Oct. 12, 1965 J. S. VAUGHN 3,210,960

CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 1

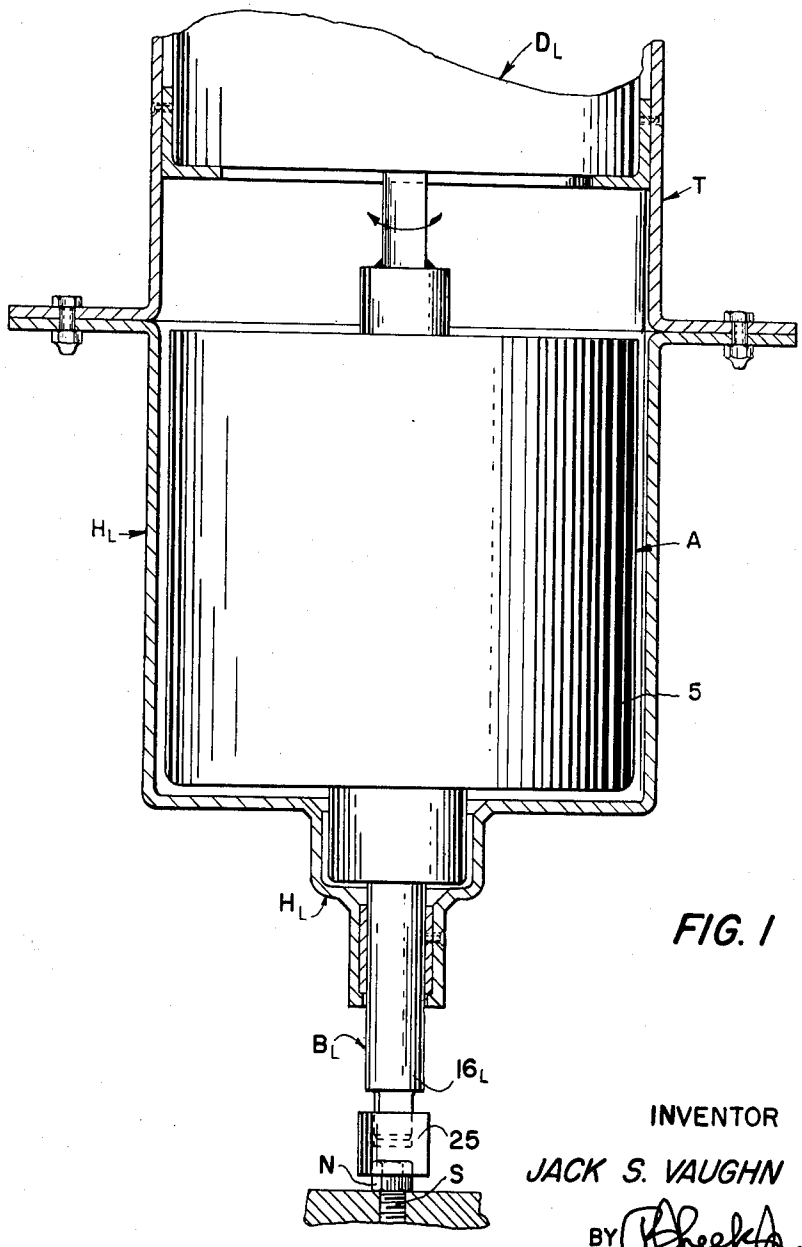


FIG. 1

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 2

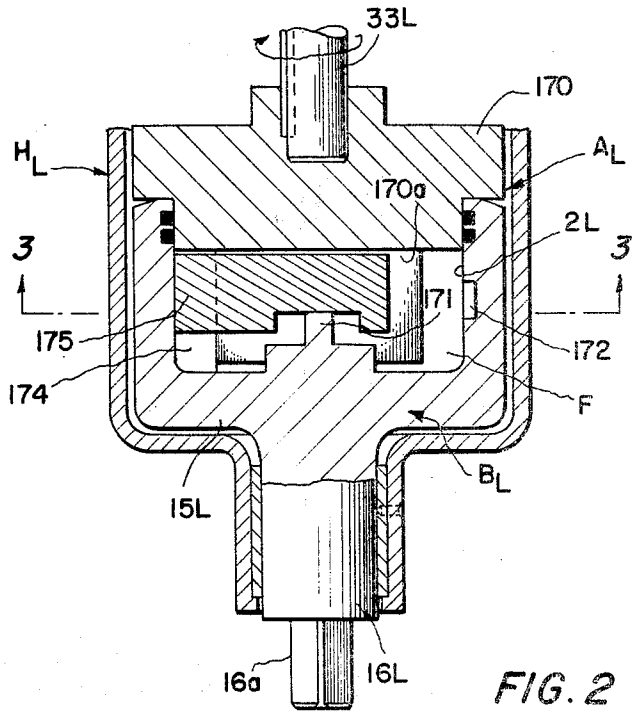


FIG. 2

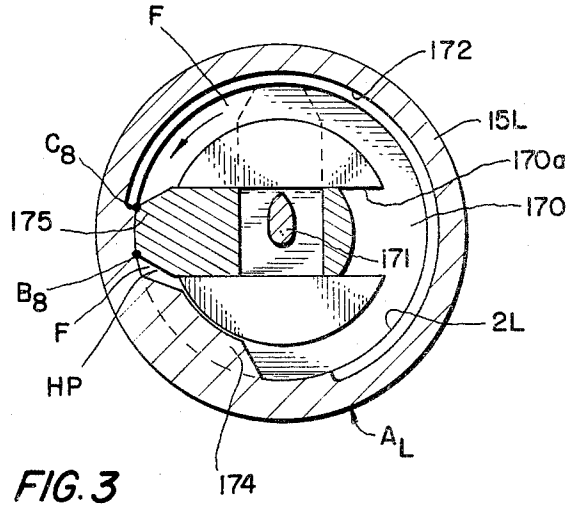


FIG. 3

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 3

