

[54] **FLUID DRIVEN ROTARY HAND TOOL**

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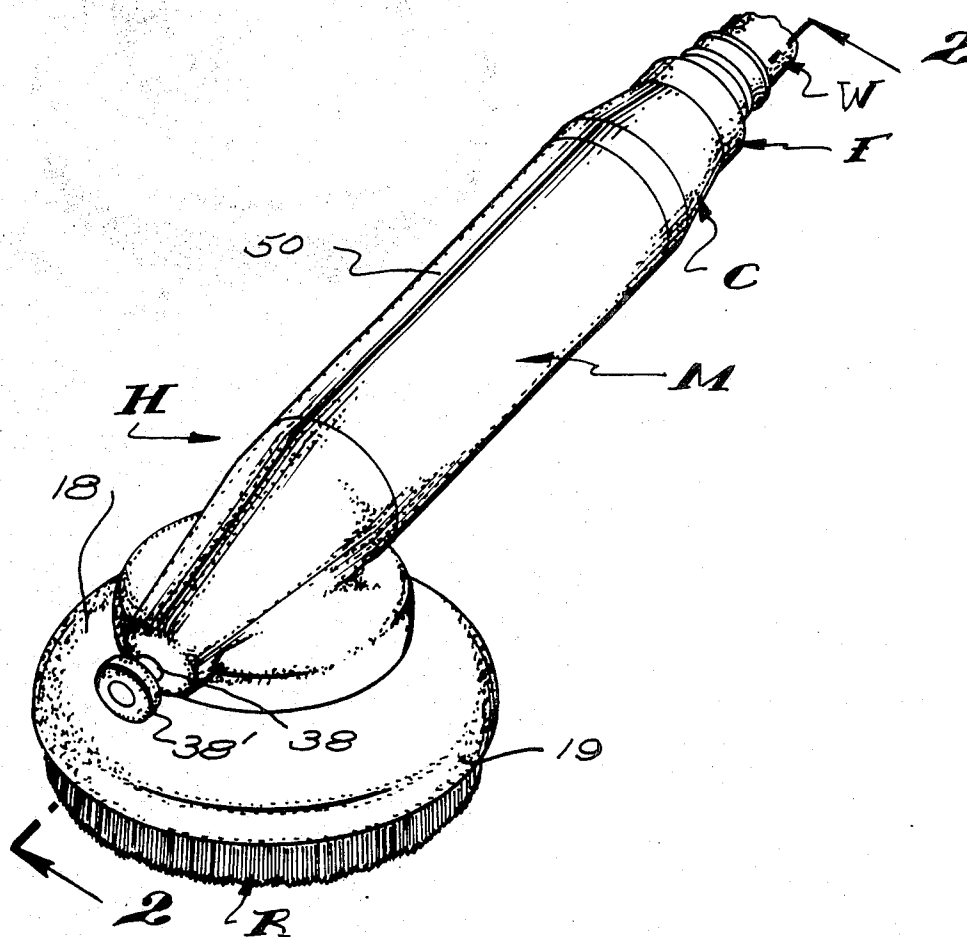
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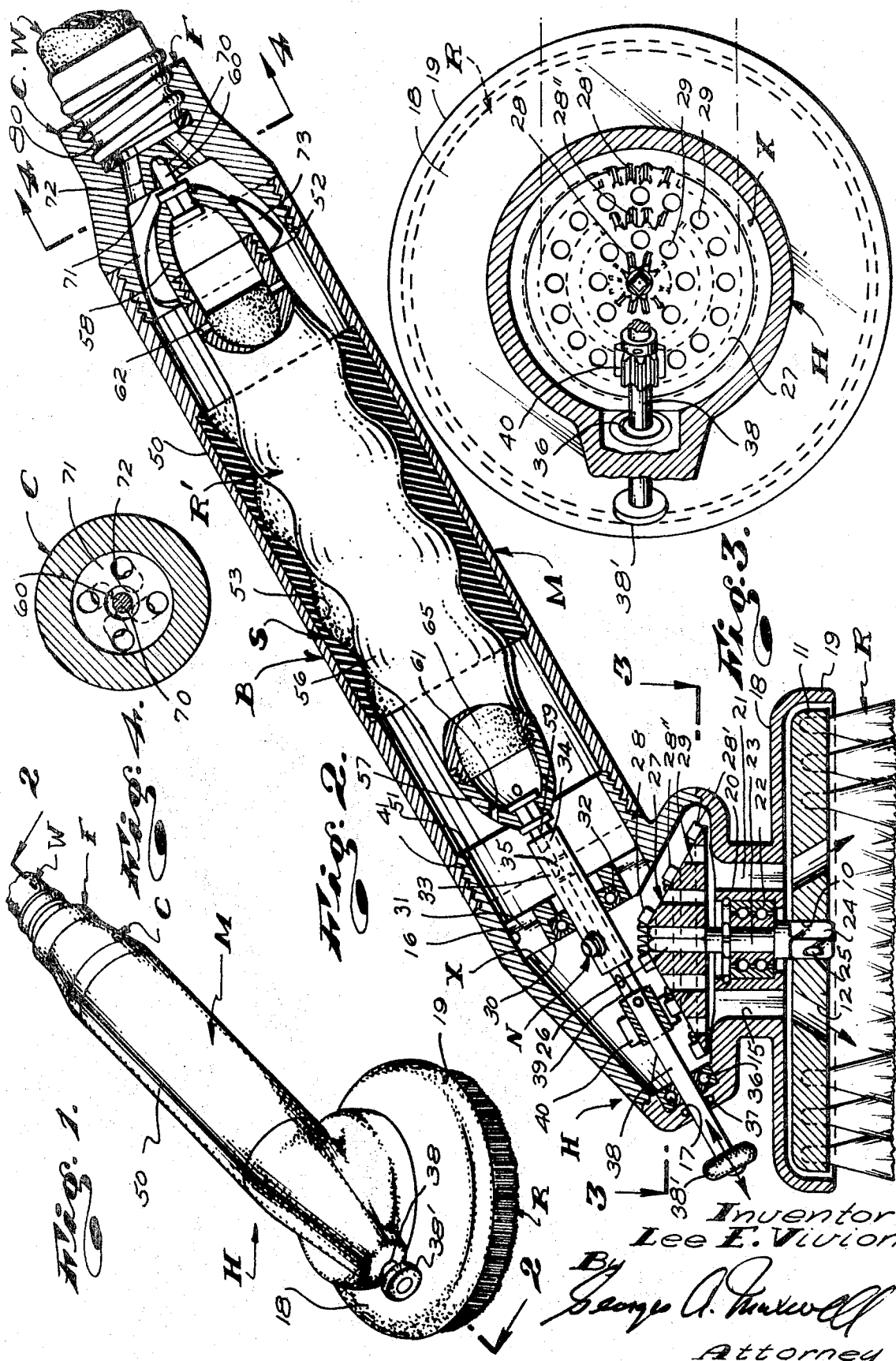
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[57] **ABSTRACT**

