United States Patent [19]

Reiland

[11] **3,763,725**

[45] **Oct. 9, 1973**

[54] **THREADED FASTENER DEVICE WITH TORQUE CONTROL AND DRIVER THEREFORE**

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[73] Assignee: **Textron Inc.,** Rockford, Ill.

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[52] **U.S. Cl.** ..... **81/121 R,** 145/50 A, 85/61

[51] **Int. Cl.** **B25b 13/06**

[58] **Field of Search** ..... 145/50 A; 85/61; 81/121 R

[56] **References Cited**

UNITED STATES PATENTS

3,584,667 6/1971 Reiland ..... 145/50 A

FOREIGN PATENTS OR APPLICATIONS

898,026 6/1962 Great Britain 85/61

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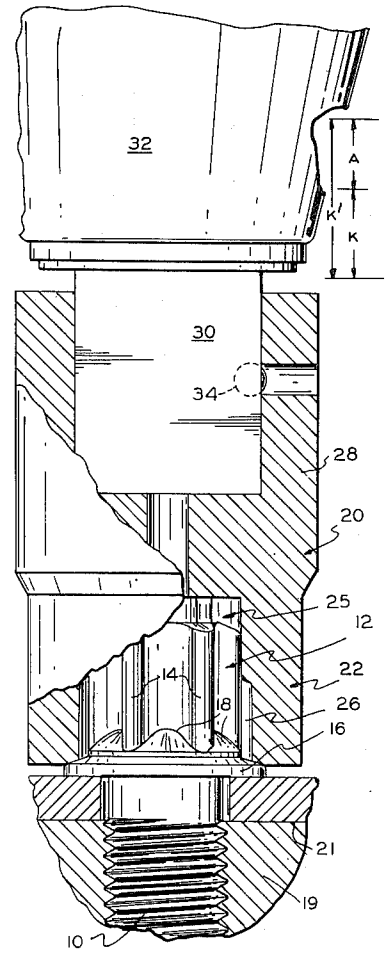
[57] **ABSTRACT**

A threaded fastener device is provided with a longitudinally uniform multi-lobular driving cross section characterized by a shearing zone where lobes are sheared off at a substantially predetermined value of applied torque employed for seating the fastener device. The portion of the lobes remaining is capable of sustaining sufficient torque for effecting removal of the seated fastener device. A driver, forming a torque control system with the fastener device, is constructed to engage only the aforementioned shearing zone for severing the lobes within such zone while leaving the aforementioned remaining portion which may be engaged by a second driver for removal of the said fastener device.

5 Claims, 7 Drawing Figures



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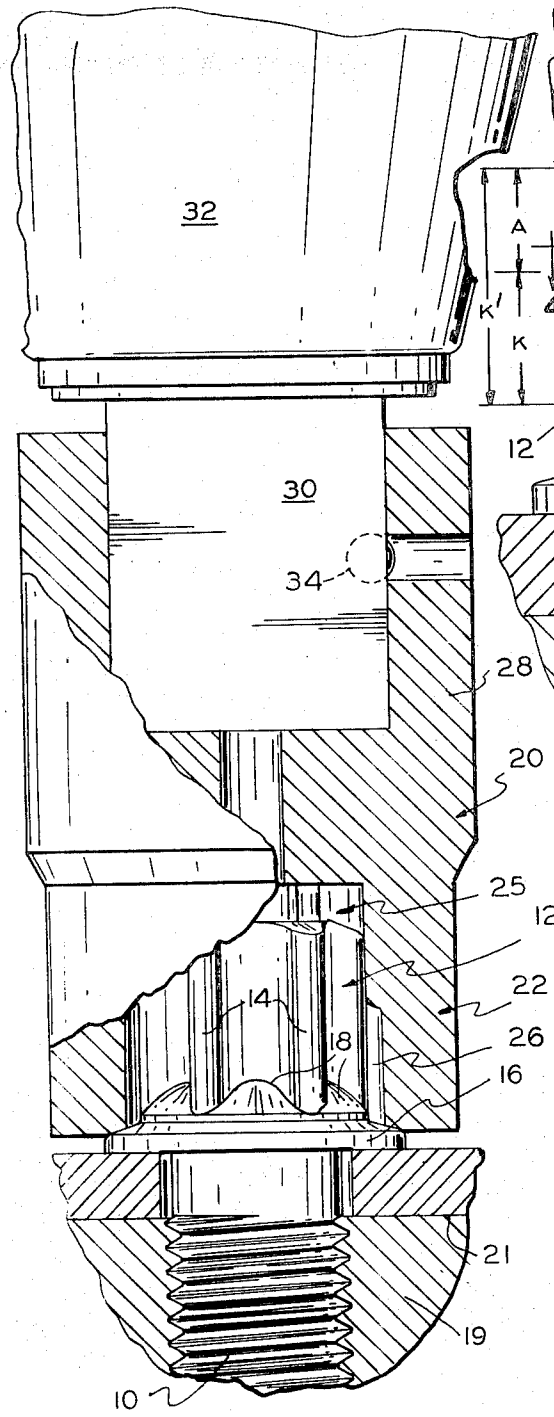
SHEET 1 OF 2

