

Nov. 6, 1923.

1,473,046

C. L. RAGOT ET AL
PORTABLE DRILLING MACHINE

Filed July 26, 1919

2 Sheets-Sheet 1

FIG. 1

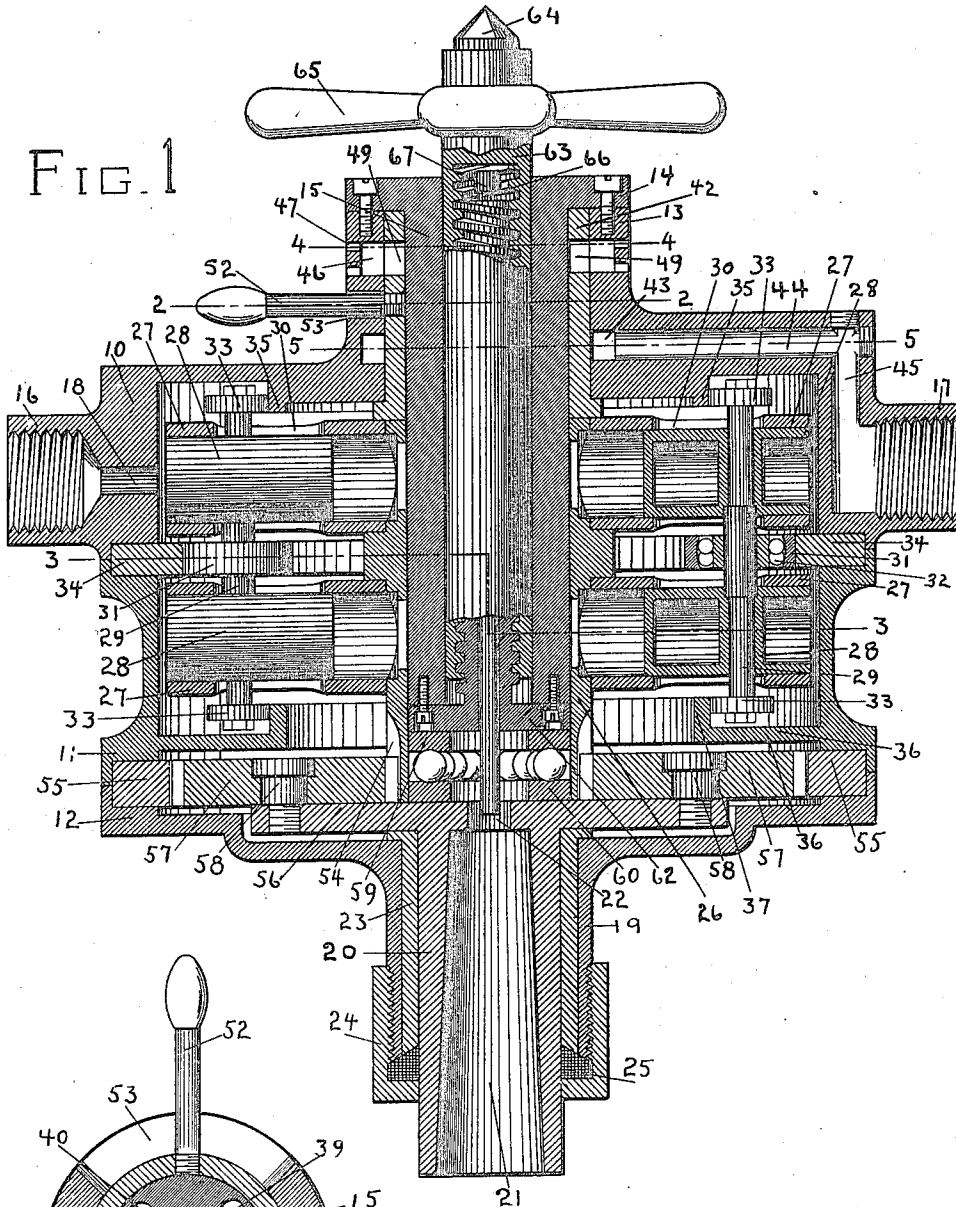
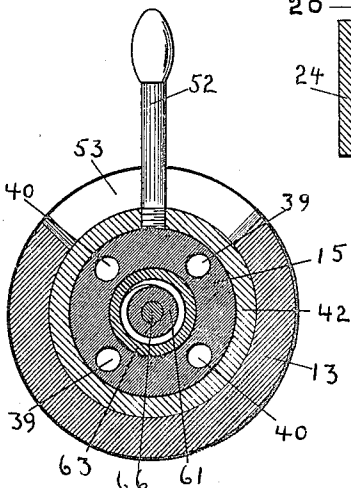