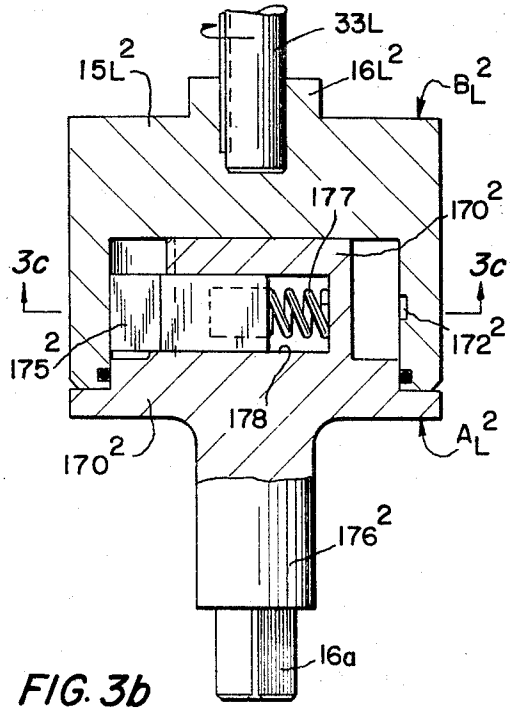


FIG. 3b

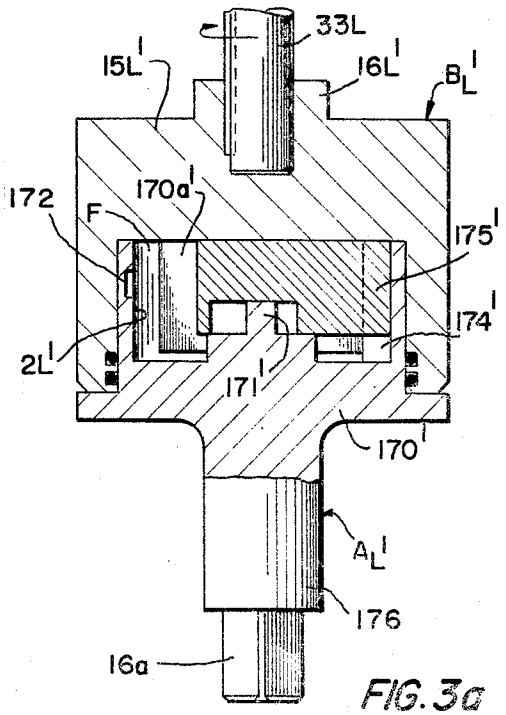


FIG. 3a

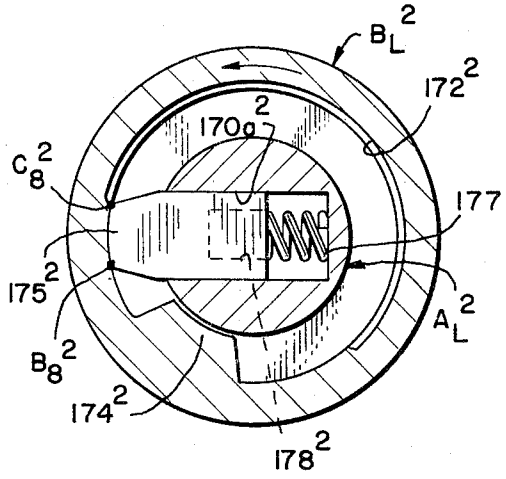


FIG. 3c

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 4

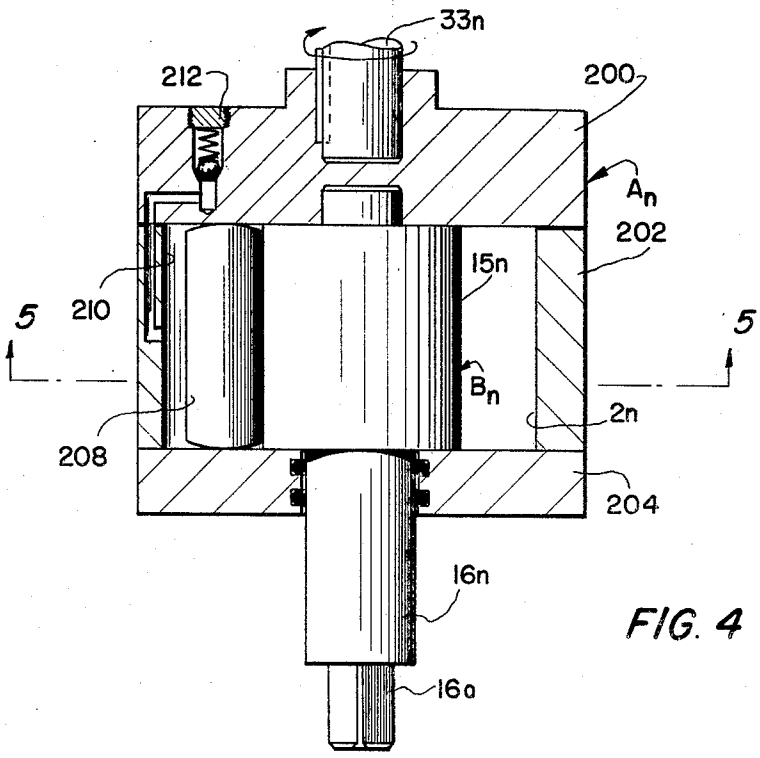


FIG. 4

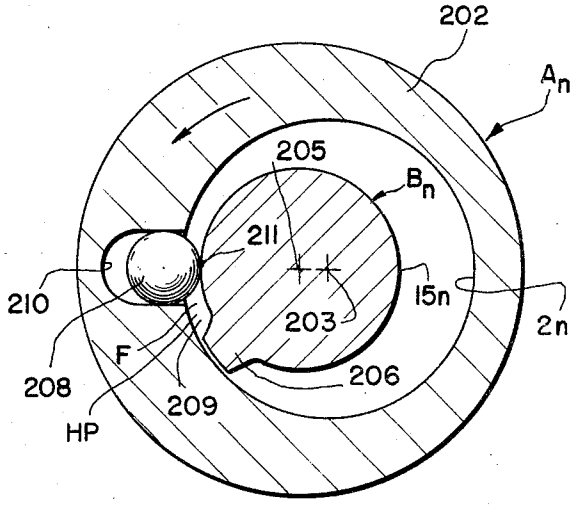


FIG. 5

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 5

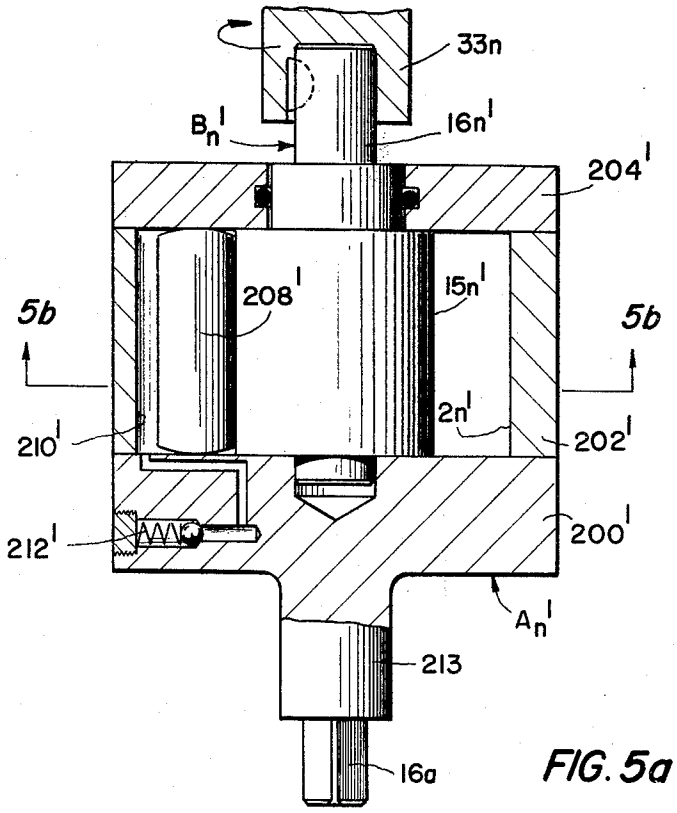