FIG. 1



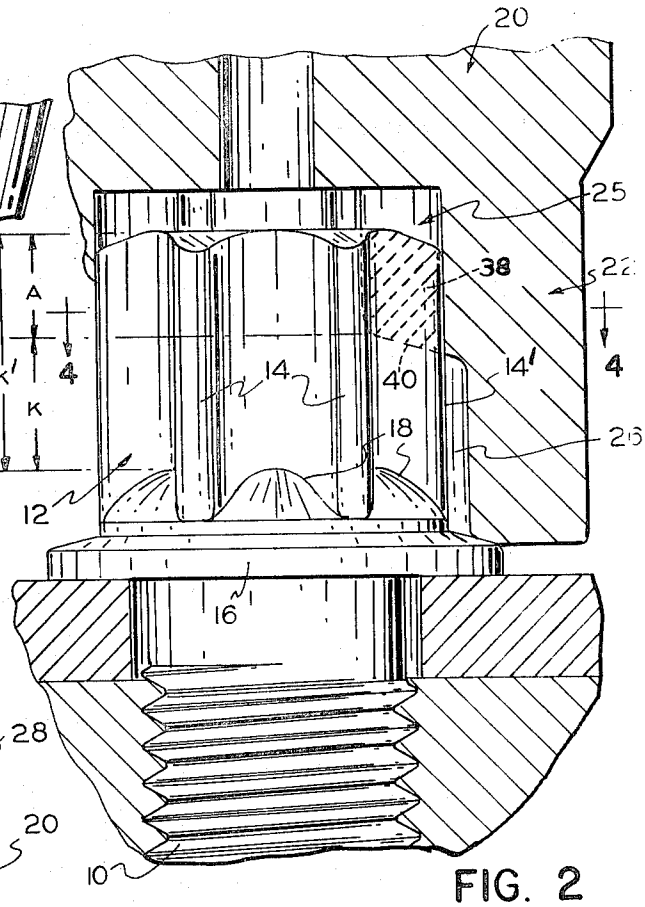


FIG. 2

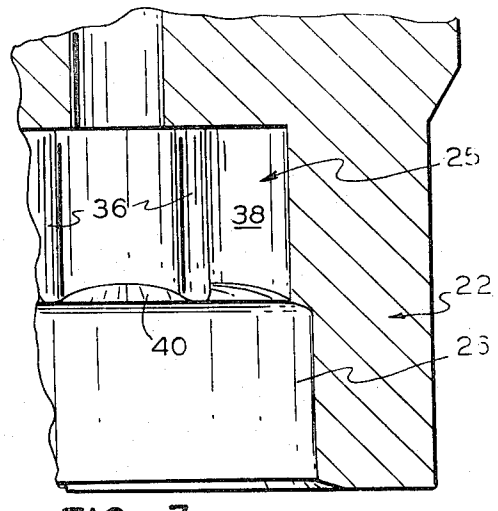


FIG. 3

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FIG. 4

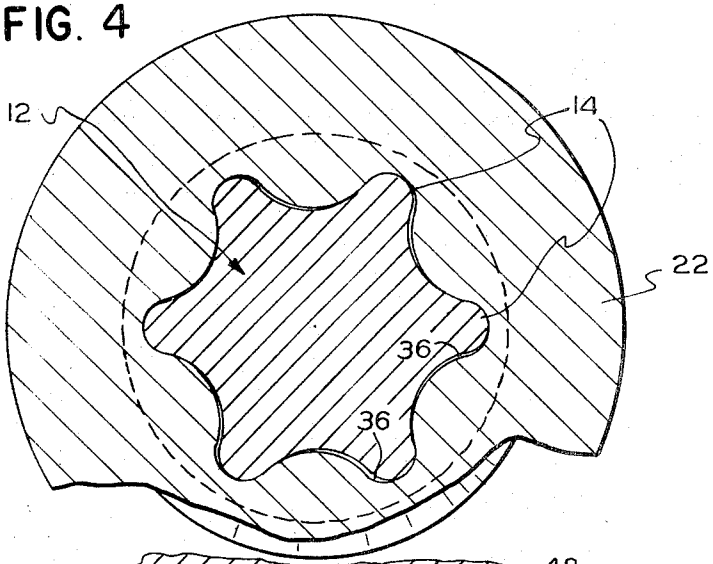


FIG. 5

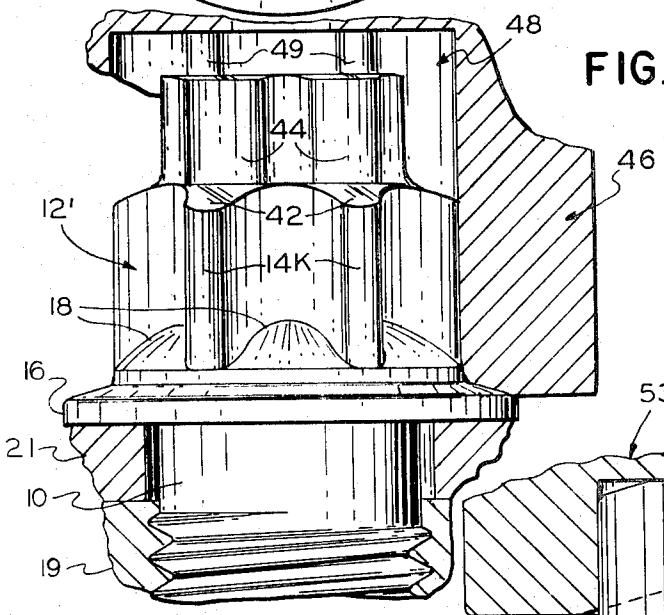


FIG. 7

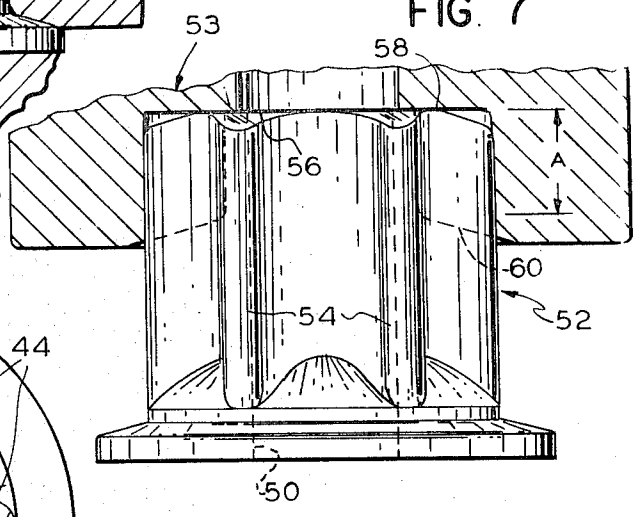
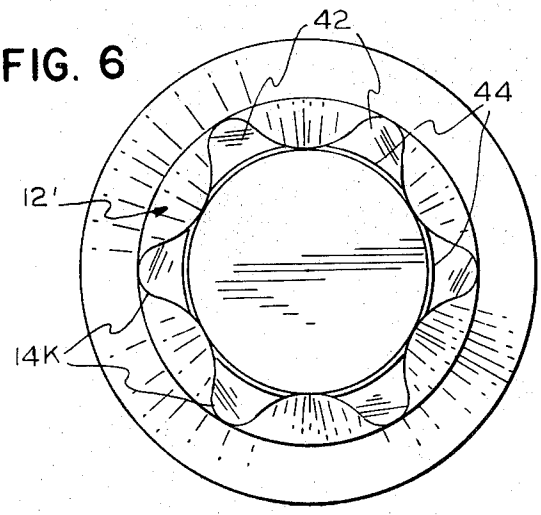


FIG. 6



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THREADED FASTENER DEVICE WITH TORQUE CONTROL AND DRIVER THEREFORE

BACKGROUND OF THE INVENTION

Threaded fastener devices are frequently seated with a power operated or manually operated torque wrench, when predetermined tension on the fastener device is required for securing members joined thereby. Torque wrenches are subject to human error in operation, and moreover, it is difficult to ascertain from a fastener device driven by a torque wrench whether or not the same has been seated properly.

