

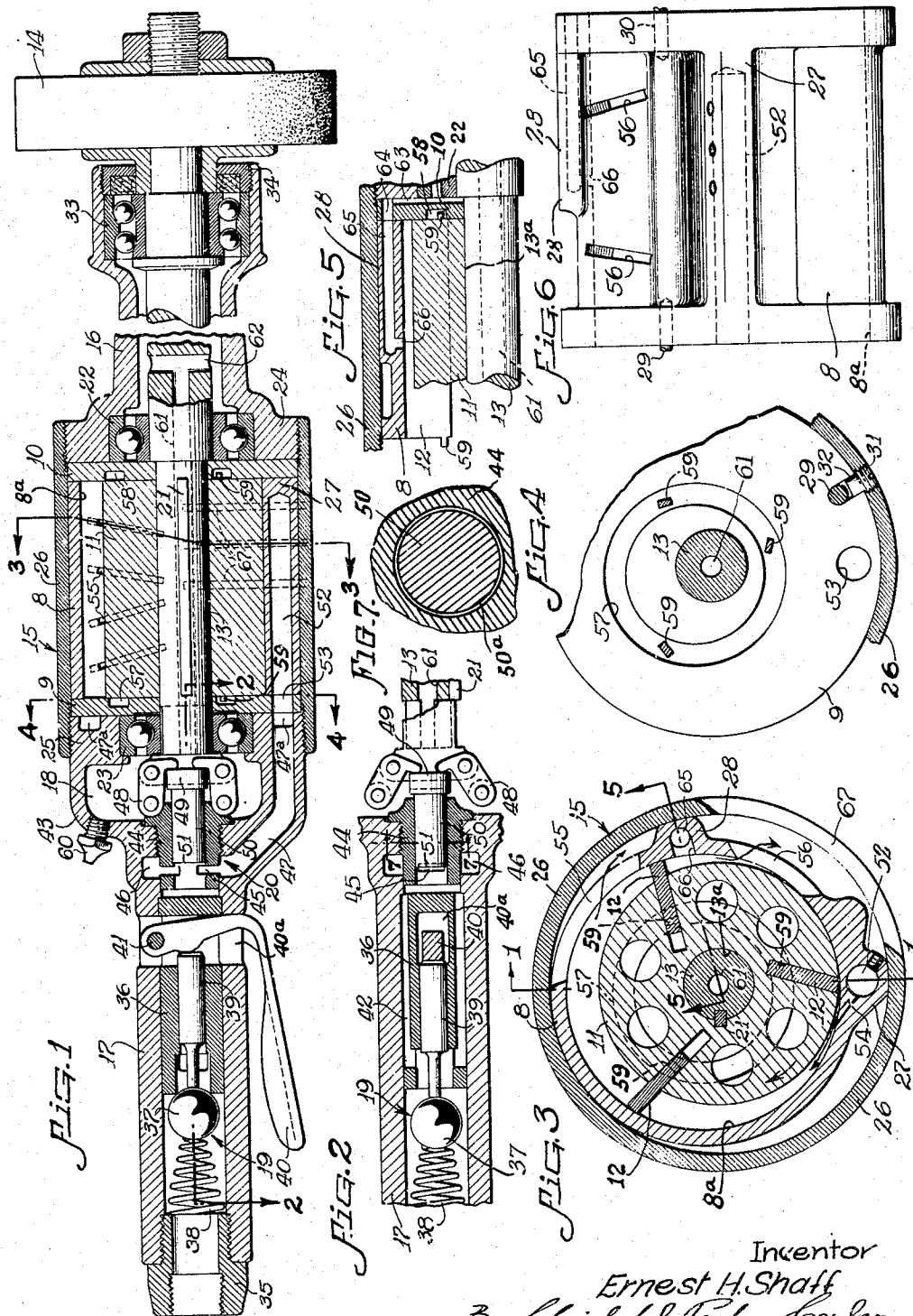
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PORTABLE PRESSURE FLUID ACTUATED TOOL

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PORTABLE PRESSURE FLUID ACTUATED
TOOL

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The invention pertains to a pressure fluid actuated tool and more particularly to a tool embodying a rotary pneumatic motor, such for example, as a portable grinder.

