Dec. 23, 1958 F. A. NEWCOMBE 2,866,173

TERMINAL BUSHING ASSEMBLIES FOR TRANSFORMERS

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Fig. 1.

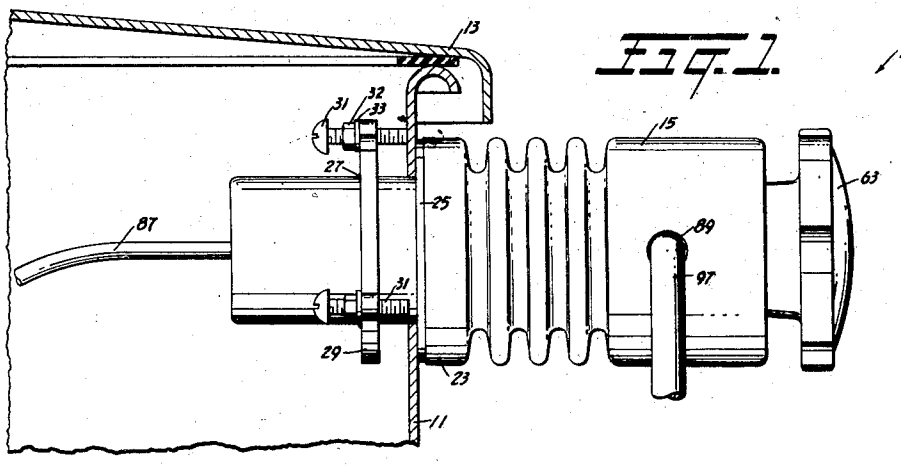
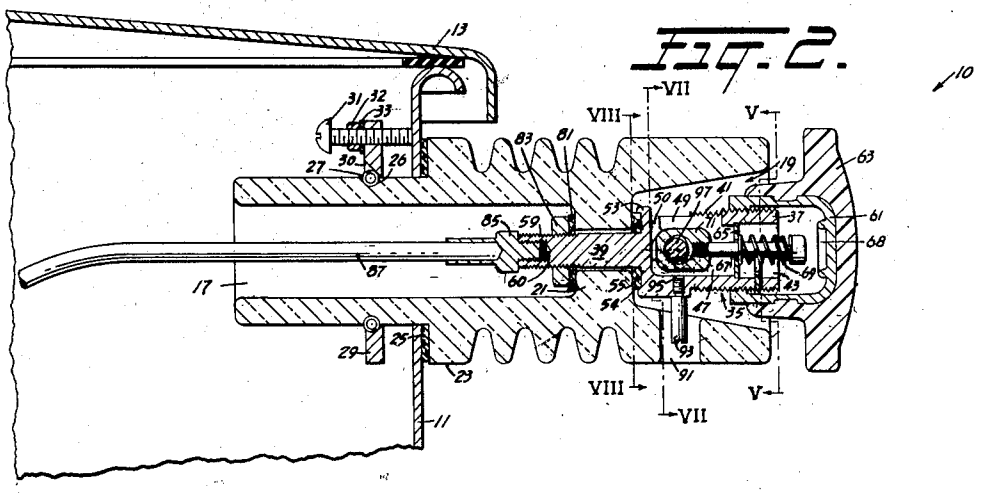


Fig. 2.



INVENTOR
FRANK A. NEWCOMBE
BY
Wheatley ford & Wheatley ford
attys

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Fig. 3.

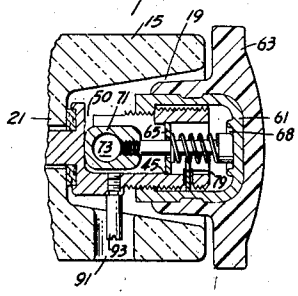


Fig. 4.

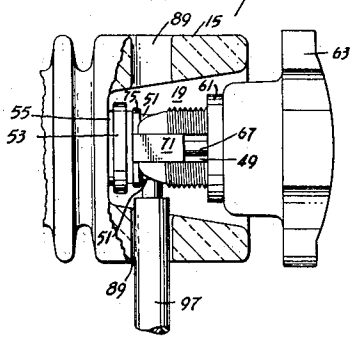


Fig. 5.

