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FLUID PRESSURE OPERATED WRENCH

Filed Aug. 29, 1967

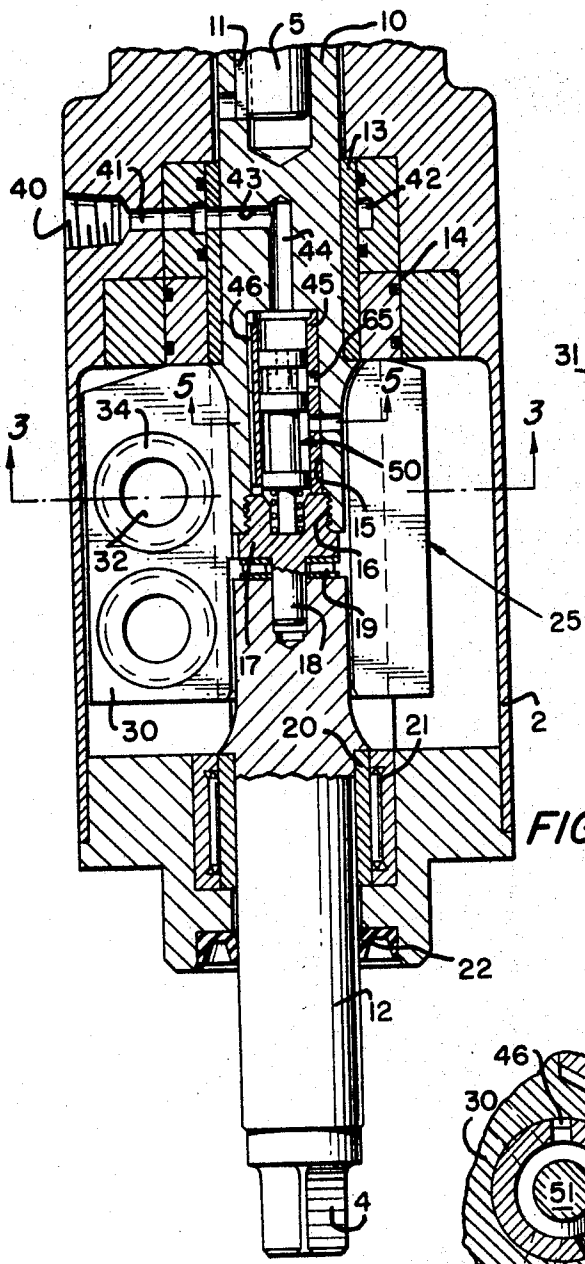


FIG. 2

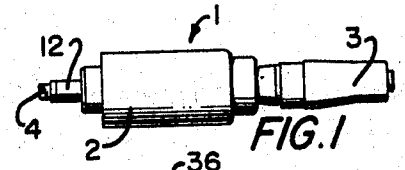


FIG. 1

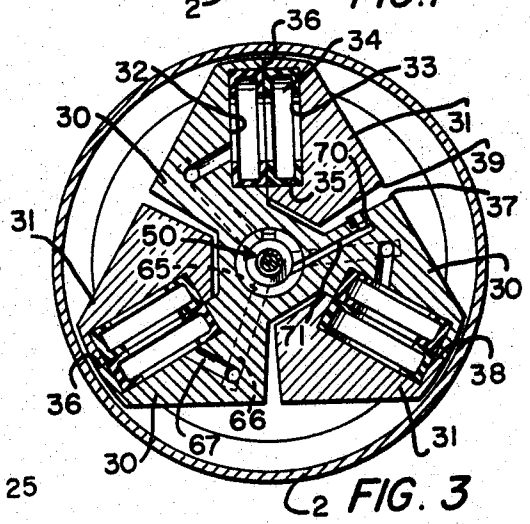


FIG. 3

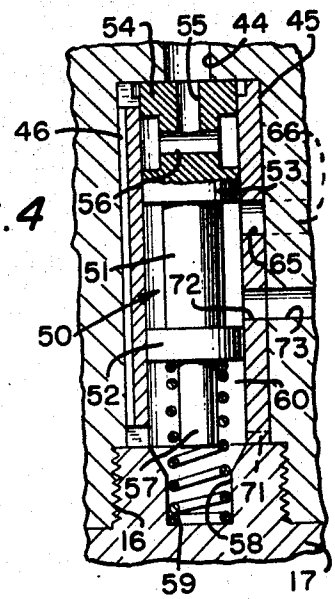


FIG. 4

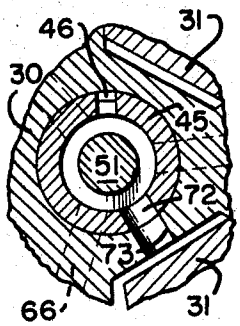


FIG. 5

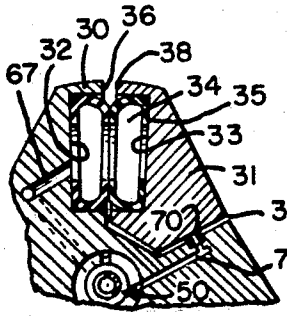


FIG. 6

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FLUID PRESSURE OPERATED WRENCH

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ABSTRACT OF THE DISCLOSURE

A wrench for tightening a fastener to a predetermined torque. A first shaft is rotated by a motor and a second shaft is adapted to have a fastener driving implement such as a socket connected thereto. There are mating arms on both the first and second shafts for transferring the rotation of the first shaft to the second shaft. When a torque which will stall the motor is reached, air pressure is supplied through a suitable valving arrangement to pockets in the mating arms to rotate the second shaft relative to the first shaft. This secondary rotation means is used to achieve the final torque which is in excess of that capable of being produced by the motor.

Background of the invention

This invention relates to rotary actuators for use in tightening fasteners to a predetermined torque. More particularly, the invention relates to a wrench which employs a secondary drive to achieve final torque.

Many prior tools used for tightening fasteners to a predetermined torque have been of the release type so that when the particular torque is reached, there is no longer a driving connection between the motor and the output. The torque release wrench can become inaccurate after prolonged use. The final torque which can be reached is almost always limited by the capacity of the drive motor. The maximum torque which can be achieved is the torque at which the motor stalls.

