Aug. 10, 1948. W. NOBLE 2,446,846

JOINT CONSTRUCTION

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Fig. 1.

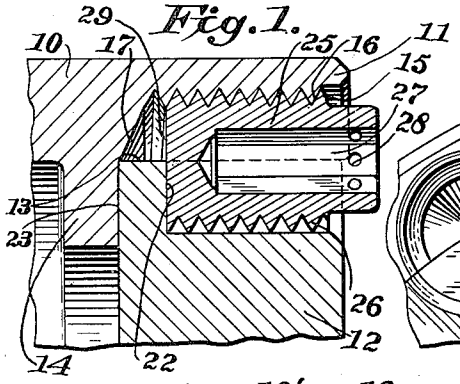

Fig. 2.

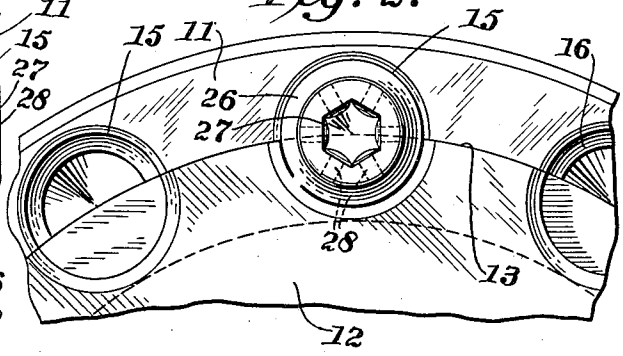

Fig. 3.

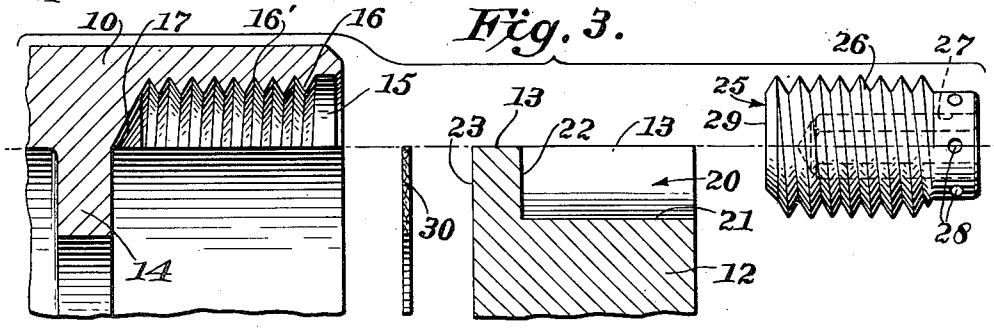

Fig. 4.

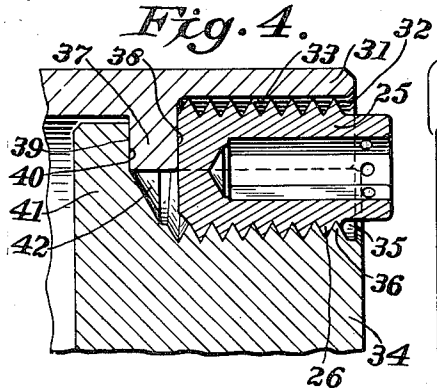

Fig. 5.

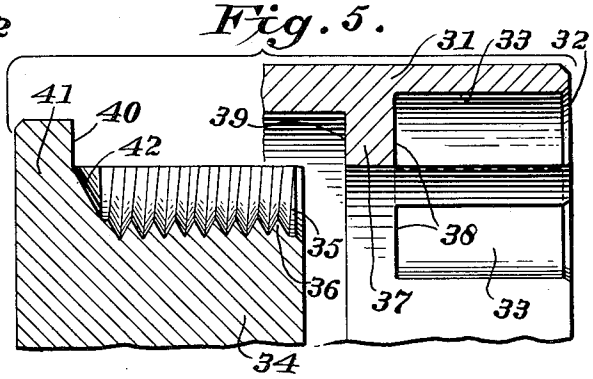

Fig. 7.

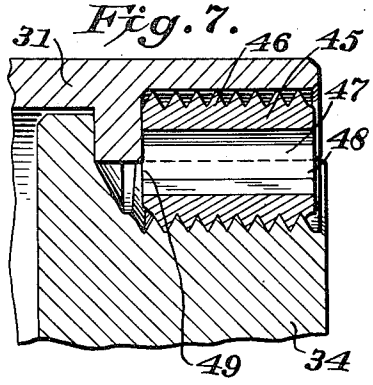

Fig. 6.

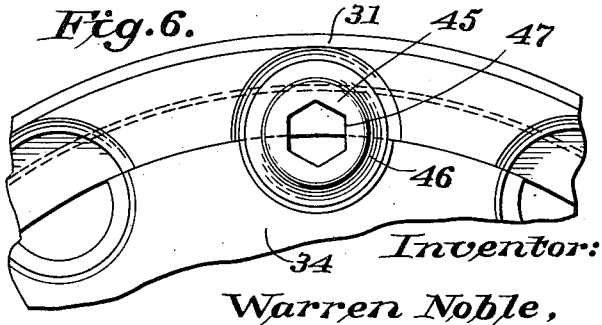

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Fig. 8.

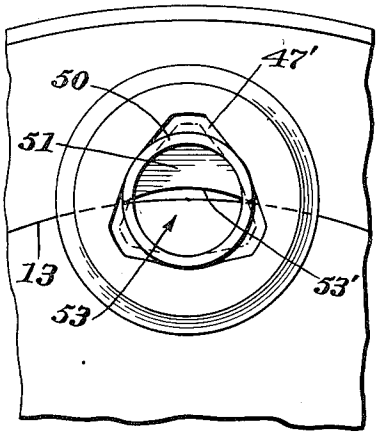


Fig. 9.