5 The primary object of the invention is to provide a tool of the character indicated which is light in weight, efficient in operation and which is strong and durable.

10 A further object is to provide for effective lubrication of the various working parts of the tool through a utilization of the air pressure in the tool for conveying and distributing lubricant to different parts of the tool.

15 Another object is to provide an improved construction for the motor tending to reduce the wear on the blades of the rotor and also insuring that the motor shall be capable of starting without manual assistance as is required in the case of the tools now on the market.

20 Still another object of the invention is to provide a novel tool structure of advantageous character, capable of easy assembly, and permitting adjustability of the motor casing of the tool with respect to the handle portion to vary the direction of discharge of the exhausting pressure fluid.

25 The objects of the invention thus generally stated, together with other and ancillary advantages, are attained by the construction and arrangement shown by way of illustration in the accompanying drawing forming part hereof, in which:

Figure 1 is a fragmentary vertical longitudinal sectional view through my improved tool taken substantially on line 1—1 of Fig. 3.

35 Fig. 2 is a fragmentary longitudinal sectional view through the handle portion of the tool, taken approximately in the plane of line 2—2 of Fig. 1 but with the parts in a different relation.

Fig. 3 is a transverse sectional view taken in the plane of line 3—3 of Fig. 1.

40 Fig. 4 is a fragmentary transverse sectional view taken in the plane of line 4—4 of Fig. 1.

Fig. 5 is a fragmentary longitudinal sectional view approximately on line 5—5 of Fig. 3 and illustrating certain of the air passages for conveying lubricant to the interior of the motor.

Fig. 6 is a side elevational view of the motor cylinder.

Fig. 7 is an enlarged, exaggerated sectional view taken in the plane of line 7—7 of Fig. 2.

My improved tool comprises a rotary pressure fluid motor of the eccentrically walled chamber type, having a cylinder 8 comprising an elongated annular member providing a rotor chamber with a smooth inner bearing surface 8^a and closed at

opposite ends by end plates 9 and 10, a rotor 11 having a plurality of blades 12 and mounted on a spindle 13 extending axially through the rotor and carrying in the present instance, a grinding wheel 14. The tool has an elongated body providing an annular casing 15 enclosing the motor, an elongated housing 16 of reduced diameter at one end of said casing in which the spindle is journaled, and a handle portion 17 at the other end of the casing with a governor chamber 18 formed between the handle portion and the motor casing. In the present instance, the handle portion 17 is tubular in form and is adapted for connection at its outer end with a source of air under pressure. This handle portion is equipped with a conventional manually operable valve device 19, and flow of pressure fluid to the motor is also controlled by a governor valve 20 operating automatically to maintain a predetermined speed of rotation of the spindle.

The motor cylinder 8 is mounted eccentrically within the casing 15 as shown clearly in Fig. 3, whereas the rotor 11 is mounted concentrically of the casing 15 and coaxially of the spindle 13. Accordingly, the rotor is disposed eccentrically with respect to its cylinder 8, with one side of the rotor in sliding contact with the cylinder at one side of the latter. At its opposite ends the rotor slidably engages with the end plates 9 and 10 which are circular in form and abut the opposite ends of the annular member forming the cylindrical side wall of the cylinder 8.

The spindle 13 is inserted through an axial bore 13^a in the rotor 11, the latter being held against rotation relative to the spindle by means of the usual key 21. At opposite ends of the rotor the spindle is journaled in roller bearings 22 and 23, respectively, carried by heads 24 and 25 screw-threaded into the opposite ends of an annular member or sleeve 26 and into abutting relation to the cylinder end plates 9 and 10. The ends of the sleeve are for this purpose extended beyond the end plates which fit snugly within the sleeve. Thus it will be observed that the heads 24 and 25 coact with the sleeve 26 to form the motor casing 15.

