Oct. 12, 1965 E. B. BURNETT 3,210,963

CUSHION TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 2 Sheets-Sheet 1

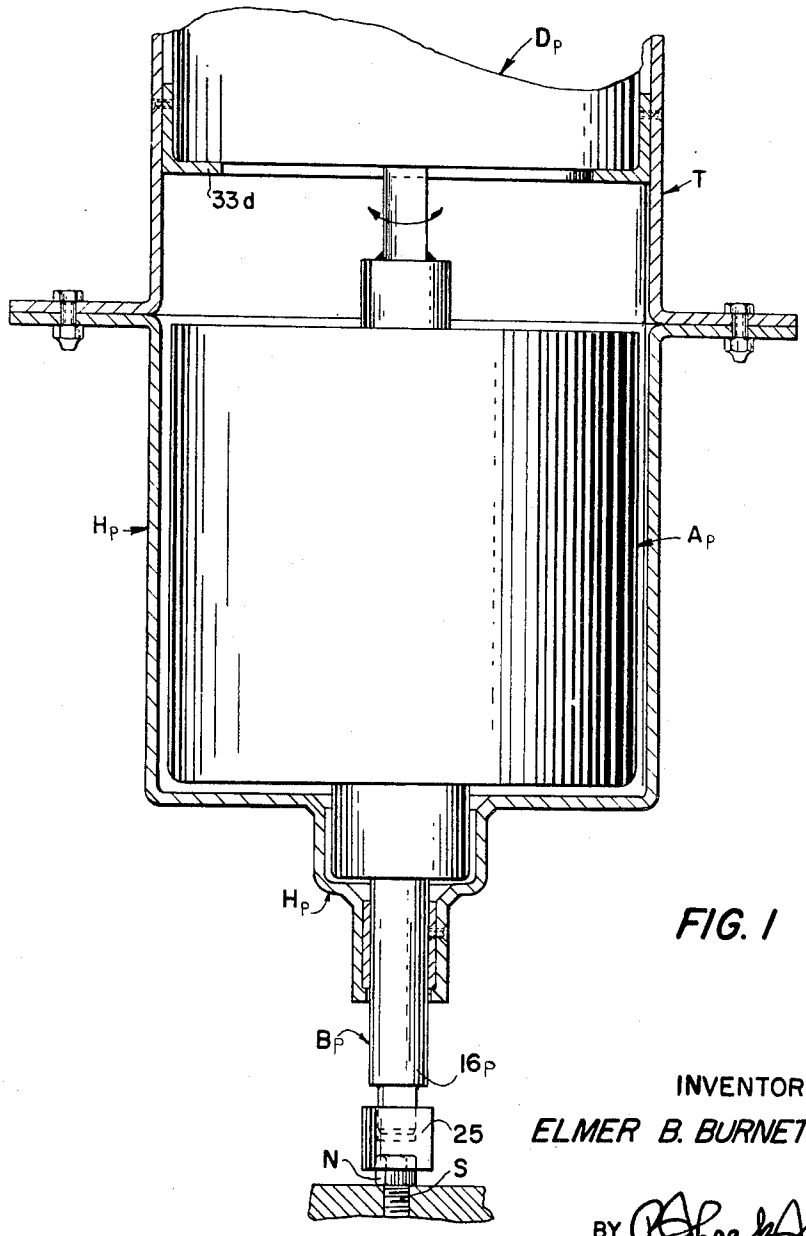


FIG. 1

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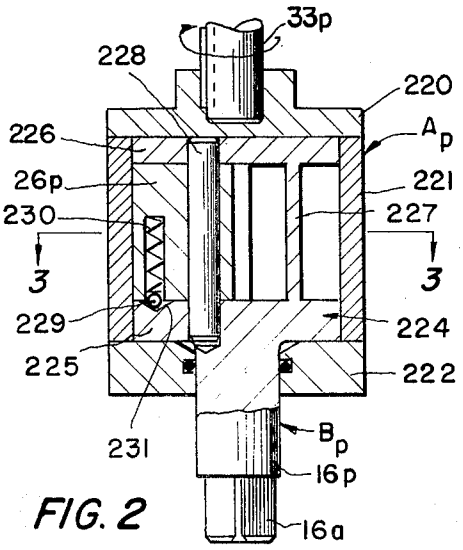