One solution of this problem has been to provide fastener devices which themselves transmit only a predetermined driving torque, and which then provide some indication of having been thus driven. Some devices of this type are difficult to manufacture. For instance, a fastener device may be formed having a pair of driving heads separated by a narrow neck or groove at which point shearing will take place as predetermined torque is applied to an outer driving head. The remaining driving head may then be employed for effecting subsequent removal of the fastener device. Manufacture of a unit providing such neck or groove would ordinarily require a separate machining operation for the groove.

SUMMARY OF THE INVENTION

According to the present invention, a fastener device is provided which has a substantially unitary driving head or driving configuration of substantially uniform longitudinal cross section comprising a series of radially outwardly extending protrudent means or lobes. The driving configuration includes a shearing zone or portion adapted to be engaged by a driver which shears off the protrudent means or lobes within such shearing zone when a substantially predetermined value of seating torque is applied to the driver for seating said fastener device. However, the driver leaves said protrudent means or lobes intact within a second zone or portion of said driving configuration wherein the latter is adapted to be engaged by a second driver for effecting removal of the fastener device. The longitudinal extent of the second zone or portion is desirably at least as great as the longitudinal extent of the shearing zone whereby adequate driving engagement for removal of said fastener device is assured.

According to a particular aspect of the present invention in a preferred embodiment thereof, a driver cooperable with a driving configuration of the fastener device is arranged to engage preferentially the aforementioned shearing zone while avoiding the zone reserved for effecting removal. The fastener device and such driver comprise an effective controlled torque transmitting system according to the present invention. A second driver may subsequently be employed for removing the fastener device as necessary.

It is an object of the present invention to provide an improved fastener device for selectively transmitting a predetermined value of applied torque and for indicating when such a value of torque has been applied for seating the fastener device.

It is another object of the present invention to provide an improved controlled torque fastener device having a driving configuration of longitudinally uniform cross section whereby manufacture thereof is simplified.

It is a further object of the present invention to provide an improved controlled torque fastener device of longitudinally uniform cross section provided with a shearing zone adapted to be engaged for shearing a portion of the driving configuration of said fastener device while leaving an easily engageable driving region capable of effecting removal of said fastener device.

It is another object of the present invention to provide an improved driver for engaging the driving configuration of a fastener device for causing said fastener device to transmit predetermined torque.

It is a further object of the present invention to provide an improved torque-transmitting system for placing a fastener device under predetermined tension.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, both as to organization and method of operation, together with further advantages and objects thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings wherein like reference characters refer to like elements.

DRAWINGS

FIG. 1 is a partially broken away elevation of a torque-transmitting system according to the present invention including a fastener device according to the present invention and a driver therefor;

FIG. 2 is a more detailed elevational view of the threaded fastener device according to the present invention, engaged by a driver, shown in cross section and partially shown in phantom, by means of which a predetermined value of torque can be transmitted;

FIG. 3 is a partially broken away cross-sectional view of the driver also illustrated in FIGS. 1 and 2;

FIG. 4 is a transverse cross section of a threaded fastener device according to the present invention and driver therefor, as taken at 4—4 in FIG. 2;

FIG. 5 is an elevational view of a threaded fastener device according to the present invention after the same has been seated with a predetermined value of torque for removing a portion of said fastener device, together with a second driver for said fastener device employed for effecting removal of same, the second driver being illustrated in cross section;

FIG. 6 is a top view of the FIG. 5 fastener device having had a portion thereof removed by the application of predetermined torque; and

FIG. 7 is an elevational view of a second form of fastener device engaged by a third form of driver, illustrated in cross section, adapted to seat such fastener device with a predetermined value of torque.