Cooperating with the end plates 9 and 10 of the cylinder to hold the latter in eccentric relation to the casing 15, are two outwardly protruding longitudinal ribs 27 and 28, which are cast integral with the side wall of the cylinder and bear at spaced points against the inner wall of the casing sleeve 26, as shown in Fig. 3. The end plate 9 of the cylinder is held against rotation relative to the annular wall member of the cylinder 8

by means of a dowel pin 29 (Fig. 4), and the end plate 10 is also suitably held against rotation by means of a dowel pin 30 (Fig. 6). A screw 31 entered through the casing sleeve 26 and into a notch 32 in the end plate 9 serves to hold the cylinder 8 against rotation in the casing 15.

The spindle housing 16 is formed integral with the head 24 of the motor casing, and at its outer end is equipped with an antifriction bearing 33 supporting the outer end of the spindle. The extreme outer end of the housing is provided with a suitable packing gland 34 to prevent the escape of lubricant delivered to the housing in a manner hereinafter set forth.

Cast integrally with the head 25 at the opposite end of the motor casing is the handle portion 17 and governor chamber 18. The handle portion is equipped at its outer end with a nipple 35 for connection with a source of air under pressure, and within the handle portion is a valve casing 36 providing a seat for a ball-valve 37 pressed by means of a spring 38 in the direction of such seat. Slidable within the casing 36 is a valve operating stem 39 adapted for actuation by a hand lever 40 extending through a slot 40^a in the valve casing 36 and pivoted at 41 in the handle portion, the latter being slotted for this purpose. As shown in Fig. 2, the valve casing 36 cooperates with the handle portion to form passages 42 extending along opposite sides of the casing and opening into the inner end of the handle portion beyond the valve casing.

The governor chamber 18 has its inner wall formed by the head 25 of the motor casing, the arrangement being such that the bearing 23 mounted in the head is exposed to the interior of the chamber. To complete the chamber, an annular wall 43 extends away from the head and thence inwardly where it is united with the inner end of the handle portion. Centrally of this wall is an axial bore coaxial with the spindle and containing the valve 20. Comprising the latter is a valve casing 44 screw threaded into said bore. The interior of this casing communicates through slots 45 with an annular chamber 46 encircling the valve casing 44 and communicating with the motor cylinder by way of a passage 47 extending longitudinally through the chamber in the wall 43 thereof.

The spindle 13 extends through the bearing 23 into the governor chamber 18 and has pivotally mounted thereon fly-weights 48 having their inner ends adapted to engage with the head 49 of a valve member 50 which is slidable in the valve casing 44. The opposite end 51 of this valve member is movable into and out of closing relation to the slots 45 of the valve casing 44 to control the pressure fluid to the passage 47, it being observed that the end 51 of the valve member 50 is exposed to the action of air under pressure tending to move the valve in an opening direction, and that the fly-weights 48 revolving with the motor spindle operate against such pressure to position the valve member so as to maintain the speed of the tool substantially constant.

Air under pressure delivered by the passage 47 is introduced into the motor cylinder by a duct 52 formed in the rib 27 on the motor cylinder and connected with the passage 47 by a port 53 in the end plate 9 and an annular groove 47^a in the inner face of the head 25. Leading from the duct 52 into the cylinder are a plurality of ports 54 (Fig. 3) which it will be observed discharge into the cylinder at one side of the rotor and at a location adjacent the point of contact of the

rotor with the cylinder wall. The motor fluid is discharged from the cylinder through two sets of slots 55 and 56 opening into the casing 15 near the opposite side of the rotor from the inlet ports 54, these two sets of slots 55 and 56 being spaced apart circumferentially of the cylinder substantially in accordance with the spacing of the rotor blades. This arrangement permits complete exhaustion of the motor fluid and prevents any possible back pressure due to high speed operation.

It is common practice in motors of this type to bevel the outer edges of the rotor blades so that while these blades are being subjected to the action of the pressure fluid in producing motor action, the blades engage with the cylinder with a line contact, it having been found that this construction improves the operation of the motor. Such bevelling of the blades, however, requires a special machining operation and furthermore requires that the blades be inserted in a certain way, which is objectionable because of the possibility that they may through error be improperly inserted reversely from that intended.

