Aug. 23, 1966 J. H. DEVINE ET AL 3,267,793

SELF-CONTAINED BLIND BOLT

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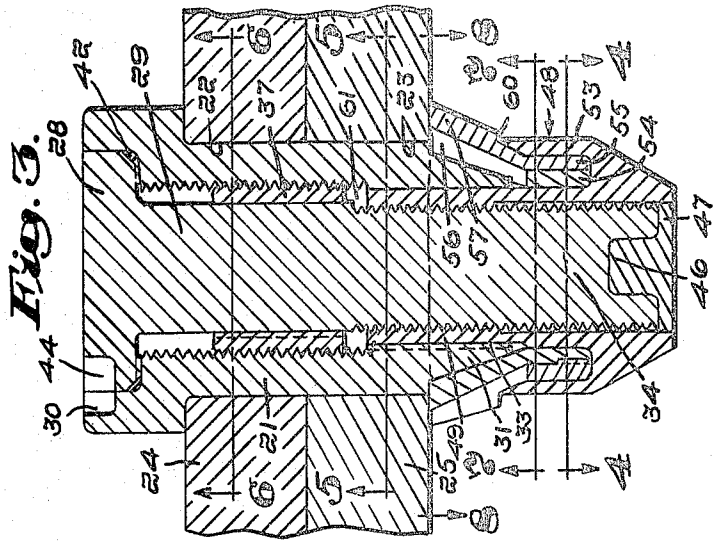


Fig. 3.

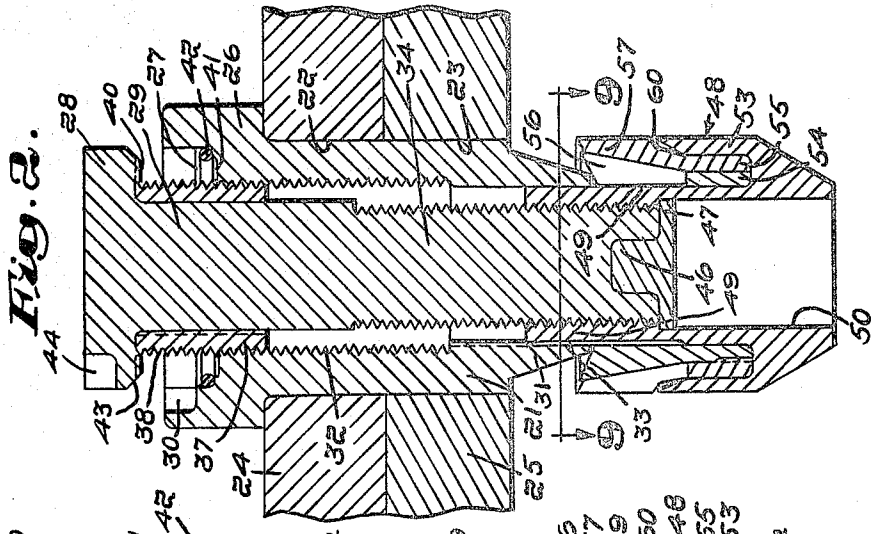


Fig. 2.

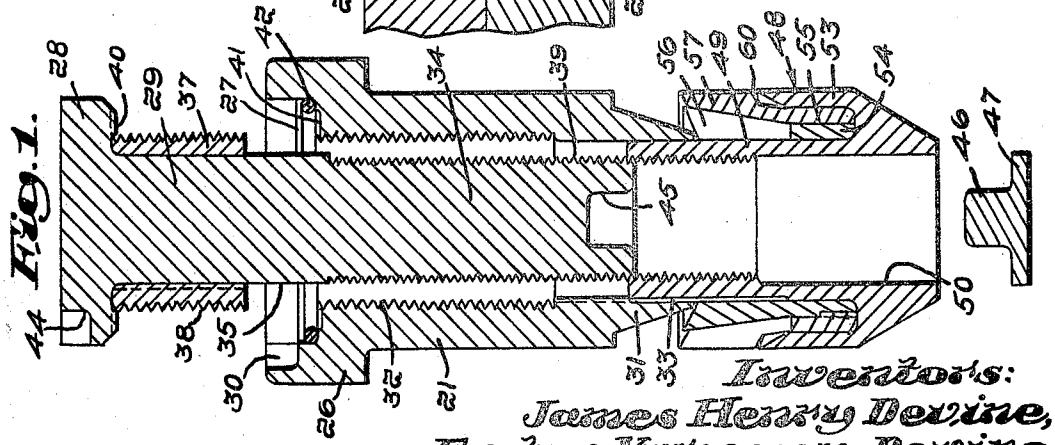


Fig. 1.

