

Sept. 17, 1946.

J. ROSAN

2,407,904

METHOD OF REMOVING AND REPLACING INSERTS

Filed June 9, 1943

3 Sheets-Sheet 1

Fig. 2.

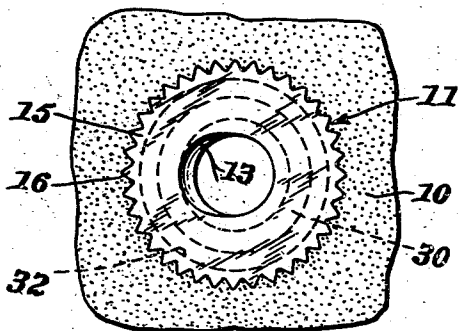


Fig. 3.

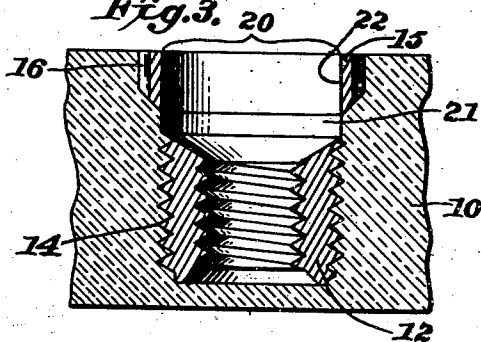


Fig. 4.

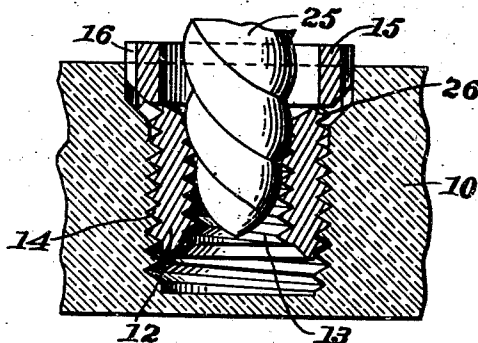


Fig. 1.

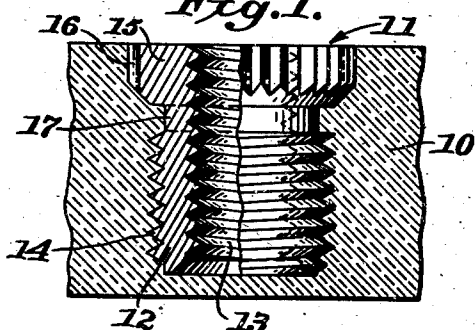


Fig. 5.

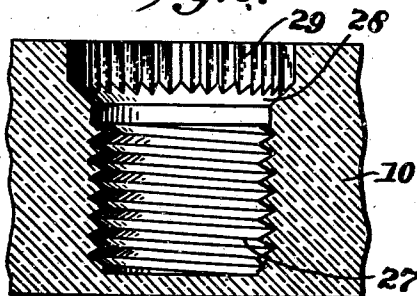


Fig. 6.

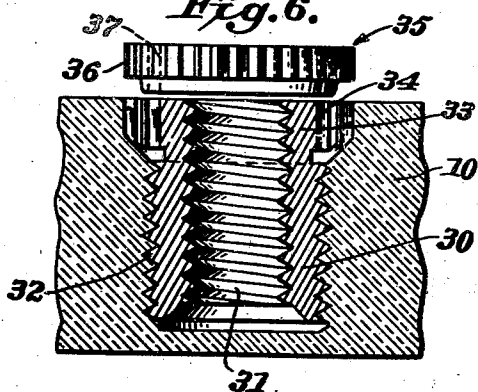
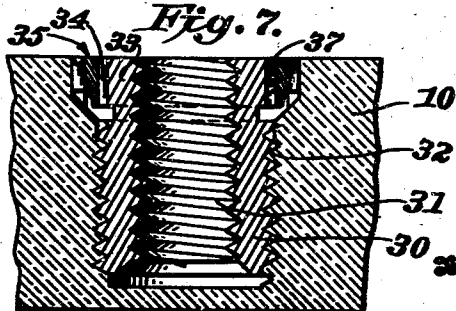


Fig. 7.