A fluid pressure driven rotary hand tool comprising an elongate helicoidal fluid motor within a manually engageable barrel, fluid inlet means at one end of the barrel and having fluid supply coupling means, a housing at the other end of the barrel with a chamber communicating with the discharge end of the motor, an outlet opening in the housing on an axis angularly related to the motor, a rotary work engaging member at the exterior of the housing in axial alignment with the outlet, power transmitting shafts in the housing related to the motor and the member and manually adjustable reduction gear means related to said shafts, said structure including chemical dispensing means related to the motor to meter and dispense chemicals into the motive fluid flowing through the motor, chamber and outlet opening.

10 Claims, 6 Drawing Figures





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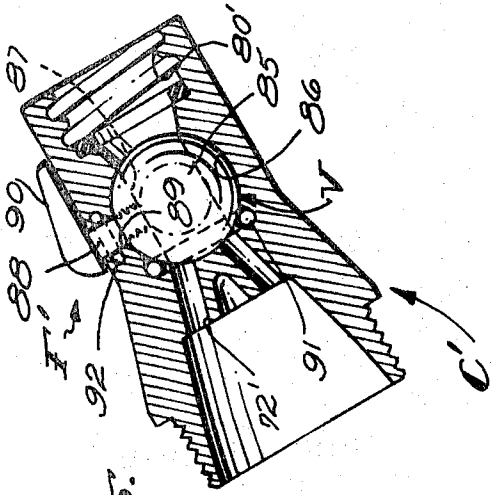


Fig. 5.