FIG. 2

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2 Sheets-Sheet 2

FIG. 3

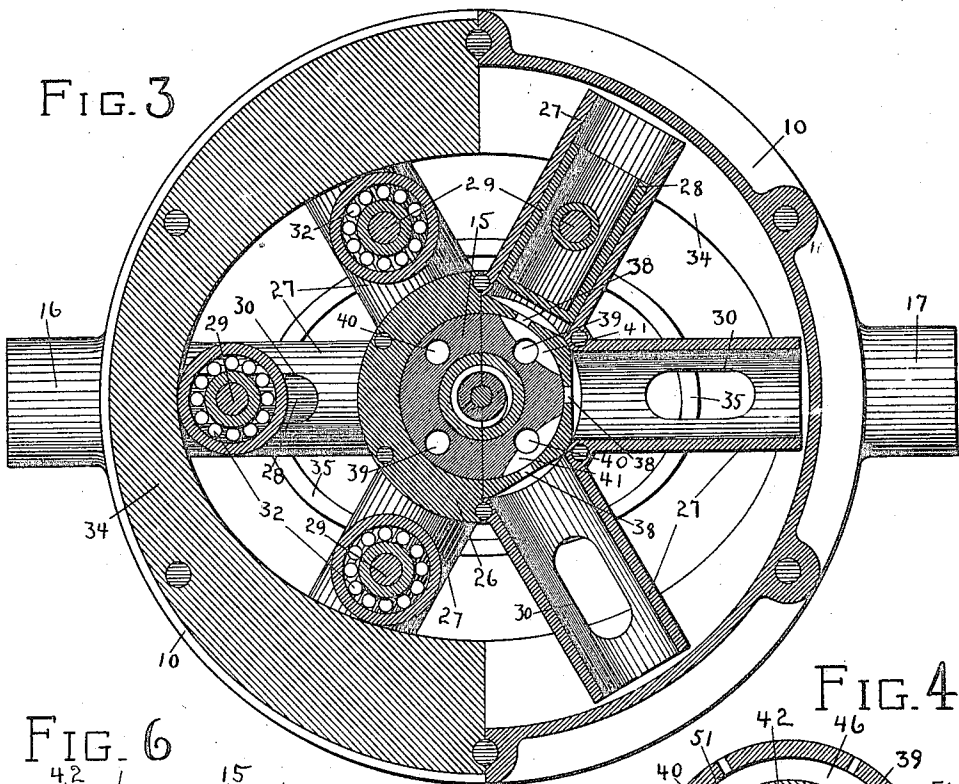


FIG. 4

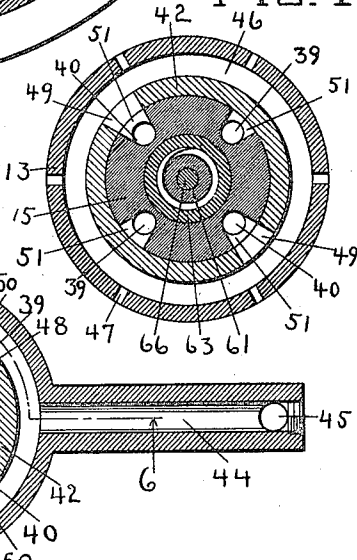


FIG. 6

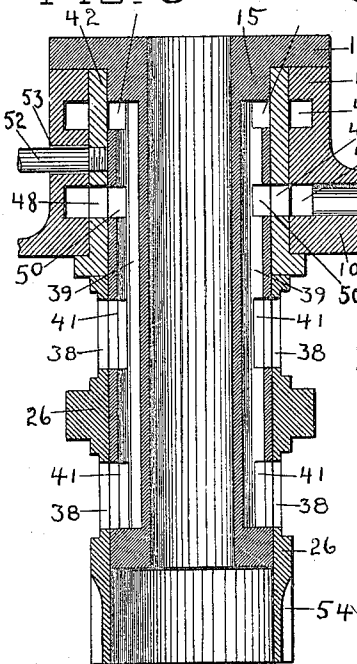
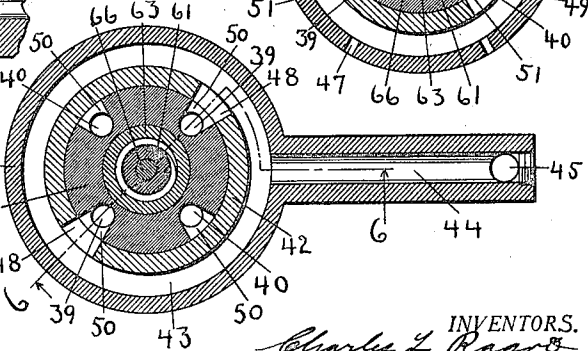


FIG. 5



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UNITED STATES PATENT OFFICE.

