Nov. 29, 1960 E. G. ROGGENBURK 2,961,903

MOTOR OPERATED, ROTARY IMPACT TOOL

Filed Aug. 6, 1956

2 Sheets-Sheet 1

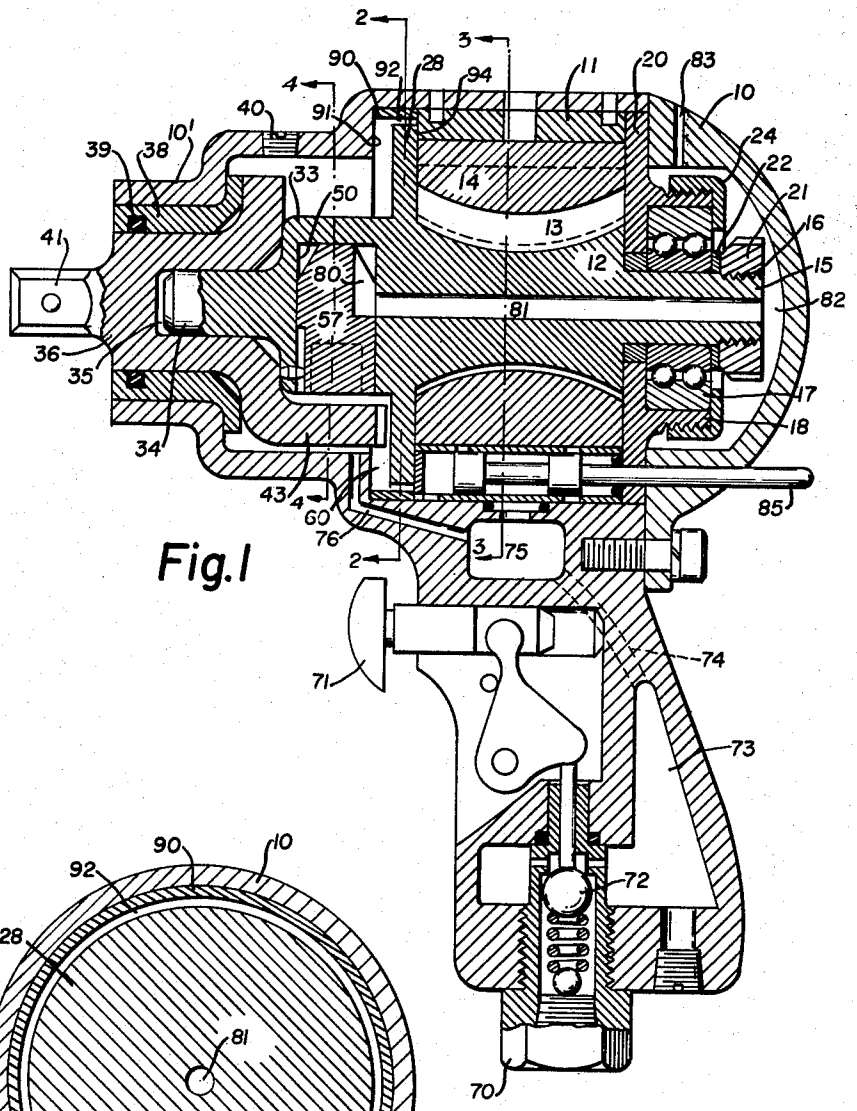


Fig.1

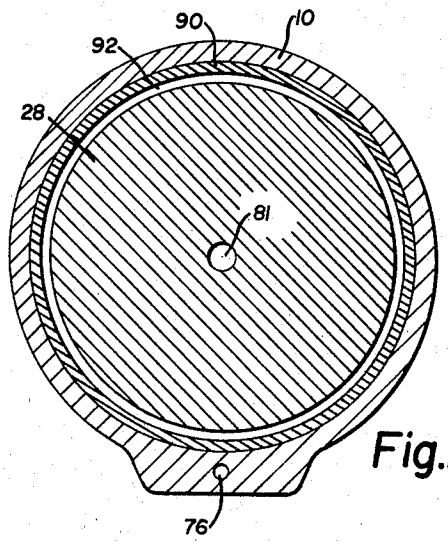


Fig.2

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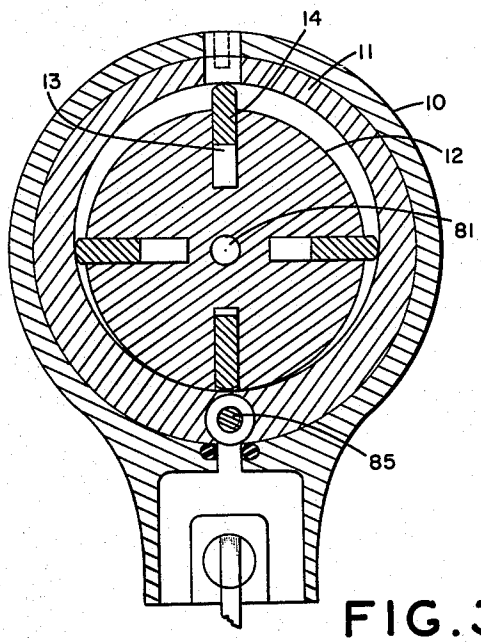