To obviate this difficulty while still providing for a line contact between the blades and the cylinder, the blades in my improved motor are inclined somewhat from a true radial position as shown clearly in Fig. 3, and this in the direction of rotation as indicated by the arrow. The outer edges of the blades may accordingly be formed square and still provide, through the medium of the trailing edge of the blade, a line contact with the inner or bearing surface of the cylinder. Accordingly, the manner in which the blades are inserted is immaterial, the possibility of error being thus removed.

Also, by reason of the inclination of the blades the motive fluid acting on the pressure side of the blade tends to counteract the tendency of the blade to move outward under the action of centrifugal force, thus reducing the wear on the blade. This is due to the fact that centrifugal force acts away from the center of rotation and through the center of gravity of the rotor 11, while the fluid pressure is at right angles to the surface of the blades 12. Therefore the pressure on the inclined blades 12 is at an acute angle against the direction of the centrifugal force, whereby the fluid pressure tends to counteract the centrifugal force and thereby relieve some pressure of the blades against the wall of the cylinder 8. In the discharge positions of the blades, the line contact above referred to is of no consequence, and in such positions the outer edges of the blades engage with the cylinder throughout a larger surface area thereby minimizing the wear on the blades and on the cylinder. Wear is also minimized in the discharge positions of the blade through having the blades at an angle in the rotor since the axis of the blades is at an acute angle relative to the direction of movement of the blades and the pressure of the blades against the cylinder wall due to centrifugal force is therefore reduced.

Difficulty is often experienced in tools of this type on account of the failure of the tool to start where centrifugal force alone is depended upon to hold the blades outwardly in the rotor and against the cylinder. For example, with the parts of the tool in the relation shown in Fig. 3, the force of gravity would when the tool is idle, tend to move the active blade on the side adjacent the inlet ports 54 inwardly to the bottom of its slot thereby rendering ineffective the admission of motive fluid to the cylinder.

To overcome this objection, I have provided the inner faces of the end plates 9 and 10 of the cylinder, annular grooves 57 and 58 positioned eccentrically with respect to the rotor axis as shown in Fig. 4. For cooperation with these grooves, lugs 59 are formed on the opposite ends of the blades 12, adapted to engage with the inner peripheral surfaces of the grooves when the motor is idle, so that when the motor comes to rest with the parts in a position corresponding to that of Fig. 3, the active blade is held outwardly and in position to respond to the introduction of motive fluid. The grooves, it will be observed, are made substantially wider than the lugs and in the normal operation of the tool, the lugs are held clear of the inner walls of the grooves by the action of centrifugal force. Also, they are prevented from engaging with the outer walls of the grooves by the bearing engagement between the blades and the inner peripheral wall of the cylinder.

An important feature of my invention has to do with the adequate lubrication of the working parts of the tool so as to reduce wear to a minimum as well as to improve the efficiency of the tool. In accomplishing this result, I utilize the governor chamber as a means for supplying a suitable lubricant, preferably in the nature of a grease, the wall 43 of the governor chamber being provided for this purpose with a conventional grease fitting 60 facilitating the introduction of the lubricant into the chamber. Because of the position of the bearing 23 at one side of the chamber 18, this bearing is of course adequately lubricated. To provide lubrication for the bearings 22 and 33 at opposite ends of the spindle housing, I provide a passage 61 axially of the spindle. This passage opens at one end into the chamber 18, and at its other end discharges through a diametrical duct 62 into the interior of the spindle housing, the internal diameter of which is somewhat larger than the spindle. The chamber 18 is constantly under air pressure due to the leakage of air escaping past the governor valve 50 which has a sufficiently loose fit, as shown in much exaggerated form at 50^a in Fig. 7, to permit a limited leakage, and by venting this air pressure into the spindle housing, a quantity of the lubricant in the chamber 18 is conveyed to the spindle housing 16 and hence to the bearings 23 and 33.