FIG. 2

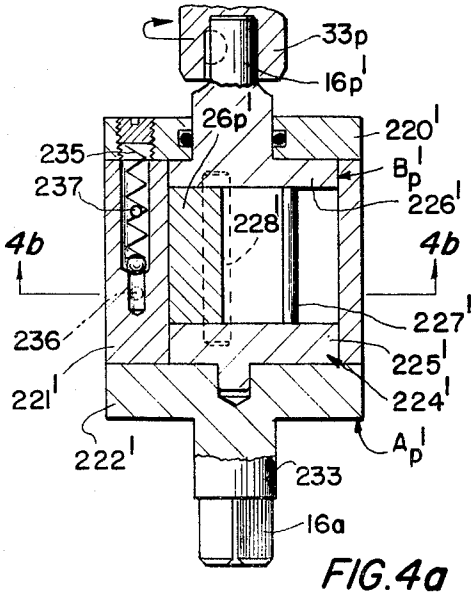


FIG. 4a

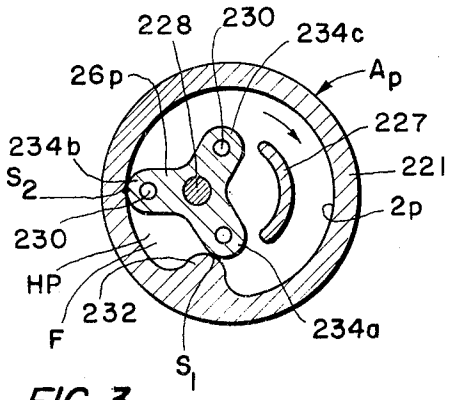


FIG. 3

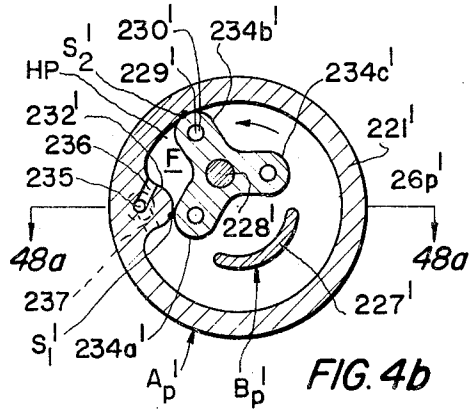


FIG. 4b

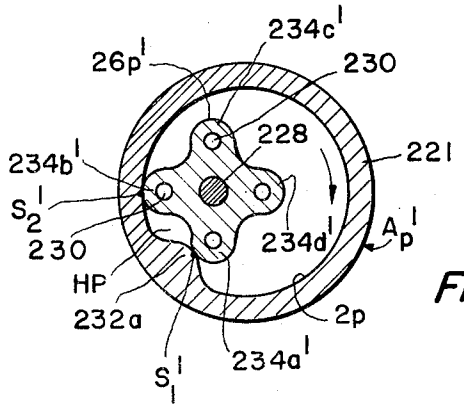


FIG. 4

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3,210,963

CUSHION TYPE IMPULSE TOOL

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Original application Dec. 12, 1962, Ser. No. 244,151. Divided and this application May 5, 1964, Ser. No. 377,791

9 Claims. (Cl. 64—26)

This application is a divisional application of U.S. patent application Serial #244,151 filed December 12, 1962, by Donald K. Skoog et al. and entitled "Impulse Tool."

The present invention relates to impulse tools of the type disclosed in U.S. Patent No. 3,116,617 issued January 7, 1964, to D. K. Skoog and in U.S. patent application Serial No. 285,160 filed March 18, 1963, by D. K. Skoog, and more particularly to an improved impulse tool of this type.

Heretofore, conventional portable, power operated tools for driving nuts, bolts and screws or for applying a torque to other objects have been of the stall, clutch and impact type. While the stall type and clutch type tools give satisfactory torque control in most applications, these types are larger and hence heavier than the impact type tool. Further the stall type and clutch type tools are slower in operation than the impact type tool. In addition the stall type and clutch type tools provide an undesirable torque reaction to the operator, which torque reaction is not present in a tool of the impact type.