FIG. 3

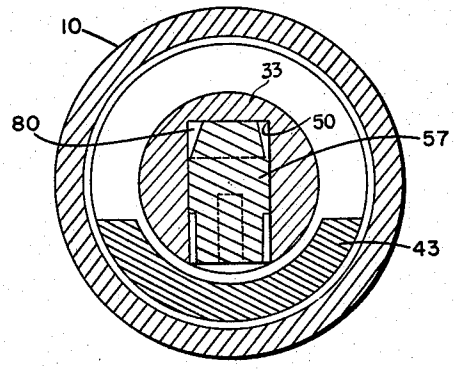


FIG. 4

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MOTOR OPERATED, ROTARY IMPACT TOOL

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8 Claims. (Cl. 81—52.3)

This invention pertains to an impact tool such as a wrench, and is a continuation-in-part of application Serial Number 486,198, filed February 4, 1955, for an Impact Tool.

In prior art impact tools a rotary fluid motor is driven at high rotary speed and by means of various coupling devices is connected to a massive rotatable hammer which in turn, through various mechanisms, is intermittently caused to strike an anvil to deliver an impact blow. In these prior art devices the rotary fluid motor has been made as light as possible in order to obtain as rapid acceleration as possible of the motor and hammer, and various devices have been utilized to decouple the motor from the hammer upon impact of the hammer with the anvil. In many of these prior art devices the mass of the motor is not of much assistance in delivering a blow, and represents to an appreciable degree a loss in the tool. The mass of the air motor was kept at a minimum in order to reduce the forces involved when the hammer was suddenly stopped upon striking the anvil. If the motor were made heavy enough to appreciably contribute to the blow, the splines or other means for connecting the motor to the hammer were usually eventually damaged in operation.

An object of the present invention is to provide an impact such as a wrench, screw driver or the like which is small in size and light in weight, yet which is just as effective in impact action as any previous tool.

Another object of the present invention is to provide an impact tool wherein the mass of the rotary fluid motor is effectively utilized to strike a blow.

A further object of the present invention is to provide an impact tool wherein the fluid motor is the hammer.

A further object of the present invention is to provide an impact tool having an absolute minimum of moving parts.

It is a further object of the invention to provide a unitary massive hammer and fluid motor for an impact tool.

For a better understanding of the present invention, together with other and further objects thereof, references is had to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawing, Figure 1 is a cross-sectional view through an impact wrench embodying the invention, and

Figure 2 is a cross-sectional view along lines 2—2 of Figure 1.

Figure 3 is a sectional piew taken along line 3—3 of Figure 1.

Figure 4 is a sectional view taken along line 4—4 of Figure 1.

In one aspect the invention lies in an impact tool comprising a housing within which there is mounted for rotation a massive fluid driven motor. There is a bore in the motor which extends in a direction transverse to the axis of rotation of the motor. A hammer pin is slidably

mounted within the bore and is eccentric with respect to the axis of rotation so that rotary motion of the fluid driven motor tends to throw the hammer pin partially out of the bore. Output drive means are mounted for coaxial rotation with the fluid driven motor and includes an anvil located in the circumferential path occupied by the portion of the hammer pin located outside of the bore when rotating to cause the hammer pin to strike the anvil when centrifugal force causes the hammer pin to project out of the bore.

In the drawing there is shown an impact tool such as a wrench comprising a housing **10** within which there is mounted a hollow liner element **11**, and within the liner there is a massive motor element or rotor **12** having a plurality of radial slots **13** within each of which there is slidably positioned a vane **14**. The massive motor element **12** is eccentrically positioned with respect to the liner element **11**. One end of the massive element **12** has a projection **15** which is threaded at **16**. The inner race of a bearing **17** is mounted around the projection **15**, and the outer race of the bearing is against an annular projection **18** carried by the end plate **20** which bears against the end of the liner **11** sealing shut one end of the hollow liner **11**. A large nut **21** screws into the projection on the massive element with a washer **22** therebetween in tight engagement with the inner race of the bearing, and a threaded ring **24** is screwed onto the annular projection **18** to firmly engage the outer race of the bearing thereby holding the bearing in place and gently holding the end plate **20** against the liner **11**.

