Aug. 19, 1969 E. WINSTON 3,462,539

GROUND BUSHING

Filed July 15, 1966

Fig.1.

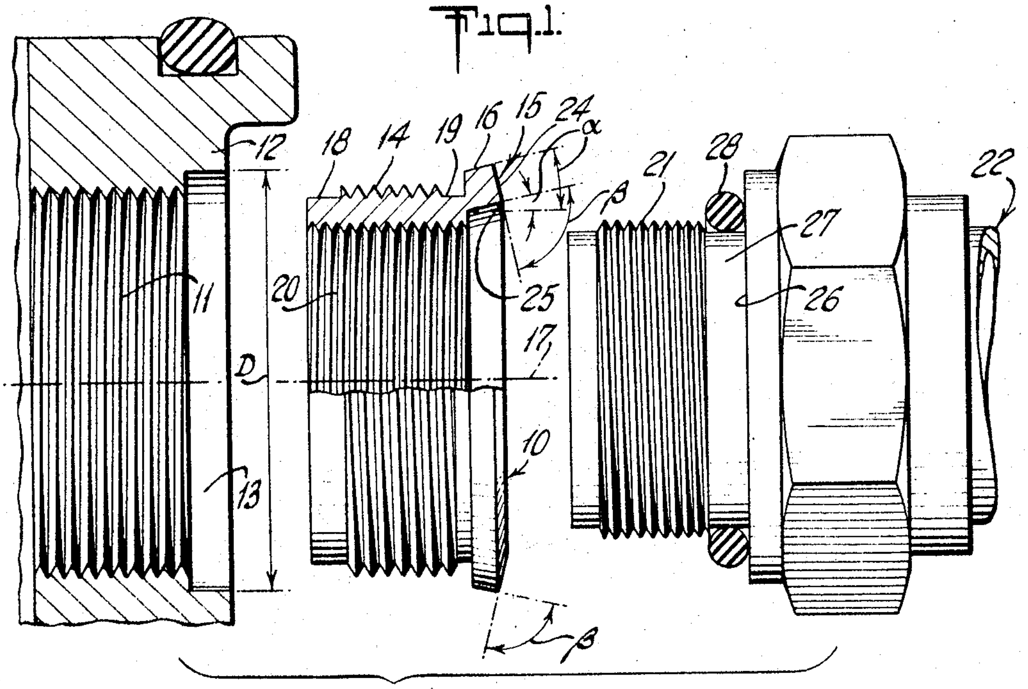


Fig.2.

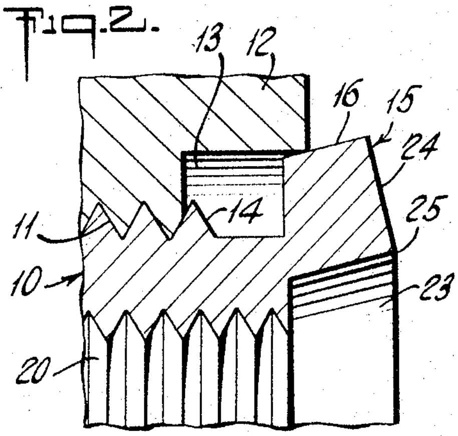


Fig.3.

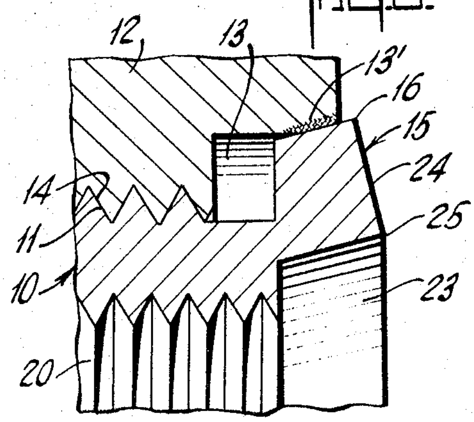
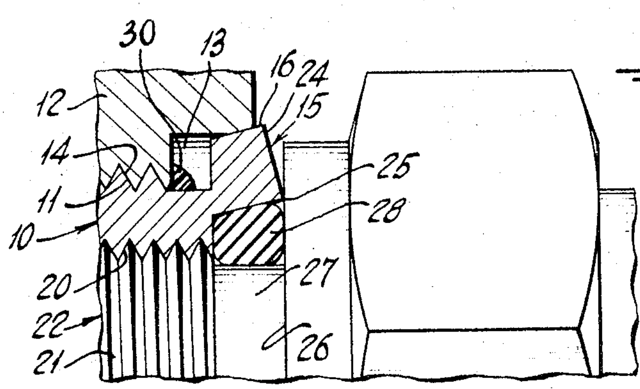


Fig.4.