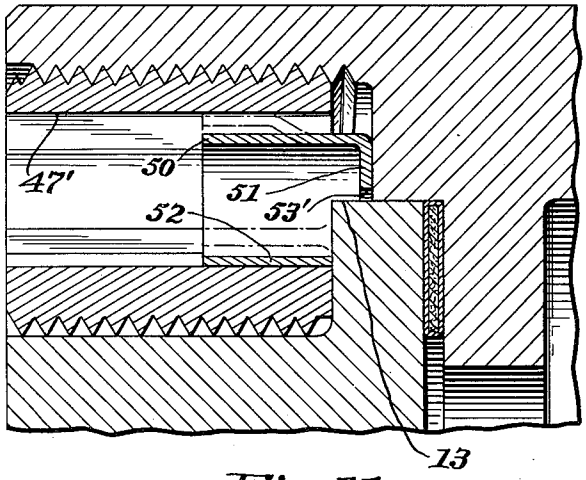


Fig. 10.

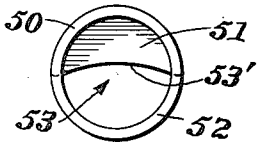


Fig. 11.

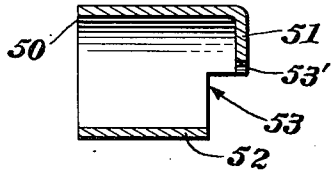


Fig. 13.

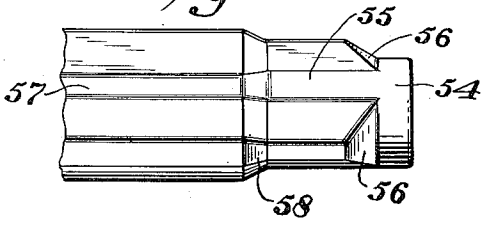


Fig. 12.

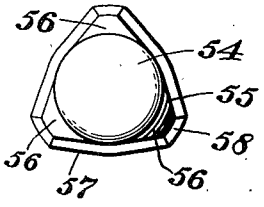
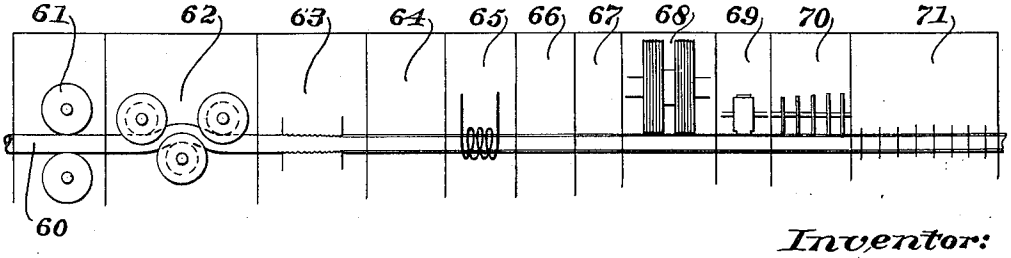


Fig. 14.



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JOINT CONSTRUCTION

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Fig. 15.

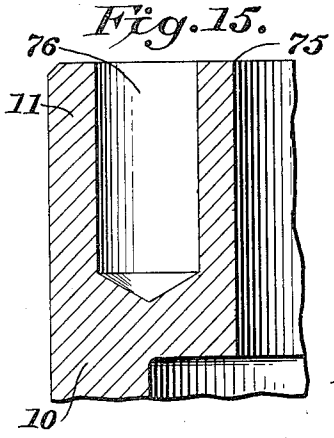


Fig. 16.

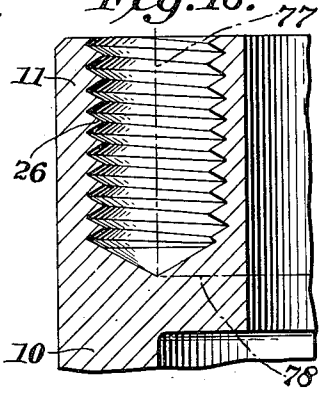


Fig. 17.

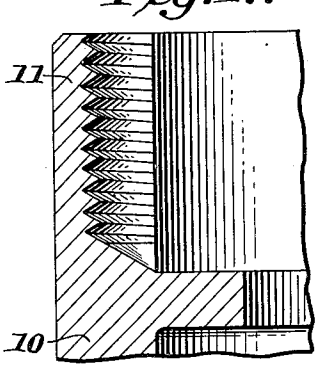


Fig. 18.

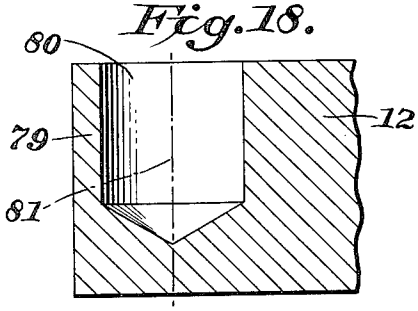


Fig. 19.

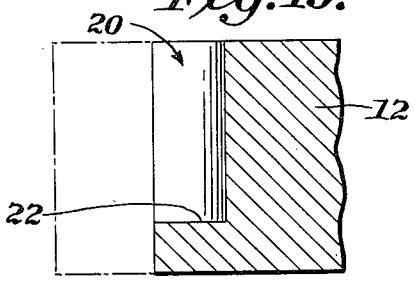


Fig. 20.