CHARLES L. RAGOT, OF NEW YORK, N. Y., AND LOUIS F. RAGOT, OF MILFORD, PENNSYLVANIA, ASSIGNORS TO RAGOT MOTOR CORPORATION, A CORPORATION OF NEW YORK.

PORTABLE DRILLING MACHINE.

Application filed July 26, 1919. Serial No. 313,464.

To all whom it may concern:

Be it known that we, CHARLES L. RAGOT, a citizen of the United States, and a resident of Kingsbridge, New York city, in the county of New York and State of New York, and LOUIS F. RAGOT, also a citizen of the United States, and a resident of Milford, in the county of Pike and State of Pennsylvania, have invented certain new and useful
10 Improvements in Portable Drilling Machines, of which the following is a specification.

This invention is an improved portable drilling machine of that type in which a
15 fluid operated motor is employed for imparting rotation to the drill or other tool and with which the tool may be fed endwise in respect to the work.

Our invention resides primarily in the
20 construction and arrangement of the tool rotating and feeding means. The main object of our invention is to arrange the operating mechanism co-axial with the tool and with all important moving as well as stationary parts both concentric with the axis
25 and evenly balanced in all operating positions. As one important feature of our invention, we provide a motor having a plurality of rigidly connected motive fluid cylinders radially arranged in respect to the
30 axis of the tool and rotatable about said axis with a feeding means arranged co-axial with and projecting through the center of the motor whereby symmetry and balance are maintained and the over all length is reduced to the minimum. As a further important feature, we provide an axially disposed stationary motive fluid distributor which is so designed, when constructed, that
35 it serves as a housing for or receives a part of the drill feeding mechanism which is preferably a feed screw projecting through the motor. The location of said tubular member in relation to the cylinder bases is
40 such that a very small dead space is obtained, adding to the efficiency of the motor. As a further important feature we provide a manually controlled rotatable sleeve encircling the distributor, by means of which
45 the speed and direction of rotation of the motor may be controlled. In its preferred embodiment, speed reducing gearing is employed between the rotor of the motor and the drill socket and in our improved construction this gearing as well as the thrust

ball bearings, the feed screw mechanism, and the drill ejector, are concentrically arranged in respect to the rotor. Although our improved motor is particularly designed
60 for use in and as a part of a portable drilling machine, yet it involves certain important features of construction useful in connection with other rotary motors of the same general type. Preferably the motor has a pair of axially spaced radially
65 arranged cylinders, the two pistons of each pair of parallel cylinders being connected by a roller carrying spindle as disclosed and claimed in our prior Patent 1,302,709 issued
70 May 6th, 1919. As an important feature of our present construction, each spindle carries not only the central roller which engages with an inwardly facing track but also carries two auxiliary rollers, one at each end
75 for engagement with a pair of stationary outwardly facing tracks located on either side of the rotor and constituting means for preventing any piston reciprocation except when accompanied by a corresponding rotation
80 of the rotor. Each cylinder is provided with diametrically opposed longitudinally extending slots through which the corresponding roller spindle extends, said slots also serving to permit of a freer lubrication
85 of the pistons.

Our improved construction also embodies various other features of importance, useful either in connection with motors of the same general type or as important features of
90 drilling or other portable tool operating machines, and which will be pointed out more particularly in connection with a detailed description of one form which our invention may assume.

In the accompanying drawings, to which
95 reference is to be had:

Figure 1 is a central longitudinal section. Figures 2, 3, 4 and 5 are sections on the
100 lines 2—2, 3—3, 4—4, and 5—5, respectively, of Figure 1, and Figure 6 is a longitudinal section of the center portion of the motor in the plane indicated by the line 6—6 of Figure 5, the feed screw mechanism being
omitted from the center.