INVENTOR
ERIC WINSTON
BY
Hopgood & Calimafde
ATTORNEYS

United States Patent Office

3,462,539

Patented Aug. 19, 1969

1

2

3,462,539

GROUND BUSHING

Eric Winston, Melrose Park, Pa., assignor to Jerrold Electronics Corporation, Philadelphia, Pa., a corporation of Delaware

Filed July 15, 1966, Ser. No. 565,534

Int. Cl. H02g 3/18; F16l 41/00, 5/00

U.S. Cl. 174—65 9 Claims

ABSTRACT OF THE DISCLOSURE

The invention contemplates a flanged insert of relatively hard metal threaded into tight permanent metal-displacing engagement with a wall opening in an electrical-equipment case of relatively soft metal. The metal-displacing binding electrically-grounding engagement occurs between a narrowly tapering or wedging outer surface on the flange, as it interferes with a right-cylindrical counterbore of the case opening. The axially outer end of the insert is also so formed as to define an axially projecting circumferential ridge for tight electrically conducting line-contact with the radial flange of a connector element fitted to the insert.

This invention relates to a threaded insert, of the variety used to provide electrical-connector access to and through the wall of a metal housing for electrical equipment.

In the past, some inserts of the character indicated have comprised bushings force-driven into permanent fitted position in the wall of a junction box or other electrical-equipment case. Other such inserts have been externally threaded, and reliance has been placed on the security of attachment to the case, by deliberately forming the case aperture so that an interference fit with the threads is necessary. I have found these and other approaches to be unsatisfactory for certain electronic applications, as where the most reliable, weather-tight, vibration-resistant, electrically grounded relation must be established between the case and the threaded bushing.

It is, accordingly, an object of the invention to provide an improved insert of the character indicated.

It is a specific object to provide an improved insert of the character indicated, wherein electrical grounding contact is circumferentially uniform and continuous, for a range of tolerance variations in the formation of the receiving opening in the case, and particulary effective as an R-F (radio-frequency) grounding element.

Another specific object is to meet the above objects with a structure which is inherently weather-sealed and highly resistant to other environmental conditions, such as mechanical vibration.

Still another specific object is to form such an improved insert with means inherently establishing a weather-sealing, good-grounding connection between the insert and the electrical fitting which is ultimately applied to the insert.

It is a general object to meet the foregoing objects with a structure which is inherently simple, easy to fabricate, and which in particular lends itself to precision mass-production installation, under controlled stressed conditions.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, a preferred form of the invention:

FIG. 1 is an exploded view in elevation of parts incorporating features of the invention, certain parts being broken away and shown in longitudinal section;

FIG. 2 is an enlarged fragmentary longitudinal sectional view of an insert of the invention, in the process of assembly to the wall of a case;

FIG. 3 is a view similar to FIG. 2, upon assembly of the insert to the case; and

FIG. 4 is a view similar to FIG. 3, upon assembly of a connector fitting to the installed insert.

Briefly stated, the invention contemplates a flanged insert of relatively hard metal threaded into tight permanent metal-displacing engagement with a wall opening in an electrical-equipment case of relatively soft metal. The metal-displacing binding and electrically-grounding engagement occurs between a narrowly tapering or wedging outer surface on the flange, as it interferes with a right-cylindrical counterbore of the case opening. The axially outer end of the insert is also so formed as to define an axially projecting circumferential ridge for tight electrically conducting line-contact with the radial flange of a connector element fitted to the insert.

Referring to the drawings, the invention is shown in application to a threaded bushing or insert **10** to be permanently secured to the tapped hole or opening **11** in the wall **12** of an electrical equipment case or box. The bore **11** is formed with a counterbore **13** at the outer end, having a right-cylindrical surface of diameter D exceeding the maximum diametral extent of the threads of bore **11**. The case **12** is of relatively soft metal, such as cast aluminum.