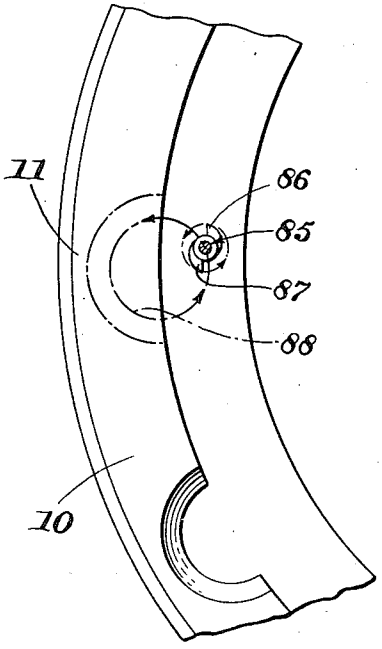
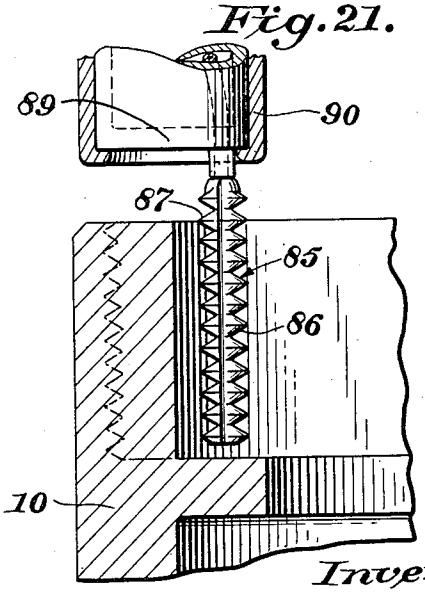


Fig. 21.



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JOINT CONSTRUCTION

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Fig. 22.

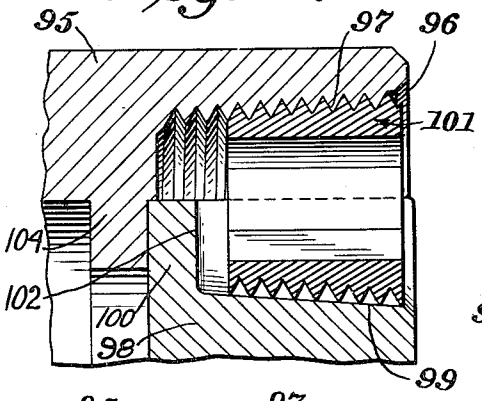


Fig. 23.

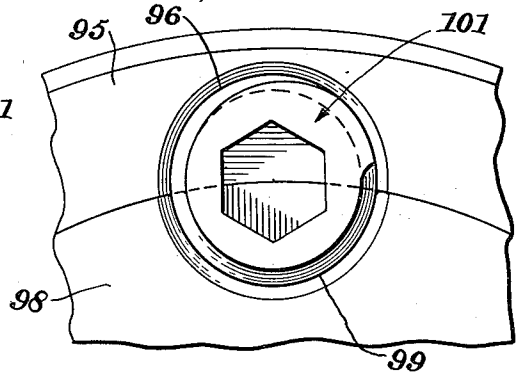


Fig. 24.

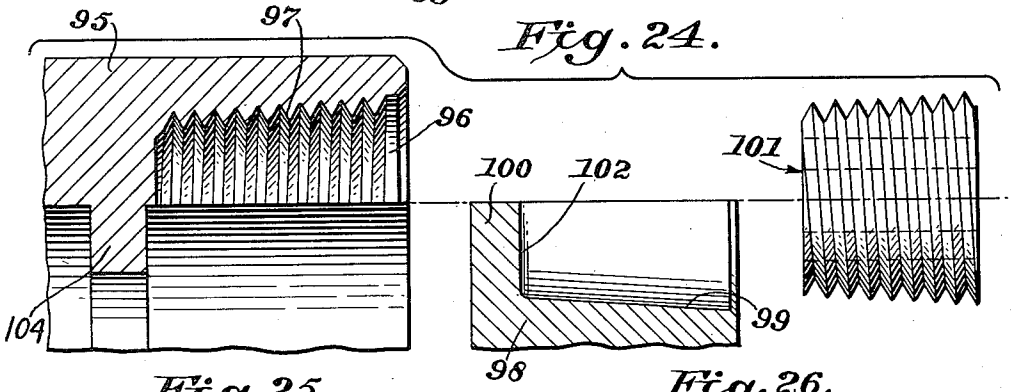


Fig. 25.

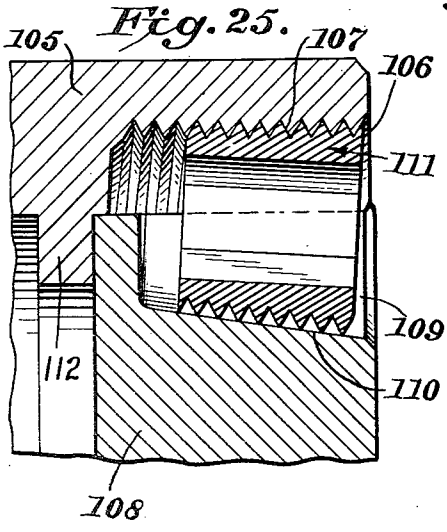
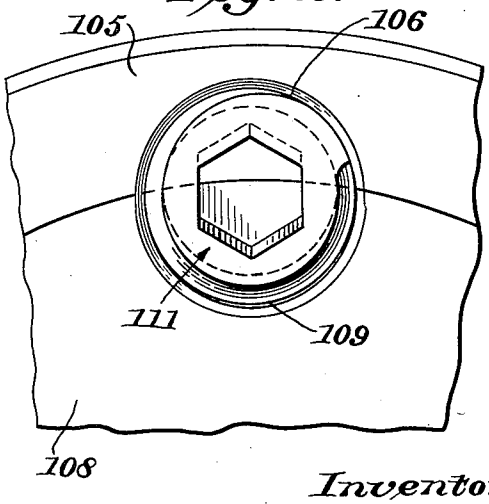


Fig. 26.



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UNITED STATES PATENT OFFICE

2,446,846

JOINT CONSTRUCTION

Warren Noble, Washington, D. C., assignor to Lilly Florence Shirley Noble, Garden City, N. Y.