In the specific form illustrated, the apparatus includes a portable casing made up
105 of three superposed rigidly connected casing sections, 10, 11 and 12. The upper casing section 10 has an upwardly extending concentric projection or boss 13, to which is
110

rigidly secured flange 14 of tubular member 15 extending co-axially into and substantially through the casing and serving both as a motive fluid distributor and as a casing for chamber for the feeding mechanism as will be described more in detail later.

The casing section 10 is also provided with two diametrically opposed threaded sockets, 16 and 17, adapted to receive supporting or operating handles. Socket 16 is provided with a hole 18 communicating with the interior of the casing, access to which may be effected by unscrewing the blind or dead handle (not shown) in order to drain or replenish the lubricant within the casing. Socket 17 constitutes a part of the motive fluid supply passages and is adapted to receive a similar hole through which motive fluid is supplied to feed the motor.

The opposite or lower casing section 12 is illustrated as provided here a depending projection or hub 19, concentric therewith, serving as a guide or bearing for the rotatable spindle 20 having a socket 21 and in its upper or inner end a slot 22, shown in its narrowest dimension in this view, said slot being adapted to receive the tang of the drill or other tools. A separate bearing sleeve 23 may be, and preferably is employed and packing nut 24 retains packing 25 to exclude foreign matter and retain the oil in the casing.

Within the casing and rotatably mounted on the tubular member 15 is a rotor illustrated as including a central sleeve or hub portion 26, and a plurality of radially disposed cylinders 27 arranged in two rows or sets and rigidly connected thereto. There are the same number of cylinders in each row and each cylinder of one row is arranged parallel with a corresponding cylinder of the other row. Within the cylinders are pistons 28, the pistons of adjacent parallel cylinders being connected by a spindle 29. Each spindle extends diametrically through both cylinders, there being provided oppositely disposed longitudinally extending slots 30 for this purpose in each cylinder. Each spindle between the two cylinders carries a roller 31 preferably mounted on ball bearings 32 and each spindle at each end carries an auxiliary roller 33 which is preferably of somewhat smaller diameter.

The casing of the motor has three tracks or annular guides with which these rollers engage. These tracks are so shaped that as the rotor turns about its axis, the pistons are caused to reciprocate in their respective cylinders. The number of reciprocations or strokes per revolution as well as the length and character of said strokes may be controlled by the shape and size of the annular tracks or guides. As shown, these are elliptical and co-axial with the rotor so that each piston is caused to make four complete

strokes during each rotation of the rotor. Thus for a compressed air, steam, or water motor or two stroke cycle internal combustion engine, each piston gives two power strokes per revolution, while for a four stroke cycle engine, each piston gives a single power stroke per revolution. The motive fluid operates at the inner ends of the pistons as will be later described and therefore the outer or larger track, that is, the one facing inwardly is the most liable to wear. Preferably there is provided a main track or guide 34 formed as a separate piece of hardened steel clamped in place between the two motor casing sections 10 and 11 which latter may be of aluminum or other light material. The inner surface of this track is elliptical as shown particularly in Figure 3 and the rollers 31 are maintained constantly in engagement therewith. The upper casing section 10 is provided with an inwardly extending rim presenting an elliptical peripheral surface serving as a track 35 for the rollers 33 at one end of each spindle 29 while the casing section 11 has an inwardly extending flange 36 presenting an elliptical peripheral surface constituting a track 37 for the rollers 33 at the other end of the spindles 29. The elliptical tracks 35 and 37 are of such shape and size in respect to the elliptical track 33 that the pistons are positively guided in and out as the rotor turns, all lost motion or pounding is prevented and all of the rollers held at all times in proper working engagement with their respective tracks, although a clearance may be provided so that while the motor is in operation only the rollers 31 will be in engagement with their track 34.

Each cylinder, at its inner end, has a port 38 serving alternately as an inlet and an exhaust port. The tubular member 15 serves as a motive fluid distributor to all of the cylinders. As shown, it has four longitudinal passages grouped into two diametrically opposed sets 39 and 40, one set constituting supply passages and the other set constituting outlet passages. Either set may serve as inlet or outlet passages, according to the direction in which the motor revolves, as will be explained. Each longitudinal passage of the two sets 39 and 40, has a pair of ports 41 located so that they may come into and out of registry with each of the ports 38 of the two sets of cylinders 27. Thus whenever a longitudinal passage 39 or 40 comes into registry with the ports 38 of one cylinder, through port 41 of the distributor, it also comes into registry with the port 38 of the adjacent parallel cylinder through the other ports 41 of the distributor, so that the same cycles of operation take place in the two cylinders of each pair simultaneously. Furthermore, as the two longitudinal passages of each set are ar-

ranged 180° apart whenever a passage of one of the sets comes into registry through its ports 41 with one pair of cylinders, the opposite passage of the same set will come

5 into registry with the opposed pair of cylinders and the same step in the cycle of operations will take place simultaneously at points diametrically opposed in respect to the axis of rotation.