FIG. 5a

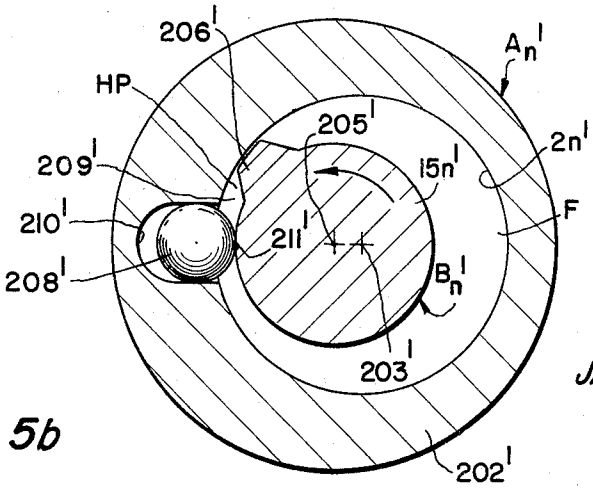


FIG. 5b

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 6

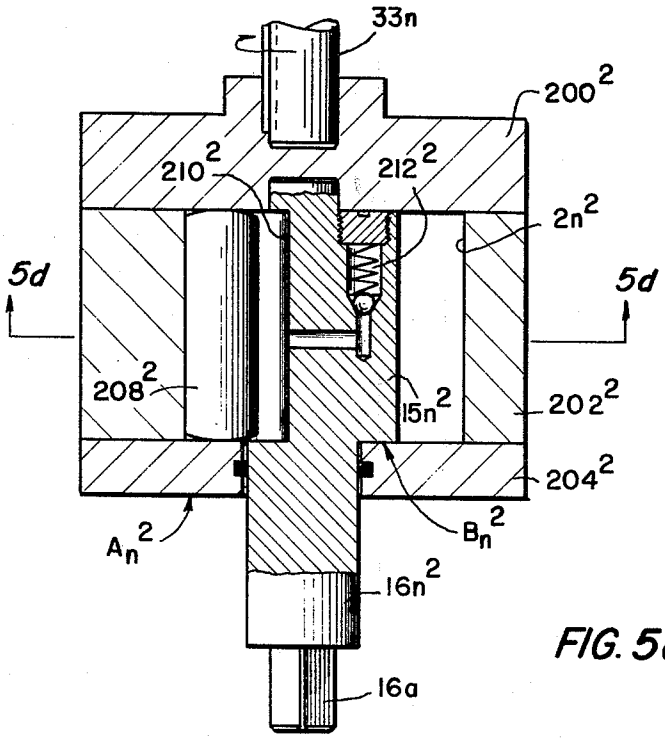


FIG. 5c

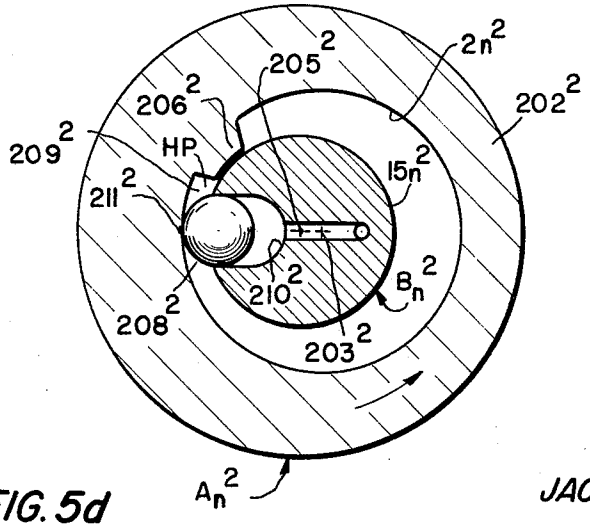


FIG. 5d

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CENTRIFUGAL TYPE IMPULSE TOOL

Original Filed Dec. 12, 1962 7 Sheets-Sheet 7