Application July 10, 1943, Serial No. 494,256

13 Claims. (Cl. 189—36)

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This invention relates to a method of fastening mechanical parts together as commonly done by bolts, cap screws and similar devices and has for its purpose the provision of a better joint using less material by eliminating the necessity for flanges or bosses, reducing overall space occupied and enhancing stiffness by condensation of design. It makes available a fastening element or screw invariably loaded in compression substantially independent of quality of material though of greater strength.

Briefly, the system contemplates semi-circular recesses having a common axis in assembly in adjacent pieces to be joined and restrained against relative transverse separation by the shape or relation of the pieces. One of the semi-circular recesses is "tapped," or grooved with a series of threads similar and parallel each to each which advance helically about the wall of the recess at a constant pitch as does an ordinary screw thread. The other recess is of smooth contour, likewise semi-circular, but with a radius equal to the greater radius of the matching grooved recess and a bottom substantially square with the axis, but less in depth than that of the tapped side. In addition to the smooth-walled and threaded recesses, the system contemplates on the pieces to be joined, surfaces which are arranged in abutment on lines transverse to the axis of the recesses, for purposes hereinafter explained.

The recesses line up in assembly to create a composite hole having one half tapped, the other smooth, the division lying on the joint line between the two parts. In this hole is inserted a screw, such as a headless screw with a non-circular bore for wrench purposes, which engages the threads in the tapped side and seats upon the smooth recess, which provides an abutment against which the mechanical advantage of the screw can be exerted, to urge one of the parts axially of the recesses relative to the other and to apply great seating forces between the above-mentioned transaxial abutment surfaces.

In this way only half of the screw diameter encroaches the metal about the joint, leading in nearly all cases to the elimination of a flange and entirely obviating the need for a boss, since the screw is buried in the depth of the part it serves. The effort is exerted normal to the screw thread section and has a reaction directly at the blind bottom of the smooth recess with friction on the crest of the threads on the same smooth side, a circumstance tending to self-locking without other provision. The screw itself can only be in compression with the threads loaded in shear.

Either side of either part may be used as the threaded recess, the matching recess in the other part will be smooth but always the compressive loading of the screw will remain true. The

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threading may be arranged to push or pull against the abutment used which may be itself relieved in smaller radius to provide wrench space. In this case the abutment becomes a semi-annulus, but the joint can always be made up in the thickness of the parts requiring no extra space either in depth or diameter, eliminating the necessity for flange area or screw head room with marked advantage to general design, which may be condensed accordingly with increased stiffness and economy of all kinds. If gaskets are employed in joints so made, an unpierced ring of gasket material replaces the usual perforated pattern. The pressure is directly above the joint face without overhang; there is no bending moment, no spring to be feared, nor does the actual location of hold-down pressure vary as with the headed screw. The abolition of bending influences applies equally to parts and screws.

From the foregoing general description, it will be understood that the primary object of the present invention is to provide a method of and means for joining parts together, so as to eliminate attaching flanges, screw-threaded bolt holes or bores, headed securing bolts or screws, and the like, thereby making it possible to materially decrease the size and the mass of the members to be joined.

A further object is to provide a joint construction or system applicable in all cases where one member is received within or embraced by another member, or otherwise arranged so that the two members are normally restrained against transverse separation along their surfaces which are arranged for limited, substantially sliding, relative movement.

Another object is to provide, in a construction of this kind, securing means confined wholly within the thickness of the metal adjacent the joint line between the members, to the end that the overall size of the parts may be reduced and the construction simplified.

A further important object of the invention is to provide a construction which makes it possible to use smaller and lighter securing screws or elements, by so arranging the parts that the screws perform their functions when under longitudinal compression, instead of tension, as is the case with conventional screws and bolts. Since the compression strength of a screw is far greater than its tensile strength, smaller, lighter and weaker securing screws may be employed with complete safety.

A further object of the invention is to provide a construction which makes possible the use of tubular screws having a non-circular bore which is open at both ends. The use of screws of this type has never been attempted in the past, and it is believed that this element of the combination disclosed herein is a new article of manu-

facture. Its use results in numerous advantages, since, in the combination of the present invention, it makes possible the use of a new screw-locking system. Moreover, the devices lend themselves to continuous manufacture in high-speed mass production methods and can be made more accurately and more economically than conventional screws.

In certain types of constructions, for instance where extreme staunchness against torsion between the two joined members is desirable, it is advantageous to employ a tapered screw disposed in tapered or frusto-conical seats, one of which is screw threaded, and the other smooth-walled. Such a construction is advantageous in other instances, specifically as where the parts must be molded, e. g., of plastics or from powdered metallurgical compositions.

It will be understood that the securing means of the present invention may be employed in innumerable combinations and relations of parts and, in fact, in substantially any case where one element or member is to be secured to another. For instance, the construction may be employed to secure cylinder liners within cylinder blocks; cylinder heads upon blocks; bearing sleeves within bearing supports; gears within or upon gear hubs; collars within or upon pipes and shafts; wheels upon axles, closures or covers within or upon casings for machinery or the like; and innumerable other combinations of elements. It must be understood, therefore, that the invention is not limited to securing one or another kind of member or element to an associated one, but covers broadly the arrangement of parts in the joint and the construction disclosed for securing two or more members together.