Inventors:
James Henry Devine,
Evelyn Vercesses Devine,
by Arthur D. Thomson
Attorney

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SELF-CONTAINED BLIND BOLT

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Fig. 4.

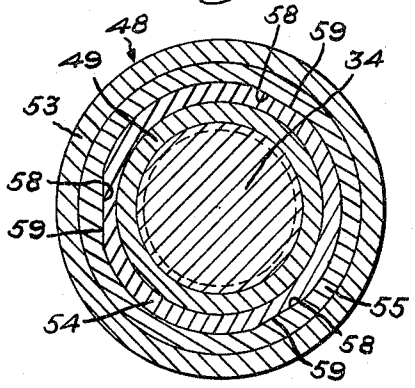



Fig. 5.

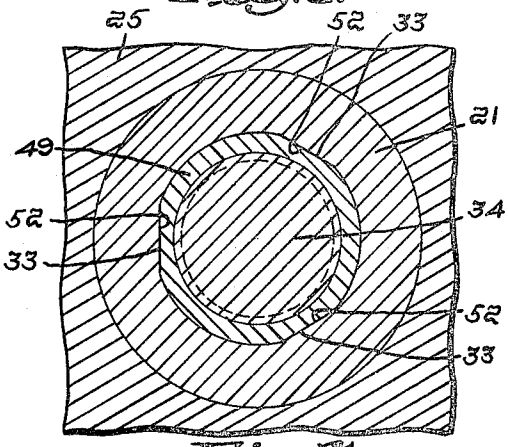



Fig. 6.

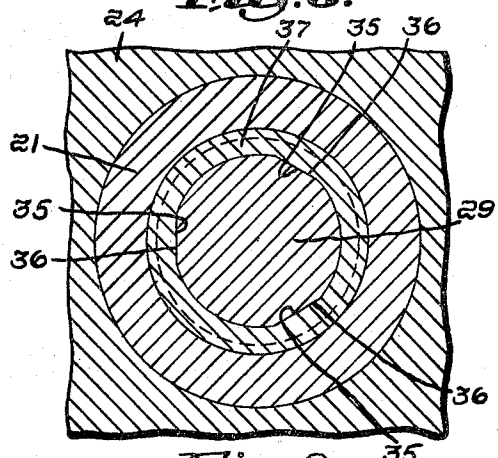



Fig. 7.

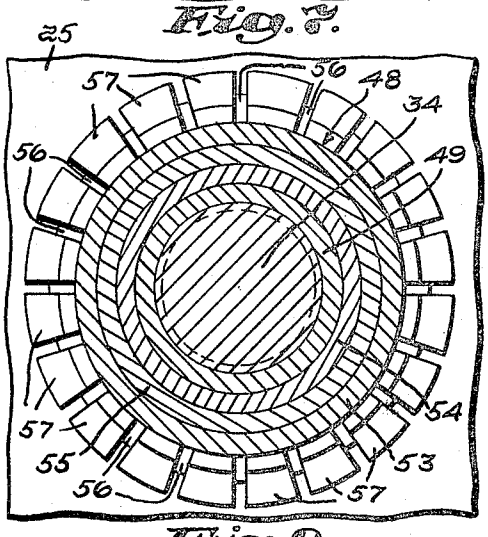



Fig. 8.

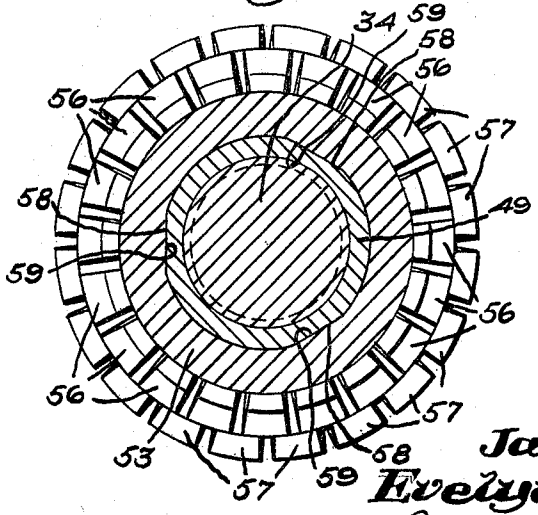
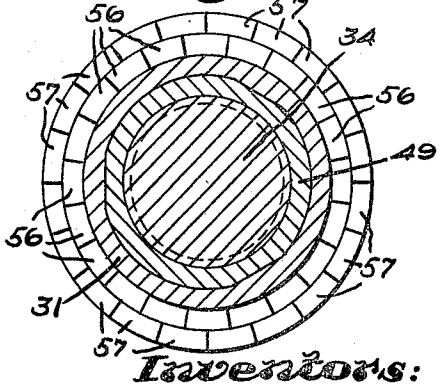



Fig. 9.