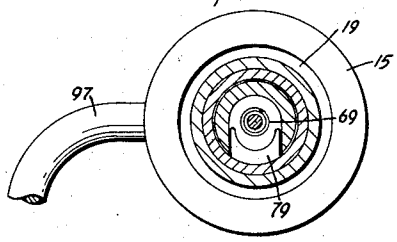


Fig. 6.

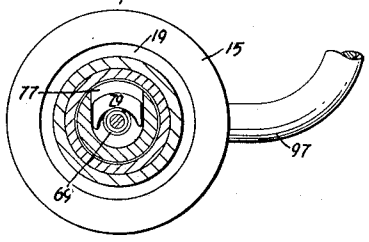


Fig. 7.

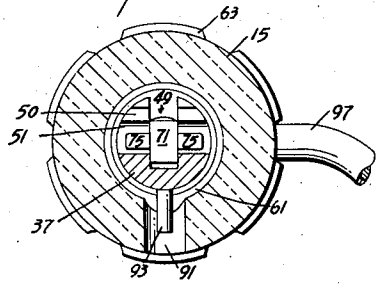
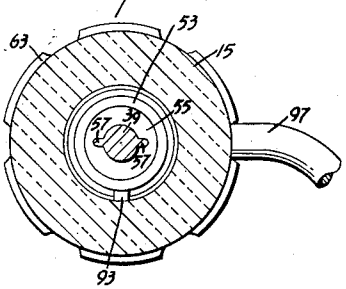


Fig. 8.



INVENTOR
FRANK A. NEWCOMBE
BY
Weatherford & Weatherford
Attys

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2,866,173

TERMINAL BUSHING ASSEMBLIES FOR TRANSFORMERS

Frank A. Newcombe, Pine Bluff, Ark., assignor to Central Transformer Corporation, Pine Bluff, Ark., a corporation of Arkansas

Application January 6, 1955, Serial No. 480,206

12 Claims. (Cl. 339—202)

This invention relates to certain new and useful improvements in terminal bushing assemblies for transformers for use in effecting connection between incoming cables and leads from transformer windings. It has heretofore been considered desirable to employ bushings for such usage in connection with transformers and in order to connect the incoming cable and wire it has been contemplated that a screw-type clamp be employed for engaging the exposed end of the incoming cable and tightly holding same against undesired removal.

Heretofore it has been considered necessary to effect such clamping through direct screw pressure upon the cable end which has resulted in the undesired crimping and deformation of such cable ends causing damage thereto and at times contributing to undesired breakage of the cable ends, interrupting the connection in an unsatisfactory manner. This problem is particularly accentuated by the wide-spread employment of relatively soft metals, such as aluminum, in such cables.

The present invention is primarily directed to a new and novel terminal bushing assembly for transformers which obviates the difficulty heretofore encountered and essentially eliminates the use of screw clamps for effecting engagement of a cable end.

The present invention contemplates the employment of a spring-operated clamping mechanism which is effective to maintain the necessary connecting clamping with a minimum of pressure being exerted upon the wire, yet adequately clamping the wire so as to hold same tightly in secure, electrical contact.

The principal object of the present invention is to provide a terminal bushing assembly for transformers which includes spring-operated means for clamping incoming cables in electrical communication with a winding lead.

A further object of the invention is to provide such an assembly which includes screw-operated means for overcoming the spring clamping pressure to effect release of the cable clamp from engagement and to condition the assembly for reception of a cable end.

A further object of the invention is to provide in such a device means for preventing the accidental removal of the screw means from the bushing; and

A further object of the invention is to generally improve the design, construction and efficiency of terminal bushing assemblies for transformers.

The means by which the foregoing and other objects of the present invention are accomplished and the manner of their accomplishment will readily be understood from the following specification upon reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary view partly in section and partly in elevation of a terminal bushing assembly mounted horizontally in a side wall of a transformer casing.