10 For controlling the direction of rotation and speed of the motor, there is provided an oscillatory throttle sleeve 42 rotatably mounted on the distributor 15 above the rotor sleeve 26 and within the cylindrical extension 13 of the casing 10. This extension 13 is provided with an annular supply passage 43 surrounding throttle sleeve 42 and connecting with live handle socket 17 through communicating passages 44 and 45, and an annular outlet passage 46 communi-

20 cating with the atmosphere through openings 47. Throttle sleeve 42 is provided with one pair of diametrically opposed ports 48 registering continuously with annular supply passage 43 and a second pair of diametrically opposed ports 49 registering continuously with annular outlet passage 44, said ports 48 and 49 being situated 90° apart.

30 The distributor has a set of four radial openings 50 connecting with the two sets of longitudinal distributor passages 39 and 40 and in line with annular supply passage 43. The distributor has also another set of four radial openings 51 connecting with the two sets of longitudinal passages 39 and 40 and in line with annular exhaust passage 46. The ports 48 are arranged intermediate of the ports 49 and axially spaced from them so that when ports 48 are connecting the

40 annular supply passage 43 with the pair of longitudinal passages 39, through radial openings 50, ports 49 will connect annular outlet passage 46 with the pair of longitudinal passages 40 through radial passages 51.

45 In normal operation the motor fluid may enter from the live handle socket 17 through the passages 44 and 45 to the annular supply chamber 43 and through the ports 48 of the throttle sleeve and two of the radial openings 50 to the two longitudinal passages 39. As the rotor turns, the ports 38 of the several cylinders will come into registry with the ports 41 of the longitudinal passages 39 and thus each cylinder will receive motor fluid twice during each complete rotation of the rotor. At the same time, the other two longitudinal passages 40 will be in open communication through radial openings 51 and

60 throttle ports 49 to the annular exhaust passage 46 and from the latter to the atmosphere to openings 47. Thus with each complete rotation of each cylinder it will twice come into registry with the exhaust passages and the motor fluid may escape. The ports 41

of the distributor and ports 38 of the cylinders are made of such size as to give the desired duration of intake and duration of exhaust. For a non-expansible motive fluid this might be nearly 90° for each, but with an expansive fluid any desired cut-off may be secured. As shown in Figure 3 the port 38 of the cylinder which is in a horizontal position is not in registry with either of the two ports 41 of the distributor and the rotor has to rotate approximately through an angle of 8° in either direction in order that ports 38 and 41 will come into registry. This has the effect of not only having a point of cut-off at 8° of rotation, but also provides for a motion through 8° of rotation at the beginning of the power stroke before admission of motive fluid is effective. This is done in order that the cut-off will be equal no matter in which direction the rotor rotates.

The throttle sleeve 42 may be oscillated through approximately 90°, any suitable mechanism being provided for this purpose. As shown, the throttle has an operating handle 52 projecting through a slot 53 in the flange 13 of the casing section 10. When in one extreme position, the motive fluid will enter each cylinder just after it passes the minor axis of the ellipse when the exhaust port will open at or about the time the cylinder passes the major axis. By rotating the throttle sleeve to the opposite limiting position, the motive fluid will be admitted to each cylinder at the other side of the minor axis and rotation in the opposite direction will be assured. By bringing the parts to an intermediate position, as for instance as shown in Figure 2, the ports 48 and 49 will be brought out of registry with the radial passages 50 and 51 in the distributor and thus the motive fluid cannot be admitted to or escape from the latter and the motor will be at rest. From the intermediate or rest position as shown in Figure 2, the handle may be moved in either direction and the rotor will turn in the direction toward which the handle is moved at a speed corresponding to the amount of movement of said handle.

From the foregoing it will be thought that the operation of the motor per se will be sufficiently fully understood, although a more detailed description of the operation of a somewhat similar construction will be found in our prior Patent 1,302,709 issued May 6th, 1919.