Inventors:
James Henry Devine,
Evelyn Yurcessen Devine,
by Arthur D. Thomson Attorney

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SELF-CONTAINED BLIND BOLT

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Fig. 10.

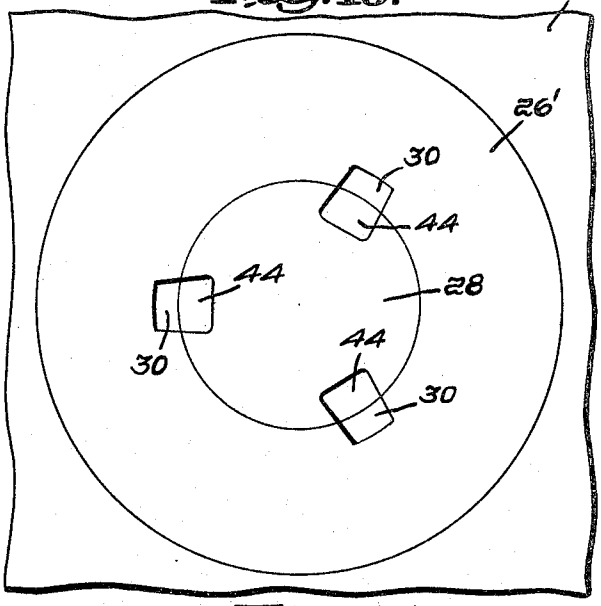



Fig. 14.

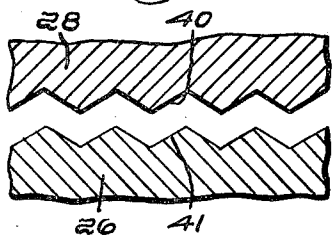



Fig. 11.

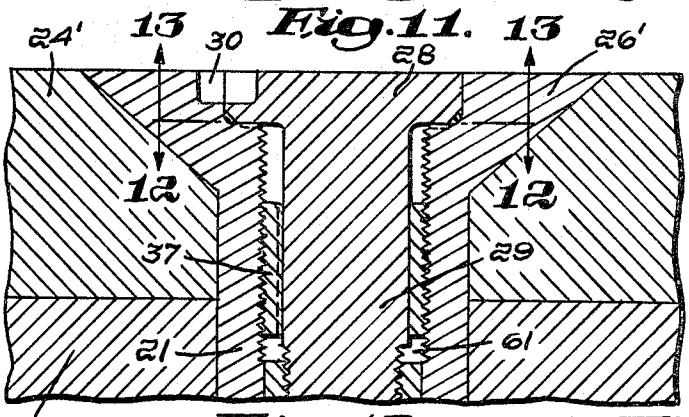



Fig. 12.

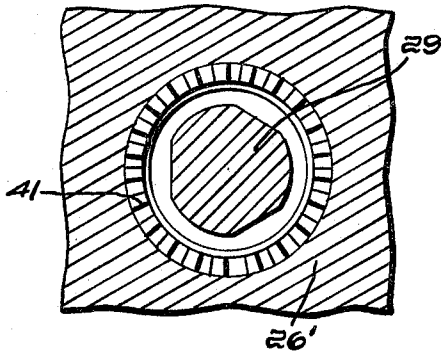
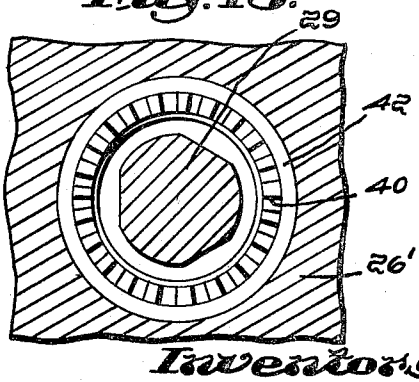



Fig. 13.




Inventors:
James Henry Devine,
Evelyn Yurcessen Devine,
by Arthur D. Thomson Attorneys