The insert **10**, on the other hand, is of relatively hard metal, such as stainless steel. It is provided with external threads **14** to engage the threads in bore **11**, and it is formed at its axially outer end with a radially outwardly directed flange **15** having an outer surface **16** which is tapered for wedging interference engagement with the cylindrical counterbore **13**. The entire outer surface **16** is of greater diameter than the maximum diameter of threads **14**; also, the inner and outer diameters of surface **16** straddle the diameter of counterbore **13**, regardless of tolerance variations. The divergence of taper surface **16** with respect to the insert axis **17** is designated α and is in the range of 9° to 15°, being preferably 12° where the case metal is cast aluminum and the insert metal is stainless steel. For simplified assembly, i.e., for self-piloting initial alignment, the insert threads **14** extend outwardly from an axially inner cylindrical land **18**, and for ease of fabrication, threads **14** and flange **15** are spaced by a similar land **19**.

The insert bore **20** is shown threaded, for reception of the external threads **21** of a connector fitting **22**. At the axially outer end of bore **20**, i.e., beneath or within flange **15**, a counterbore **23** is formed, tapering with essentially the slope of surface **16**. Counterbore **23**, throughout its tapering surface, exceeds the maximum diametral extent of the bore threads **20**. Finally, the axially outer limit of insert **10** is defined by a hard, sharp ridge **25**, established by intersection of counterbore taper **23** with a converging end-face taper **24**. The convergence of face **24** is preferably at substantially a right angle (suggested at β) with respect to the inner and outer tapers **16–23**, as viewed in a longitudinal section.

The assembly of insert **10** to threaded opening **11** is best illustrated in FIGS. 2 and 3. Rotary drive to insert **10** is imparted by a suitable tool (not shown) threaded to the insert bore **20**. Driving torque is continuously applied after initial contact between taper surface **15** and counterbore **13**, producing physical displacement of the softer metal by the harder metal as friction and local heat develop over the surface; rotary drive continues until a predetermined limiting torque is reached, as by using conventional torque-limited power wrench of the impact variety. This metal-displacing action will be seen to dispose of aluminum axide at the resulting tapered interface (see FIG. 3) and an optimum metallic-aluminum to metallic-stainless-steel bond and electric contact are achieved under circumferentially continuous controlled stress, symbolically suggested by crosses at the region **13'**. The ultimate fit of the insert **10** places the outer end taper **24** virtually in flush alignment with the outer flat wall surface of the case **12**, leaving the ridge projection **25** extending sufficiently axially outwardly to permit assured driven contact with the radial flange surface **26** of the connector fitting **22**.

Connector **22** is shown with an outwardly facing groove **27** in which an elastomeric seal ring, such as O-ring **28**, is located, between threads **21** and radial flange surface **26**. It will be appreciated that, on take-up of threads **21–20**, ring **28** is compressed by counterbore taper **23**, thus providing a secondary seal, but that the biting action of ridge **25** into the radial connector surface **26** establishes a primary sealing, securing and grounding action.

It will be seen that I have described an improved grounding or other electrical-connection insert of the character indicated, achieving the foregoing objects, and lending itself to accurately reproducible effectiveness with mass-production techniques using power tools, such as an impact wrench, for assembly purposes.

A superior R-F ground is assuredly established with my insert, even when sealant is applied to eliminate any possible airflow through the installed insert-to-case connection, under the most extreme diurnal temperature fluctuations. For example, although not shown in the drawings, it will be appreciated that, upon hard-driven take-up of the thread engagement at **11–14**, a spiral passage for possible air or other gas flow will be established by normal clearance behind the tightened threads; this clearance is preferably completely filled by a suitable sealant, which may be an anaerobic or other hardenable flexible liquid, applied initially to the external insert threads **14**. As the insert is driven into home position, excess sealant (suggested at **30** in FIG. 4) is accommodated within counterbore **13**, without contacting or in any way interfering with the direct and intimate metal-to-metal grounding contact at **16–13'**.

While I have described the invention in detail for the preferred form shown, it will be understood that modification may be made without departing from the scope of the invention.