At the other end of the massive element **12** there is a flange or end plate **28** forming an integral part of the massive element. Flange **28** overlaps the liner **11** thereby sealing shut the other end of the hollow liner. With end plate **20** closing one end and the flange **28** closing the other end all of the radial slots **13** are closed at both ends and each of the vanes **14** therein is free to move in a radial direction under influence of centrifugal forces until its end face **30** is in sealing engagement with the inner face of the liner **11**. As is known in the art, expansion of compressed air or the like in the space between the massive element **12** and the liner **11** forces the massive member and its vanes to rotate very rapidly.

A ring **90** lies circumferentially around and is spaced from the peripheral edge of the end plate **28**. It is located between a shoulder **91** inside the housing **10** and the edge of the eccentric liner **11**, thereby positively holding the liner **11** in place. Due to the space **92** between the stationary ring **90** and the rotatable end plate **28** there are no frictional forces set up between these two portions and due to the slight overlap at **94** of the plate **28** over the end of the eccentric liner **11** there is a good air seal established.

Forward of the flange **28** and forming an integral part of the massive element **12** there is a projection or hub formed of a large section **33** and a small section **34**, each circular in cross-section transverse to the axis of the tool. The smaller section **34** is mounted in a bore **35** in a driven member **36**, and can rotate with respect thereto. The driven member **36** is mounted inside a sleeve bearing **38** for relative rotation with respect thereto, and an "O" ring **39** is located between the two members to prevent escape of compressed air. The bearing **38** is held by a reduced portion **10'** of the housing **10**, and a threaded plug **40** is located through the housing adjacent the end of the bearing **38** for providing access to the interior for lubrication purposes.

The end **41** of the driven member **36** is square in cross-section and is located outside of the housing **10** for engagement with various types of tools to be driven. The output drive means **36, 41** includes an anvil portion **43** located in the circumferential path outside of the large

section 33 of the massive element 12, and within this large section 33 of the massive element there is a bore 50 extending perpendicular to the axis of rotation of the massive element 12. A hammer pin 57 is slidably mounted within the bore 50, and is eccentric with respect to the axis of rotation of the tool, whereby centrifugal force when the tool is up to speed throws the pin 57 into the path occupied by the anvil 43, thereby imparting a sharp rotary blow to the anvil. When the tool slows down due to the work load coupled to the output shaft 41, air pressure in the chamber 60 overbalances any centrifugal force acting on the pin and causes the pin to retract within the bore 50. The air pressure in chamber 60 is derived from live air supply in chamber 75 through passageways 76. The closed end of bore 50 is vented to atmosphere by the groove 80, passageway 81, through the center of the massive rotor 12 to chamber 82 which is vented by opening 83 through the housing to the outside. Vent 83 is small and a controlled amount of air is permitted to seep past the end plate 20, through bearing 17 etc. into the chamber 82 so that air pressure therein is only slightly below the line pressure, for example, about ten pounds below. The air pressure in chamber 82 is also present behind the pin 57 in order that centrifugal force on the pin need only overcome about a ten pound pressure differential in order to throw out the pin into engagement with the anvil 43.

A reversing valve mechanism 85 is provided, the detailed operation of which is described in the aforesaid application Serial Number 486,198.

A unique and outstanding feature of the hammer of this invention lies in the solid, massive, integral motor and hammer mechanism. Prior to this invention the art has tried to make the air rotor and vane structure as light as possible, and often the rotor was not tightly coupled to the hammer. When the hammer reached proper speed, it would deliver a blow to the anvil and, during this sharp blow, the rotor was permitted to slip with respect to the hammer.

In the present construction the rotor 12 of the motor and the hammer are the same, resulting in an impact tool which is much shorter and lighter than prior art tools, yet the mass of the rotor (hammer) system is high and the tool exerts a forceful blow. By combining the functions of the light-weight air-driven rotor and the massive hammer into one massive element which serves both purposes, a much better tool is provided, since it is smaller in over-all size and weight, has fewer parts, and the remaining parts are less expensive. Prior to this invention therew as usually a splined shaft coupling the rotor to the hammer, necessitating expensive machining operations on both the male and female splined portions. Also, in prior devices the rotor itself was extensively machined to make it hollow to reduce its weight. Accordingly, it will be seen that the present tool not only has fewer parts, but the parts which are in the tool require less machining and accordingly are less expensive. The result of the invention is a much smaller, lighter, less expensive tool which is just as good as the best prior art tools in impact action and air consumption.

