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ROTARY IMPACT TOOL

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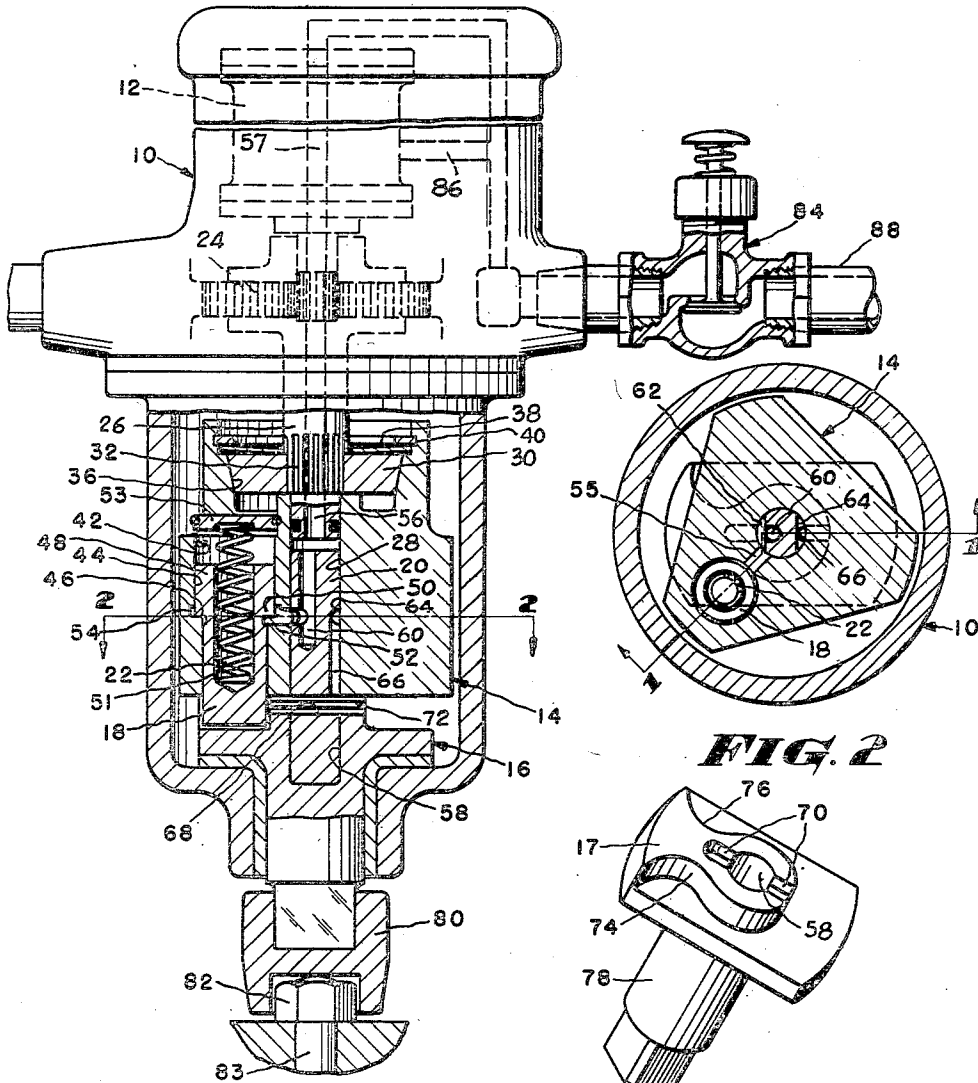


FIG. 1

FIG. 3

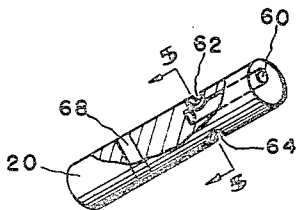


FIG. 4

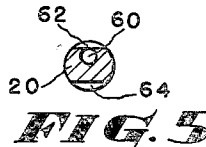


FIG. 5

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## ROTARY IMPACT TOOL

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4 Claims. (Cl. 192—30.5)

This invention relates to rotary impact tools, and more particularly to air-operated impact tools of the type adapted to rotate screws, nuts and similar work.