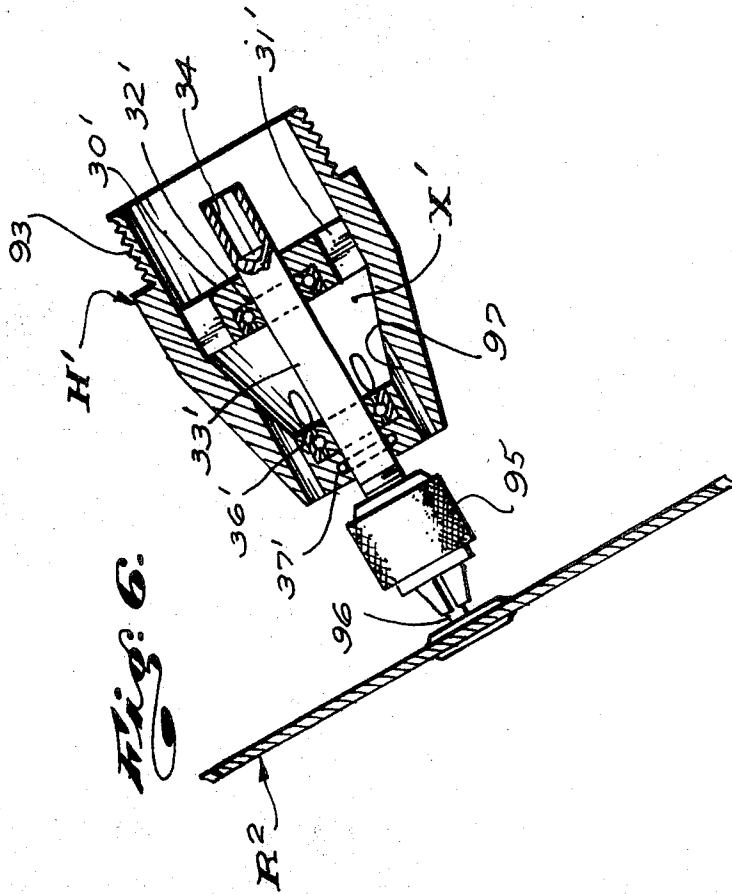


Fig. 6.

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FLUID DRIVEN ROTARY HAND TOOL

This invention has to do with a fluid pressure operated rotary hand tool and is more particularly concerned with a tool of the character referred to which is such that it can be advantageously employed to drive rotary brushes, sanding and/or polishing discs and other like means for performing work on objects and a structure which is such that it can be driven by water, air, gas, oil or substantially any other fluid medium under pressure.

It is an object and feature of my invention to provide a hand tool of the character referred to having a novel positive displacement helicoidal type fluid motor involving an elongate, resilient, tubular stator with internal helical groove and an elongate, concentric, helicoidal rotor within the stator and engageable therewith and such that when fluid is forced through and between the stator and rotor, the rotor is rotated.

It is an object and feature of this invention to provide a tool of the character referred to wherein the motive fluid is discharged and dispensed through and/or about the rotary, work engaging brush or disc carried and driven by the tool to assist and enhance the effectiveness of the brush or disc to perform its intended work.

It is another object and feature of the present invention to provide a tool of the character referred to wherein the rotator is tubular or hollow and adapted to receive and hold a volume of fluid and is provided with novel means to meter and dispense a fluid deposited therein into the fluid medium employed to drive the motor, whereby the fluids are mixed and blended and whereby said mixture or blend of fluids is dispensed through and/or about the brush or work engaging part carried and driven by the tool.

It is an object of this invention to provide secondary or supplemental fluid dispensing means such as referred to above which is such that soaps, solvents, lubricants, liquid polishing compounds or substantially any other desired chemical can be dispensed at the work engaging brush or disc and deposited on the work, about the brush or disc, whether the motive fluid be gaseous or liquid.

It is an object and feature of this invention to provide secondary liquid metering and dispensing means in the rotor which includes inlet ports in the upstream end of the rotor and communicating with the barrel of the motor, upstream of the stator where the pressure of the motive fluid medium is greatest, outlet ports at the other or downstream end of the rotor and communicating with the barrel downstream of the stator where the pressure of the motive fluid medium is less than at the upstream end of the rotor and a core of interconnected cellular material removably engaged within the rotor to carry and assist metering of the secondary fluid.

It is an object and feature of my invention to provide a structure of the character referred to wherein secondary fluid mediums of different viscosity and the like can be accurately dispensed by changing and controlling the pressure of the motive fluid medium, the size of the inlet and/or outlet ports and by changing the porosity of the core in the rotor.