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Sept. 17, 1946.

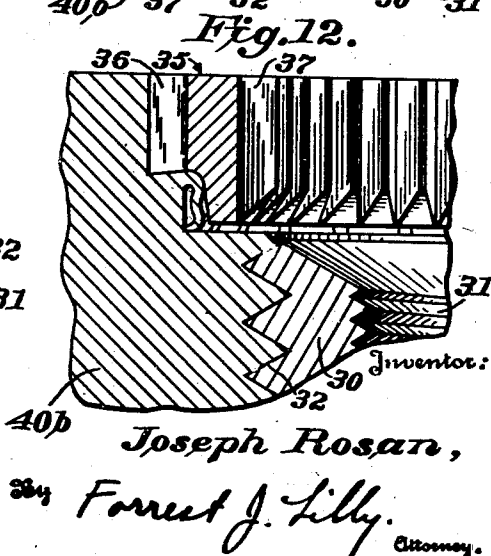
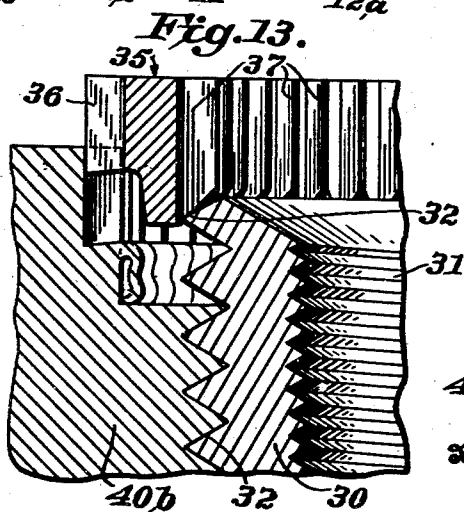
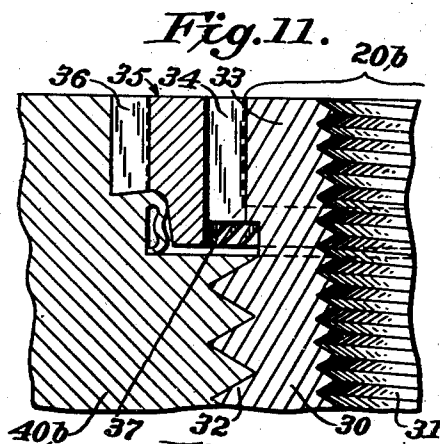
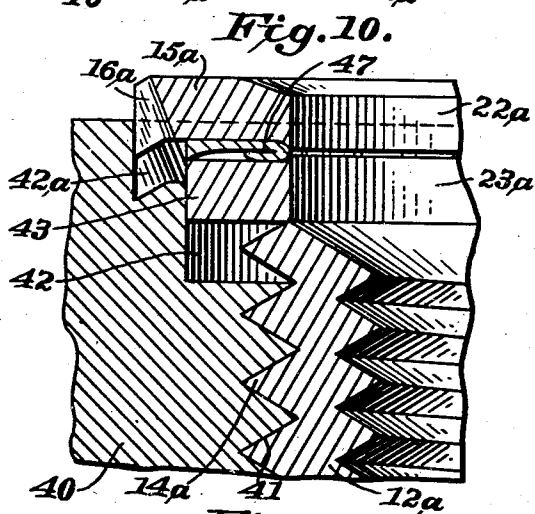
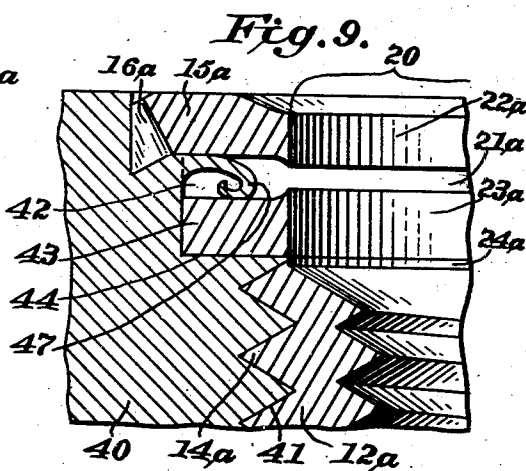
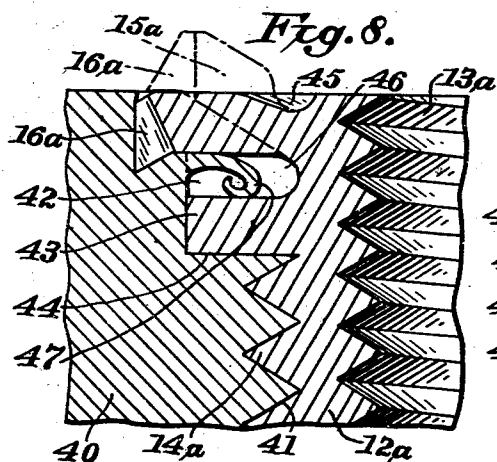
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3 Sheets-Sheet 2



