the bell-shaped widened portion 7 of the main insulating member, thus preventing the washer and likewise the retainer nut from being turned while the lock washer is in position. The lock washer is provided with downwardly extending ears 35 that are adapted to engage slots 36 in the retainer nut to hold the lock washer in position at the upper end of the hexagonal portion 25 of the retainer nut between the shoulders 34. After the stud 17, the retainer nut 23 and the insulating insert 20 are assembled in position as shown in Figs. 1, 3 and 4 the cement 21 is placed within the portion 6 as shown in Fig. 1. A button 41 is provided at the lower end of the retainer nut consisting of a flange 42 extending outwardly and spaced from the lower end of the retainer nut by a neck 43.

Referring particularly to Figs. 5, 6, 7 and 8, a keeper washer 44 is provided consisting of a central disk portion having an opening 45 therein of sufficient diameter to permit passage of the button 41 therethrough and having a downwardly extending outer rim or wall 46, a part of which is divided into sections 47 which may be bent outwardly from the center, as shown in Fig. 6(e). Two jaws 51 are provided one of which is shown in perspective view in Fig. 6(f), the pair being shown in section in Fig. 7 and in elevation in Figs. 5 and 8. The upper end of each jaw is provided with a semicircular groove 52 above which an inwardly extending flange 53 is provided for retaining the jaw in place, the flange 53 extending between the button 41 on the lower end of the retaining nut 23 about the neck portion 43. When the two sections 47 of the lock washer 44 are bent radially outward, as shown in Fig. 6(e), each one of the pair of jaws 51 is slipped into place through the open portion of the wall section 47 and about the button 41, after which the sections 47 are bent downwardly as shown in Figs. 6(b), (c), (d) and Fig. 7. In this position, the pair of jaws, as may be readily seen by reference to Fig. 7, has a certain lateral motion, permitting lateral separation between them, but not sufficient motion to permit the inwardly extending flanges 53 on the upper ends thereof to be removed from behind the flange 42 forming the button on the lower end of the retainer nut.

As best shown in Fig. 6(f) and Fig. 7, V-shaped clamping surfaces 54 are provided on the inner surface of the clamping jaws for engaging a circuit conductor 55 positioned between them. A wire guide 56 is provided, one on the middle portion of the outer rim of each of the two jaws and adapted to engage similarly shaped depressions 57 on the opposite cooperating surface of the adjacent jaw. The outer lower walls of the jaws are conical in shape and are adapted to engage the inner conical surface 61 of a tapered nut 62 having a relatively long upper sleeve portion 63 provided with screw threads 64 on the interior surface thereof for engaging the screw threads 28 on the lower portion of the retainer nut 23.

As shown in Fig. 8, the upper end 65 of the tapered nut 62 is spaced considerably below the shoulder 26 on the hexagonal portion 25 of the retainer nut, thus lowering the inner conical wall 61 and permitting separation of the jaws 51 as indicated by the space 66 between them so that the conductor 55 may be readily inserted or removed from between the jaws 51. After the line circuit conductor 55 is inserted in the position shown in Fig. 8 and the tapered nut 62 is tightened, that is, screwed upwardly into the position shown in Figs. 1 and 5, the jaws 51 are forced tightly against the conductor 55 holding it in position. The upper end 65 of the tapered nut 62 is shown as bevelled and when it is first screwed into place, when the bushing is first assembled and before the conductor 55 is inserted, this nut is tightened against the shoulder 26 on the upper end of the retaining nut, the end thread lining the bore of the sleeve is crimped or jammed inwardly. When the tapered nut 62 is unscrewed sufficiently for this upper or jammed thread 64 at the end of the bore to engage the threads 28, the further movement of the tapered nut will definitely stiffen or become harder, thus notifying the operator that the movement of the tapered nut, necessary to completely release the jaws 51 has been completed and that further downward movement thereof is unnecessary. When the threads 64 and 28 tend to bind so that the retainer nut 23 tends to rotate with the tapered nut 62, it will be prevented from doing so by the lock washer 31.

It is unnecessary when loosening the line conductor 55 to entirely separate the tapered nut 62 from the assembly. If this were done the tapered nut 62 might become lost or misplaced. This nut 62 is permanently retained on the assembly either in its loosened or tightened position.

A lower or disconnect insulating member 71 is provided, which is permanently affixed to the tapered nut 62 as by babbitt, plastic cement, or similar material 72 cemented in the space between the two members. The lower portion of the disconnect insulating member extends downwardly about the cable 14 thus protecting conducting parts that would otherwise be exposed. This feature also provides a degree of shielding not readily obtainable without a shielding cap or similar extra middle structure about the conductor.

Since modifications may be made in the details of the structure illustrated and described, we do not wish to be limited otherwise than by the scope of the appended claims.

