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FASTENING DEVICE

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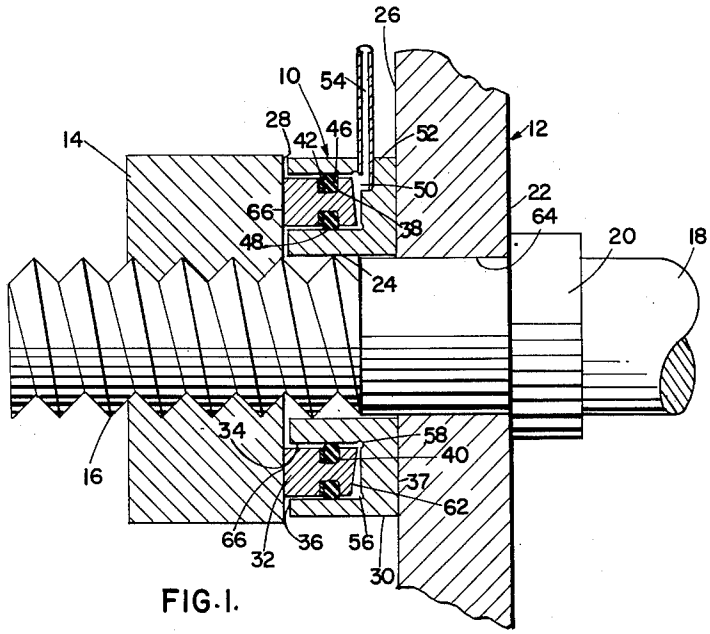


FIG. 1.

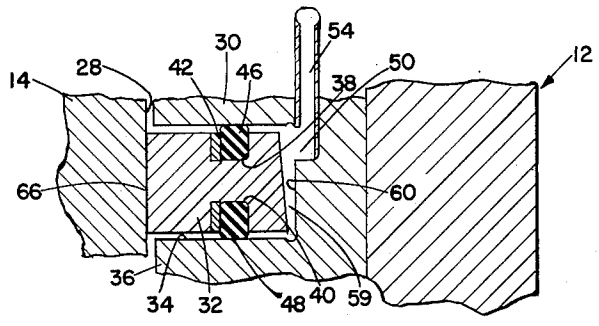


FIG. 2.

Herbert D. Strong, Jr,
INVENTOR.

BY S. J. Rotondi
A. J. Dupont
Leonard Flank

United States Patent Office

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FASTENING DEVICE

Herbert D. Strong, Jr., La Canada, Calif., assignor to the United States of America as represented by the Secretary of the Army

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This invention relates to devices for applying a predetermined axial load between threadedly engaged fastener members, and more particularly to a fluid-operated device for applying such axial load.

In many applications of a fastener element, such as a nut and bolt, it is highly desirable to accurately torque the bolt-nut arrangement to predetermined value. This is normally done by the use of torque wrenches of various types. However, in situations where extremely large bolt-nut arrangements are used, such as in atomic engines, and where extremely accurate torquing is imperative, the use of a conventional torque wrench becomes extremely expensive, as well as somewhat inaccurate, due to the size of the wrench required. Also, in many constructions where the creation of an axial tension or stress on a bolt-nut arrangement is required, but, due to the construction, there is no space in which a torque wrench can be applied to the bolt-nut arrangement, the problem of applying an axial tension or stress is difficult and time consuming involving the use of special tools or structural changes in the apparatus in which the bolt-nut arrangement is used.

In the use of the conventional type of torque wrenches, extreme accuracy is difficult of achievement due to usual indeterminate frictional factor encountered in wrench torquing.

It is therefore an object of this invention to provide a method and device for applying or creating an axial tension or stress on a fastener arrangement whereby a more accurate torque can be provided, the need for a large torque wrench eliminated, and accurate torquing accomplished within narrow area confined or obstructed by structure where ordinary torquing tools would be inoperative due to lack of necessary space requirements for their use.