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Fig. 14.

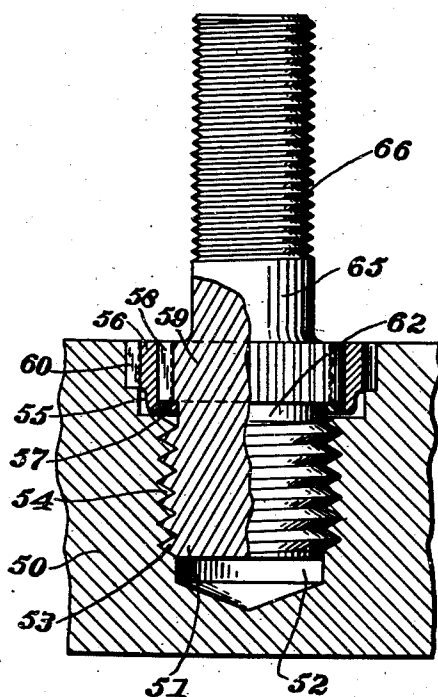


Fig. 15.

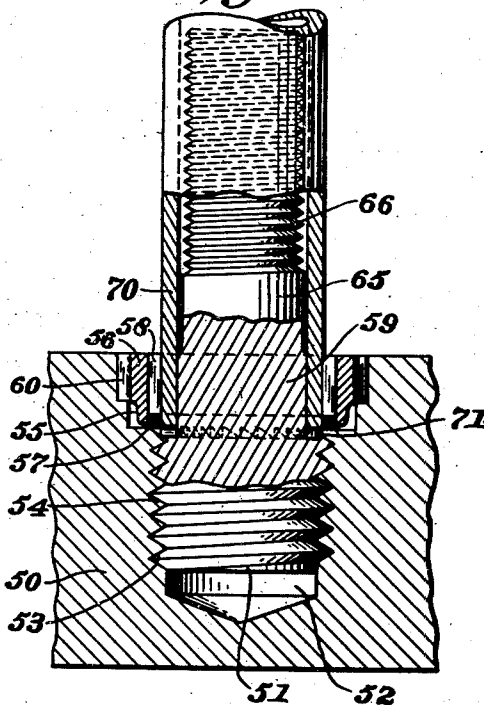


Fig. 16.

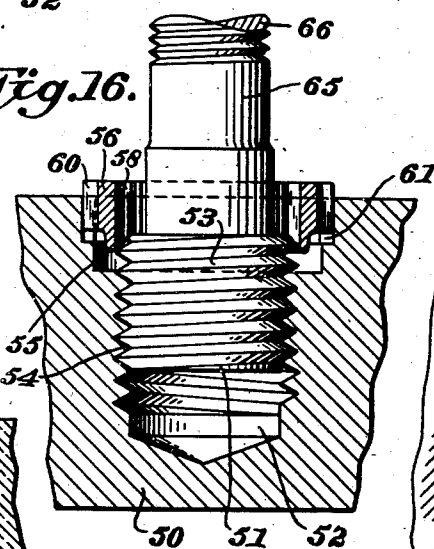


Fig. 17.