We claim as our invention:

1. In a connector for electrical apparatus, an insulating sleeve having a narrow inner end having a passageway therethrough and an electrical

conductor enclosed in the passageway and a widened bell-shaped outer end portion, the bell-shaped outer end portion of the sleeve being provided with shoulders within its inner end, a stud having an inner end connected to said electrical conductor and cemented within the narrow inner end portion of the sleeve and having a screw-threaded end extending into the widened outer end portion of the sleeve, a retainer nut adapted to be screw-threadedly attached to the stud and having a polygonal periphery at its inner end, a lock washer adapted to surround the retainer nut and having a polygonal opening therein fitting the periphery of the retainer nut and adapted, when pressed to the inner end thereof, to lock with said nut between the shoulders provided at the inner end and within the widened bell-shaped outer end portion of the insulating sleeve, and means for electrically connecting the retainer nut to the conductor of an electrical circuit.

2. In combination, an electrical apparatus casing, a sleeve of insulating material having an end of relatively small cross-section extending into the casing through an opening therein and an end having a relatively larger cross-section positioned outside the casing, the relatively larger section of the sleeve being provided with shoulders within its inner end, a passageway extending through the smaller section and an electrical conductor therein, a stud having an inner end electrically connected to said electrical conductor and cemented within the smaller section of the sleeve and having a screw threaded end extending into the widened end portion of the sleeve, a retainer nut having a screw threaded bore for attaching the nut to the stud and provided with a polygonal head on the inner end of the nut, a lock washer for surrounding the polygonal head of the retainer nut and provided with a polygonal opening therein fitting the polygonal head of the retainer nut and arranged to fit between the shoulders provided within the inner end of the larger section of the sleeve for preventing the lock washer and the retainer nut from turning with respect to the sleeve, the lock washer having ears for engaging the polygonal head for retaining it in position on the polygonal head of the retaining nut, and means for electrically connecting the retainer nut to the conductor of an electrical circuit.

3. In combination, an electrical apparatus casing, a sleeve of insulating material having a portion extending through an opening in the casing wall into the casing, an electrical conductor therein, a retainer nut within the outer portion of the sleeve electrically connected to the conductor, a button shaped projection on the lower end of the retainer nut having a neck portion extending from the body portion of the retainer and a flange spaced from the body portion and extending outwardly from the neck portion, a keeper washer having a central opening therein of sufficient size to permit the button shaped projection to pass therethrough and a wall extending downwardly from the outer rim of the keeper washer, the wall having separable sections capable of being bent outwardly to provide an opening in the wall, a pair of jaws for gripping the end of an electrical conductor and each having slots in the base portion thereof into which the rim of the projecting button fits, the jaws being provided with inwardly extending flanges fitting behind the button limiting their longitudinal movement, the walls of the keeper washer limiting the transverse movement of the jaws to prevent the inwardly extending

flanges from disengaging the flange of the button shaped projection, and means for forcing the jaws together to grip a conductor between them.

4. In combination, an electrical apparatus, a connector for connecting an electrical conductor to the apparatus comprising a retainer nut, the outer end of the retainer nut being provided with external screw threads, a shoulder on the retainer nut spaced from the screw threaded portion of the retainer nut and a stem intermediate the screw threaded portion of the retainer nut and the shoulder, a button shaped projection on the outer end of the retainer nut having a neck portion extending from the body portion of the retainer nut and a flange spaced from the body portion and extending outwardly from the neck portion, a keeper washer having a central opening therein of sufficient size to permit the button shaped projection to pass therethrough and a wall extending downwardly from the outer rim of the keeper washer, the wall having separable sections which may be bent outwardly to provide an opening in the wall, a pair of jaws for gripping the end of an electrical conductor and each having slots in the base portion thereof into which the rim of the projecting button fits, the jaws being provided with inwardly extending flanges fitting behind the button limiting their longitudinal movement, the walls of the keeper washer limiting the transverse movement of the jaws to prevent them from disengaging the flange of the button shaped projection, the outer surfaces of the jaws being cone shaped, a tapered nut comprising a sleeve having an internally threaded portion at one end for engaging the screw threaded portion of the retainer nut and a conical internal surface at the other end cooperating with the jaws for forcing them together in gripping relation to a conductor placed between them.

5. In combination, an electrical apparatus, a connector for connecting an electrical conductor to the apparatus comprising a retainer nut, the outer end of the retainer nut being provided with external screw threads, a shoulder on the retainer nut spaced from the screw threaded portion of the retainer nut and a stem intermediate the screw threaded portion of the retainer nut and the shoulder, a button shaped projection on the outer end of the retainer nut having a neck portion extending from the body portion of the retainer nut and a flange spaced from the body portion and extending outwardly from the neck portion, a keeper washer having a central opening therein of sufficient size to permit the button shaped projection to pass therethrough and a wall extending downwardly from the outer rim of the keeper washer, the wall having separable sections which may be bent outwardly to provide an opening in the wall, a pair of jaws for gripping the end of an electrical conductor and each having slots in the base portion thereof into which the rim of the projecting button fits, the jaws being provided with inwardly extending flanges fitting behind the button limiting their longitudinal movement, the walls of the keeper washer limiting the transverse movement of the jaws to prevent them from disengaging the flange of the button shaped projection, the outer surfaces of the jaws being cone shaped, a tapered nut comprising a sleeve having an internally threaded portion at one end for engaging the screw threaded portion of the retainer nut and a conical internal surface at the other end cooperating with the jaws for forcing them together in gripping relation to a conductor placed between

them, the internally threaded portion being adapted to engage the shoulder and being provided with a jammed end thread for causing the threads of the tapered nut to bind when the nut has been unscrewed sufficiently to cause the jammed end thread to engage the threaded portion of the retainer nut.