One object of this invention is to provide an impact tool of such type which is relatively inexpensive to construct and maintain.

A further object of this invention is to provide an air-operated dog, or jaw, for engaging and disengaging the hammer with the anvil.

Other objects of this invention will become obvious from the following specification and drawings in which,

Figure 1 is a vertical elevation, partly in section, of an impact tool constructed in accordance with the practice of this invention,

Fig. 2 is a transverse view taken through Fig. 1 along the line 2—2 looking in the direction of the arrows,

Fig. 3 is a view in perspective of the anvil,

Fig. 4 is a perspective view, partly in section, of a valve element for controlling the flow of pressure fluid for actuating the hammer dog, and

Fig. 5 is a transverse view taken through Fig. 4 along the line 5—5 looking in the direction of the arrows.

Referring to Fig. 1 of the drawings, the impact tool disclosed comprises, in general, a casing 10 housing a motor 12 connected to rotate a hammer 14 adapted to deliver a series of rotational hammer blows in rapid succession for rotating an anvil 16. In the tool shown, the hammer 14 and anvil 16 remain engaged and are rotated continuously at a relatively high speed whenever the work is relatively loose or easily rotated. When, however, the work reaches some predetermined degree of tightness, the hammer is alternately disengaged and engaged with the anvil such that the hammer delivers a series of high velocity blows to the anvil to rotate the work.

In furtherance to this end the hammer includes a reciprocating dog or impact pin 18 constantly urged by a spring 22 into one limiting position such that it will strike, or engage, a jaw 17 on the anvil 16. Immediately after impact of this blow, the dog 18 is retracted into its other limiting position to disengage the anvil from the hammer by pressure fluid valved thereto by a valve 20. Upon such disengagement the hammer is rotated rapidly by the motor 12 to strike another hammer blow. During this free rotation of the hammer 14, the valve 20 exhausts pressure fluid from the dog 18 and the spring 22 actuates the dog 18 into its forward limiting position for engagement with the anvil.

Referring now in greater detail to the construction of the impact tool, the motor 12 shown is of the air-operated type connected to a spindle 26 piloted in a transverse bore 28 in the hammer 14. The gearing 24 shown may, if desired, be connected between the motor 12 and spindle 26. The driving connection between the spindle 26 and hammer 14 is of the type adapted to limit the

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impact shock of the hammer transmitted to the motor. The connection shown by way of illustration comprises a cone clutch 30 having a splined connection at 32 with the spindle 26 and a frictional connection at its peripheral surface with the surface of a cone-shaped recess in the rearward end portion of the hammer 14. The clutch 30 is constantly urged into frictional contact with the hammer by a spring 38 biased between the rearward end of the clutch 30 and a retaining ring 40 mounted in the hammer 14. With this construction, limited relative movement between the spindle 26 and the hammer 14 is permitted at the time of impact of the hammer 14 with the anvil 16 so as to limit the amount of shock transversed through the spindle to the gears 24 and motor 12.

The hammer 14, shown by way of illustration only, is of generally triangular shape and having in one corner a longitudinal chamber 42 for the reception of the impact pin or dog 18. The chamber 42 is somewhat enlarged at its rearward end portion 44 thereby providing a shoulder 46 for limiting the forward movement of the dog 18. In furtherance to this end the dog 18 is similar in its outside dimensions to the chamber 42 thereby providing a head 48 reciprocable in the chamber portion 44 and a shoulder 50 defining a pressure surface 52.

The dog 18 is constantly urged into its forward limiting, or hammer engaging, position by the spring 22 positioned in a recess 51 in the dog and bearing at its rearward end against a spring seat 53. The dog 18 is periodically actuated into its rearward limiting position and out of engagement with the anvil 16 by a pressure fluid intermittently supplied to the surface 52. In furtherance to this end an annular groove 54 is cut in the periphery of the chamber 42 immediately adjacent the shoulder 46. This groove 54 is communicated with the interior of the hammer bore 28 by a port 55. The bore 28 in turn is communicated with a pressure fluid source (not shown) through a central bore 56 in the spindle 26 and passage 57 in the motor 12 and casing 10.