In the impact type of tool the kinetic energy of the rotary hammer (of large mass) is transferred to the spindle (of relatively lower mass) by a collision between the jaws of the hammer and the spindle. These conventional impact tools have several limitations. First the rigid jaws of the hammer and the similar jaws of the spindle are relatively light in order to satisfy the demand of the fabricating industries for a light portable tool. However the forces between the jaws of the hammer and the jaws of the spindle are very high during the time of impact therebetween, with resultant breakage or failure of such jaws and a shorter service life than in other conventional power tools, such as those of the stall or clutch types. Secondly, with these conventional impact tools it is very difficult to control or limit the final torque on a threaded fastener to a final predetermined value within satisfactory limits of accuracy. Further the impact tools are difficult to manufacture because of their complicated structure and are rather noisy in their operation.

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of an improved tool of the impulse type which tool has all of the advantages of the stall type, clutch type and impact type tools and none of the disadvantages thereof.

A further object of the present invention is the provision of an impulse type tool which operates in a fluid at low force levels with resultant minimum wear and attendant longer service life than conventional impact tools.

Another object of the present invention is the provision of an impulse tool which is operable to control the final torque on a threaded fastener accurately and precisely within predetermined limits.

Still another object of the present invention is the provision of an impulse tool which, because of the simplicity of its structure, is easy to manufacture.

Yet another object of the present invention is the provision of an impulse tool which provides relatively quiet operation as compared to an impact tool.

A further object of the present invention is the provision of an improved tool of the impulse type, the major elements of which tool act to seal dynamically or at high velocity and function as a valve statically or at low velocity.

A still further object of the present invention is the provision of an impulse tool which is lighter in weight and faster in operation than the tools of the stall type and clutch type.

A further object of the present invention is the provision of an impulse tool which is operable to apply a torque or a series of impulses at an angle with respect to the longitudinal axis of the impulse tool.

A further object of the present invention is to provide a cushion type impulse tool which is very efficient in operation and provides plural impulses during each revolution of the driven means.

For a better understanding of the present invention reference should be had to the accompanying drawings, wherein like numerals of reference indicate similar parts throughout the several views and wherein:

FIG. 1 is a side elevational view of the improved tool of the impulse type, shown in engagement with a threaded fastener and with a stationary casing means shown in vertical section;

FIG. 2 is a longitudinal sectional view of the cushion type impulse tool showing the housing means as the driven member;

FIG. 3 is a vertical sectional view along the line 3—3 of FIG. 2 in the direction of the arrows;

FIG. 4 is a view similar to FIG. 3 of an alternative embodiment of the spindle with the connecting web omitted for clarity;

FIG. 4*a* is a view similar to FIG. 2 showing the spindle means driven by the output shaft of an air motor and the housing means connected to the square drive for a fastening socket, the housing means being provided with pressure relief means with the balls and springs utilized for keying the spindle blade to front flange being eliminated for the sake of clarity;

FIG. 4*b* is a horizontal sectional view along the line 4*b*—4*b* of FIG. 4*a* in the direction of the arrows.

The aforesaid objects of the present invention and other objects which will become apparent as the description proceeds are achieved by providing an impulse tool for applying a predetermined torque to an object. This impulse tool comprises housing means provided with a cavity adapted to contain a fluid, a spindle means in the housing means and in the fluid, and drive means connected to one of the housing means and of the spindle means for impulsing the other which is connected to the object. A first and second spaced lobe means are carried by the one. Lug means are carried by the other of the spindle means and housing means. The spaced lobe means and the lug means are disposed in sealing engagement during a relatively small portion of each revolution of the relative rotary movement. The lug means and the first spaced lobe means and the second spaced lobe means and the one are operable during the relatively small portion of each revolution of the relative rotary movement to dynamically seal off the cavity into a high pressure portion so that the pressure in said high pressure portion and on the other increases thereby causing the other to rotate with respect to the one and to apply a torque to the object.

The cushion type impulse tool has lug means carried by the driven element (either the housing means or the spindle means). Lobe means are carried by the other or normally stationary element to which the impulse is applied.

While the impulse tool of the present invention may be advantageously employed for applying a torque to objects

and as a source of fluid impulses in general, the impulse tool of the present invention is particularly adapted for use in conjunction with applying a torque to a threaded fastener and hence it has been so illustrated and will be so described.