Other torque wrenches apply a secondary turn principle in which the fastener to be tightened is turned until a certain torque is reached or until the drive motor stalls. The output shaft is then driven at a slower speed and higher torque through a gear train until the motor stalls, or the output shaft and fastener are rotated an additional partial turn to achieve the final torque. The maximum torque which can be achieved with these tools also depends on the capacity of the drive motor. If a higher torque is desired, a larger motor and thus larger tool must be used. Tools which turn the fastener an additional partial turn have the disadvantage that the final torque is not always accurate.

Summary

It is therefore the principal object of this invention to provide a wrench which is accurate and is capable of tightening a fastener to a torque higher that that which can be achieved by the motor.

It is another object of this invention to provide a wrench which is capable of tightening a fastener to a high final torque but may use a small drive motor.

In general, these and other objects are carried out by providing a wrench which comprises a first shaft adapted to be rotated by a motor. There is a second shaft adapted to rotate a fastener. A rotary actuator is provided for transferring the rotation of the first shaft to the second shaft. There is a source of fluid under pressure and passage means for selectively conducting fluid under pressure to the rotary actuator for rotating the second shaft a predetermined amount relative to the first shaft.

Brief description of the drawing

The foregoing and other objects will become apparent from the following description and drawings wherein:

FIG. 1 is a plan view of a wrench employing one embodiment of this invention;

FIG. 2 is a secitonal view showing the operating mechanism of this invention;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2 looking in the direction of the arrows;

FIG. 4 is a fragmentary view on an enlarged scale of a valve mechanism of this invention;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 2 looking in the direction of the arrows; and

FIG. 6 is a fragmentary detail of a portion of FIG. 3 with the rotary actuator in a different position.

Description of the preferred embodiment

The wrench of this invention is generally indicated at 1. It includes a casing 2 and a suitable motor means 3 such as a vane type air motor. A square drive member, indicated at 4, may have a socket attached thereto for tightening nuts.