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SELF-CONTAINED BLIND BOLT

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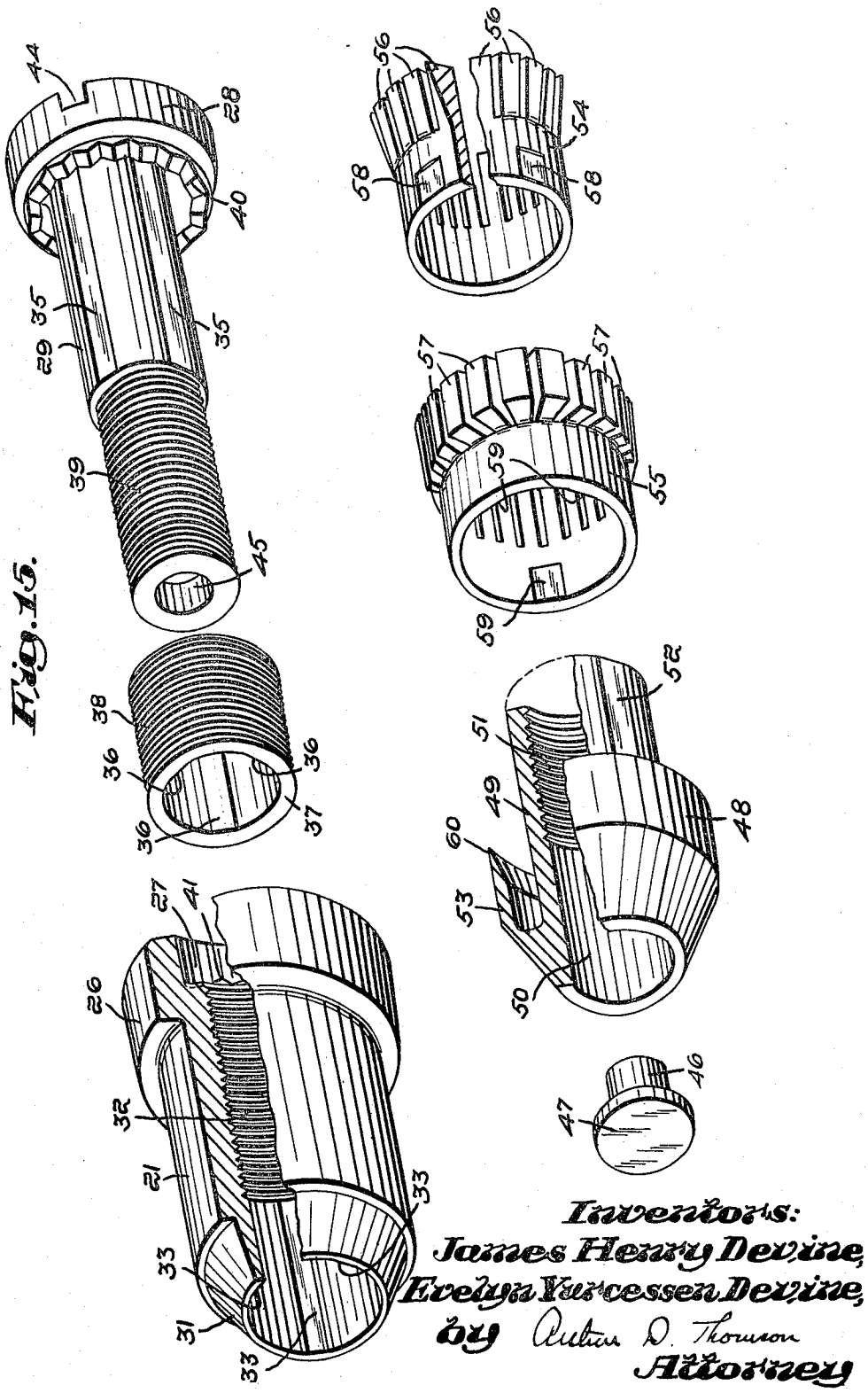



Fig. 15.

Inventors:
James Henry Devine,
Evelyn Vercessen Devine,
by Arthur D. Thomson
Attorney

United States Patent Office 3,267,793 Patented August 23, 1966



3,267,793

# SELF-CONTAINED BLIND BOLT

James Henry Devine and Evelyn Yurcessen Devine, both of 380 Washington St., Brookline, Mass.

Filed June 16, 1964, Ser. No. 375,454
12 Claims. (Cl. 88—75)

This invention relates to self-contained blind bolts for clamping together two or more structural sheets or panels, irrespective of the accessibility of the outer side of one of the sheets or panels; and is an improvement on the bolt disclosed in our Patent No. 3,096,678 dated July 9, 1963, and on other blind bolts previously patented by us or by James H. Devine.

The principal purpose of the present invention is to provide a self-contained, composite blind bolt assembly which is insertable and removable at one side of the sheets or panels to be secured; which has a nut member affording a plurality of resilient clamping fingers engageable with the opposite side of the sheets or panels with clamping contact throughout a circumference of 360°; which is exceptionally strong and resistant to stresses in torque, tension and shear; which incorporates locking means resistant to loosening of the bolt under vibration; and which comprises a centering sleeve, the aforesaid nut member, a center component or bolt proper extending through the sleeve and threading into the nut member or component, and a collar having keyed sliding engagement with the center component and threaded engagement with the sleeve component, to ensure that the bolt may be torqued to tight clamping position and that the center component is automatically lifted outwardly of the sleeve when the bolt proper is unscrewed, to facilitate removal of the blind bolt as a unit.