Fig. 2 is a sectional view taken on a vertical plane along the longitudinal axis of the bushing assembly and illustrating an incoming cable clamped by the clamping means of the assembly.

Fig. 3 is a fragmentary view similar to Fig. 2, but illustrating the clamping means moved into cable releasing position.

Fig. 4 is a top plan view of the bushing assembly as seen in Fig. 1 with portions broken away for purposes of illustration.

Fig. 5 is a transverse sectional view taken as on the line V—V of Fig. 2.

Fig. 6 is a view similar to Fig. 5 with the bushing assembly rotated 120 degrees from the position of Fig. 5.

Fig. 7 is a transverse sectional view taken as on the line VII—VII of Fig. 2; and

Fig. 8 is a transverse sectional view taken as on the line VIII—VIII of Fig. 2.

Referring now to the drawings in which the various parts are indicated by numerals, the terminal bushing assembly **10** of the present invention is illustrated as mounted in an opening formed in a side wall **11** of a transformer casing **13**. The bushing assembly **10** includes a bushing body **15**, preferably of porcelain or other suitable non-conductive material.

Bushing body **15** is provided with an inner bore or chamber **17** which extends from the inner end of the bushing body throughout a substantial portion of the length of the body. At its outer end the body **15** is provided with an additional bore or chamber **19** which is outwardly open. The chambers **17**, **19** are preferably separated by a shoulder **21**, the shoulder being preferably centrally bored axially of the bushing body to provide communication between the inner and outer chambers **17**, **19**. Externally body **15** is provided with an annular flange **23** which is adapted to seat in adjacency to casing side wall **11**, a suitable sealing gasket **25** being interposed between flange **23** and side wall **11** to effect seal of the bushing entrance into the casing side wall.

Adjacent its inner end and beyond flange **23** body **25** is provided with a peripheral groove **26** in which is seated a retainer spring **27** engaging and retaining a ring **29** which surrounds body **15** against removal from the body, ring **29** being preferably undercut as at **30** to closely fit spring **27**. Ring **29** is preferably apertured to receive a plurality of bolts **31** which are provided with lock nuts **32** and lock washers **33**. The bushing body is anchored to the casing side wall **11** by bolts **31**, the bolts being extended through ring **29** into engagement with the inner face of side wall **11** and bearing thereagainst, pulling shoulder **23** and gasket **25** into tight sealing engagement with the side wall.

Mounted in bushing body **15** is an integral connector element **35** which is formed of suitable conductive metal, such as a suitable grade of silicon bronze or the like and which is adapted to have a transformer lead connected to it and to engage an incoming cable to effect electrical communication between the cable and lead. Connector **35** includes an outer terminal portion **37** and an inner stem portion **39** which is of reduced diameter relative to the diameter of the terminal portion. Externally terminal portion **37** is threaded as at **41**, and, internally, adjacent its outer end, it is chambered as at **43**, chamber **43** terminating at its inner end in an annular shoulder **45**, Fig. 3.

Inwardly from and in communication with chamber **43**, terminal **37** is longitudinally channelled to provide a guideway **47** extending substantially throughout the remainder of the length of terminal **37** and preferably being of substantially rectangular cross section. Terminal **37** is longitudinally slotted as at **49** through its material to provide access to guideway **47**. The terminal is additionally slotted as at **50** substantially perpendicularly to slot **49** for similar purpose. Additionally the terminal **37** is transversely bored along an axis

perpendicular to the plane of slot 49 to provide opposite cable openings 51, the cable openings communicating with slot 50 and extending through the material of terminal 37.

At the junction between terminal 37 and stem 39, connector 35 includes a disc-like annular flange 53 which is annularly grooved as at 54 to receive and retain a sealing gasket 55. Preferably connector 35 includes a pair of diametrically opposed minor length ribs 57 which lie along a minor portion of stem 39. At its distal end stem 39 is externally threaded as at 59 and the stem includes an internally threaded socket 60 in its distal end.