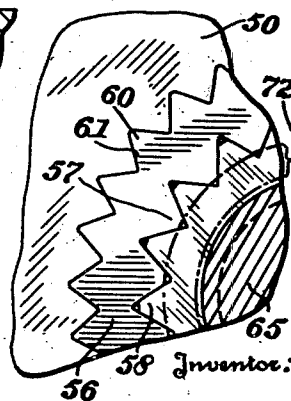
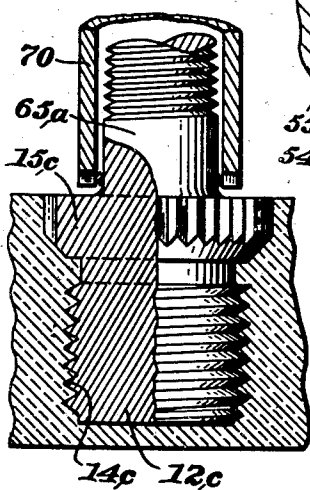


Fig. 18.



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UNITED STATES PATENT OFFICE

2,407,904

METHOD OF REMOVING AND REPLACING
INSERTS

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Application June 9, 1943, Serial No. 490,200

1 Claim. (Cl. 29—148)

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This invention relates generally to method of removing and replacing inserts designed for anchorage in bodies of relatively soft materials, for such typical purposes as making connections with such bodies, as for instance, providing a secure mounting for a screw threaded stud, bolt or the like in such a body.

With the recent advent of widely extended use of many types of relatively soft bodies in construction, particularly in the aircraft industry, the problem of providing secure connections or anchorages to such bodies has become acute and has received much attention. Such relatively soft bodies as are referred to herein, include relatively soft materials such as aluminum and magnesium alloys, "dural," wood and plastic materials such as synthetic resins and the like. The invention also contemplates certain special cases of materials usually considered as being fairly hard, such as steel, provided the insert or any portion thereof designed to cut into the material in question, be of still harder material. Particularly in the case of aircraft construction, where the fastening is subject to constant vibratory action, assurance must be provided that the insert will not loosen and fail either by longitudinal displacement or by rotation.

The invention of the present application provides a novel insert structure, normally restrained against accidental loosening or removal, even under the most severe conditions of use, and a novel method of removing inserts in the event that they become damaged, for replacement by a substitute insert of novel design and in accordance with a novel method.

In the aircraft industry, as well as in other industrial arts, it has heretofore been the practice to mould into plastic bodies, metallic inserts for the reception of studs, bolts, nuts and other connecting devices. The inserts have been embedded directly in the plastic material, during the moulding or casting thereof, and the inserts have been so shaped that they formed an intimate union with the material of the body, effectively preventing their removal. In many cases, constructions of this type have been satisfactory for their intended purposes, but difficulty has arisen when the inserts have become damaged by carelessness, accident, or excessively abusive usage. For instance, if the internal threads on a socketed insert become crossed, stripped or otherwise mutilated, no practical method or means have been known for removing the damaged inserts and replacing them with substitute inserts. As a result, the practice has been to discard

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the moulded plastic article with the defective insert and to substitute a new moulded article having a non-damaged insert therein. This practice, in the past, has resulted in tremendous waste and expense, since the moulded plastic articles are often large, complicated and expensive.

Heretofore, no one has devised an insert which could be held within a moulded or plastic body with sufficient rigidity to serve its intended purposes, yet which could be deliberately removed from the body if damaged, without damaging the body beyond repair. Moreover, prior to the present invention, it was impossible to replace such a damaged insert with a new insert which would be held within the body with substantially the same firmness as the original one. Inserts of the prior art have been secured in plastic bodies against longitudinal movement and relative rotation, by moulding the plastic material about their exterior surfaces, but with such constructions, the inserts could not be removed without materially damaging the bodies. When attempts were made to remove them by completely drilling them out, it was impossible to replace them with substitute inserts, since no construction was available which could be applied to the drilled-out hole to resist both longitudinal and rotational movement.

A further object of the invention is to provide a novel method of removing the inserts of the types described in my copending applications, referred to hereinafter, said inserts being of both the one-piece and two-piece types and including studs and socket members.