Further advantageous features of the improved blind bolt will become apparent from the following description of the recommended embodiments of the invention illustrated in the accompanying drawings. It will be understood, however, that the structural details of the blind bolts herein illustrated and described may be varied to meet the conditions of particular applications, without departing from the essence of the invention as set forth in the appended claims.

In the drawings:

FIG. 1 is a diametrical section of one form of the improved blind bolt, the centering sleeve having a protruding type head; a locking cap for the inner end of the center component being shown separately, prior to assembly;

FIG. 2 is a similar section showing the assembled bolt located in concentric openings of two structural sheets or panels to be clamped together;

FIG. 3 is a section similar to FIG. 2 with the bolt elements locked in clamping position;

FIGS. 4 to 8 are transverse sections taken on lines 4—4, 5—5, 6—6, 7—7 and 8—8, respectively of FIG. 3;

FIG. 9 is a transverse section taken on line 9—9 of FIG. 2;

FIG. 10 is a plan view of the bolt head in locked position, the centering sleeve having a flush type head as shown in FIG. 11;

FIG. 11 is a fragmentary section similar to FIG. 3, but showing a sleeve component having a flush type head;

FIGS. 12 and 13 are transverse sections taken on lines 12—12 and 13—13 respectively of FIG. 11, showing the vibration lock engagement between the sleeve and center components;

FIG. 14 is an enlarged fragmentary radial section of the vibration lock, the opposed toothed surfaces being spaced apart; and

FIG. 15 is an exploded view, in perspective, of the main components and auxiliary elements of the blind bolt illustrated in FIGS. 1 to 9; certain of the elements being partially broken away and in section.



The blind bolt chosen for the purpose of illustration in FIGS. 1 to 9 and 15 is of the protruding type; the modified bolt shown in FIGS. 10 and 11 is of the flush type; and the vibration lock teeth of FIGS. 12 to 14 are common to both types.

In the protruding type of FIGS. 1 to 9 and 15, the improved bolt comprises a centering sleeve **21** adapted to fit within concentric openings **22**, **23** of two or more structural sheets or panels **24**, **25** (FIGS. 2 and 3), and to provide a substantially cylindrical interior wall affording a bearing surface for the bolt parts disposed within the sleeve component, independently of any surface irregularities of the openings bored in the panels. The outer end of the sleeve has a flanged head portion **26** which seats on the surface of the outermost panel when the bolt is inserted into said openings.

The sleeve head is recessed at **27** to receive the head **28** of a center component or bolt proper **29**, and also has circumferentially spaced recesses **30** (see FIG. 10) to receive the prongs of a holding tool (not shown) for holding the sleeve against rotation while the center component is being screwed down to tighten the bolt.

The inner end of the sleeve is formed with a conically tapered skirt **31**, extending beyond the innermost panel **25** and inclining downwardly and inwardly for a purpose to be explained.

The sleeve is internally threaded at **32** from the recess **27** inwardly, and the bore of the sleeve, at its inner end portion, including the skirt portion **31**, has one or more longitudinal flats **33**, preferably three as shown, for purposes also to be described and explained.

In the flush type bolt shown in FIGS. **10** and **11**, the sleeve head **26'** is frustro-conical in shape, to fit within a counterbored opening of the outer panel **24'**, with its surface flush with the surface of the panel. Otherwise, the flush type sleeve and the other elements of the modified bolt are the same in construction and operation as the elements of the protruding type bolt of FIGS. 1 to 9 and 15.

The center component **29** is a solid bolt member having a shank portion **34** of substantially uniform diameter from its outer headed end to its inner end. The outer portion of shank **34** has three longitudinal flats **35** which cooperate with complemental flats **36** on a collar or ring member **37** having external threads **38** mating with the internal sleeve threads **32**. Said flats extend parallel to the axes of the center component and sleeve, respectively. The lifting collar **37** is thus keyed to the center component so that it may slide longitudinally thereof, but is restrained from rotation relative thereto. The inner portion of the shank **34** is externally threaded at **39** to cooperate with internal threads of a nut component to be described; the threads **39** being of the same size, number of turns per inch and pitch as the sleeve threads **32** and the collar threads **38**.

The annular shoulder of the flanged bolt head **29** is adapted to seat on the annular bottom of the sleeve recess or socket **27**, and the meeting surfaces are so formed as resist relative rotation, under vibration or otherwise, when the blind bolt is tightened to clamp the panels **24**, **25** together. For this purpose the opposed surfaces of the bolt head **28** and of the sleeve recess **27** preferably have radially shaped teeth **40** and **41** respectively (best shown in FIG. 15), or other mutually engageable serrations providing a gear-like vibration lock. An O-ring or other sealing means **42** may be disposed in the sleeve recess **27** beneath the chamfered periphery **43** of bolt head **28**.