I claim:

1. In combination, a case of relatively soft metal and having a threaded bore through a wall thereof, said bore having a counterbore at the axial outer end, said counterbore being initially formed with a right-cylindrical peripheral wall of diameter exceeding the maximum diameter of the threaded bore; an insert sleeve of relatively hard metal having a cylindrical body with external threads engaged to the threads of said bore, said sleeve being internally threaded and formed at its axially outer end with a radially outwardly extending flange, the radially outer surface of said flange tapering from an axially inner end at a diameter less than that of said counterbore and diverging to an axially outer end at a diameter greater than that of said counterbore, said tapered outer surface being so engaged to said counterbore as to displace substantial adjacent counterbore metal and to cause said counterbore to assume the tapered contour of said flange, the axially outer end of said flange being conically tapered, the axially outer end of the sleeve bore being tapered, the sleeve-bore taper and the axially outer end taper being divergent in opposite directions and intersection in a relatively sharp circumferentially continuous circular ridge which constitutes the axially outer limit of said sleeve; and a threaded connector engaged to the sleeve-bore threads, said connector including an outwardly directed radial flange surface in circumferentially continuous engagement with said ridge.

2. The combination of claim **1**, in which said case is of cast aluminum.

3. The combination of claim **1**, in which said sleeve is of stainless steel.

4. The combination of claim **1**, in which said connector has a circumferentially extending radially outwardly facing groove between said radial surface and the threads of said connector, and an elastomeric ring in said groove and compressed by and beneath the adjacent sleeve-bore taper.

5. The combination of claim **1**, in which the axial depth of the counterbore is such in relation to the interference fit of said flange thereto that an axially extending annular clearance is defined between the axially inner end of said flange and the axially inner end of the counterbore, whereby excess sealant applied to said threads, and squeezed-out as the insert is taken-up into the threaded bore, may be accommodated in said clearance without impairing the direct and intimate metal-to-metal grounding contact at the interference fit of said flange.

6. In combination, a case of relatively soft metal and having a threaded bore through a wall thereof, said bore having a counterbore at the axial outer end, said counterbore being initially formed with a cylindrical peripheral wall of diameter exceeding the maximum diameter of the threaded bore; an insert sleeve of relatively hard metal having a cylindrical body with external threads engaged to the threads of said bore, said sleeve being formed at its axially outer end with a radially outwardly extending flange, the radially outer surface of said flange tapering from an axially inner end at a diameter less than that of said counterbore and diverging to an axially outer end at a diameter greater than that of said counterbore, said tapered outer surface being so engaged to said counterbore as to displace substantial adjacent counterbore metal and to cause said counterbore to assume the tapered contour of said flange upon threaded take-up of said sleeve in the bore of said case, said sleeve having a bore including internal threads, the axially outer end of said flange being conically tapered to an axially outer end at intersection with the sleeve bore, thereby defining a circumferentially continuous circular ridge which constitutes the axially outer limit of said sleeve; and a threaded connector engaged to the sleeve-bore threads, said connector including an outwardly directed radial flange in circumferentially continuous engagement with said ridge upon threaded take-up of said connector in the bore of said sleeve.

7. The combination of claim **6**, in which the taper of the radially outer surface of said flange is at an angle of 9 to 15 degrees divergence with respect to the sleeve axis.

8. The insert of claim **7**, in which the divergence of said taper is substantially 12 degrees.

9. In combination, a case of relatively soft metal and having a threaded bore through a wall thereof, said bore having a counterbore at the axial outer end, said counterbore being initially formed with a cylindrical peripheral wall of diameter exceeding the maximum diameter of the threaded bore; an insert sleeve of relatively hard metal having a cylindrical body with external threads engaged to the threads of said bore, said sleeve being formed at its axially outer end with a radially outwardly extending flange, the radially outer surface of said flange tapering from an axially inner end at a diameter less than that of said counterbore and diverging to an axially outer end at a diameter greater than that of said counterbore, said tapered outer surface being so engaged to said counterbore as to displace substantial adjacent counterbore metal and to cause said counterbore to assume the tapered contour of said flange upon axially-stressed threaded take-up of said sleeve in the bore of said case, said sleeve having a bore including internal threads, the axially outer end of said flange being conically tapered to an axially outer end at intersection with the sleeve bore, thereby defining a circumferentially continuous circular ridge which constitutes the axially outer limit of said sleeve, whereby said ridge presents a circumferentially continuous electrical grounding contact for the radial flange of a flanged electrical connector when threaded into axially-stressed relation with said sleeve.

References Cited

UNITED STATES PATENTS

2,254,502	9/1941	Thomas	285—39
3,128,386	4/1965	Bynum	151—41.73

FOREIGN PATENTS

500,583	3/1954	Canada.

THOMAS F. CALLAGHAN, Primary Examiner

U.S. Cl. X.R.

151—41.73; 285—158, 173, 212, 334.4, 335, 357