Threadedly engaged with the externally threaded terminal is an internally threaded, closed-end, hollow sleeve or cap 61, to the exterior of which is preferably fixed a protective cap 63, cap 63 being preferably of a non-conductive material, such as one of the suitable phenolic plastics or other suitable material. Preferably the cap 63 is of a size to extend radially beyond the open outer end of chamber 19 formed in bushing body 15. Sleeve 61 is internally undercut so that outwardly of the threaded end portion of sleeve 61 the sleeve is spaced from the threads of terminal 37.

Seated on inner shoulder 45 of terminal 37 is a centrally apertured retainer ring 65 through which extends a central plunger 67, the head of plunger 67 being seated against the inner surface of closed sleeve 61, the sleeve 61 being preferably provided with means, such as an annular boss 68, for preventing lateral movement of the plunger relative to the sleeve. Interposed between retainer ring 65 and the head of plunger 67 is a compression spring 69 urging movement of the plunger toward the inner surface of closed sleeve 61.

Beyond retainer ring 65 an eyelet block 71 is connected to plunger 67, eyelet block 71 preferably being provided with a threaded socket and the distal end of plunger 67 being externally threaded and engaged with the socket of the eyelet block. The eyelet block is of a size and shape to closely and slidably fit guideway 47 and the eyelet block is transversely bored as at 73 to provide an eyelet as a cable receiving opening which may be moved into register with terminal cable openings 51 for the insertion of a cable end therethrough. Preferably eyelet block 71 at its inner end includes integrally formed tab members 75 which extend transversely beyond the limits of the eyelet block and when mounted in terminal 37, extend into terminal cable openings 51 and provide means for limiting the travel of the eyelet member, as well as furnishing additional conductive surface for engaging with an inserted cable end.

Additionally terminal 37 adjacent its outer end is slotted as at 77 through the material of the terminal, and in slot 77 is loosely and slidably mounted a key 79 which is adapted for gravity-operation. Preferably key 79 is of substantially arcuate shape and is adapted, when terminal 37 is turned to position slot 77 facing downwardly, to drop through slot 77 and seat against the undercut portion of closed sleeve 61, thus extending radially beyond the threads of terminal 37 and preventing relative movement of the cap and sleeve therebeyond.

In the assembly of the device eyelet block 71 is introduced through longitudinal slot 49 into guideway 47, cross slot 50 providing for the entry of tabs 75 therewith. Plunger 67, surrounded by spring 69, is inserted through the central aperture of retainer ring 65 and engaged with eyelet block 71, preferably in the manner described. Sleeve 61 with cap 63 may then be engaged with the exterior threads of terminal 37 and with the terminal positioned so as to retain key 79 within slot 77, the cap and sleeve 61 may be rotated and run down beyond slot 77. Thus the connector and the spring-operated eyelet, together with the protective cap, are assembled together.

Connector stem 39 is then inserted through the central bore formed in shoulder 21, the bore being preferably radially undercut to accommodate terminal ribs 57, the ribs effectively keying the connector to the bushing body against relative rotation. Gasket 55 is brought into engagement with the outer face of shoulder 21. A washer 81 is passed over the threaded end of stem 39 and a nut 83 is engaged with the external threads of stem 39 and is moved into tight fitting engagement with the inner face of shoulder 21, thus fixing the connector to the bushing body against withdrawal. When so positioned it will be observed that it is preferred that slot 77 of terminal 37 be positioned downwardly so that key 79 drops by gravity beyond the threads of terminal 37 as described.

The threaded end of a lead stud 85, to which is attached a transformer lead 87, is then threadedly engaged with the threaded socket 60 formed in the distal end of stem 39, thus electrically connecting lead 87 to terminal 37. Bushing body 15 is preferably provided with a pair of diametrically opposed cable apertures 89 which are in transverse alinement with terminal cable openings 51 for selective introduction of a cable end to the connector from the exterior. Preferably bushing body 15 is additionally provided with a further aperture 91 disposed substantially ninety degrees from the cable apertures 89 and providing for the reception and housing of a suitable spark rod 93, the wall of terminal 37 being apertured substantially diametrically opposite to longitudinal slot 49 as at 95, the aperture 95 being internally threaded and spark rod 93 being externally threaded and engaged therewith.