Bolt head **28** has peripherally spaced recesses **44** to receive the prongs of a suitable wrench for tightening and

loosening the center component while the sleeve component is held stationary as aforesaid.

In order that the lifting collar **37** may be temporarily retained in the position of FIG. 1, with the outer end of the collar abutting the inner annular surface of the head **28** of the center component, the flats **35** of the shank **34** may be slightly inclined outwardly, in a radial direction, adjacent the head **28**, to afford a frictional fit with the flats **36** of the collar.

The inner end of the shank portion of the bolt or center component is formed with a central cylindrical recess **45** for receiving the stud **46** of a retainer cap **47**. The cap is applied after the blind bolt has been assembled and serves to hold the parts in assembled relation as a self-contained unit; for the diameter of the cap is the same as the diameter of the shank **34**, and the rim of the cap is adapted to engage the threads of the nut component to be described, thereby limiting outward movement of the center component relative to the nut component. The stud **46** is preferably locked in the recess or cavity **45** by thermal expansion, but other fastening means may be employed if desired.

The nut component **48** of the blind bolt comprises a tubular body portion **49** having a smooth bore **50** at its inner end portion and a threaded bore **51** at its outer portion (the upper portion as shown in FIGS. 1 to 3). The threads **51** are designed to mate with the threads **39** on the inner portion of the center component. The external surface of the threaded portion of the nut is formed with flats **52** (FIG. 15) which cooperate with the flats **33** of the sleeve skirt **31** to permit longitudinal sliding movement between the sleeve and nut components while preventing relative rotation therebetween.

The nut has an integral exterior wall portion **53** spaced circumferentially from its body portion **49** and providing an annular socket receiving an inner clamping ring **54** and an outer clamping ring **55**, each of which has a plurality of upstanding, concentrically disposed spring fingers **56** and **57** respectively. The fingers of each ring are uniformly spaced by intermediate slots no wider than the respective fingers. When assembled in said socket the two clamping rings are so disposed relative to each other that the fingers of the outer ring overlie the slots of the inner ring, and that staggered relation is maintained by complemental flats **58** and **59** on the exterior of inner ring and on the interior of the outer ring, respectively, which prevent relative rotation thereof. Thus, when the nut component is tightened to clamping position (FIG. 3) by torquing the center component the ends of the respective ring fingers engage the surface of the innermost panel **25** throughout substantially 360°.

During the torquing operation, the fingers of both rings are flared outwardly as they are drawn over the inclined, conical skirt **31** of the sleeve component **21**. The rim of the nut wall **53** is preferably beveled internally, as at **60**, to permit such flaring of the spring fingers. Each finger is preferably thickened relative to the thickness of its confined ring; the expanded fingers of the outer ring **55** being thickened externally to overhang the rim of wall **53**, and the fingers of the inner ring **54** being thickened internally, so that the clamping effect of the spring fingers is strengthened. When the clamping action is released by loosening the center component, the nut is moved inwardly off the sleeve skirt **31** and the fingers spring back to normal position (FIGS. 1 and 2). In that position, the overall diameter of the nut component is no greater than the external diameter of the sleeve component, and the unlocked blind bolt may be withdrawn as a unit through the openings of the panels **24** and **25**.

The sliding collar **37** contributes materially to the withdrawal of the bolt and also to the clamping action of the fingered nut. When the assembled blind bolt is inserted in the panel openings, as to the position of FIG. 2, with the center component partially screwed into the



nut component, the keyed lifting collar **37** has partially entered the threaded bore of the centering sleeve **21**. Further inscrewing of the center component causes the collar to thread inwardly in the sleeve and the bolt proper to thread further into the nut, until the bolt head **28** seats in the socket **27** of the sleeve head. At that point the collar has moved inwardly a distance approximately equal to the length of the collar. Still further torquing of the bolt **29** will then draw the nut **48** upwardly or outwardly to expand the spring fingers over the sleeve skirt **31**, as aforesaid, until the fingers are in clamping position, while the collar is being threaded to the approximate position shown in FIG. 3. It will be noted that, in the clamping position of FIG. 3, there is an annular space **61** between the inner end of the collar and the outer end of the nut body, so that the center component may be tightened even further, if necessary for secure clamping of the panels **24**, **25**. When so tightened, the blind bolt is locked against loosening due to vibration by the mutual engagement of the teeth **40** in the bolt head and the teeth **41** in the sleeve recess, as aforesaid.