6. In a connector for electrical apparatus, an insulating sleeve having a narrow inner end having a passageway therethrough and an electrical conductor enclosed in the passageway and a widened bell-shaped outer end portion, the bell-shaped outer end portion of the sleeve being provided with shoulders within its inner end, a stud having an inner end connected to said electrical conductor and cemented within the narrow inner end portion of the sleeve and having a screw-threaded end extending into the widened outer end portion of the sleeve, a retainer nut adapted to be screw-threadedly attached to the stud and having a polygonal periphery at its inner end, a lock washer adapted to surround the retainer nut and having a polygonal opening therein fitting the periphery of the retainer nut and adapted, when pressed to the inner end thereof, to lock with said nut between the shoulders provided at the inner end and within the widened bell-shaped outer end portion of the insulating sleeve, the outer end of the retainer nut being provided with external screw threads, a shoulder on the retainer nut spaced from the screw threaded portion of the retainer nut and a stem intermediate the screw threaded portion of the retainer nut and the shoulder, a button shaped projection on the outer end of the retainer nut having a neck portion extending from the body portion of the retainer nut and a flange spaced from the body portion and extending outwardly from the neck portion, a keeper washer having a central opening therein of sufficient size to permit the button shaped projection to pass therethrough and a wall extending downwardly from the outer rim of the keeper washer, the wall having separable sections which may be bent outwardly to provide an opening in the wall, a pair of jaws for gripping the end of an electrical conductor and each having slots in the base portion thereof into which the rim of the projecting button fits, the jaws being provided with inwardly extending flanges fitting behind the button limiting their longitudinal movement, the walls of the keeper washer limiting the transverse movement of the jaws to prevent them from disengaging the flange of the button shaped projection, the outer surfaces of the jaws being cone shaped, a tapered nut comprising a sleeve having an internally threaded portion at one end for engaging the screw threaded portion of the retainer nut and a conical internal surface at the other end cooperating with the jaws for forcing them together in gripping relation to a conductor placed between them.

7. In combination, an electrical apparatus casing, a sleeve of insulating material having an end of relatively small cross-section extending into the casing through an opening therein and an

end having a relatively larger cross-section positioned outside the casing, the relatively larger section of the sleeve being provided with shoulders within its inner end, a passageway extending through the smaller section and an electrical conductor therein, a stud having an inner end electrically connected to said electrical conductor and cemented within the smaller section of the sleeve and having a screw threaded end extending into the widened end portion of the sleeve, a retainer nut having a screw threaded bore for attaching the nut to the stud and provided with a polygonal head on the inner end of the nut, a lock washer for surrounding the polygonal head of the retainer nut and provided with a polygonal opening therein fitting the polygonal head of the retainer nut and arranged to fit between the shoulders provided within the inner end of the larger section of the sleeve for preventing the lock washer and the retainer nut from turning with respect to the sleeve, the lock washer having ears for engaging the polygonal head for retaining it in position on the polygonal head of the retaining nut, the outer end of the retainer nut being provided with external screw threads, a shoulder on the retainer nut spaced from the screw threaded portion of the retainer nut and a stem intermediate the screw threaded portion of the retainer nut and the shoulder, a button shaped projection on the outer end of the retainer nut having a neck portion extending from the body portion of the retainer nut and a flange spaced from the body portion and extending outwardly from the neck portion, a keeper washer having a central opening therein of sufficient size to permit the button shaped projection to pass therethrough and a wall extending downwardly from the outer rim of the keeper washer, the wall having separable sections which may be bent outwardly to provide an opening in the wall, a pair of jaws for gripping the end of an electrical conductor and each having slots in the base portion thereof into which the rim of the projecting button fits, the jaws being provided with inwardly extending flanges fitting behind the button limiting their longitudinal movement, the walls of the keeper washer limiting the transverse movement of the jaws to prevent them from disengaging the flange of the button shaped projection, the outer surfaces of the jaws being cone shaped, a tapered nut comprising a sleeve having an internally threaded portion at one end for engaging the screw threaded portion of the retainer nut and a conical internal surface at the other end cooperating with the jaws for forcing them together in gripping relation to a conductor placed between them, the internally threaded portion being adapted to engage the shoulder and being provided with a jammed end thread for causing the threads of the tapered nut to bind when the nut has been unscrewed sufficiently to cause the jammed end thread to engage the threaded portion of the retainer nut.

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