To lubricate the interior or bearing surface 8^a of the motor cylinder a radial duct 63 is provided in the outer face of the end plate 10 (see Fig. 5) which duct terminates at its inner end at the surface of the spindle as it passes through this end plate. At its outer end the duct 63 communicates with a port 64 near the peripheral edge of the end plate and registering with a passage 65 formed in the rib 28 protruding from the outer surface of the cylinder 8. The inner end of the passage 65 connects by means of a port 66 through the bearing surface 8^a with the interior of the cylinder, so that air pressure escaping from the spindle housing 16 along the spindle and through the bearing 22 enters the radial duct 63 and finds its way by means of the passage 65 and port 66 into the cylinder. This air current carries with it a quantity of grease which is distributed throughout the cylinder by means of the blades 12 of the rotor. Preferably the port 66 opens into the cylinder between the exhaust ports 55 and 56 and in the area in which the blades 12 contact the cylinder surface 8^a with the greatest pressure in the course of operation due to the combined centrifugal and inward forces acting on the blades dur-

ing the return movement thereof. Thus, the lubricant becomes immediately useful where it will be of greatest benefit.

It has been found that by this construction, it is only necessary to introduce lubricant into the governor chamber 18 from whence it is conveyed and effectually distributed to the spindle bearings and to the interior of the motor.

To permit the discharge of the exhausting air from the casing 15, a plurality of arcuate slots 67 are provided in the wall of the casing between the ribs 27 and 28 (Fig. 3). These slots are disposed opposite the exhaust slots 56 in the cylinder but the air exhausting through the slots 55 of the cylinder is permitted to pass externally around the cylinder owing to the fact that the rib 28 does not extend throughout the length of the cylinder, as indicated in Figs. 5 and 6.

In the use of tools of this character, it is desirable that the position of the exhausting slots 67 in the outer casing be capable of being changed with respect to the handle portion 17 according to varying conditions. With my improved construction for the body of the tool, it is possible to adjust the motor casing and the motor therein as a unit with respect to the handle portion 17 and this merely by varying the extent to which the sleeve 26 forming the outer wall of the motor casing is screwed onto the head 25, the difference being compensated for by tightening the head 24 into the opposite end of the sleeve 25. The annular groove 47^a permits air under pressure delivered by passage 47 to issue to duct 52 regardless of the relative position of the communicating openings of the passage and duct due to the adjustment of the motor casing.

To reduce the weight of the tool, the spindle housing 16 and the head 24 integral therewith, and the handle portion 17 together with the head 25 and governor chamber, are preferably constructed of aluminum. The sleeve 26, however, is constructed of steel to provide more effective protection to the motor.

It will be observed that I have provided a tool of a very practical character, which is efficient in operation and is capable of starting at all times from a position of rest. A high degree of durability is also obtained, and the parts are capable of being assembled and disassembled; the usual fastening bolts or screws are eliminated; the motor casing and handle portion are capable of relative adjustment to suit varying conditions; and a strong tool of minimum weight is assured.

I claim as my invention:

1. A portable tool having a rotary pneumatic motor, a tool spindle driven by the motor and extending axially therethrough, an elongated body providing an annular motor casing, an elongated housing at one end of the motor casing having bearings for said spindle, and a handle portion at the opposite end of the motor casing with a governor chamber between the motor casing and the handle portion adapted to contain a lubricant, valve controlled means for supplying pressure to the motor including a valve member projecting into said chamber, speed responsive means in said chamber for actuating said valve member, and means for venting to the interior of the motor air pressure escaping past said valve member into the governor chamber.

2. A portable tool having a rotary pneumatic motor, a tool spindle driven by the motor and extending axially therethrough, an elongated body providing an annular motor casing and an elongated housing at one end of the motor cas-