The flow of pressure fluid to and from the chamber 42 for actuating the dog 18 is controlled by means of the rotary valve 20. The valve shown by way of illustration is in the shape of a cylinder with the forward portion fitted in a recess 58 in the anvil 16. The rearward end portion of the valve 20 extends into the hammer bore 28 and has a longitudinal passage 60 leading from the rear end surface of the valve 20 to a peripheral cut or notch 62 in the valve 20 lying in the same horizontal plane as the port 55 in the hammer.

Positioned 180 degrees from the cut 62 is a similar cut 64 registering with a longitudinal groove 66 leading forwardly to a transverse hole 68 in the valve 20. When the valve 20 is placed in its operative position as shown in Fig. 1 the transverse hole 68 is in alignment with a pair of cuts 70 in the anvil 16 for the reception of a pin 72 securing the valve 20 against rotation relative to the anvil 16. The pin 72 is preferably of cruciform shape or some similar shape such that clearance is provided to communicate the groove 66 through the hole 68 and cut 70 with the atmosphere.

With this valve construction, whenever the hammer 14 rotates relative to the anvil 16 such that the dog 18 contacts the anvil jaw 17 (see Fig. 2, right-hand rotation being assumed), the cut 62 will register with the port 55 to valve pressure fluid to the dog surface 52. The cut 62 does not, however, register fully with the port 55 in this hammer position and accordingly, a relative short period of time is required for the pressure in the groove 54 to build up to the pressure in the passage 60. Thus the pressure acting on the surface 52 does not build up

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sufficiently to retract the dog 18 against the pressure of the spring 22 until after the hammer has struck a blow.

Immediately after the blow is struck the force of pressure fluid acting against the surface 52 will retract the dog 18 disengaging the hammer from the anvil, and the hammer will then be rotated some 360 degrees prior to striking the next blow. During this free rotation of the hammer and some 180 degrees after the dog 18 is retracted, the peripheral cut 64 registers with the port 55 thereby exhausting pressure fluid from the groove 54 through the groove 66, hole 68 and cut 70 to the atmosphere thereby permitting the spring 22 to return the dog 18 to its forward limiting position preparatory to striking the next hammer blow.

The anvil shown is provided with a single jaw 17 such that the hammer strikes only one blow per revolution. Two or more jaws could, of course, be provided if more blows per hammer revolution is desired. The jaw 17 shown has curved portions 74 and 76 on its opposite sides, the curve of each portion having a radius corresponding to the radius of the dog 18 so as to provide surface contact between the surfaces of the dog 18 and the jaw 17. The curved portion 74 serves as a striking surface on the jaw 17 during right-hand rotation of the hammer 14, the surface 76 is the striking surface for left-hand rotation. An extension 78 on the anvil is connected through a socket 80 or similar connecting element with the work 82.

Reviewing briefly the operation of the impact tool, the tool is started by opening the control valve 84 in the tool handle 88 to supply air to the motor 12 and valve 20. Assuming that during the initial portion of the tightening cycle that the nut 82 runs relatively free on the bolt 83, the dog 18 will remain in engagement with the anvil jaw 17 and the hammer and anvil will be rotated at the speed of the spindle 26 until the resistance to rotation of the nut reaches some predetermined torque. The reason the dog 18 is not intermittently engaged to and disengaged from the anvil during this portion of the tightening cycle is due to an operating characteristic of an air-motor which makes it serve as a means for automatically controlling the pressure of air supplied to the valve 20. Specifically, when there is little resistance to rotation of an air-motor it runs at a relatively high speed—e. g., 6,000 revolutions per minute (R. P. M.). At this speed there is very little resistance to air flowing through the motor, and the air pressure downstream of the motor control valve 84, as in the air supply passages 86 and 57 for the motor 12 and valve 20, respectively, is relatively low as compared to line pressure upstream of valve 84. When, however, the motor is running at a slower speed, as when resistance to rotation of the work is above said predetermined value, the pressure downstream of the valve 84 builds up to a value more nearly equal to line pressure. Thus, the pressure available to actuate the dog 18 is not sufficiently high during the run-down period to actuate the dog 18 against the force of the spring 22. When, however, the resistance to rotation of the work slows the speed of the motor 12 down to, say for example, 1,000 R. P. M. average, the pressure of the air between the motor control valve 84 and the motor 12 is sufficiently high to actuate the dog 18.