It must be understood, therefore, that the invention is not limited to an insert of the type adapted to be secured in a moulded or plastic body, although one embodiment has special application to that field, but is broader and covers new features of construction and method procedures irrespective of the type of material from which the body in which the insert is secured is made.

In the accompanying drawings, a number of embodiments of the invention are diagrammatically shown for purposes of illustration. Also, a number of methods of removing and replacing different types of inserts in different materials are diagrammatically illustrated. It must be understood, however, that the invention is not limited to the details of construction or to the procedural steps shown and described, since many modifications will readily occur to those skilled in the art from a consideration of this disclosure.

In the drawings:

Figure 1 is a vertical, longitudinal section partially in elevation showing one form of insert.

Figure 2 is a plan view of the insert of Figure 1.

Figure 3 is a vertical, longitudinal section of the insert of Figures 1 and 2, after the first step in the method of removal has been performed.

Figure 4 is a similar view illustrating the next step.

Figure 5 is a similar view showing the cavity left in the body after the insert has been removed.

Figure 6 is a similar view showing one step in the replacement of the removed insert by a substitute insert.

Figure 7 is a similar sectional view showing the substitute insert in place.

Figure 8 is a fragmentary vertical longitudinal section, on an enlarged scale, showing a modification.

Figure 9 is a similar view showing the first step in removing the insert of Figure 8.

Figure 10 is a similar view showing another step in the method of removal.

Figure 11 is a fragmentary vertical longitudinal section showing another form of insert.

Figure 12 is a similar view showing the condition of the parts after the first step in the method of removing this form of insert has been performed.

Figure 13 is a similar view indicating the next step.

Figure 14 is a vertical, longitudinal section, partially in elevation, showing a two-piece, stud type insert.

Figure 15 is a similar view showing a tool used in the first step in the method of removing such an insert, and the relation of parts after that step has been completed.

Figure 16 is a similar view showing the next step in the method of removal.

Figure 17 is a fragmentary plan and horizontal section of the insert of Figure 14, and

Figure 18 is a vertical longitudinal section, partially in elevation, showing a one-piece, moulded-in, stud type insert and a tool which may be employed in its removal.

Having reference first to Figures 1-7 of the drawings, a body of plastic material is represented at 10. Of course, this body may be of any suitable size and shape, for its intended purpose. In accordance with the first form of the invention, it is formed by being cast or moulded about the insert, represented generally at 11 and firmly embedded in the body 10.

The insert comprises a tubular shank 12 having internal threads 13 for the reception of a stud, bolt or the like and outwardly projecting external threads 14 embedded in the body 10. The insert further comprises a laterally enlarged head 15 having axially disposed serrations 16 on its outer circumference, similarly embedded in the body 10 during moulding. The head 15 is connected to the threaded shank 12 by a non-threaded shank section or neck 17 of reduced diameter. In the embodiment illustrated, the neck 17 is of a diameter substantially equal to the root diameter of the thread 14. It is important that this neck be of less diameter than the maximum diameter of the thread 14.

From a consideration of the structure shown in Figure 1, it will be apparent that the insert is restrained against relative longitudinal movement by the thread 14, fitting within a correspondingly shaped cavity in the body 10 and,

further, that the insert is restrained against relative rotation by the serrations 16 on the head 15, disposed within a correspondingly shaped cavity in the body. Hence, the insert is firmly anchored against any movement within the body and will serve as an efficient, internally threaded socket or bore for a stud, bolt or other attaching device.

In the event that the internal threads 13 of the body become mutilated, or if it should be desired to remove the insert for any other reason, the following procedure may be adopted. As shown in Figure 3, the interior bore of the insert may be drilled out on a diameter indicated at 20, to a depth sufficient to remove a substantial portion of the neck 17, as indicated at 21, thereby disconnecting the shank 12 from the remainder of the head 15. The drill selected for this operation should be of a size between the diameter of the neck 17 and a diameter just less than the overall, maximum diameter of the lands of the threads 14. As shown in Figure 3, the drill extends downwardly below the undersurface of the head 15 and preferably terminates substantially at the threaded section of the shank. In this condition of the parts, the thread 14 projects outwardly beyond the inner circumference 22 of the head 15 and underlies the portion of the head adjacent thereto.