- ing having bearings for said spindle, and a handle portion at the opposite end of the motor casing with a chamber between it and the handle portion adapted to contain a quantity of lubricant,
- 5 valve controlled means for supplying pressure to the motor including a valve member projecting into said chamber, and means for venting to said spindle housing and to the interior of said motor air pressure escaping past said valve member to said chamber.
- 10 3. A pressure fluid actuated tool having a motor of the eccentrically walled chamber type, comprising a cylinder, a rotor mounted eccentrically in said cylinder and having a plurality of
- 15 blades movable outwardly from the rotor by centrifugal action in the rotation of the rotor, said cylinder having end walls providing grooves concentric with the cylinder, and said blades having means thereon extending into said grooves and
- 20 operable in the idle position of the tool to prevent movement of the blades from a projected position inwardly into the rotor, said grooves being of a contour and width to provide a clearance between said means and the outer peripheral
- 25 walls of the grooves throughout operative movement of the rotor.
4. A pressure fluid actuated tool having a motor of the eccentrically walled chamber type, comprising a cylinder having opposite end walls,
- 30 a rotor mounted eccentrically in said cylinder and having a plurality of blades movable outwardly from the rotor by centrifugal action in the rotation of the rotor, means operable in the idle position of the tool to prevent movement of the
- 35 blades from a projected position inwardly into the rotor, said means including a part on each of said blades and a groove in one end wall of a width to provide a continuous clearance between said part on the blade and the inner and outer
- 40 walls of the groove in the normal operation of the tool.
5. A portable tool having a rotary pneumatic motor including a cylinder, a rotor mounted eccentrically in said cylinder and adapted to be
- 45 rotated by the force of fluid pressure, a pair of passages in the walls of said cylinder, one of said passages communicating with a source of pressure fluid and having ports communicating with the interior of said cylinder to direct the pressure
- 50 fluid into operative engagement with said rotor, and the other of said passages communicating with a source of lubricant and having a port to the interior of said cylinder to direct lubricant to said rotor.
- 55 6. A portable tool having a rotary pneumatic motor including a cylinder and a rotor mounted upon a tool spindle extending through said cylinder, an elongated body providing an annular motor casing, an elongated housing of reduced
- 60 diameter at one end of the motor casing having bearings for said spindle, a handle portion at the opposite end of the motor casing with a chamber between said motor and the handle portion adapted to contain a quantity of lubricant,
- 65 valve controlled means for supplying air under pressure to the motor and including a valve projecting into said chamber, means for venting from said chamber to the spindle housing air pressure escaping past said valve into the chamber and including a passage formed in said spindle and communicating with said spindle housing, and a pas-
- 70 sage in the wall of said cylinder communicating with said spindle housing and the interior of the cylinder.
7. A pressure fluid actuated tool having a rotary motor including a cylinder and a rotor in said cylinder, a sleeve encircling the cylinder in eccentric relation thereto, a head connected with one end of the sleeve and providing a laterally offset fluid supply passage, said cylinder having
- 5 an inlet port arranged to communicate with said passage and a discharge port opening into the interior of said sleeve, said sleeve having a discharge port permitting lateral escape of exhausted pressure fluid therefrom, a handle portion
- 10 rigid with said head and having valve-controlled means for supplying motive fluid to said passage, means closing the end of the sleeve opposite said head and acting to clamp the cylinder against the head in various positions of circumferential
- 15 adjustment of the sleeve relative to the head whereby to permit a variation in the position of said discharge port in the sleeve relative to said handle portion, and a flow passage connecting said inlet port and said passage for providing an
- 20 uninterrupted flow of pressure fluid from said passage to said inlet port regardless of the adjusted position of the sleeve and the head.
8. A pressure fluid actuated tool having an elongated cylindrical casing, comprising a sleeve
- 25 having heads closing the ends thereof, and a rotary motor of the eccentrically walled chamber type rigid within said sleeve between said heads and having a cylinder comprising an annular
- 30 thin-walled member of a length substantially less than said sleeve, and a pair of spaced longitudinal ribs on said cylinder for defining the position of the latter eccentrically in said sleeve, said ribs having passages extending partially
- 35 therethrough from opposite ends and in communication with the interior of the cylinder.
9. A pressure fluid actuated tool having an elongated cylindrical casing, comprising a sleeve and heads at the ends of said sleeve, a rotary motor of the eccentrically walled-chamber type
- 40 including a thin cylinder comprising an annular member shorter than said sleeve and secured between said heads, a longitudinal rib on said cylinder for supporting the latter in said sleeve in eccentric relation thereto, an eccentric rotor
- 45 rotatably mounted within said cylinder, discharge openings formed in the wall of said cylinder on opposite sides of said rib, and exhaust openings in said sleeve, said rib being shorter than said cylinder, and providing a passage for the escape
- 50 of pressure from the openings on both sides of said rib through said exhaust openings.
10. A pressure fluid actuated tool having a rotary motor of the eccentrically walled chamber type comprising a rotor and a plurality of blades
- 55 mounted for movement outwardly relative to the rotor and a cylinder disposed eccentrically of the rotor and providing an inner surface adapted to be engaged by the outer edges of said blades, each of said blades being inclined from a radius
- 60 of the rotor in the direction of rotation thereof and having edge faces substantially perpendicular to the side faces of the blade so as to provide relatively sharp trailing edges engageable with the inner surface of the cylinder in the projected
- 65 positions of the blades, a chamber for containing grease to lubricate the tool, means defining a passage from said chamber to said inner surface of the cylinder and providing a port opening to the interior of the cylinder through said surface,
- 70 a passage for conducting pressure fluid to the interior of the cylinder for actuating said blades and motor, and means providing communication between said chamber and said pressure fluid passage so that grease will be forced from the
- 75