DETAILED DESCRIPTION

Referring to FIGS. 1, 2, and 4 a fastener device according to the present invention is illustrated having a threaded shank 10 and a driving head 12 characterized by a driving formation including a plurality of outwardly extending longitudinal protrudent means or lobes 14 separated by inwardly recessed flutes. In the preferred embodiment, there are six such lobes. The lower portion of the head is also provided with an enlarged base or bearing washer portion 16. The lobes are reinforced next to the bearing washer by means of shoulders 18 which slope inwardly from the lower ex-

tremity of the lobes and upwardly toward the inwardly recessed longitudinal flutes.

A fastener device having this general head configuration is described and claimed in my U.S. Pat. No. 3,584,667, granted June 15, 1971, entitled "Coupling Arrangement and Tools for Same," that patent being a continuation-in-part of application Ser. No. 624,853 filed Mar. 21, 1967, and which in turn was a continuation-in-part of my application Ser. No. 580,223, filed Sept. 19, 1966. The centers or axes of curvature of the lobes **14** are suitably located at the apices of a regular hexagon, while the recessed flutes, having a larger radius of curvature than the lobes, merge smoothly and tangentially therewith. This driving head permits a matching driving tool to supply a positive and predetermined driving torque without slipping of the tool or rounding off of projections.

In FIGS. **1** and **2**, the fastener device is illustrated as threadably engaged with a matingly threaded workpiece **19** to which an apertured structural member **21** is secured by means of the head of the fastener device, and specifically bearing washer portion **16** thereof. Alternatively, the fastener device may be of the self tapping variety. It is desired that the shank of the fastener device be placed under predetermined tension for adequately securing member **21** in place. Driving torque will be employed as a gauge of such tension, with the relationship therebetween being experimentally ascertainable for a particular environment as influenced by frictional factors.

The fastener device according to the present invention is provided with a driving head having the above described multi-lobular driving cross section which is substantially uniform in a longitudinal direction, but which includes first and second portions, with the first portion defining a shearing zone wherein the portions of lobes **14** within such zones are dimensioned to shear off at a substantially predetermined value of seating torque for the fastener device or value within a predetermined torque range. This first portion, or shearing zone, is designated by the letter A in FIG. **2**, and extends downwardly from the top of the driving head for a distance less than half of the height of the head above bearing washer **16**. The driving head **12'**, having the lobes sheared off in the aforementioned shearing zone, is further illustrated in FIG. **5**.

The driving head's second zone, designated by the letter K in FIG. **2**, is dimensioned for sustaining sufficient driving torque for subsequently effecting removal of the fastener device from the workpiece or matingly threaded means engaged by the fastener device. Thus, assuming the fastener device is driven into a threaded member with sufficient torque for bringing about shearing in shearing zone A as hereinafter more fully described, the remaining portion, K, should desirably sustain an equal value of torque which may be required for removing the fastener device from the mating threaded member. While the removal torque is frequently less than the seating torque required for placing the fastener device under tension, it is nonetheless preferred that the dimension, K, exceed the dimension A. The sum of A and K equals the dimension K', or the full lobe height of the driving head. It will be appreciated, of course, that some driving contact may also be procured below such full lobe configuration of the driving head for reinforcing the adaptability of the fastener device for removal from a workpiece after being torqued to a tension condition. Removal ability is thus assured.

The driver for the fastener device as thus far described is provided with an internal surface configuration including longitudinal recesses for mating with the driving head lobes. The driver is generally complementary in cross section to the driving head except the surfaces are so dimensioned that there will be a reasonable amount of clearance to permit ready assembly of the driver over the fastener device head. A driver **20** for applying seating torque to the fastener device according to the present invention and thereby placing the same under a predetermined amount of tension is illustrated in FIGS. **1**, **2**, and **3**. The driving head and the driver therefor form a torque transmitting system for providing the proper amount of torque for seating a given fastener device.

In FIG. **1**, the driver, **20**, is shown assembled over the head **12** of the fastener device. The driver comprises a coupling portion **22** provided with a circumferential inner surface **25** which is complementary to the peripheral configuration of head **12** as previously described. However, this configuration is complementary only with the upper portion A of the driving head, as defined in connection with FIG. **2**, with the remainder of the driver comprising a hollow cylindrical socket **26**, the interior of which is spaced outwardly from the lobes of the driving head. The lower end of the socket is adapted for resting upon washer **16**, thereby spacing the complementary portion **25** of the driver thereabove so it will only engage portion A of the driving head. Since the lower end of the socket is designed to rest upon washer **16**, the inside diameter of the socket at this point will naturally be less than the outside diameter of washer **16**. The lower inner corner of the driver is provided with a slight bevel or chamfer to match the upper bevel of the washer.