By the use of an "easy-out" or an equivalent extracting tool 25, the threaded shank 12 may be unscrewed, without imparting rotation to the head 15 since the connection between the two parts has previously been broken. The thread 14 cuts a groove in the plastic body as the insert is rotated. It will be evident that the greater the diameter to which the bore 22 is drilled, the less will be the depth of this groove, and it is accordingly desirable from the standpoint of ease in removal that the bore 22 be as large as possible. On the other hand, the bore 22 must be adequately smaller than the outside diameter of threads 14, for a reason that will immediately appear. When the body 10 is comparatively soft, the bore 22 may be substantially equal to or just slightly in excess of the diameter of the neck 17. With harder bodies, the bore 22 should be larger, but never of quite the outside diameter of threads 14. As the threaded shank 12 is unscrewed, its upper end 26, more particularly the uppermost point on the thread 14, will engage the undersurface of the disconnected head 15, applying axial force thereto and causing the head to be axially removed from its cavity in the body 10, this movement being permitted by the axial serrations on the head 15 and the correspondingly shaped margins of the cavity.

As shown in Figure 5, the body 10 will be left with an internally threaded bore 27 terminating at its upper end in an enlarged counter-bore 28 having axial serrations 29 formed in its side wall, these cavities corresponding in shape to the exterior surfaces of the original moulded insert.

A substitute insert of the type shown, described and claimed in my copending application Serial No. 466,855 may readily be placed in the cavity so formed. As explained in that application, the insert comprises a cylindrical member 30 having an internal thread 31 and an external thread 32 adapted to mate with the thread 27 in the bore formed in the body 10. At its upper end, the insert has a head 33 provided with axial serrations 34 on its outer circumference. The insert 30 is screwed into the body, as indicated in Figure 6, with a space remaining, between the

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serrations 34 on its head and the serrations 29 on the walls of the enlarged counter-bore 28. A locking ring 35 having exterior serrations 36 and internal serrations 37 is forced into the space between the head and the walls of the counter-bore, with the internal serrations mating with the serrations 33 on the head and the external serrations 36 mating with the serrations 29 in the counter-bore. Hence, the ring 35 effectively locks the insert 30 against relative rotation with respect to the body 10, as is fully described in the above identified application.

The form of the invention shown in Figure 8 is substantially the same as that shown in my copending application Serial No. 488,169, filed May 24, 1943. This insert is adapted to be associated with a previously formed body of relatively soft material 40, such as an aluminum or magnesium alloy, wood, plastic material or the like, or, as a matter of fact, of any material softer than the material of the insert itself, and to be threaded into a previously formed and tapped bore 41 therein, having an enlarged counter-bore 42 formed at its outer end. As originally supplied by the manufacturer, the insert comprises a shank 12a having internal threads 13a, external threads 14a and an integral stop flange 43 adapted to be seated upon the floor 44 of the counter-bore 42. The head 15a initially extends upwardly and outwardly at an angle of about 30° from the axis of the tubular shank 12a, as shown in dotted lines in Figure 8. The parts are so dimensioned that, when the flange 43 is seated upon the shoulder 44, the upper or outer end of the insert body is preferably flush with the outer surface of the body 40. At the same time, the peripheral or rim portion of the head 15a is above the surface of the body and may partially overhang or extend radially outwardly beyond the wall surface defining the counter-bore 42. This peripheral or rim portion of the head 15a comprises a multiplicity of serrations 16a, which, preferably, are constructed as specifically described in the copending application last-mentioned above.

After the insert has been screwed into position, it is locked against accidental removal by deflecting the flange or head 15a from the position shown in dotted lines in Figure 8 to the full line position, by the use of a suitable drive tool, hammer, or spinning device. To facilitate deflection of the head, a groove 45 adjacent the line of junction between the head and the tubular body 12a may be provided, or the connection otherwise weakened. The space 46, between the stop flange 43 and the head 15a, preferably extends inwardly to a circumferential line disposed upon a diameter substantially equal to the root diameter of the threads 14a on the shank 12a. When the head 15a is deflected inwardly, the pointed serrations 16a tend to broach or cut similar serrations in the body 40, around the counter-bore 42, forcing shavings, slivers or chips 47 inwardly into the space 46, as shown in Figure 8 and as described in said application.