Referring to FIG. 2 a first shaft 10 is secured to the motor drive shaft 5 by means of a suitable key 11. A second or output shaft is indicated at 12 and extends into the casing 2 from the end opposite the first shaft 10 and has the drive member 4 fixed thereto. A sleeve 13 and a one-way brake 14 for limiting to one direction the rotation of the first shaft surround the first shaft 10.

The first shaft 10 is provided with a drilled out portion 15 and a threaded counterbore 16. An insert 17 is threaded into the counterbore 16 and is provided with a guide end 18 received by a drilled out portion in the second shaft 12. Suitable bearing means 19 is positioned between the second shaft 12 and insert 17. The second shaft 12 is surrounded by a sleeve 20 and is adapted to rotate in a bearing 21. A seal 22 is provided at the forward end of the casing 2.

A rotary actuator generally indicated at 25 is provided to transfer the rotation of shaft 10 to shaft 12. The first shaft 10 is provided with suitable arms 30 each being provided with first and second surfaces 36 and 37, respectively. In this case I have shown three arms although it is intended that the number of arms not be a limiting factor. The second shaft 12 is provided with suitable arms 31 of a number equal to the number of arms of the first shaft. Each of these arms is provided with first and second surfaces 38 and 39, respectively. The arms 30 and 31 are positioned to be in mating relationship so that the first surface 36 of arm 30 is in normal contact with the first surface 38 of the arm 31 and the rotation of the first shaft 10 is transferred through the arms 30 and 31 to the second shaft 12. The second surfaces 37 and 39 are normally spaced from each other.

The arms 30 are provided with recesses 32 while the arms 31 are provided with recesses 33. The recesses are in mating relationship to form pockets 34. Seal means 35 is positioned in the pockets. These seals include lips which insure that when the surfaces 36 and 38 of the arms separate, the pocket 34 will remain sealed.

The drilled out portion 15 is provided with a sleeve 45 having a cut out portion 46 to provide a fluid flow path. A spool valve 50 is mounted for reciprocal movement within the sleeve 45 and includes a center spool portion 51 and enlarged portions 52, 53 and 54 along its length. An axial passage 55 is provided in the upper end of the spool valve and has connected to it a diametrical passage 56 between the enlarged portions 53 and 54. The lower end 57 of the valve is adapted to be received by a drilled out portion 58 in the insert 17. A suitable spring 59 is provided to bias the spool valve 50 rearwardly. The

upper end of the casing 2 is provided with a fluid supply connection 40. A passage 41 leads through the casing wall to an annular groove 42. A radial passage 43 and longitudinal passage 44 in the first shaft connects the fluid supply 40 to the sleeve 45 and valve 50.

The sleeve 45 is provided with a plurality of ports 65 each of which is in communication with a passage 66 in the arms 30. Each of the passages 66 is connected to a passage 67 leading to the pockets 34 formed by the recesses 32 and 33. The sleeve 45 is also provided with an exhaust port 72 leading to an exhaust passage 73, best shown in FIG. 5. A suitable valving orifice 70 is provided in second surface 37 of the arm 30 at the end of a passage 71 which is connected to the forward end of the valve 50 and chamber 60. Although only a single valving orifice has been shown, one may be provided between each of the second surfaces 37 and 39.

Operation

When a fastener is to be tightened the motor 3 is in continuous operation. During initial rundown of the fasteners, the shaft 10 is rotated by the motor drive shaft 5 and the rotation of the shaft 10 is transferred through arms 30 and 31 to rotate the second shaft 12 and the fastener. When a certain torque is reached the motor will stall. Fluid under pressure is then supplied to the connection 40 and passes through passage 41, annular groove 42 and passage 43 and 44 to the upper end of the valve 50. The fluid under pressure moves spool valve 50 downward against the force of spring 59. The fluid under pressure then moves through passages 55 and 56 of valve 50 to port 65 in the sleeve 45 and passes through the passages 66 and 67 to the pockets 34. The fluid under pressure in the pockets tends to separate the surfaces 36 and 38 of the arms 30 and 31 as is shown in FIG. 6. The one-way brake 14 prohibits the shaft 10 from backing up so that the fluid under pressure rotates the arms 31 and shaft 12 relative to the first shaft.