Accordingly, whenever the work reaches some predetermined degree of tightness and the anvil rotates to a position to register the cut 62 with the port 55, pressure fluid is conducted to the pressure surface 52 on the dog 18 to retract that dog 18 immediately after a hammer blow is struck. Movement of the dog 18 out of engagement with the anvil frees the hammer to be rotated by the spindle 26 through some 360 degrees preparatory to striking a succeeding hammer blow. During the free rotation of the hammer, the groove 54 is communicated through the port 55, peripheral cut 64, groove 66, hole 68 and cut 70 with the atmosphere such that the spring 22 actuates the dog 18 into its forward limiting position for engagement with the anvil 16.

While I have shown and described a specific form of

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my invention, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. An impact tool comprising a pressure fluid motor, an anvil, a hammer for connection with the motor and rotated thereby for delivering a series of rotational blows to the anvil, said hammer having a chamber, and a dog mounted in said chamber having a pressure surface thereon and being movable into one position for engagement with the anvil and movable into a second position out of such engagement, means constantly urging the dog into one of said positions, valve means mounted on the anvil and cooperating with the hammer to valve pressure fluid to said surface whenever the hammer is in one location relative to the anvil and to exhaust pressure fluid from said surface to the atmosphere whenever the hammer is in another location relative to the anvil, and means for supplying pressure fluid to said valve means.

2. An impact tool for rotating a work-piece comprising, a pressure fluid motor, an anvil, a hammer for connection with the motor and rotated thereby for delivering a series of rotational blows to the anvil, said hammer having a chamber and a bore formed therein and a port communicating said chamber and bore, a dog reciprocable in said chamber and having a pressure surface thereon, said dog being actuated into one position for engagement with the anvil and actuated into another position out of such engagement, means for constantly urging the dog into one of said positions, a valve in said bore held against rotation relative to said anvil for intermittently communicating said port with a source of pressure fluid to supply pressure fluid to said surface for actuating the dog into the other of said positions and intermittently communicating said port with the atmosphere to exhaust pressure fluid from said chamber, means for supplying pressure fluid to said motor and valve, and means for automatically reducing the pressure of fluid supplied to the valve whenever the turning force supplied to the work-piece is below a predetermined value.

3. A rotary impact tool comprising, an air motor, an anvil, a hammer adapted to be rotated by the motor for delivering a series of rotational hammer blows to the anvil, said hammer including a dog having a pressure surface thereon and movable relative to the hammer in one direction for engagement with the anvil and retractable in the other direction to disengage the hammer from the anvil, spring means for constantly urging the dog in the direction for engagement with the anvil, means for valving pressure fluid to said pressure surface immediately prior to engagement of the dog with the anvil for disengaging the hammer from the anvil after a blow is struck and for exhausting such fluid to the atmosphere after the dog is retracted to permit the spring to actuate the dog into engaging position prior to the next hammer blow, and a conduit for supplying pressure fluid to the motor and the last said means.

4. An impact tool comprising, a pressure fluid motor, a conduit for supplying fluid under pressure to said motor, means for controlling flow through said conduit, an anvil having a jaw, a hammer for connection with the motor and rotated thereby for delivering a series of rotational blows to the anvil jaw, said hammer having a chamber and a bore formed therein and a port communicating said chamber and bore, a dog reciprocable in said chamber and having a pressure surface thereon, means for constantly urging the dog into a position for engagement with the anvil jaw, a valve in said bore held against rotation relative to the anvil, said valve having a cut therein adapted to be constantly communicated with a pressure fluid source and arranged to register with said port to supply pressure fluid to actuate the dog out of said engagement whenever the hammer location relative to the anvil places the dog in contact with the anvil jaw, said valve having a

second cut therein adapted to be constantly communicated with the atmosphere and arranged to register with said port at a point in the hammer cycle subsequent to said contact of the dog with the jaw, and a passage leading from said conduit from a point downstream of said means to supply pressure fluid to said valve.

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