If it is desired to remove the insert of Figure 8, a method similar to that previously described may be employed. The upper end of the insert is drilled out with a drill of a diameter indicated at 20a, leaving enlarged cylindrical bores 22a and 23a in the head 15a and the flange 43 respectively and disconnecting the head from the flange as indicated at 21a and the flange from the threaded shanks 12a, as indicated at 24a. The drill selected is substantially equal or only

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slightly larger than the root diameter of the thread 14a, thereby leaving the thread projecting outwardly under the flange 43 and the head 15a.

As indicated in Figure 10, the threaded shank 12a may be unscrewed, thereby applying axial pressure to the flange 43 and forcing the same upwardly, to compress the shavings 47 and shear the same from their connection with the wall of the counter-bore 42. As the threaded shank 12a is further unscrewed, it forces the flange 43 upwardly and lifts the head 15a from the counter-bore, leaving in the body 40 a screw-threaded bore 41 and a counter-bore 42 which terminates at its upper end in marginal serrations 42a, formed by the serrations 16a on the head.

The insert may be replaced by an insert of the type shown in Figure 8, by screwing the same into position and then deflecting the head 15a from the dotted to the full line position, or an insert substantially identical to that shown in Figures 6 and 7 may be employed.

Figure 11 illustrates a typical two-part insert of the type shown, described and claimed in my copending application Serial No. 466,855, filed November 25, 1942, which insert may be applied to a body 40b as an initial installation or as a replacement for an insert of the type shown in Figures 1 and 8 of this application. As explained above, in connection with the replacement of the insert of Figure 1, this insert, as shown in Figure 6, may comprise a tubular body 30 having internal threads 31, external threads 32 and a head 33 having external serrations 34 on its periphery, the head being connected to the tubular body by a neck of reduced diameter. A locking ring 35 is provided with external serrations 36 and internal serrations 37. The internal serrations 37 mate with the serrations 34 on the head and the external serrations 36 mate with preformed serrations in the material or cut their own serrations therein. If the serrations in the ring are to cut their way into the body 40b, the ring must, of course, be harder than the body, and if the body 40b be of some fairly hard material, as steel, then the ring will be steel and will usually be heat-treated for hardness.

This type of insert may be removed quite expeditiously by drilling the upper end of the head 33 on a diameter 20b, equal to the diameter of the root of the serrations 34 on the head and substantially equal to the root diameter of the threads 32 on the tubular body 30, thereby breaking the connection between the body and the serrations 34 and leaving the thread 32 on the body projecting outwardly beneath the serrations 37 on the ring 35, as indicated in Figure 12. The drilling need be continued only to a depth sufficient to clear the lower ends of the serrations 34 on the head 33, but, as shown in Figure 12, it has been extended inwardly to remove the material in the neck of reduced diameter between the head and the body.

When the tubular body 30 is unscrewed from the threaded bore, by the use of an "easy-out" or similar tool, the upper end thereof, more particularly the upper end of the thread 32, will engage the undersurfaces of the serrations 37 and axially remove the ring 36, whereupon the insert may be replaced by a new insert of the same type or, if preferred, by an insert of the type shown in Figure 8.

A similar method of removal and substitution may be employed with two-piece and one-piece stud type inserts. Figure 14 illustrates a two-

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piece stud insert similar to the disclosure of my application Serial No. 466,855 and comprising an externally threaded cylindrical member 51 screwed into a bore 52 in a body of relatively soft material 50, of the type referred to above. The insert body is provided with threads 53, disposed within similar threads 54 in the bore. Adjacent the surface of the body 50 and in concentric relation to the bore 52 is an enlarged counterbore 55, adapted to receive a locking ring 56 having internal serrations 57 mating with similar external serrations 58 on a head 59 of the insert, the ring having external serrations 60, disposed within similar serrations 61, preformed in the body 50 around the margins of the counter-bore 55 or broached therein when the ring is driven home, as previously described. The insert further comprises an outwardly projecting stud or boss 65 having external screw threads 66 formed thereon, for the reception of a nut or the like.