chamber to the interior of the cylinder through said first mentioned passage to lubricate said surface and said blades and minimize wear as said sharp trailing edges move at high speed over the surface.

11. A portable pressure fluid actuated tool comprising, in combination, means housing a motor of the eccentrically walled chamber type including an internally cylindrical wall having a smooth inner surface and a rotor having a plurality of blades disposed for movement outwardly relative to the rotor for engagement with said surface when said motor is in operation, said means having therein a valve-controlled passage for pressure fluid to actuate said rotor, ports in said surface establishing communication between the motor and said passage, a lubricant chamber in said means and in restricted communication with said valve-controlled passage so as to develop fluid pressure in said lubricant chamber, a second passage in said means in communication with said lubricant chamber, and a port opening into said surface from said second passage to deliver lubricant under pressure to said blades.

12. A portable pressure fluid actuated tool comprising, in combination, means enclosing a motor including an internally cylindrical wall having a smooth inner surface and an eccentrically mounted rotor having a plurality of blades disposed for movement outwardly relative to the rotor for engagement with said surface upon rapid rotation of said rotor, a valve controlled passage in said means communicating at one end with a source of pressure fluid and at its other end opening through said surface to the interior of said motor for creating an operative pressure condition therein, a lubricant chamber near one end of said rotor and having therein one end of a governor valve, the other end of said valve projecting into a part of said passage to govern the flow of pressure fluid therethrough, said valve being relatively loosely fitted and thereby permitting the restricted escape of pressure fluid from

said passage into said chamber to establish a pressure condition therein, a lubricant passage leading from said chamber to said cylindrical surface for conveying lubricant under pressure from said chamber, and a port in said surface establishing communication with said lubricant passage and spaced from the point at which said valve controlled passage opens into the motor, the position of said port being such that lubricant under pressure is delivered to said blades in the area in which the blades contact said surface with greatest pressure in the course of operation.

13. A pressure fluid actuated tool, including a rotary motor comprising an internally cylindrical smooth surface wall having circumferentially spaced sets of inlet and outlet ports, a rotor of smaller diameter than the inner diameter of said wall and mounted on an eccentric axis with a portion of its periphery in sliding abutment with said wall between said sets of ports, and a plurality of blades mounted in said rotor for movement outwardly relative to the rotor near the inlet ports and inwardly near the outlet ports so as to follow the inner surface of said wall, each of said blades being inclined from a radius of the rotor in the direction of rotation thereof and having an outer edge face substantially perpendicular to the side faces of the blade, the inclination and circumferential spacing of said blades being such that the sharp trailing edge of each of their edge faces engage said inner surface of the wall with a line contact while the blades are moving outwardly and the outer edge faces contact said surface throughout a larger area while the blades are moving inwardly near said outlet ports, and means for supplying lubricant to said surface in the region in which said blades are moving inwardly, whereby to relieve said blades from wear due to the combined centrifugal and inward pressure acting on the blades during the return movement.

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