The bolt may, however, be readily unlocked by loosening the center component with a suitable wrench, while holding the sleeve component against rotation, thereby causing the nut component to be moved inwardly off the skirt sleeve **31** and causing the lifting collar to engage the head of the center component so that the center component is moved outwardly away from its seat, as to the position of FIG. 2, permitting the projecting head **28** to be conveniently grasped to remove the blind bolt as a unit from the panel openings.

Each of the sleeve holding recesses **30** of the sleeve head **26** and **26'** and the torquing recesses **44** of the bolt head **28** is formed with straight side walls which, as shown in FIG. 10, extend in a generally radial direction but which converge slightly in an outward direction, to form an included angle that becomes smaller in the direction of the torquing force. Hence, when tools formed with three projections corresponding in shape to the respective sets of recesses are applied to the recessed heads of the sleeve and the bolt, the projections have a precision, jamming fit in each recess which holds securely without slipping during the torquing operation of the center component; yet the interfit may be quickly disengaged when the torquing action is discontinued. As previously indicated, three such torquing recesses, spaced 120°, are preferably provided in each of the heads, but more may be used if desired; and the recesses in the head **28** of the center component are located at the periphery thereof, to afford maximum leverage during torquing action.

The improved blind bolt may readily be assembled by the following operations: the two clamping rings **54** and **55** are so telescoped together, with their complemental flats in registration, to provide a pressed or thermo-expanding fit, thereby insuring that the fingers of the respective rings are permanently maintained in staggered relation in the clamping ring assembly. That assembly is then pressed downwardly into the annular socket behind the annular wall portion **53** of the nut component **48** and secured therein by a pressed fit or by thermal expansion, thus providing a permanent nut component assembly.

The nut component assembly is then preferably locked in a suitable jig or fixture (not shown), and the sleeve component **21** is telescoped over the nut component assembly, with their complemental flats in registration, until the inner end of the skirt sleeve **31** rests on the tips of the spring fingers **56**, as shown in FIG. 1.

The shank of the bolt proper **29** is next telescoped into the lifting collar **37**, with the complemental flats in registration, and the parts are retained in the position of FIG. 1, by frictional engagement of an inclined flat or otherwise, providing a center component assembly; and that assembly is inserted into the sleeve component to the position of FIG. 1. The bolt is then rotated until its threaded

shank portion is screwed into the nut component assembly substantially to the position of FIG. 2; the lifting collar **37** being partially threaded into the sleeve component, in the same operation.

Finally, the stud **46** of retainer cap **47** is pressed into the cavity **45** at the inner end of the center component, and secured therein by thermal expansion, or otherwise, as previously indicated, to maintain the several components of the improved blind bolt as a unitary, self-contained assembly. It will be apparent that, after the retaining cap is so secured, the center component cannot be removed from the nut or sleeve components, and the nut component cannot be removed from the sleeve or center components, for relative longitudinal movement of the center and nut components is limited by the engagement of the rim of the retaining cap with the threads of the nut component. Hence, the bolt components or elements are not subject to loss or misplacement, and the blind bolt can be inserted as a unit and locked in clamping position, by one man from one side of the panels which are to be clamped together, and can readily be unlocked and removed when desired. It will be noted, moreover, that the bolt is torqued to clamping position by relatively short and precise travel of the center component assembly and the nut component assembly.

We claim:

**1.** A blind bolt for clamping together two or more structural panels having concentric openings therethrough, irrespective of the accessibility of the opening in the innermost panel, the bolt being insertable as a unit into said openings and removable as a unit therefrom, and comprising:

a sleeve component extending through said openings and constituting a centering sleeve of the bolt, said sleeve having a flanged outer head portion engageable with a surface of the outermost panel, and having an inwardly tapered skirt portion, extending beyond the innermost surface of the innermost panel, at its inner end portion;

said head portion having an annular socket therein, and the outer portion of the bore of said sleeve being screw-threaded from said socket inwardly thereof;

a center component receivable in the bore of said sleeve and having a flanged head receivable in the sleeve socket and a cylindrical shank portion, the inner portion of said shank being screw-threaded;

a lifting collar slidable over said shank portion and keyed thereto against relative rotation thereon at the outer end portion thereof, from said head portion inwardly, the exterior of the collar having screw threads mating with the screw threads in the bore of said sleeve; and

a nut component having a tubular body slidable longitudinally within the inner and skirt portions of said sleeve and keyed thereto against relative rotation therein, the outer portion of the bore of said body having screw threads mating with the screw threads of said shank portion;

said nut component having spring fingers adapted to slide over and be flared outwardly by the tapered skirt portion of said sleeve and to engage the innermost panel, when the nut component is moved to clamping position by rotation of the center component therein.

**2.** A blind bolt as described in claim **1**, said nut component having an exterior annular socket, a pair of concentric clamping rings disposed in said socket, each of said rings having a plurality of circumferentially spaced, upstanding spring fingers, and means restraining relative rotation between said rings, so that the fingers of one ring are maintained in staggered relation to the fingers of the other ring.