The driver or tool **20** also includes an upper coupling portion **28** which is provided with a recess for cooperatively receiving end **30** of a shaft forming a part of a power unit **32**. The recess and the end **30** are suitably of square cross section, and the square end **30** is adapted to be snapped in place through engagement with a detent ball **34**.

Referring to FIG. **3**, showing the driver in greater detail and particularly inner surface **25** thereof, the longitudinal recesses **36** may be seen which are adapted to receive lobes **14** of the fastener device head. Between these longitudinal recesses are located inwardly extending convexly rounded surfaces which mate with the inter-lobe flutes of the fastener device head. The side of one of such surfaces is illustrated at **38** in FIG. **3**, and also partially in phantom in FIG. **2**. This surface engages the opposing side of lobe **14'** only within the shearing zone A thereof, whereby when the proper torque is applied, the portion of lobe **14'** within such shearing zone will shear off. The inner configuration **25** is chamfered at **40** to provide an upper chamfer upon the driving surface of the head remaining after the lobe in zone A has been removed.

When driver **20** is rotated in a clockwise direction, the fastener device will be threaded into a mating tapped thread in workpiece **19** until the fastener device is drawn up tight with washer **16** bearing against member **21**. Further torque is then applied up to the value of a substantially predetermined seating torque desired. At this point, the lobes **14** are severed in the aforemen-

tioned shearing zone. Turning to FIG. 5, illustrating the fastener device having the lobes thereof sheared off within the aforementioned zone A, it can be seen the remainder of the lobes, 14K, have been chamfered at 42. The appearance of the driving head is, however, sufficiently different from its former appearance as illustrated in FIGS. 1 and 2 that a ready indication is given of predetermined applied torque. Thus, properly seated fastener devices can be ascertained by visual inspection.

As hereinbefore mentioned, the inner surfaces of the driver were so dimensioned that a reasonable amount of clearance occurs between driver and the fastener device head whereby a driver may be easily applied and removed. Consequently, the driving head in zone A is not stripped to a completely cylindrical configuration, but rather a residual root portion of the lobes remains at 44 defining the shearing surface. The shearing cross section, represented by the sum of an area 44 and an area 42, multiplied by six represents the total root cross section which must be sheared by driver 20. This total area, equal to about half the circumferential area in shearing zone A after the lobes are removed, is designed to shear at substantially the desired value of seating torque. Such total area should be less than the cross-sectional area of shank 10 at the minor diameter of the thread thereof whereby lobe shearing will take place before the head 12' shears from the shank of the fastener device. The corresponding cross section of the lobe portions remaining, i. e., the root cross section of a lobe 14K, multiplied by six for the number of lobes, should exceed the cross-sectional area of the shank at the minor thread diameter to prevent failure of the driving head in removing the fastener device.

For removing the fastener device from a workpiece after the same has been driven with sufficient torque to remove the lobes in the aforementioned shearing zone, a second tool or driver 46 is employed having an interior configuration 48 for complementarily engaging lobes 14K. i. e., the interior of the socket is provided with longitudinal recesses 49 for receiving lobes 14K. The mating lobular configuration of the driver may be present for substantially the whole depth of the socket of driver 46, but of course, since only the height of lobes 14K need be engaged, such interior configuration need extend only for the height of such lobes. The lower end of the socket, as viewed in FIG. 5, is suitably beveled to match the bevel on the upper edge of bearing washer 16 and sloping shoulders are suitably provided interior the driver for mating with shoulders 18 of the driving head. Thus, as the driver 46 is turned in a counterclockwise direction, a sufficient torque may be applied for removing the fastener device from workpiece 19.

Although the driver 20 illustrated in FIG. 1 is preferred, wherein the means for preventing simultaneous engagement of the driver with the portion K of the thread constitutes an open-end socket, other driving means are applicable for shearing the lobes in shearing zone A. One such alternative form of driver is illustrated in FIG. 7, and is here illustrated as applied to a fastener device according to the present invention which in this instance is shown as comprising a nut 52 having an internally threaded bore indicated at 50. The nut 52 may be otherwise substantially similar to the driving head 12 as hereinbefore described.