For transmitting motion and power from the rotor to the spindle 20, and for securing the desired relative speeds, we provide a planetary gearing. The lower end portion of the rotor is provided with a driving pinion. As shown, the hub portion 26 is extended below the lower end of the stationary distributor 15 and is cut to form a pinion

54 integral with the rotor. Rigidly clamped between the two casing sections 11 and 12 is an annular member cut to form an internal gear 55 in the same transverse plane with the pinion 54. The spindle 20 is provided with a lateral flange or head 56 below the plane of these two gears and this flange or head carries a plurality of intermediate gears 57 mounted in any suitable manner, as for instance, on bearing pins 58 threaded into the head 56. These intermediate gears 57 mesh with both the pinion 54 of the rotor and the stationary internal gear 55 of the casing. The rotation of the rotor will cause these intermediate gears to rotate about their own axes and travel along the stationary gear 55, thereby effecting the desired positive rotation of the spindle 20 at the desired lower speed than that of the rotor.

In order to take the end thrust of the tool, a thrust ball bearing is mounted between the upper surface of the tool holder head and the inner end of the distributor 15. This is shown as including a pair of race rings 59 and 60 disposed within the rotor sleeve 26. The lower race ring may be carried by the sleeve 20 and the upper race ring by the distributor 15. Both race rings should clear the rotor sleeve in order not to make contact with the latter.

For feeding the tool into the work, there is provided a pair of threaded members normally housed or contained within the distributor. As shown, an inner member constituting feed post 61 is disposed entirely within the distributor and at its inner or lower end has an outwardly extending flange 62 rigidly secured to the inner end of the distributor 15 and if desired disposed between the latter and the thrust bearing race ring 60. Feed post 61 is externally threaded so that the outer member or sleeve 63 which is internally threaded may be screwed on to the same thereby telescoping it within the tubular distributor 15 which, as previously noted, constituted a casing for the feed mechanism. The outer end of the feed sleeve 63 may be constructed in any suitable manner for engagement with a stationary support and may be provided with any suitable means to facilitate the rotation of said member. As shown, feed sleeve 63 has a pointed outer end 64 which may be a separate hardened inserted piece and is provided with a suitable handle 65 to facilitate its rotation. With the drill or tool in place against the work and feed sleeve 63 screwed out until the point 64 engages a stationary support, it will be noted that the entire end thrust of the drill or tool is transmitted from the spindle 20 through the thrust bearing to the flange 62 of the feed post 61 and from the latter to the feed sleeve 63 and the stationary support (not shown). Thus none of the thrust is directly sustained by the distribu-

tor or the motor casing, and therefore the casing and distributor may be made of comparatively light material, although the distributor itself should be of such material as will provide a suitable bearing for the rotor. It will be noted that one of the two threaded members constituting the screw feed is rigid with the casing and that the other is movable into and out of the casing, and that we have shown the member that moves out of the casing as being internally threaded. Thus the threads are protected from dust and dirt and are concealed from view. It will be evident that if desired it may be the inner of the two threaded members which is to be movable into and out of the casing, and in that event, the distributor itself may be internally threaded and serve not only as the distributor but also as one of the two threaded members of the feed screw.

For removing the drill or tool from the socket 21 there is provided a pin 66 slidably mounted within and co-axial with the feed post 61. The lower end of this pin may project through the ball thrust bearing to such a position that it may engage with the inner end of the drill or tool shank and force the latter out of the socket of the spindle 20. For forcing this pin endwise and for normally preventing the pin from falling out when the tool is removed, the upper or inner end of the pin may be provided with a head 67 above the upper end of the feed post 61 and within the feed sleeve 63. When the latter is screwed in nearly to its limiting position, a transverse wall or stop will engage with the head of the pin and force the latter downwardly a sufficient distance to dislodge the tool. The feed sleeve 63 must be screwed out again to a slight extent to permit the proper reinsertion of the tang of the tool. Owing to the fact that so-called pneumatic drills are not always provided with a screw feed mechanism, but often have a breast plate or a grip handle in its place then in that case the ejecting pin can be inserted directly through the tubular distributor. Furthermore, if the device is used to drive a tool not requiring ejection the distributor may be left with a solid center.

It will be noted that in our improved construction, the rotor of the motor is co-axial with the tool socket and that the entire mechanism is balanced and symmetrical. The radial movement of each piston is accompanied by a corresponding but opposite movement of a diametrically opposed piston and the same step in the cycle of operation takes place simultaneously in diametrically opposed cylinders. The motor is so constructed that the feed mechanism operated directly through the center of the motor and the casing or housing of the feed screw mechanism serves as a motive fluid distrib-

utor and has a journal or bearing for the rotor. The parts most liable to wear, such as the elliptical guide 34 and the annular gear 55 are formed separately from the casing and are rigidly secured in position upon the assembling of the casing so that they cannot become displaced or loosened. The parts are so designed that they may be very readily removed or replaced and the moving parts may be readily lubricated.