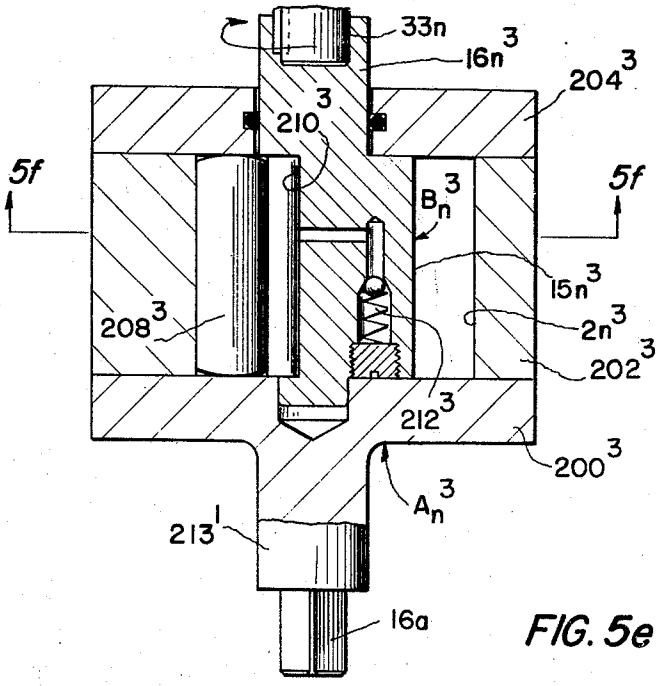


FIG. 5e

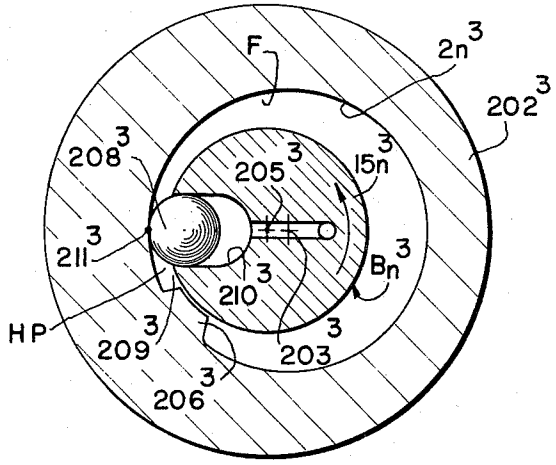


FIG. 5f

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3,210,960

CENTRIFUGAL 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. 377,790

19 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 the centrifugal 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.

Another object of the present invention is the provision of a centrifugal type impulse tool which is capable of high torques and the provision of multiple impulses during each revolution of the driven means and eliminates the pressure relief means.

Yet another object of the present invention is to provide a cushion type impulse tool capable of producing high torque output and a long operational tool life.