With the terminal bushing assembly thus mounted on casing 13, an incoming cable 97 is to be introduced thereto. In so doing cap 63 is rotated, running the cap and sleeve 61 inwardly along threaded terminal 37, effecting inward movement of plunger 67, and apertured eyelet block 71 carried thereby, against the action of spring 69, this movement being continued until the eyelet block seats against disc-like annular flange 53, thus preventing further inward movement of eyelet block 71 and moving the eyelet cable opening 73 into registry with the terminal cable openings 51. With the openings thus in registered alinement an exposed end of incoming cable 97 may be inserted through a selected bushing body aperture 89 and extended through the alined eyelet and terminal cable openings. With the cable end thus inserted in the alined cable openings, cap 63 is reversely rotated, backing the cap and sleeve 61 along threaded terminal 37, relaxing the force exerted on spring 69, the spring urging the plunger 67 and eyelet block 71 outwardly and effecting a tight clamping engagement of the inserted cable end, the tabs 75 effecting a contact of substantial area and the cable end being moved firmly against the outer portion of terminal cable opening 51. Reverse rotation of the cap is continued until the threaded portion of sleeve 61 moves into engagement with gravity-positioned key 79 by which further backing off movement of the cap and sleeve is prevented.

As shown in the drawings, when the cap and sleeve have thus been backed off along the terminal the entire clamping of the cable end is effected by the action of spring 69, the sleeve 61 having been moved away from engagement of plunger 67 and exerting no influence thereon. As is apparent in the event of wear or other change in the condition of the inserted cable end, the spring is fully effective to maintain firm clamping engagement and electrical contact with the cable end and that the same is accomplished without effecting crimping or other deformation of the cable end, it being particularly noted that since the eyelet block tabs 75 extend into the terminal cable openings 51, there is no tendency to bend the cable end between the eyelet and the terminal.

It will further be observed that since the elements of connector **35**, eyelet block **71**, plunger **67**, and closed sleeve **61** are all formed of conductive material, a superior electrical connection is effected between incoming cable **97** and transformer lead **87**. It will also be observed that the gravity-operated key **79** is completely effective to prevent accidental removal of cap **63** and sleeve **61** from terminal **37**. When, however, it becomes necessary for any reason to remove the cap and sleeve from the terminal the bushing assembly may be rotated approximately one hundred eighty degrees, moving slot **77** to an upper position and causing key **79** to drop by gravity into slot **77**, thus removing from the threads of terminal **37** the previously existing limit and freeing the cap and sleeve for removal from the terminal.

I claim:

1. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body extending from an outer portion of said body to an inner portion of said body and including means for electrically coupling a lead, said connector in said outer portion including an externally threaded hollow terminal, internally threaded cap means engaged with and enclosing the outer end of said terminal, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block and extending toward said cap means, spring means urging said plunger and block outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured to provide a cable opening adapted to register with said terminal openings for said cable insertion, threaded advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger and block against said spring means urging inwardly toward registering alinement of said cable openings, limit means carried by said terminal blocking shift of said block inwardly beyond cable opening registry, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said block away from said limit means to clampingly engage a cable end inserted into said cable openings when registered, said block including transversely extending tabs adjacent the inner portion of said block cable opening, said tabs being of a length to project into said terminal cable openings to extend contact along an inserted cable end and prevent crimping and shearing of such a cable end, and means limiting cap means retracting to prevent removal of said cap means from said terminal.

2. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body extending from an outer portion of said body to an inner portion of said body and including means for electrically coupling a lead, said connector in said outer portion including an externally threaded hollow terminal, internally threaded cap means engaged with and enclosing the outer end of said terminal, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block and extending toward said cap means, spring means merging said plunger and block outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured to provide a cable opening adapted to register with said terminal openings for said cable insertion, threaded advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger and block against said spring means urging inwardly toward registering alinement of said cable openings, limit means carried by said terminal blocking

shift of said block inwardly beyond cable opening registry, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said block away from said limit means to clampingly engage a cable end inserted into said cable openings when registered, said block including transversely extending tabs adjacent the inner portion of said block cable opening, said tabs being of a length to project into said terminal cable openings to extend contact along an inserted cable end and prevent crimping and shearing of such a cable end.

3. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body, said connector including an externally threaded hollow terminal, internally threaded cap means engaged with and enclosing the outer end of said terminal, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block and extending toward said cap means, spring means urging said plunger and block outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured to provide a cable opening adapted to register with said terminal openings for said cable insertion, threaded advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger and block against said spring means urging inwardly toward registering alinement of said cable openings, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said block toward said cap means to clampingly engage a cable end inserted into said cable openings when registered, said block including transversely extending tabs adjacent the inner portion of said block cable opening, said tabs being of a length to project into said terminal cable openings to extend contact along an inserted cable end and prevent crimping and shearing of such a cable end, and means for coupling said connector to an electrical lead.

4. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body, said connector including an externally threaded hollow terminal, internally threaded cap means engaged with and enclosing the outer end of said terminal, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block and extending toward said cap means, spring means urging said plunger and block outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured to provide a cable opening adapted to register with said terminal openings for said cable insertion, threaded advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger and block against said spring means urging inwardly toward registering alinement of said cable openings, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said block toward said cap means to clampingly engage a cable end inserted into said cable openings when registered, and means for coupling said connector to an electrical lead.

5. In a terminal bushing assembly, a horizontally extending, externally threaded terminal, a screw cap mounted on and enclosing the outer end of said terminal, said cap including a threaded portion adjacent its inner end threadedly engaging said terminal and outwardly therefrom being spaced away from said terminal, said terminal adjacent its outer end being cut out to form a slot

spaced inwardly from the outer end of said terminal and being radially outwardly open, a curved key shiftably mounted in said slot and being gravity biased for shift relative to said terminal, said key extending beyond the threads of said terminal into contact with said cap when said terminal is positioned with said slot downward and blocking disengagement of said cap from said terminal, rotation of said terminal to position said terminal with said slot upward moving said key by gravity to return within said slot and remove key blocking of cap disengagement.

6. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body, said connector including a hollow terminal spaced at its outer end from said body, cap means advanceably and retractably engaged with and enclosing the outer end of said terminal in the space between said terminal and said body, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block, spring means urging said plunger outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured inwardly from said cap means to provide a cable opening adapted to register with said terminal openings for said cable insertion, advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger against said spring means urging inwardly toward registering alinement of said cable openings, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said plunger and block toward said cap means to clampingly engage a cable end inserted into said cable openings when registered.

7. In a terminal bushing assembly for transformers which includes a non-conductive bushing body adapted for mounting in a transformer casing, a conductive connector within said body, said connector including a hollow terminal spaced at its outer end from said body, cap means advanceably and retractably engaged with and enclosing the outer end of said terminal in the space between said terminal and said body, a block slidably mounted in said terminal for movement longitudinally of said terminal, a plunger connected to said block, spring means urging said plunger outwardly toward said cap means, said terminal being transversely apertured inwardly from said cap means to provide cable openings for receiving endwise insertion of an incoming cable end, said block being transversely apertured inwardly from said cap means to provide a cable opening adapted to register with said terminal openings for said cable insertion, advancement of said cap means inwardly along said terminal engaging said plunger and shifting said plunger against said spring means urging inwardly toward registering alinement of said cable openings, retraction of said cap means outwardly along said terminal releasing engagement of said plunger, said spring means effecting shift of said plunger and block toward said cap means to clampingly engage a cable end inserted into said cable openings when registered, and means for coupling said connector to an electrical lead.