In the operation of the impact tool compressed fluid, such as compressed air, is admitted through the end connection 70, through the valve 72 which is actuated by the trigger 71, through the opening 73, through passage 74 to opening 75. Air is admitted into the motor enclosure formed by end plates 20, 28 and the liner 11, thereby forcing the rotor 12 to rotate rapidly. The hub 33, being integral with the massive motor element 12, rotates with it and carries with it the hammer pin 57. When the motor reaches a given speed centrifugal force throws the hammer pin 57 partially out of the bore 50 causing its end to strike the anvil portion 43 of the driven member 36, thereby to impart a rotary motion to the driven member. In the event there is not much of a work load coupled to the end 41 of the driven member

36 the massive rotor 12 will run with sufficient speed that the hammer pin 57 will remain in its extended position and the tool will run the nut or screw driver down without impacting. As soon as the work load builds up, however, the speed of the motor will drop down to a point where the centrifugal force on the pin 57 is insufficient to hold the pin in its extended position, and at that time air pressure in the chamber 60 will be greater than the air pressure in chamber 80, thereby forcing the pin 57 into its retracted position in bore 50, as shown in Figure 1. In its retracted position the pin 57 cannot engage the anvil portion 43 of the driven member 36, thereby permitting motor 12 to pick up speed under the driving force of compressed air entering the tool, until it again reaches the speed at which centrifugal force throws the hammer pin into the path of the anvil portion 43 of the driven member 36.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An impact tool comprising a housing, a fluid driven motor including a massive rotor mounted within said housing for rotation about an axis and having a bore extending in a direction transverse to the axis of rotation, a hammer pin slidably mounted within said bore and eccentric with respect to said axis of rotation, whereby rotary motion of said rotor tends to throw said hammer pin partially out of said bore, and output drive means mounted for coaxial rotation with said rotor and including an anvil portion located in the circumferential path occupied by the said portion of said hammer pin outside of said bore when rotating, whereby said hammer pin strikes said anvil when centrifugal force causes said hammer pin to project out of said bore.

2. An impact tool comprising a housing having a bore therein, a massive rotor having vane slots, said rotor being eccentrically mounted within said bore for rotary motion about an axis, vanes slidably mounted in said vane slots, fluid pressure conduit means connected to said housing for admitting fluid under pressure thereto for rotating said massive rotor, said rotor having a bore extending in a direction perpendicular to the axis of rotation thereof, a hammer pin slidably mounted within the bore in said rotor and eccentric with respect to said axis of rotation, whereby rotary motion of said rotor tends to throw said hammer pin partially out of said bore, and output drive means mounted for coaxial rotation with said rotor and including an anvil portion located in the circumferential path occupied by the said portion of said hammer pin outside of said bore when rotating, whereby said hammer pin strikes said anvil when centrifugal force causes said hammer pin to project out of said bore.

3. An impact tool comprising a housing, an eccentric liner having a bore therein, mounted within said housing, a massive rotor, having vane slots therein, mounted for rotation within said bore, said rotor including an integral end plate rotatable therewith and overlapping one end of said liner and forming therewith an air seal, means for sealing the other end of said liner, a driven member including an anvil rotatable coaxially with said rotor and mounted within said housing, and a hammer pin mounted in said massive rotor and for intermittently connecting said rotor directly to said anvil.

4. An impact tool comprising a housing, an eccentric liner having a bore therein, mounted within said housing, a massive rotor, having vane slots therein, mounted for rotation within said bore, said rotor including an integral end plate rotatable therewith and overlapping one end of said liner and forming therewith an air seal, means for

sealing the other end of said liner, a liner positioning ring mounted circumferentially around and spaced from said end plate, said ring engaging said housing and said liner for holding said liner in place, a driven member including an anvil mounted within said housing for rotation coaxially with said rotor, and hammer pin means mounted in said massive rotor for intermittently connecting said rotor directly to said anvil.

5. An impact tool comprising a housing, an eccentric liner having a bore therein, mounted within said housing, massive rotor means mounted for rotation within said bore, an end plate integral with said rotor means and overlapping one end of said liner and forming therewith an air seal, means for sealing the other end of said liner, a hub integral with said end plate and having a bore extending perpendicular to the axis of rotation of said rotor means, a slidable pin eccentrically mounted within the bore in said hub, an anvil having an engaging portion overlying said pin, whereby it is engaged by said pin when centrifugal force causes said pin to project out of said bore, and means for retracting said pin within said bore.

6. An impact tool as set forth in claim 5, further characterized by said means for retracting said pin comprising air pressure means.

7. An impact tool comprising housing means, a fluid

driven motor including a massive rotor mounted for rotation within said housing means, said rotor having a bore therein, a driven member mounted in said housing for rotation about the axis of said rotor and including an anvil portion displaced to the side of said axis of rotation and overlying said bore in said rotor, and a hammer pin slidably mounted in said bore and being eccentric with respect to the axis of said rotor, whereby centrifugal force when said rotor reaches a first given speed forces a portion of said hammer pin out of said bore into engagement with said anvil portion to deliver a blow thereto.

8. An impact tool as set forth in claim 7, further characterized by means for applying fluid under pressure to said portion of said hammer pin which extends out of said bore to force said pin back into said bore when the rotor reaches a second given speed below that of said first given speed.

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