It is a further object of this invention to provide a method and device for creating an axial tension or stress on a bolt-nut arrangement which is simple in operation, durable in use, and readily applicable to existing situations and capable of extended use in a specialized field of endeavor.

These and other objects may be attained by employing this invention which embodies among its features a loading ring or a washer which is disposed between threadedly engaged fastener members, which in turn clamp, a workpiece, the loading ring having means in the form of a piston mounted for movement axially of the ring and into engagement with one of the fastener members, and means for introducing a fluid under pressure of a predetermined value into the ring to cause the piston to transfer and apply the predetermined pressure against the one fastener member which it engages. The feature of this invention which embodies the method comprises introducing and maintaining a fluid pressure of predetermined value between the workpiece and one of the fastener members of a bolt-nut arrangement so that an axial tension or stress is created in the bolt-nut arrangement with the torque being applied between one fastener member and the workpiece whereby the predetermined value of the pressure introduced into the loading ring device will be transmitted accurately to the one of the fastener members.

Other features include a cylinder of annular form

having a groove therein opening through one face of the cylinder adjacent a parallel face of one fastener member, and a piston disposed in the groove for movement axially of the cylinder. The piston in the groove is subjected to a predetermined fluid pressure introduced into the loading ring device so that the piston will apply the same, predetermined fluid pressure against the adjacent face of the one fastener member.

Other objects, features and advantages will become apparent from the following detailed description, forming the specification, and taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a partial cross-sectional view of the device of the present invention as used on a standard bolt-nut arrangement.

FIGURE 2 is an enlarged cross-sectional view of a portion of the device as shown in FIGURE 1.

With continued reference to the drawings, there is shown for the purpose of illustration only, not by way of limitation, one embodiment through which the present invention can be employed. In the illustration as shown, the fluid washer or loading ring, generally indicated at **10**, is one form which the device of the present invention can take and is shown as being disposed between a workpiece **12** and a nut **14** threadedly engaged upon an externally threaded shank **16** of a bolt **18** which has an upstanding flange **20**, intermediate its ends and bearing against one face **22** of the workpiece **12**. The flange **20** may represent the head of a bolt or a raised flange on a tension rod.

The device or loading ring **10** has a central aperture **24** axially therein and through which the shank **16** of the bolt may be inserted as shown in FIGURE 1. The device, as shown, is disposed between the other face **26** of the workpiece **12**, opposite to the face **22**, and the adjacent face **28** of the nut **14**. It will be apparent that if desired, or more convenient, the loading ring **10** could be disposed between the flange or bolt-head **20** and the adjacent workpiece face **22**.

The loading ring **10** comprises an annular cylinder **30** in which the central axial aperture **24** occurs, and a ring-like piston **32** disposed in an annular groove **34** in the cylinder **30** and opening through the face **36** thereof adjacent the face **28** of the nut **14**. Thus, it will be seen that the piston **32** can move axially of the cylinder **30** in the groove **34** toward the adjacent face of the nut **14** so as to be placed into engagement therewith.

The piston has a pair of appositely disposed annular grooves **38** and **40** in the upper and lower surfaces respectively, of the pistons to provide a seat for a back-up ring **42** in the groove **38** and for a similar back-up ring **44** in the groove **40**. Two O rings **46** and **48** are provided in the respective grooves **38** and **40** in order to effect the seal on the internal and external walls of the groove **38** (FIGURES 1 and 2).

In order to provide means for moving the piston axially of the cylinder, the cylinder **30** is provided with a passageway **50** therethrough which opens through the outer surface **52** of the cylinder **30**. A connection tube **54** is received into the passageway **50** and extends outwardly from the cylinder **30** to be connected into a conventional source of fluid pressure, preferably hydraulic (not shown). As the fluid (or hydraulic pressure) is introduced through the tube **54** and passageway **50**, the piston **32** will move outwardly through the groove **34** and apply the hydraulic pressure introduced into the cylinder against the adjacent face **28** of the nut. It will be quite apparent that if a predetermined fluid pressure is introduced into the loading ring, this pressure will be transmitted and applied against one of the fastener mem-

bers, namely the nut 14 as shown in the accompanying illustration.