The mechanism may be employed for operating any kind of rotary tool for use on any variety of work, such as wood, or metal. In designating the invention as a portable drilling machine, it will of course be evident that such term is used in its broadest meaning and includes reaming, tapping, counter-sinking, and other operations performed by a rotary tool, the character of the operation depending upon the particular tool selected. Any suitable motive fluid may be employed, such as compressed air, steam, water or explosive mixture. It will of course be evident that the arrangement and sizes of the ports must be properly designed in accordance with the motive fluid to be employed.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is:

1. In a portable drilling machine, a tool holder, a fluid operated rotor coaxial therewith and having a plurality of cylinders with their axes disposed radially in respect to said tool holder, speed reducing gearing connecting said rotor and said tool holder, and screw feed mechanism extending axially through said rotor.

2. In a portable drilling machine a rotary fluid operated motor, a tool holder coaxial therewith, speed reducing gearing connecting said motor and said tool holder, a stationary motive fluid distributor extending axially through said rotor, and screw feed mechanism disposed within said distributor.

3. A portable drilling machine including a rotary fluid operated motor, a tool holder coaxial therewith, speed reducing gearing connecting said motor and said tool holder, a stationary motive fluid distributor extending axially through said rotor, and a sleeve mounted for oscillation on said distributor for controlling the flow of motive fluid to the latter.

4. A portable drilling machine including a casing having a cylindrical extension at one end thereof, a tubular motive fluid distributing member coaxial with said casing and secured to said extension, an oscillatory throttle sleeve within said extension and encircling said distributor, and a motive fluid operated rotor mounted for rotation on said distributor.

5. A portable drilling machine including a casing having a cylindrical extension at

one end thereof, a tubular motive fluid distributing member coaxial with said casing and secured to said extension, and oscillatory throttle sleeve within said extension and encircling said distributor, a motive fluid operated rotor mounted for rotation on said distributor, a tool holder coaxial with said distributor and a tool ejector movable axially through said distributor.

6. A portable drilling machine including a casing having a cylindrical extension at one end thereof, a tubular motive fluid distributing member coaxial with said casing and secured to said extension, and oscillatory throttle sleeve within said extension and encircling said distributor, a motive fluid operated rotor mounted for rotation on said distributor, and feed screw mechanism disposed within and axially movable in respect to said distributor.

7. In combination, a rotary fluid operated motor, comprising a plurality of radially disposed cylinders, a tool holder co-axial therewith, speed reducing gearing connecting said motor and said tool holder, a stationary motive fluid distributor extending axially through said rotor and screw feed mechanism disposed within said distributor.

8. In combination a rotary fluid operated motor having a stationary tubular motive fluid distributor and a rotor comprising a plurality of radially disposed cylinders mounted thereon, a tool holder co-axial with said distributor, and planetary gearing connecting said rotor and said tool holder, and screw feed mechanism disposed within said distributor and extending axially beyond the ends thereof.

9. A portable drilling machine, including a rotary fluid operated motor having a stationary tubular motive fluid distributor and a rotor comprising a plurality of radially disposed cylinders mounted thereon, a tool holder co-axial with said distributor, planetary gearing connecting said rotor and said tool holder, and mechanism operating within said distributor for feeding said rotor and said tool holder axially, said mechanism extending axially from end to end of said distributor.

10. In a portable drilling machine, a stationary tubular motive fluid distributing member, a tool holder co-axial therewith, a thrust bearing between said member and said tool holder, a fluid operated rotor having a plurality of cylinders mounted on and radial in respect to said tubular member, and a casing enclosing said rotor and secured to said member and providing a bearing for said tool holder.

11. A portable drilling machine including a stationary tubular motive fluid distributing member, a tool holder co-axial therewith, a thrust bearing between said member and said tool holder, a fluid operated rotor

comprising a plurality of radially disposed cylinders rotatably mounted on said tubular member, and a casing enclosing said rotor and secured to said member and providing a bearing for said tool holder, said tubular member having two diametrically opposed pairs of axially disposed passages therethrough, one of said pairs being for the delivery of and the other of said pairs being for the collecting of motive fluid to and from said rotor respectively.