With specific reference to the form of the present invention illustrated in the drawings, and referring particularly to FIG. 1, the impulse tool of the present invention for applying torque to a nut N on a bolt S by a socket **25** is indicated generally by the reference letter T.

As shown in FIG. 1 this impulse tool T has a housing means A_p adapted to contain a fluid, such as oil F.

FIGS. 2–4. 4a–4d

As shown in FIGS. 2–4 lug means, such as the cylinder lug **232** (FIG. 3), **232***a* (FIG. 4) are carried by the driven element (either the housing means A_p (FIG. 3) or the spindle means B_p). Lobe means, such as the lobes **234***a*, **234***b*, **234***c* (FIG. 3) or lobes **234***a*^{1}, **234***b*^{1}, **234***c*^{1}, **234***d*^{1} (FIG. 4) are carried by the other or normally stationary element in this case the spindle means B_p (FIG. 3) and $B_p{}^1$ (FIG. 4). As in the prior embodiments, the impulse is applied to the lobe means **234***a* etc., (FIG. 3) and **234***a*^{1}, (FIG. 4) and the other element B_p, (FIG. 3) and $B_p{}^1$, (FIG. 4).

The driven housing means A_p (FIG. 2) comprises a rear end plate **220**, (FIG. 2) as a cylinder **221** (FIGS. 2–4) and a front end plate **222** (FIG. 2). Within the housing means A_p is mounted a spindle blade housing **224** (FIG. 2), comprising flanges **225** and **226** (FIG. 2) and connecting web **227** (FIGS. 2, 3). The spindle blade **26***p* (FIGS. 2, 3) is eccentrically mounted by meaons of a pin **228** (FIGS. 2–4) in the spindle blade housing **224**. The spindle blade **26***p* is keyed to the bottom flange **225** by means of a plurality of balls **229** (FIG. 2) each biased by a spring **230** (FIGS. 2–4) into a socket **231** (FIG. 2) in the bottom flange **225**.

Referring to FIG. 3, the cylinder lug **232** has engaged lobe **234***a* of the spindle blade **26***p* and is compressing the entrapped oil F in high pressure portion HP thereby impulsing and rotating the spindle blade **26***p* and the spindle shaft **16***p* (FIG. 2) in the direction of the arrow. Leakage of the oil at seal points S_1 and S_2 permits the clinder lug **232** to continue to rotate beyond seal points S_1 thus breaking the seal and releasing the entrapped compressed oil F in high pressure portion HP.

Thereafter the cylinder lug **232** (FIG. 3) engages the spindle lobe **234***b* and indexes the spindle blade **26***p* (against the resisting action of the fastener not shown) out of engagement with the socket **231** in the bottom flange **225** (FIG. 2) and through 120° so that the spindle lobe **234***c* assumes the position of spindle lobe **234***a* (FIG. 3), preparatory for the next impulse.

One impulse of the spindle blade **26***p* occurs during each revolution of the housing means A_p. The provision of a plural number of cylinder lugs **232**, **232***a* provides a plural number of impulses per revolution of the housing means A_p.

Alternative embodiment.—As shown in FIG. 4, the spindle blade **26***p*^{1} may have four lobes **234***a*^{1}, **234***b*^{1}, **234***c*^{1}, **234***d*^{1} or any other desired number.

As shown in FIGS. 4*a*, 4*b*, the spindle shaft **16**$_p{}^1$ of the spindle means $B_p{}^1$ is driven by the output shaft **33***p* of a drive means, such as an air motor D_p (FIG. 1). A housing shaft **233** (FIG. 4*a*) of the housing means $A_p{}^1$ carries the square drive **16***a* for a fastener socket **25** (FIG. 1). The housing means $A_p{}^1$ is provided with pressure relief means, such as an adjustable spring loaded poppet valve **235**, (FIGS. 4*a*, 4*b*) which pressure relief means **235** is utilized to open at a maximum predetermined desired pressure in the high pressure portion HP and hence to control maximum torque output.

Passages **236**, **237** (FIG. 4*b*) connect the poppet valve **235** to the high pressure portion HP and the low pressure portion LP, respectively, of the cavity **2***p*.