The driver, illustrated at 53 as partially broken away, has an internal configuration substantially mating with the external configuration of nut 52, which is also of the type illustrated in FIG. 4. However, the tool is foreshortened such that the driving head engages the nut only for the length of shearing zone A, without engaging the major portion of lobes 54. The end wall 56 of the socket of driver 54 is arranged to abut the top surface 58 of the nut 52 whereby the configuration of the driver engages only the top portion of the nut as indicated. Consequently, when predetermined torque is applied, the lobes in shearing zone A will be severed, leaving lobes in a removal zone. Also, it is readily determined upon visual inspection that the nut has been thus seated. The lower portion of the internal configuration of the driver's convex surfaces are chamfered at 60 to produce a similar chamfer upon the portion of the lobes 54 remaining. The remaining portion of lobes 54, desirably having a full lobe height greater than the portion of the lobes severed, is readily engageable with a separate tool, such as illustrated at 46 in FIG. 5, for removal of the nut. Since the portion of the lobes remaining is greater than the portion severed, the ability to transmit removal torque is assured.

While I have shown and described preferred embodiments of my invention, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from my invention in its broader aspects. I therefore intend the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. A torque transmitting system comprising a driving member and a driven threaded fastener device member, said driven member being provided with radially directed protrudent means adapted to receive said driving member, said radially directed protrudent means having a first portion adapted to be engaged by said driving member and a second portion comprising a substantial continuation of the first portion, said driving member including means permitting said driving member to engage only the first portion of said radially directed protrudent means, while preventing simultaneous engagement with the second portion of said protrudent means, said first portion of said radially directed protrudent means being dimensioned to transmit torque up to a substantially predetermined value from said driving member to said driven member at which value shearing of said first portion of said protrudent means takes place as said fastener device is tightened relative to a mating threaded member to place said driven member in predetermined tension relative to said mating member, said second portion of the same protrudent means being dimensioned to transmit said value of torque adapting the same for subsequent engagement for removing said driven member from a mating member.

2. A torque transmitting system comprising: a fastener device adapted to engage a second member in threadably mating relation, said fastener device having a driven head provided with an outer configuration including a plurality of outwardly extending, radially directed longitudinal lobes separated by inwardly recessed longitudinal flutes, the said configuration having a length including a first longitudinal portion and a second longitudinal portion being a continuation of said first portion and of longer effective length than the first

adapting the lobes in the said first portion to shear off at a substantially predetermined value of torque applied to said driven head, and a driving member provided with an inner configuration including longitudinal recesses for mating with said radially directed lobes, said driven head having an abutment surface against which said driving member is positionable with said inner and outer configurations in mating relation, said abutment surface locating said driving member longitudinally relative to the driven head with said inner configuration of said driving member in driving relation with said driven head only for the length of the said first portion thereof for shearing off the lobes thereof as said driving member applies said predetermined value of torque when said fastener device is initially driven into mating relation with the threadably mating member, said second portion of the outer configuration of the driven head having an effective length adapting the same to transmit at least said predetermined value of torque for removing said fastener device from said threadably mating member.

3. The system according to claim **2** wherein said abutment is provided by a washer flange located on said driven head adjacent said second portion of said outer configuration thereof, said driving member comprising a socket having said inner configuration on the interior of said socket in longitudinally spaced relation with the outer open end of said socket for engaging said first portion of said head, the open end of said socket having an inside diameter less than the outside diameter of said washer flange and greater than the outside diameter of said outer configuration of said head for the longitudinal distance between the outer open end of said socket and the said inner configuration of said driving member.

4. A torque transmitting system according to claim **1**, wherein said driving member comprises a socket having an internal wall configuration including at least one segment thereof adapted for engagement with said first portion of said radially directed protrudent means on the driven member, and said means for preventing simultaneous engagement comprising a cylindrical extension on said socket said extension having an inner surface spaced from said radially directed protrudent means of said second portion thereof, and flange means formed on said driven threaded fastener for engagement by said cylindrical extension to limit thereby engagement of said driven member with said protrudent means to only said first portion thereof.

5. A torque transmitting system as defined in claim **1**, wherein said driven member comprises a socket having an inner wall surface configured to engage said first portion of said radially directed protrudent means, and said means for preventing simultaneous engagement with said second portion of said radially directed protrudent means comprising an end wall formed in said socket for engagement with the top surface of said driven member whereby engagement of said socket and said radially directed protrudent means is limited only to said first portion thereof.

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