12. A portable drilling machine including a stationary tubular motor fluid distributing member, a tool holder co-axial therewith, a thrust bearing between said member and said tool holder, a fluid operated rotor comprising a plurality of radially disposed cylinders rotatably mounted on said tubular member, a casing enclosing said rotor and secured to said member and providing a bearing for said tool holder, and a screw member extending axially through said tubular member for engaging a stationary support and rotatable to axially feed the rotor and tool holder.

13. A portable drilling machine, having a stationary tubular motive fluid distributing member, a fluid operated rotor mounted thereon, a tool holder co-axial with said member, a thrust bearing between said tubular member and said tool holder, a casing enclosing said rotor and providing a bearing for said tool holder, and a threaded mechanism operatively connected to and axially extending through said tubular member and telescoping therewith, and rotatable to effect the feeding of said casing and tool axially.

14. A portable drilling machine, including a tool holder, a member co-axial therewith, a thrust bearing between said tool holder and said member, a second member having threaded engagement with said first mentioned member for feeding said tool holder and said first mentioned member axially, a stationary tubular motive fluid distributor surrounding said members and rigid with said first mentioned member, a fluid operated motor rotatably mounted on said distributor and encircling said members, said motor having radially disposed cylinders and a casing rigid with said distributor and encircling said motor.

15. A portable drilling machine, including a tool holder, a member co-axial therewith, a thrust bearing between said tool holder and said member, a second member having threaded engagement with said first mentioned member for feeding said tool holder, and said first mentioned member axially, a stationary tubular motor fluid distributor surrounding said members and rigid with said first mentioned member, a fluid operating motor rotatably mounted on said distributor and encircling said members said motor having radially disposed cylin-

ders, a casing rigid with said distributor and encircling said motor, and speed reducing gearing connecting said rotor and said tool holder.

16. A portable drilling machine, including a stationary tubular motive fluid distributor, a rotor mounted thereon, a tool holder, speed reducing gearing, connecting said rotor and said tool holder, and feed screw mechanism for said tool holder within said distributor and extending axially therethrough.

17. In a portable drilling machine, a fixed tubular motive fluid distributor, a rotary fluid operated motor rotatably mounted thereon, a tool holder mounted axially therewith and connected to said motor by speed reducing gearing, a screw operated feeding mechanism extending therethrough, said mechanism having a stationary member secured to the inner end and a rotary telescoping member emerging from the outer end of said distributor and means extending axially through said stationary member for engagement with said telescoping member for ejecting tools from said tool holder.

18. In combination, a casing having a cylindrical extension at one end thereof, a tubular member co-axial with said casing and secured to said cylindrical extension, an oscillatory throttle sleeve within said extension and encircling said tubular member, a motive fluid operated rotor mounted on said tubular member, supply and exhaust passages extending lengthwise through the walls of said tubular member, annular supply and exhaust passages within said cylindrical extension, and ports in said throttle sleeve for establishing communication between either of said first mentioned passages and either of said second mentioned passages to control the rotation of said rotor.

19. A portable drilling machine, including a casing having motive fluid supply and exhaust passages, a tubular member co-axial and rigid therewith and having four longitudinally extending motive fluid passages within the walls thereof arranged in two sets of diametrically opposed pairs, a rotor and an oscillatory sleeve mounted on said member and axially spaced from each other, radial ports in said tubular member, rotor and sleeve, the ports in said sleeve being disposed to connect the casing supply passage with either of said pairs of tubular member passages, and said casing exhaust passage with the remaining pair of tubular member passages when said sleeve is manually oscillated in either direction.

20. A portable drilling machine, including a casing having motive fluid supply and exhaust passages, a tubular member co-axial and rigid therewith, a fluid pressure operated rotor and an oscillatory throttle

sleeve mounted and axially spaced on said member, ports in said rotor and said sleeve, said tubular member having longitudinally disposed passages connecting said rotor and
5 said sleeve ports, the ports in said sleeve being disposed to connect every alternate tubular member passage to the source of supply and the remaining tubular member
10 passages to the atmosphere, said throttle being manually oscillated through an arc

of sufficient magnitude to reverse the relation of the throttle ports to the tubular member passages in order to reverse the flow of motive fluid through said rotor.

Signed at New York, in the county of 15
New York and State of New York, this
24th day of July, A. D. 1919.

CHAS. L. RAGOT.
LOUIS F. RAGOT.