It should be noted that, as in the embodiment previously described, the threaded shank 51 is connected to the head 59 by a neck 62 of reduced diameter as compared with the maximum diameter of the thread 53, and that the thread 53 underlies the inwardly projecting serrations 57 on the locking ring.

In order to remove an insert of the type shown in Figure 14, in accordance with the method of the present application, a tubular milling tool 70 having a circular cutting edge 71 may be employed, to cut away the head 59 throughout a circular zone 72 (Fig. 17), severing the connection between the outwardly projecting serrations 58 on the head and the body of the insert, but leaving the inwardly projecting serrations 57 on the ring 56 substantially undisturbed and in their original position, overlying the outwardly projecting thread 53 on the shank 51.

In Figure 15, the milling tool 70 is shown in the position which it occupies at the conclusion of this cutting operation. After the milling tool is removed, the stud 65 may be turned to unscrew the threaded shank 51 from the bore 52, thereby bringing the thread 53 into engagement with the undersurfaces of the inwardly projecting serrations 57 on the ring 56 and withdrawing the ring by axial movement, as indicated in Figure 16. This procedure will leave, in the body 50, a threaded bore terminating at its upper end in an enlarged counter-bore having a serrated margin, so that another insert of the type shown in Figure 14 may be inserted. Obviously, if desired, a one-piece, stud type insert of the kind shown in the second application referred to above, may be employed as a substitute for the one removed.

Figure 18 illustrates a one-piece, moulded-in, stud type insert, similar in many respects to the socket type insert shown in Figures 1 and 2. It is desired to point out that an insert of this kind may readily be removed, in accordance with the method of the present invention, by either of two expedients. The stud 65a may be sawed off flush with the outer surface of the head 15c and the head drilled, in the manner shown in Figure 3, to disconnect the marginal portion of

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the head from the threaded shank 12c. The shank may be drilled a short distance on a smaller diameter to receive an "easy-out," so that the shank may be unscrewed, to withdraw the head by axial movement as previously described.

In the alternative, the marginal portion of the head may be disconnected from the threaded shank and the stud 65a by the use of a milling tool 70a, in the same manner as described in connection with Figure 15. Such a tool will remove the material of the head between the serrations thereof and the central portion, leaving a serrated ring in position to be engaged by the thread 14c on the insert body 12c when the latter is unscrewed, for instance, by applying a Stillson wrench to the stud 65a.

It will be noted that, in each form of the invention shown herein, the insert, when in operative position, is restrained against both axial and rotational movement with respect to the body in which it is mounted. By severing the connection between the part restrained against rotation and the part restrained against axial movement, the latter may be rotated for removal simultaneously applying axial movement to the former, so that both parts may be quite readily removed.

The present invention is not limited to the details of construction shown in the accompanying drawings and described above or to the exact steps or sequence of steps described, but covers all modifications coming within the scope of the appended claim and its equivalents.

This application is a continuation-in-part of my copending application Serial No. 466,855, filed November 25, 1942. Reference is also made to my copending application entitled Replaceable insert, Serial No. 601,454, filed June 25, 1945, which is a continuation-in-part of the present application.

I claim:

A method of removing an insert from a body and replacing the same with a substitute insert, the first insert having a threaded shank fitting within a correspondingly shaped cavity in the body, and an enlarged axially serrated head disposed and restrained against rotation within a correspondingly shaped cavity, said method comprising cutting into the body on a diameter less than the root diameter of the axial serrations on the head to disconnect the head from the shank, unscrewing the shank from its cavity, axially removing the head, thereby leaving in said body an interiorly threaded bore and an enlarged, axially serrated counterbore, screwing into the bore a substitute insert having an exteriorly threaded shank and an axially serrated head of substantially less diameter than said counterbore, and inserting in the counterbore a locking ring having internal serrations mating with those on the insert head and external serrations mating with those in the walls of the counterbore, to prevent rotation of the ring and the substitute insert with respect to the body.

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