To prevent stress build-up on the interior corners of the piston 32, the internal corners 56 and 58 of the annular groove 34 are annularly recessed. Fluid distribution in the device 10 is accomplished through an annular channel or chamber 59 formed between the bottom of 60 of the groove 38 and the adjacent inner face 62 of the piston which is inclined or slightly beveled, as shown.

In actual use, the bolt or tension rod 18 is placed so that its threaded shank portion 16 is inserted through a suitably formed opening 64 transversely through the workpiece 12 to a position where the bolthead or the shank 16 is in abutting relation against the adjacent face 22 of the workpiece. The loading ring 10 is then placed over the shank 16 so that the inner face 37 of the cylinder 30 is in substantial abutting relation with the adjacent surface or face 26 of the workpiece. The nut 14 is then threadedly engaged upon the shank 16 and turned until it engages against the outer end 66 of the piston 32 which projects slightly outwardly away from the outer face 36 of the cylinder. The nut 14 is in abutting relation against the adjacent end of 66 of the piston with substantially no actual pressure. Thus, the loading ring or fluid washer 10 is always prevented from accidental displacement off the shank 16 by the nut 14.

Any fluid or hydraulic pressure now introduced into the loading ring 10 will cause the piston to apply the same introduced pressure against the adjacent surface 28 of the nut. This will, in turn, cause the bolt or tension rod 18 to be stressed under an axial load and create an axial tension or stress on the bolt-nut arrangement 18, 14. Hence, to achieve the same torquing effect as that accomplished by the use of the conventional torque type wrench, while at the same time increasing the accuracy to which the nut-bolt arrangement can be torqued, it is merely necessary in the practice of the present invention to apply a fluid or hydraulic pressure of the desired value into the loading ring 10. Substantially the exact input pressure will be transmitted and applied against one fastener member so that the desired axial tension or stress will be placed upon the bolt or tension rod 18 and nut 14 fastener arrangement.

To maintain the desired torque upon the bolt-nut arrangement, it is only required that the closed fluid or hydraulic system through which a predetermined pressure value is introduced into the loading ring 10 be closed off as by a valve, plugging or valving the tube 54 by any conventional or well-known means; or the tube 54 can remain in continual communication with the source of hydraulic pressure. This latter incidence would be particularly applicable to use in underwater vessels where various hydraulic systems are continually hooked up and in which the maintenance of the specified torque upon a fastener arrangement is of prime importance.

While there is shown and described the preferred embodiment of the invention, it is to be understood that the structure is susceptible to change and modification within the practicability of the invention and therefore should be limited only by the scope of the claim and that hereto.

What is claimed is:

A fastening device comprising a bolt having a threaded portion and a raised flange portion thereon, a workpiece having an aperture therein, said bolt extending through said aperture with the raised flange portion bearing against one face of said workpiece, a threaded nut engaging the threaded portion of said bolt, a loading ring comprising a cylinder and a piston disposed between said workpiece and said nut, said cylinder and said piston each having an opening therethrough and encircling said bolt, means carried by said cylinder for introducing a fluid under a predetermined pressure into said cylinder to cause said piston to move axially of said bolt to apply pressure against said nut and said raised flange portion, said nut having an external transverse dimension greater than the greatest transverse dimension of the opening in said piston, the length of said bolt which extends from said raised flange portion through said nut being integral and having substantially the same external diameter throughout, said cylinder having an annular groove therein which contains said piston, said piston having an axial length corresponding substantially to the depth of said groove, the inner face of said piston being beveled and defining, along with the bottom of said groove, an annular chamber into which the fluid under pressure flows.

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