The recesses employed in the joint are known as "seats." They may be made by several methods. One workable method is to leave on the parts sufficient extra stock to permit drilling, tapping and counterboring as usual, later remachining to fit the parts together along the screw axes and cutting away half the hole in each case. This method is slow and suffers from the ills of tapping in common with other screw-joined parts, but, in many cases, it is entirely satisfactory. A better method is to thread mill the "tapped" seats using a cutter of less than the radius of the seat and with parallel grooves of the screw thread section. Rotated at proper, relatively rapid cutting speed this cutter is caused to sweep eccentrically at the necessary radius to form the seat to the proper diameter and advanced simultaneously to give the screw lead. With this method parts finished as to contour (or substantially so) need no subsequent manipulation other than burring. The smooth seats may be similarly formed using ungrooved cutters. Threads thus milled are square with the axis—need no taper for entrance and may run to the bottom of the recess, which need be only a small portion of a pitch deeper than the to-be inserted screw. The smooth sided recess bottom can be made truly normal to the axis with no clearance dimple and precisely to depth. In either case the complete seat is precision finished at a single pass of the tools at a single station more quickly than the multiple operation of drilling and tapping. In another method the recesses are formed on different radii and the thread produced with a backed-up tap. Recesses may also be formed by shaping processes, but all things considered, the orbital milling process is preferable.

It is not essential for the smooth seat to be of the radius of the screw. Sometimes a larger radius put in with a bigger cutter can be used. The function of the smooth recess is after all to hold the screw in proper engagement with the thread and provide an abutment against which it can bottom. Sometimes it is feasible to use tapped seats and a cylindrical backing turned concentrically with the matching part of the joint.

In the accompanying drawings, a number of simple embodiments of the invention are shown for purposes of illustration, in order to explain and demonstrate the fundamental principles of the invention and without in any way limiting the scope of application of the invention.

In the drawings:

Figure 1 is a fragmentary longitudinal section through the securing means for two parts adapted to be joined;

Figure 2 is an elevation looking from the right of Figure 1;

Figure 3 is an exploded sectional view, with the screw in elevation, showing the relation of parts before assembly;

Figure 4 is a view similar to Figure 1, showing a modification;

Figure 5 is a disassembled view of the two members shown in Figure 4, with the screw omitted;

Figure 6 is an elevational view of the construction shown in Figure 4, looking from the right thereof;

Figure 7 is a view similar to Figure 4 showing a modified form of screw;

Figure 8 is an elevation of another modification, showing a locking member for the screw;

Figure 9 is a longitudinal section of Figure 8;

Figure 10 is an end elevation of a locking member;

Figure 11 is a longitudinal section of the same;

Figure 12 is an end view of a tool for expanding and locking member;

Figure 13 is a fragmentary side view thereof;

Figure 14 is a diagrammatic layout of a screw manufacturing line;

Figures 15, 16, and 17 illustrate a number of successive steps in one method of forming the threaded semi-cylindrical seats;

Figures 18 and 19 illustrate the successive steps in one method of forming the smooth-walled semi-cylindrical seats;

Figures 20 and 21 illustrate, diagrammatically, in plan and section, a method of milling the threaded semi-cylindrical seats;

Figure 22 is a fragmentary longitudinal section of another modified form of joint and securing means;

Figure 23 is a fragmentary plan view thereof;

Figure 24 is an exploded sectional view, with the screw in elevation, of the form shown in Figure 22, showing the relation of the parts before assembly;

Figure 25 is a fragmentary longitudinal section through still another modification, and

Figure 26 is an elevation thereof.

Referring to Figure 1, a member 10, which may be cylindrical or otherwise shaped, has an outer end defined by a wall 11, which end is adapted to be closed by a second member 12 having a margin 13 receivable within and adjacent to the wall 11 in substantially sliding relation, the member 12 having an inner surface 23 adapted to seat upon a flange, abutment, or other seating surface 14 formed interiorly within the mem-

ber 10. The member 10, in the embodiment shown in Figures 1–3, is provided with a plurality of substantially semi-cylindrical recesses or screw seats 15 formed in the wall 11 and having parallel, helically disposed threads 16 formed on their side walls. Each recess 15 may terminate at its bottom substantially adjacent the seating surface or abutment 14, as indicated at 17.

The member 12 has a corresponding series of semi-cylindrical seats 20 formed in its margin 13, each being disposed opposite to and coaxial with a corresponding seat 15 in the outer member 10. Each seat 20 has a substantially smooth, semi-cylindrical side wall 21 and a transverse bottom wall 22 which, preferably, is normal to the axis of the seat and is spaced outwardly from the bottom of the threaded seat 15, when the parts are assembled as indicated in Figure 1. In other words, the smooth-walled seat is shallower than the threaded-walled seat. The radius of the smooth-walled seat 20 is slightly larger than the diameter of the threaded-walled seat 15, when the threads thereof are considered. Preferably, the radius of recess 20 is substantially equal to the radius of the bottom of the groove 16' between the thread 16, although it may be slightly larger.

A screw 25 having an external thread 26 is adapted to be threaded into the substantially cylindrical recess formed by the two semi-cylindrical seats 15 and 20. The thread 26 is complemental to the thread 16 on the side wall of the threaded recess 15 and is held in engagement therewith by the smooth side wall 21 of the recess 20 which is disposed in embracing relation to and in engagement with the tips of the threads 26. Of course, there is no threaded engagement between the screw and the smooth-walled recess 20.

Preferably, the screw 25 has a non-circular interior bore or socket 27, which may be hexagonal in cross-section, to receive a hex bar wrench, as is well understood in connection with set-screws of similar type. Radial openings 28 may be provided for the reception of a locking pin or wire.

As the screw is inserted by rotation, it advances toward the bottom of the recess until its end face 29 engages the bottom 22 of the smooth-walled recess 20. Further rotation of the screw causes the same to follow the thread 16, but the abutment of its inner end with the surface 22 forces the screw to urge the member 12 inwardly relative to the member 10 and seats the inner surface 23 of the member 12 firmly upon the flange, lug or abutment 14 associated with the member 10. This action results from the fact that the screw is in threaded engagement with the member 10, but not with the member 12. Its engagement with the latter member has a dual function, in that it has a sliding fit with the side wall 21, permitting relative rotation with respect thereto, and is in abutting relation to the bottom wall 22, bearing directly against the same in an endwise manner and transmitting force thereto.