While fluid under pressure is being supplied to the valve 50 some of it moves through passage 46 to chamber 60 and from this chamber through passage 71 to the valving orifice 70 and the space formed between second surfaces 37 and 39. As arm 31 is moved away from arm 30, surface 39 approaches surface 37 until they are in near contact to close the orifice 70. This results in a build up of pressure in the passage 71 and the chamber 60. This pressure build up, when combined with the biasing force of spring 59, moves the valve 50 upwardly to the position shown in FIG. 4. The area bounded by the enlarged portions 52 and 53 permits communication between passages 67, 66 ports 65 and 72 and exhaust passage 73. The pockets 34 are thereby exhausted. Since arm 31, shaft 12 and thus the fastener being tightened have been advanced relative to the arm 30, there is essentially no resistance to the rotation of shaft 10. Since the motor 3 is still operating, the first shaft 10 and arms 30 catch up with the second shaft 12 until the arms 30 and 31 are again in mating relationship. The steps of the final tightening, of course, occur in rapid succession and are repeated until the fastener is tightened to the final desired torque.

The torque to which the fastener is tightened is determined by the air pressure supplied to connection 40 and is independent of the torque which can be achieved by the motor 3. As the air pressure is supplied to connection 40 it is increased, the final torque to which the fastener is tightened is increased. The tool therefore has a capability of producing a range of final torque which is not dependent on the size of the drive motor or some clutch means.

It is intended that the foregoing description be merely that of the preferred embodiment and that the invention be limited only by that which is within the scope of the appended claims.

I claim:

1. A wrench comprising:
a first shaft adapted to be rotated by a motor;
a second shaft adapted to rotate a fastener;
a rotary actuator for transferring the rotation of the first shaft to the second shaft and for selectively rotating said second shaft relative to said first shaft;
said rotary actuator including at least one arm extending radially from each of said first and second shafts; the arm on said first shaft is in selective contact with the arm on said second shaft for transmitting the rotation of said first shaft to said second shaft;
a source of fluid under pressure; and
passage means for selectively conducting fluid under pressure to said rotary actuator so that said rotary actuator can rotate said second shaft relative to said first shaft.

2. The wrench of claim 1 wherein at least one of said arms is provided with a recess the walls of which form with the other arm a pocket said passage means being connected to said pocket so that fluid under pressure can act on said arms and rotate said second shaft relative to said first shaft.

3. The wrench of claim 2 further comprising means for permitting rotation of said first shaft in one direction only.

4. The wrench of claim 3 further comprising passage means for selectively exhausting said pocket and valve means for permitting said pocket to be exhausted.

5. The wrench of claim 4 further comprising seal means positioned in said pocket.

6. A wrench for tightening a fastener comprising:
a first shafts;
motor means for rotating said first shaft;
a second shaft adapted to rotate a fastener;
at least one arm on each of said first and second shaft;
each of said arms having first and second surfaces;
the first surface of each arm being in normal contact with each other for transferring the rotation of said first shaft to said second shaft and the second surface of each arm being normally out of contact with each other; and
means for rotating said second shaft relative to said first shaft until said second surfaces are in near contact with each other to thereby tighten the fastener to a torque greater than that obtainable by said motor.

7. The wrench of claim 6 further comprising a recess formed in at least one of said first surface and passage means for selectively supplying fluid under pressure to said recess for rotating said second shaft relative to said first shaft.

8. The wrench of claim 7 further comprising passage means for supplying fluid under pressure to the space between said second surfaces, and passage means for exhausting said recess; said passage means for supplying fluid under pressure to space between said second surfaces adapted to be closed when said second surfaces are in near contact to thereby permit said recess to be exhausted.

9. The wrench of claim 8 further comprising a valve for controlling the flow of fluid to and exhaust from said recess.

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MYRON C. KRUSE, Primary Examiner

U.S. Cl. X.R.

81—52.4; 91—59