It will be recognized by those skilled in the art that the objects of the present invention have been achieved by the provision of an impulse tool which applies a force, namely oil pressure, on the spindle blade and spindle for a short time (namely during the dynamic sealing portion of the operating cycle of the impulse tool) thus providing operation in a fluid at low force levels with resultant minimum wear and attendant longer service life than conventional impact tools.

The impulse tool of the present invention is operable to control the final torque on a threaded fastener accurately and precisely within predetermined practical limits. Further, because of the simplicity of its structure, the impulse tool is easy and economical to manufacture. In addition, the impulse tool provides relatively quiet operation as compared with conventional impact tools. The impulse tool acts as a seal dynamically and as a valve statically; has all of the advantages of the stall type, clutch type and impact type tools and none of the disadvantages thereof; is lighter in weight and faster in operation than the tools of the stall type and clutch type.

In addition, a cushion type impulse tool is provided which is very efficient in operation and which provides plural impulses during each revolution of the driven member.

While in accordance with the patent statutes one best known embodiment of and alternative embodiment of the present invention has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. An impulse tool for applying a torque to an object, said impulse tool comprising:

(a) housing means provided with a cavity for sealingly containing a fluid,

(b) spindle means in said housing means and in said fluid,

(c) drive means operatively associated with one of said housing means and said spindle means for causing relative rotary movement between said housing means and said spindle means,

(d) the other of said housing means and said spindle means being adapted to engage said object,

(e) lug means carried by said one, the other of said housing means and said spindle means being adapted to engage said object,

(f) a first and second spaced lobe means carried by said other,

(g) said lug means and said spaced lobe means being disposed in sealing relation during a relatively small portion of each revolution of said relative rotary movement,

(h) said lug means and said first spaced lobe means and said second spaced lobe means and said one being operable during said relatively small portion of each revolution of said relative rotary movement to dynamically seal off a portion of said cavity into a high pressure portion so that the pressure in said high pressure portion of the fluid and on said other increases thereby causing the other of said housing means and said spindle means to rotate with respect to said one and to apply a torque to said object.

2. An impulse tool for applying a torque to an object, said impulse tool comprising:

(a) housing means provided with a cavity for sealingly containing a fluid,

(b) spindle means in said housing means and in said fluid and adapted to engage said object,

(c) drive means connected to said housing means for rotating said housing means with respect to said object and said spindle means,

(d) lug means carried by said housing means,

(e) a first and second lobe means carried by said spindle means,

(f) said lug means and said spaced lobe means being disposed in sealing relation during a relatively small portion of each revolution of said housing means,

(h) said lug means and said first spaced lobe means and said second spaced lobe means and said housing means being operable during said relatively small portion of each revolution of said housing means to dynamically seal off a portion of said cavity into a high pressure portion so that the pressure in said high pressure portion of the fluid and on said spindle means increases thereby causing said spindle means to rotate with respect to said housing means and to apply a torque to said object.

3. An impulse tool for applying a torque to an object, said impulse tool comprising:

(a) housing means provided with a cavity for sealingly containing a fluid and adapted to engage said object,

(b) spindle means rotatable in said housing means and in said fluid,

(c) drive means connected to said spindle means for rotating said spindle means with respect to said object and said housing means,

(d) a first and second spaced lobe means carried by said housing means,

(e) lug means carried by said spindle means,

(f) said spaced lobe means and said lug means being disposed in sealing engagement during a relatively small portion of each revolution of said spindle means,

(g) said first spaced lobe means and said lug means and said second spaced lug means and said spindle means being operable during said relatively small portion of each revolution of said spindle means to dynamically seal off a portion of said cavity into a high pressure portion so that the pressure in said high pressure portion of the fluid and on said housing means increases thereby causing said housing means to rotate with respect to said spindle means and to apply a torque to said object.

4. The impulse tool recited in claim 1 wherein said drive means is connected to said housing means.

5. The impulse tool recited in claim 1 wherein said drive means is connected to said spindle means.

6. The impulse tool recited in claim 1 wherein said lug means is carried by said housing means.

7. The impulse tool recited in claim 1 wherein said lug means is carried by said spindle means.

8. The impulse tool recited in claim 1 wherein said first and second spaced lobe means is carried by said spindle means.

9. The impulse tool recited in claim 1 wherein said first and second spaced lobe means is carried by said housing means.

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