It will be seen that, as the screw is tightened, the lines of force extend from the threads 16 and 26 through the screw, under compression, somewhat diagonally to the abutment between the end 29 of the screw and the surface 22 of the smooth-walled recess. Hence, the screw is under compression, instead of being under tension, as is the case with conventional screws, bolts and the like.

If a hermetic or substantially leakproof seal is desired between the members 10 and 12, an appropriately shaped gasket 30 may be interposed between the surface 23 of the member 12 and the flange or abutment 14 of the member 10, as indicated diagrammatically in Figure 3.

In the modification shown in Figures 4, 5 and 6, the exterior member 31 is provided with a semi-cylindrical recess 32 having a smooth side wall 33 and the other member 34 has a semi-cylindrical, coaxial recess 35 provided with screw threads 36 on its side wall, adapted to be engaged by the threads 26 formed on the screw 25, which may be the same as the one previously described. The member 31 carries an inwardly projecting flange 37 having a surface 38 substantially normal to the axis of the cylindrical recess 32 and adjacent the bottom thereof. The flange has an undersurface 39 which, in this case, is engaged by a seating surface 40 formed on a flange 41 carried by the member 34 and lying substantially at the bottom end 42 of the threaded recess 35.

With an arrangement of this kind, the parts may be assembled as indicated in Figure 5, with the outer part 31 slipped over and seated upon the inner part 34, or with the inner member 34 inserted within the outer member 31. The screw 25, held in engagement with the threads 36 by the smooth wall 33 of the recess 32 engages the bottom surface 38 thereof and forces the flange 37 against the seating surface of the flange 41, bringing the abutment surfaces 39 and 40 tightly into engagement.

In the arrangement shown in Figure 7 the construction is the same as in Figure 4, except that the screw 45, provided with the external thread 46, is tubular and has a non-circular central bore 47 extending entirely through the screw and open at both ends, as at 48 and 49. This type of screw has numerous advantages. It may be placed in the recess or socket with either end first and a wrench applied to the bore from the outer end. Screws of this type may be manufactured with extreme accuracy at high production rates in a continuous process, in extremely long lengths, from which individual screws may be severed in any desired manner, as explained below. Finally, as shown in Figures 8–13, the tubular screw cooperates with, and makes possible the use of, an entirely new and greatly improved screw-locking system, in the combination of the present invention.

In accordance with this system, there is provided a metallic, cylindrical, drawn cup 50 having substantially one-half of its bottom 51 and an adjacent, semi-cylindrical portion of its side wall 52 cut away as indicated at 53. The cup so formed may have an outside diameter substantially equal to the smallest diameter of the non-circular bore 47' of the screw, which bore, in the form shown in Figures 8 and 9 may be substantially triangular or, as in Figure 7, substantially hexagonal. The cup may be inserted into the bore, with the cut-out notch receiving the flange 13 as indicated in Figure 9. The cylindrical side wall of the cup may then be expanded by the use of a suitable tool, to conform to the interior bore 47' of the screw, whereby the screw and the cup cannot rotate relative to each other and the cup is firmly held in place by frictional engagement with the surface of the bore. The expanded condition of the cup is indicated in dotted lines in Figures 8 and 9.

The edge 53' of the cut-out 53 engages the corresponding edge 13 of the flange in the member 12 and effectively prevents rotation of the cup and of the screw, thereby constituting a lock for

the assembly. A tube having a stepped end may be substituted for the cup if desired. The cup is, however, stiffer and cheaper.

A punch of the type shown in Figures 12 and 13 may be employed to expand the cup. This member has a leading end 54 which is circular in cross-section and of a diameter equal to the inside diameter of the cup 50. The body 55 of the punch, connected to the leading end 54 by sloping shoulders 56, is of a cross-section similar to the inside of the bore 47', but reduced in size by an amount corresponding to the thickness of the side wall of the cup. As the punch is driven inwardly, the leading end serves as a guide, and the body forces the side wall of the cup outwardly into extremely tight engagement with the inner surface of the bore 47'. The body 55 of the punch may have an enlarged, outer portion 57 of a shape and size conforming nicely with the bore 47' in the screw, to serve as a guide to aline the expansion operation accurately within the non-circular bore, as the same is driven home. A tapered section 58, between the body 55 and the enlarged portion 57 may have a swaging effect on the outer end of the side wall of the cup.

Figure 14 shows, diagrammatically, a suitable continuous method of making the tubular, open-ended screws shown in Figures 7 and 9. A tube, such as a drawn seamless tube 60 having a triangular, hexagonal or other non-circular interior, is delivered from feed rollers 61 to a conventional tube straightening station 62 and from this station to and through an apparatus 63 for forming rough continuous threads on the periphery of the tube. From this point, the threaded tube may be drawn through a cleaning station 64, a high frequency heating station 65 and a quenching station 66, by means associated with a drawing station 67. Then the tube may be subjected to an accurate thread-grinding operation at station 68, from which it passes to a chamfering station 69 where the rough, sharp ends of the threads are eliminated, then to a cut-off machine 70, where screw sections of any desired length may be severed from the continuous tube. Finally, the individual screws may pass through an automatic inspecting station 71.

Figures 15–17 illustrate one method of forming in one of the members to be joined, the semi-cylindrical, threaded seats 25 for the reception of the screws. The piece 10 is initially formed with a relatively thick end 11, extending radially inwardly a suitable distance as indicated at 75. The piece may be drilled with a standard drill press, as indicated at 76, and, by the use of well-known multiple drilling heads and jigs, a plurality of similar holes may be drilled simultaneously.

As indicated in Figure 16, the holes so formed may be tapped to provide the threads 26, by suitable equipment. Then, the material enclosed within the dotted lines 77, 78 in Figure 16 may be removed by turning or milling, to produce the structure shown in Figure 17, which is substantially identical to that shown in Figure 1 and at the left of Figure 3.