8. In a terminal bushing assembly, a horizontally extending terminal, a cap mounted on and enclosing the outer end of said terminal, said cap including a portion adjacent its inner end engaging said terminal and outwardly therefrom being spaced away from said terminal, said terminal being cut out to form a slot spaced inwardly from the outer end of said terminal and being radially outwardly open, a key shiftably mounted in said slot and being gravity biased for shift relative to said terminal, said key extending beyond the periphery of said terminal into contact with said cap when said terminal is positioned with said slot downward and blocking disengagement of said cap from said terminal, rotation of said terminal to position said terminal when said slot upward moving said key by gravity to return within said slot and remove key blocking of cap disengagement.

9. In a terminal bushing assembly, a substantially horizontally extending terminal, a cap mounted on and enclosing the outer end of said terminal, said cap including a portion adjacent its inner end engaging said terminal and outwardly therefrom being spaced away from said terminal, a key shiftably mounted in the material of said terminal inwardly from the outer end of said terminal and being gravity biased for shift relative to said terminal, said key extending beyond the material of said terminal into contact with said cap when said terminal is positioned with said key downward and blocking disengagement of said cap from said terminal, rotation of said terminal to position said terminal with said key upward moving said key by gravity to return within said terminal and remove key blocking of cap disengagement.

10. In a terminal bushing assembly, a substantially horizontally extending, externally threaded terminal, a screw cap mounted on and enclosing the outer end of said terminal, said cap including a threaded position adjacent its inner end threadedly engaging said terminal and outwardly therefrom being spaced away from said terminal, said terminal being cut out to form a slot spaced inwardly from the outer end of said terminal and being radially outwardly open, a key shiftably mounted in said slot and being gravity biased for shift relative to said terminal, said key extending beyond the threads of said terminal into contact with said cap when said terminal is positioned with said slot downward and blocking disengagement of said cap from said terminal, rotation of said terminal to position said terminal with said slot upward moving said key by gravity to return within said slot and remove key blocking of cap disengagement.

11. In a terminal bushing assembly for transformers which includes a non-conductive bushing body, an electrically conductive connector within said body, said connector including a threaded hollow terminal apertured to provide openings for loosely receiving a cable end inserted therein, plunger means slidably mounted in said terminal and apertured adjacent its inner end to provide an opening for loosely receiving a said cable end, said plunger means being shiftable inwardly to register the openings in said plunger means and said terminal, a cable end inserted through said openings, spring means within said terminal engaging said plunger means and urging said plunger outwardly, said plunger means clampingly engaging said cable end received in said openings, threaded cap means threadedly engaging said threaded terminal, said cap means being threadedly advanceable inwardly along said terminal into engagement with the outer end of said plunger means to effect inward shift of said plunger means, and said cap means being threadedly retractable outwardly along said terminal to free said plunger means to clampingly engage said cable end, said cap means being spaced outwardly away from said plunger means outer end when said plunger means so engages said cable end.

12. In a terminal bushing assembly for transformers which includes a non-conductive bushing body, an electrically conductive connector within said body, said connector including a threaded hollow terminal apertured to provide openings for loosely receiving a cable end inserted therein, plunger means slidably mounted in said terminal and apertured adjacent its inner end to provide an opening for loosely receiving a said cable end, said plunger means being shiftable inwardly to register the openings in said plunger means and said terminal, a cable end inserted through said openings, spring means within said terminal engaging said plunger means and urging said plunger outwardly, said plunger means clampingly engaging said cable end received in said openings,

threaded cap means threadedly engaging said threaded terminal, said cap means being threadedly advanceable inwardly along said terminal into engagement with the outer end of said plunger means to effect inward shift of said plunger means, and said cap means being threadedly retractable outwardly along said terminal to a position in which said plunger means clampingly engages said cabic end and said cap means is spaced outwardly away from said plunger means outer end, and limit means

blocking retraction of said cap means outwardly beyond said position.

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