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 centrifugal 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;

FIG. 3*a* is a view similar to FIG. 2 showing the spindle means connected to the output shaft of the drive means and carrying the blade and with the housing means connected to the square drive for the fastener socket and carrying the jaw;

FIG. 3*b* is a view similar to FIGS. 2, 3*a* showing the spindle means connected to the output shaft of the drive means and provided with the bypass slot and the housing means connected to the square drive for the fastener socket and provided with the blade slot thus eliminating the loading cam and the effect of centrifugal force on the blade;

FIG. 3*c* is a horizontal sectional view along the line 3*c*—3*c* of FIG. 3*b* in the direction of the arrows;

FIG. 4 is a longitudinal sectional view of the Cushion type Impulse Tool showing the housing means as the driven member;

FIG. 5 is a vertical sectional view along the line **5—5** of FIG. 4 in the direction of the arrows;

FIG. 5*a* is a view similar to FIG. 4 showing the spindle means connected to the drive means and the housing means connected to the square drive for the fastener socket;

FIG. 5*b* is a horizontal sectional view along the line 5*b*—5*b* of FIG. 5*a* in the direction of the arrows;

FIG. 5*c* is a view similar to FIGS. 4, 5*a* showing the housing means as the driven member and provided with the lug and the spindle means connected to the square drive for the fastener socket and provided with the slot and roller and the pressure relief means;

FIG. 5*d* is a horizontal sectional view along the line 5*d*—5*d* of FIG. 5*c* in the direction of the arrows;

FIG. 5*e* is a view similar to FIGS. 4, 5*a*, 5*c* (and more particularly FIG. 5*c*) showing the spindle means as the driven member and provided with the slot and roller and pressure relief means; the housing means connected to the square drive for the fastener socket and provided with the lug;

FIG. 5*f* is a horizontal sectional view along the line 5*f*—5*f* of FIG. 5*e* 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 rotatable in the housing means and in the fluid and drive means connected to one of the housing means and spindle means for rotating the other of the housing means and spindle means with respect to the object. Blade means are reciprocable in a recess in one of the housing means and the spindle means and are adapted by centrifugal force to engage the other. Jaw means are on the other. The blade means and the other and the jaw means and the one are operable during a relatively small portion of each revolution of the relative rotary movement to dynamically seal off a portion of the cavity into a high pressure portion and to apply an impulse to the other and the object.

The centrifugal type impulse tool has blade means carried by the driven means (either housing means or spindle means) and adapted by centrifugal force to engage the normally stationary means. Jaw means are carried by the normally stationary means and receive the impulse.

The cushion type impulse tool has jaw means on the normally stationary means (either the housing means or the spindle means). The other element is provided with receiving means and has sealing means normally disposed in such receiving means.

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 screw 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 AL adapted to contain a fluid, such as oil F.

FIGS. 2, 3, 3a–3c

Alternatively, blade means, such as the blade **175** (FIGS. 2, 3), can be carried by one of either the housing means A_L (inner housing **170**) or spindle means B_L (spindle **15L**) in this case by the housing means A_L and is adapted by centrifugal force to engage the other of either the housing means A_L or spindle means B_L in this case the spindle means B_L. Jaw means, such as the jaws **174** (FIGS. 2, 3) are mounted on the other of either the housing means A_L or the spindle means B_L in this case spindle means B_L.

As the inner housing **170** rotates in counterclockwise direction (FIG. 3) a stationary loading cam **171** (FIGS. 2, 3) on spindle **15L** (FIGS. 2, 3) moves the blade **175** carried by the inner housing **170** (radially outwardly in a slot **170***a* (FIGS. 2, 3) in the inner housing **170**) into the (dotted line loading position, FIG. 3) and against the side wall of the oil-filled cavity **2L** (FIGS. 2, 3). The blade **175** is held by centrifugal force against such side wall. A by-pass slot **172** (FIGS. 2, 3) in the spindle **15L** permits passage or free flow of the oil F around the blade **175** as it moves from the dotted line position (FIG. 3) to the solid line position (FIG. 3).

As the leading edge B_8 of the blade **175** reaches the end C_8 of the slot **172**, oil F is entrapped and compressed between blade **175** and a spindle jaw **174** (in high pressure section HP) to provide an impulse and cause rotation of the spindle jaw **174** and spindle **15L**.

It will be noted that no pressure relief means is utilized thereby preventing metal-to-metal contact on impact between the blade **175** and jaw **174**.