The smooth-walled semi-cylindrical seats 20 in the piece 12 may be produced by first forming the piece 12 of enlarged size, as indicated at 79, to provide sufficient material for drilling the holes 80. The excess material may then be removed substantially on the dotted line 81, in Figure 18, to produce the structure shown in Figure 19, the bottom wall 22 of the recess 20 being squared up by any suitable means, such as a milling cutter or square-ended counterbore.

Figures 20 and 21 indicate diagrammatically a preferred method of forming the semi-cylindrical seats. In this case, the member 10 is initially formed in substantially its finished condition, except that the seats or recesses have not been provided. A serrated milling tool 85 having two or more sets of teeth 86, 87 spaced apart a distance equivalent to and shaped in accordance with the contour of the threads 16, is mounted for rotation about its own axis and for revolution along a circular path, indicated at 88 in Figure 20. This may be accomplished by mounting the milling tool 85 eccentrically upon a circular support 89 which rotates in a head 90. Any appropriate means may be provided to positively rotate the tool about its axis, as the eccentric support revolves slowly, to feed the tool into the face of the work, thereby to cut a semi-circular recess therein. As the tool cuts this recess in the work, it is advanced axially, to impart the desired pitch to the threads formed by the teeth 86, 87 on the side wall of the recess.

In making the smooth-walled recesses 20, substantially the identical procedure may be followed, except that a straight-cutting milling tool is substituted for the thread cutting milling tool previously described, in order to produce a semi-cylindrical, smooth side wall for the recesses and a bottom surface substantially normal thereto.

The form of the invention shown in Figures 22–26 differs from the forms previously described, primarily in that the securing screws are tapered, and in that at least one of the seats is correspondingly tapered, on a frusto-conical surface. Constructions of these types are desirable, as pointed out above, where the parts are subject to torsional forces and strains along their joint surfaces, as, for instance, where a gear or wheel must be secured to a hub or shaft without angular play. Moreover, in constructions made of parts moulded in plastics or metal powders, it is often advantageous to use a construction of this type which automatically provides mould draft at the recesses.

Referring to Figure 22, a member 95 is provided with a threaded, semi-conical recess 96 having screw threads 97 in its side wall. The other member 98 has a similarly shaped frusto-conical smooth-walled recess 99, the members being interconnected by a transverse bottom surface 100, as previously described. A tapered screw 101, which may be tubular and open at both ends, or closed at its bottom end as previously described, is received in the composite recess formed by the two semi-conical seats. In this instance, the screw need not abut the bottom wall 102 of the smooth-walled recess, since it exerts an axial component of force against the smooth side wall of the recess 99 and imparts axial thrust through that wall to the corresponding member, against a suitable abutment surface 104.

In the form of the invention shown in Figure 25, the member 105 is provided with a semi-conical recess 106 provided with a thread 107 on its side wall, while the other member 108 has formed therein a steeply pitched recess 109, which is a section of a truncated cone and is provided with a smooth side wall 110. A frusto-conical screw 111, which may be similar to the screw 101 previously described, engages the thread 107 in the semi-conical seat 106 and bears firmly against the smooth side wall 110 formed in the recess 109 on the member 108, thereby

imparting axial thrust to the member against an abutment surface 112, as the screw is tightened.

This construction is of particular utility where the smooth side walled recess 109 is moulded in the associated part 108, and the thread 107 is milled or otherwise cut in a previously moulded semi-conical recess, since in many cases it is uncommercial to mould threads in plastic or powdered metal parts.

In view of the foregoing, it will be clear that the invention is not limited to the use of cylindrical screws or semi-cylindrical threaded and smooth-walled recesses, but covers various other shapes.

It must be understood that the invention is not limited to the details of construction described above and shown in the accompanying drawings or to the use of particular materials, as the general principles of the invention may be employed in other specific relations and with practically any materials. The invention is useful in connection with parts or members made of plastics, wood, compressed fibrous materials, and any other substances capable of being moulded, cast, machined, or otherwise shaped. More particularly, the screw elements need not be formed of metal, since other materials, such as glass and various plastics have greater strength, under compression, as distinguished from tension, than steel and other metals. Hence, the invention contemplates the use of glass or other plastic screws which can be moulded roughly to approximately their final shape and then ground accurately to the exact finished conformation. The use of securing elements such as screws which, when in their operative position, are under compression instead of tension, opens up great possibilities for re-design of machinery and mechanical elements generally, as well as the use of materials heretofore thought unsuitable.

All changes and modifications coming within the scope of the appended claims and their equivalents are intended to be included within the invention.

I claim:

1. A joint construction between two members comprising a recess formed in both of the members and having at least a portion of its composite side wall screw-threaded, a stepped bottom in the recess, a tubular, open-ended screw having an axial bore disposed in the recess and a locking member non-rotatably mounted in said bore and engaging the step in the bottom of the recess to prevent rotation of the screw relative to the recess.

2. A joint construction between two members comprising a recess formed in both of the members and having at least a portion of its composite side wall screw-threaded, a stepped bottom in the recess, a tubular, open-ended screw having a non-circular, axial bore in the recess and a locking member non-rotatably mounted in said bore and engaging the step in the bottom of the recess to prevent rotation of the screw relative to the recess.

3. A joint between two members comprising a substantially cylindrical recess formed in part in one member and in part in the other, one recess part having a threaded side wall and the other having a substantially smooth side wall and bottom defined by a transverse edge, a tubular, open-ended screw having a non-circular bore in said recess bearing against said bottom, and a locking element non-rotatably engaging the bore in the screw and the transverse edge of said bottom, thereby preventing rotation of the screw relative to the walls of the recess.