**3.** A blind bolt as described in claim **1**, the socket of the sleeve and the head of the center component having opposed annular surfaces adapted to be mutually engaged, and said surfaces having complemental serrations providing a vibration lock when the bolt is torqued to clamping position.



**4.** A blind bolt as described in claim **1**, the keyed relation of the collar on the center component and of the nut component in the sleeve comprising at least one pair of mutually engaged flats on the keyed parts, thereby restraining said parts from relative rotation while permitting relative longitudinally sliding movement therebetween.

**5.** A blind bolt as described in claim **1**, the head portions of the sleeve and of the center component having circumferentially spaced recesses in their margins for receiving tools, whereby the sleeve may be held against rotation while the center component is rotated to tighten or loosen the bolt.

**6.** A blind bolt as described in claim **1**, the inner end of the shank portion having a recess therein, and a retaining cap having a stud portion secured in said recess and a rim portion having a diameter no less than that of the shank portion, whereby outward movement of the center component relative to the nut component is limited by the engagement of said rim portion with the screw threads in the bore of said nut component, the inner portion of said bore being smooth to permit longitudinal movement of the retaining cap therein.

**7.** A blind bolt as described in claim **2**, the means restraining relative rotation of the clamping ring comprising opposed flats on the inner and outer rings, and the overall diameter of the nut component when in unclamped position being no greater than the external diameter of the sleeve component, whereby the unclamped bolt may be removed as a unit from the openings in said panels.

**8.** A blind bolt for clamping together two or more structural panels having concentric openings therethrough, irrespective of the accessibility of the opening in the innermost panel, the bolt being insertable as a unit into said openings and removable as a unit therefrom, and comprising:

a sleeve component extending through said openings and constituting a centering sleeve for the bolt, said sleeve having a flanged outer head portion engageable with a surface of the outermost panel, and having an inwardly tapered skirt portion extending beyond the innermost surface of the innermost panel, at its inner end portion;

said head portion having an annular socket therein and having circumferentially spaced recesses in its margin for receiving a holding tool, and the bore of said sleeve being screw threaded from said socket inwardly thereof;

a center component receivable in the bore of said sleeve and having a flanged head receivable in the sleeve socket and a cylindrical shank portion, the inner portion of said shank being screw threaded, and said head having circumferentially spaced recesses in its margin for receiving a torquing tool;

the annular socket of said sleeve and the underside of the head of the center component having mutually engageable serrations for restraining loosening of the bolt under vibration when it is torqued to clamping position;

a lifting collar slidable over said shank portion and keyed thereto against relative rotation thereon, at the outer portion of said shank from said head portion inwardly, the exterior of the collar having screw threads mating with the screw threads in the bore of said sleeve; and

a nut component having a tubular body slidable longitudinally within the inner and skirt portions of said sleeve and keyed thereto against relative rotation therein, the outer portion of the bore of said body having screw threads mating with the screw threads of said shank portion;

said nut component having an exterior annular socket and a pair of concentric clamping rings disposed in said socket, each of said rings having a plurality of circumferentially spaced, upstanding spring fingers, and said rings being keyed together against relative rotation, whereby the fingers of one ring are maintained in staggered relation to the fingers of the other ring, said fingers being adapted to slide over and be flared outwardly by the tapered skirt portion of said sleeve and to engage the innermost panel, when the nut component is moved to clamping position by rotation of the center component therein.

**9.** A blind bolt as described in claim **8**, said center component having a recess in its inner end, and a retaining cap having a stud portion secured in said recess and a rim portion have a diameter no less than that of said shank portion, whereby outward movement of the center component relative to the nut component is limited by the engagement of said rim portion with the screw threads in the bore of said nut component, the inner portion of said bore being smooth to permit sliding movement of the retaining cap therein.

**10.** A blind bolt as described in claim **8**, the keyed relation of the aforesaid parts comprising complemental flats on the keyed parts, whereby said parts may move longitudinally relative to each other but are restrained from relative rotation.

**11.** A blind bolt as described in claim **5**, each of said recesses having straight side walls extending in a generally radial direction and being inclined toward each other in an outward direction, to form an included angle which becomes smaller in the direction of the torquing force, whereby a tool having complemental projections received in the recess of the respective heads fits precisely therein without slipping or displacement during the torquing operation.



**12.** A blind bolt as described in claim **11**, the recesses in the head portion of the center component being located in the peripheral margin thereof, and the recesses in the head of the sleeve component being located in an interior annular margin thereof.


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CARL W. TOMLIN, *Primary Examiner.*

R. S. BRITTS, *Assistant Examiner.*