In order to provide disengagement between the blade **175** and jaw **174**, the oil pressure in high pressure section HP is utilized to force the blade **175** past the impulsed spindle jaw **174**.

One impulse per revolution of the inner housing **170** is obtained. The use of multiple jaws **174** would provide a like number of impulses.

As shown in FIG. 3*a*, the spindle means B_L^1 may be connected to the output shaft **33L** of a drive means, such as an air motor similar to motor D_L FIG. 1 as the driven member. In this embodiment the spindle means B_L^1 is provided with the blade slot **170***a*^{1} and the blade **175**^{1} is reciprocable in the blade slot **170***a*^{1} by centrifugal force. The shaft **176** of the housing means A_L^1 is connected to the square drive **16***a* for the fastener socket (not shown) and carries the loading cam **171**^{1}. The housing means A_L^1 is provided with the by-pass slot **172**^{1}.

Referring now to FIGS. 3*b*, 3*c* it will be understood by those skilled in the art that the loading cams **171** (FIGS. 2, 3) and **171**^{1} (FIG. 3*a*) and the effect of centrifugal force on the blades **175** (FIGS. 2, 3) and **175**^{1} (FIG. 3*a*) can be eliminated by connecting the spindle shaft **16L**^{2} to the output shaft **33L** of an air motor similar to motor D_L FIG. 1; by providing the spindle means B_L^2 with a by-pass slot **172**^{2}; by connecting the housing shaft **176**^{2} of the housing means A_L^2 to the square drive **16***a* for the fastener socket similar to socket **25** FIG. 1; and by providing the housing means A_L^2 with a blade slot **170***a*^{2} in which a blade **175**^{2} is biased radially outwardly by a spring **177**. The spring **177** is contained in the blade slot **170***a*^{2} and a slot **178** in the blade **175**^{2}.

FIGS. 4, 5, 5a–5f

In this embodiment the cushion type impulse wrench has jaw means, such as the spindle lug **206** (FIG. 5) carried by the normally stationary one of either the housing means A_n or the spindle means B_n in this case spindle means B_n. The driven or other element (i.e. housing means A_n) is provided with receiving means, such as the roller slot **210** (FIGS. 4, 5). Sealing means, such as the roller **208** (FIGS. 4, 5), is normally disposed in such receiving means or roller slot **210**.

The housing means A_n comprises a rear end plate **200** (FIG. 4) connected to an output shaft **33***n* (FIG. 4) of an air motor D_n FIG. 1, a cylinder **202** (FIGS. 4, 5) and a front end plate **204** (FIG. 4). The oil cavity **2***n* (FIGS. 4, 5) in the cylinder **202** is eccentric with respect thereto, as shown in FIG. 5 by the location of the center **203** (FIG. 5) of the cavity **2***n* and the center **205** (FIG. 5) of the outside diameter of the cylinder **202**. The spindle **15***n* (FIGS. 4, 5) is concentric with the outside diameter of the cylinder **202** and carries a spindle lug **206** (FIG. 5).

As the housing means A_n rotates in counterclockwise direction (FIG. 5), a rolling means, such as the roller **208** (FIGS. 4, 5), or sliding means, such as a spindle, having a square, rectangular, etc. cross section (not shown) entraps oil F between the roller **208** and lug **206** (FIGS. 4, 5), (portion **209** (FIG. 5), or high pressure portion HP of cavity **2***n*) and the roller **208** and end of roller slot **210** (FIGS. 4, 5) in housing means A_n, thereby cushioning the impact of roller **208** against lug **206** and applying an impulse and rotation to the lug **206** and spindle **15***n*.

As the pressure in portion **209** (FIG. 5) increases, the roller **208** is moved outwardly in the slot **209** thus relieving the oil pressure at sealing point **211** (FIG. 5) in portion **209**.

The number of impulses per revolution of the housing means depends on the number of pairs of associated rollers **208** and of roller slots **210**.

At predetermined torque a pressure relief valve **212** (FIG. 4) (which is in communication with roller slot **210** and in housing means A_n) opens, thus relieving the fluid pressure thereon, and allowing roller **208** to clear the spindle lug **206**.