4. A joint between two members comprising a substantially cylindrical recess formed in part in one member and in part in the other, one recess part having a threaded side wall and the other having a substantially smooth side wall and bottom defined by a transverse edge, a tubular, open-ended screw having a non-circular bore in said recess bearing against said bottom, and a locking element comprising a cup member having a bottom shaped to engage the transverse edge of the recess bottom and a side wall non-rotatably engaging the non-circular bore in the screw, thereby preventing rotation of the screw relative to the walls of the recess.

5. A joint between two members comprising a substantially cylindrical recess formed in part in one member and in part in the other, one recess part having a threaded side wall and the other having a substantially smooth side wall and bottom defined by a transverse edge, a tubular, open-ended screw having a non-circular bore in said recesses bearing against said bottom, and a locking element comprising a stepped member having a cut-out bottom providing a transverse edge engaging the edge of the recess bottom and a side wall expanded into firm engagement with and conforming in shape to the non-circular bore in the screw, thereby preventing rotation of the screw relative to the walls of the recess.

6. A joint for two members, one of which is seated upon the other, comprising mutually facing surfaces on the members, a plurality of spaced, parallel, arcuate, threaded recesses in said surface of the underlying member, a plurality of spaced, parallel, arcuate, smooth walled recesses in the overlying member, each disposed opposite to and facing one of said threaded recesses and having a transverse bottom, and a screw operatively disposed in each threaded recess, having a portion of its side wall in engagement with the adjacent non-threaded recess and a portion of its end face in engagement with the transverse bottom thereof and transmitting force from the threaded recess to said bottom to seat the one member upon the other.

7. A joint for two members one of which is seated upon the other comprising adjacent substantially parallel mutually facing surfaces on the members, a plurality of threaded recesses having parallel axes formed in said surface of the underlying member, a plurality of wall sections formed in the other member spaced from and facing the threaded recesses and each terminating in a transverse bottom, and a plurality of screws, each having an arcaute, longitudinally extending portion of its threaded side wall in engagement with one of said recesses, and a diametrically opposite longitudinally extending portion of its side wall in engagement with said wall section of the overlying member, said screws each having a portion of its inner end face in endwise contact with said transverse bottom and transmitting endwise pressure thereto to seat the one member upon the other.

8. A joint construction for securing two members together, comprising an integral underlying part on one member and an integral overlying part on the other, seated on the first part, the first member having a plurality of threaded recesses, each projecting transversely with respect to the underlying part, the second member having a plurality of non-threaded recesses, each

having its side wall parallel to and facing one of the threaded recesses and having a closed bottom, and a screw in each pair of recesses, having one longitudinal section only of its side wall in threaded engagement with the threaded recess and a diametrically opposite longitudinal section only of its side wall in abutting engagement with the non-threaded recess and a portion of its inner end face, contiguous with the last mentioned side wall section overlying said bottom and in engagement therewith, the body of the screws being wholly in compression and transmitting force from the threaded recesses to the bottoms of the non-threaded recesses and clamping the overlying part upon the underlying part.

9. A joint construction for securing one member upon another, comprising an underlying part on one member upon which an overlying part of the second member is seated, the first member having a plurality of threaded, arcuate, recessed surfaces projecting in parallel relation transversely with respect to said underlying part, the second member having a non-threaded surface facing each threaded recessed surface, terminating at its inner end in a transverse surface, and a plurality of headless screws, each having one arcuate, longitudinal section only of its side wall in engagement with one of the threaded recessed surfaces and a diametrically opposite longitudinal section only of its side wall in engagement with said non-threaded surface and a portion of its end face adjacent the last mentioned side wall section in engagement with said transverse surface, the body of each of said screws being wholly in compression and transmitting pressure from the threaded recessed surface to the transverse surface of the other member, to clamp the overlying part upon the underlying part.

10. In a joint construction for securing two members together, substantially parallel overlapping parts on the members providing cooperating seating surfaces with one part seated upon the other, jointing surfaces extending outwardly beyond the overlapping parts and seating surfaces, a plurality of threaded recesses formed in the jointing surface of the member carrying the underlying seating surface, a plurality of smooth walled recesses, facing the threaded recesses, associated with the jointing surface of the member carrying the overlapping seating surface and a plurality of screws, each held in engagement with the side wall of one of the threaded recesses by the smooth walled recess, each screw being in endwise abutting relation to the overlapping seating surface part and transmitting endwise pressure thereto, to clamp the overlapping part upon the underlying part.

11. The combination with a member having a substantially horizontal seating surface and a transversely arranged jointing surface extending outwardly therefrom having a plurality of threaded recesses therein, of another member having a

part seated on said seating surface, inwardly of the outer end of the jointing surface, and an outwardly extending surface facing the jointing surface of the first member, and a plurality of screws substantially completely confined between the outwardly extending surfaces, each being in threaded engagement with one of the threaded recesses and in endwise engagement with the part of the second member seated on the seating surface of the first member.

12. In a screw system for joining adjacent parts, a plurality of pairs of coaxial and complementary semicircular recesses in the respective parts disposed on parallel axes, one recess of each pair being threaded on its periphery and the other being smooth walled and having a bottom normal to its side wall, said parts having cooperating seating surfaces below said bottoms, and a plurality of parallel screws, each lying wholly within one pair of complementary recesses, exerting axial pressure between the threads in the threaded recess and the bottom of the other, to urge said seating surfaces together, said screws being in compression.

13. In a screw system for joining adjacent parts, a plurality of substantially parallel headless screws lying wholly within the thickness of the parts, said parts having a plurality of pairs of complementary recesses formed therein, each pair enclosing one screw throughout its length, and transverse seating surfaces at the inner ends of the recesses, one recess of each pair being grooved to take the threads of the screw and the other being smooth to support the body of the screw and having an abutment against which the reaction of the threads may be impressed to develop seating pressure between said seating surfaces.

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