As shown in FIGS. 5*a*, 5*b* the shaft **16***n*^{1} of spindle means B_n^1 may be connected to the output shaft **33***n* of

a drive means, such as an air motor similar to D_n (FIG. 1) as the driven member, and the shaft **213** of the housing means A_n^1 connected to the square drive **16***a* for a fastener socket similar to socket **25** (FIG. 1).

Referring now to FIGS. *5c*, *5d* the housing means A_n^2 is connected to the output shaft **33***n* of an air motor similar to motor D_n (FIG. 1). The housing means A_n^2 carries the lug **206**^{2}. The shaft **16***n*^{2} of the spindle means B_n^2 is connected to the square drive **16***a* and such spindle means B_n^2 is provided with a slot **210**^{2} (in which the roller **208**^{2} reciprocates). In addition, the pressure relief means **212**^{2} is disposed in the spindle means B_n^2.

In FIGS. *5e*, *5f* the shaft **16***n*^{3} of the spindle means B_n^3 is driven by the output shaft **33***n* of an air motor similar to motor D_n (FIG. 1). The spindle means B_n^3 is provided with a slot **210**^{3} (on which the roller **208**^{3} is reciprocated) and a pressure relief means **212**^{3}. The shaft **213**^{3} of the housing means A_n^3 is connected to the square drive **16***a* for the fastener socket similar to socket **25** (FIG. 1) and carries the lug **206**^{3}.

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 centrifugal type impulse tool has been provided which produces high torques and multiple impulses during each revolution of the driven means and eliminates the pressure relief means.

Further a cushion type impulse tool has been provided capable of a long operational life and adapted to produce high torque output.

While in accordance with the patent statutes one best known embodiment of and alternative embodiments 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) one of said housing means and said spindle means being provided with a recess,

(f) blade means reciprocable in said recess and adapted by centrifugal force to engage said other, jaw means on said other,

(g) said blade means and said other and said jaw means and said one being disposed in sealing relation during a relatively small portion of each revolution of said relative rotary movement,

(h) said blade means and said other and said jaw 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 cavity 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. The impulse tool recited in claim **1** wherein said drive means is connected to said housing means.

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

4. The impulse tool recited in claim **1** wherein said blade means is in said housing means.

5. The impulse tool recited in claim **1** wherein said blade means is in said spindle means.

6. The impulse tool recited in claim **1** wherein said jaw means is in said housing means.

7. The impulse tool recited in claim **1** wherein said jaw means is in said spindle means.

8. The impulse tool recited in claim **1** wherein said blade means is in said housing means and having cam means on said other engageable with said blade means for forcing said blade means into engagement with said spindle means.

9. The impulse tool recited in claim **1** wherein said blade means is in said spindle means and having cam means on said other engageable with said blade means for forcing said blade means into engagement with said housing means.

10. The impulse tool recited in claim **1** wherein said blade means is in said housing means and having biasing means in said housing means for forcing said blade means into engagement with said spindle means.

11. The impulse tool recited in claim **1** wherein said blade means is in said spindle means and having biasing means in said spindle means for forcing said blade means into engagement with said housing means.

12. 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) one of said housing means and said spindle means being provided with a recess,

(f) sealing means in said recess,

(g) jaw means on said other of said housing means and said spindle means,

(h) said jaw means and said one and said sealing means and said other being disposed in sealing relation during a relatively small portion of each revolution of said relative rotary movement,

(i) said jaw means and said one and said sealing means and said other 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 cavity 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.

13. The impulse tool recited in claim **12** wherein said drive means is connected to said housing means.

14. The impulse tool recited in claim **12** wherein said drive means is connected to said spindle means.

15. The impulse tool recited in claim 12 wherein said sealing means is in said housing means.

16. The impulse tool recited in claim 12 wherein said sealing means is in said spindle means.

17. The impulse tool recited in claim 12 wherein said jaw means is on said housing means.

18. The impulse tool recited in claim 12 wherein said jaw means is on said spindle means.

19. The impulse tool recited in claim 12 wherein said sealing means is a roller.

References Cited by the Examiner

UNITED STATES PATENTS

2,564,212	8/51	Ramsey	192—58
2,565,289	8/51	Zak	64—28
2,986,024	5/61	Powers	64—26
3,116,617	1/64	Skoog	64—26

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