It is an object and feature of my invention to provide means at the inlet or upstream end of the motor to start and effect rotation of the rotor when the flow of the motive medium is initiated.

Another object and feature of this invention is to provide a tool of the character referred to wherein the motor establishes a hand grip for the tool and wherein the axis of the motor is angularly related to the rotative axis of the work engaging brush or disc.

It is an object and feature of this invention to provide a structure of the character referred to wherein the downstream end of the rotor engages and drives a jack-shaft and said jack-shaft is gear related to and drives a driven shaft, angularly related to the rotor and jack-shaft and on which work engaging brushes and/or discs are releasably engaged.

Yet another object and feature of this invention is to provide a structure of the character referred to wherein the gear drive between the jack-shaft and driven shaft include a pair of inter-engaged bevel gears and a structure wherein one of said shafts is provided with a plurality of bevel gears of like pitch and of varying diameters and wherein the bevel gear on the other shaft is selectively shiftable into and out of engagement with the several gears on the first mentioned shaft whereby the rotative speed of the work engaging brush or disc carried and driven by the tool can be varied and/or controlled and/or whereby the torsional forces delivered to and through said brush or disc can be varied, as desired and as circumstances require.

It is yet another object and feature of the present invention to provide a structure of the character referred to wherein the structure and/or means provided to support and house the motor, jack-shaft, driven shaft and gear means between said shafts serve to conduct and direct the flow of fluid or fluids flowing from the downstream end of the motor to, through and/or about the work engaging brush or disc carried and driven by the tool.

It is an object and feature of my invention to provide a tool structure of the character referred to which is easy and economical to manufacture, a structure which is rugged and durable and a structure which is highly effective and dependable in operation.

The foregoing and other objects and features of my invention will be fully understood from the following detailed descriptions of typical and preferred forms and carrying out of the invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is a perspective view of my new tool;

FIG. 2 is an enlarged detailed sectional view of my new tool, taken substantially as indicated by line 2—2 in FIG. 1;

FIG. 3 is a sectional view taken as indicated by line 3—3 in FIG. 2;

FIG. 4 is a sectional view taken as indicated by line 4—4 in FIG. 2;

FIG. 5 is a sectional view of another form of cap and fluid connecting means; and

FIG. 6 is a sectional view of another form of head section as provided by this invention.

Referring to FIG. 1 of the drawings, the tool T that I provide includes an elongate cylindrical motor unit M defining a manually engageable handle, a head H at one end of the unit M, a work-engaging rotary unit R carried by the head and fluid supply connecting means F at the other end of the unit M.

The rotary unit R can be in the form and/or nature of an abrasive disc, buffing disc, or, as shown in the form of a round or disc-shaped brush. The unit R,

whichever form it might take, is characterized by a central opening 10 in which a driven shaft carried by the head H and which will hereafter be described, releasably engaged. The opening 10 is established in a rigid core or plate-like body portion 11 of the unit. In practice, the core or body of the unit R can be provided with a plurality of circumferentially and/or radially spaced, axially opening, fluid conducting ports or windows 12 to allow for the free axial flow of fluid there-through. Since the exact nature of the unit R can be varied and since the nature of the unit R controls the nature or character of the core or body 11, further detailed consideration and description of the unit R need not be entered into.

The housing H is preferably established by a pair of cemented or otherwise joined together molded plastic shell like sections and defined chamber X, a central, vertical, downwardly opening outlet opening 15 communicating with the chamber X, a radially outwardly and upwardly opening inlet opening 16 communicating with the chamber X, on axis which intersect the axis of the opening 15 at a point spaced above the opening 15 and with the chamber X. A bearing opening 17 in axial alignment with the opening 16 and extending through the housing at its side opposite from the opening 16 is provided.

The housing can, as shown, include a radially outwardly projecting round plate 18 about and concentric with the opening 15 and having a downwardly projecting annular flange 19 about its outer periphery and defining a protective shroud or shield to freely accommodate overly and surround the top and outer peripheral sides of the unit R, as clearly shown in the drawings.

The opening 15 is provided with a central, annular bearing support 20 supported by a spider 21 comprising a plurality of circumferentially spaced radially extending spoke-like webs formed integrally with the support and housing. The support 20 carried an anti-friction bearing 22, which bearing carries an elongate vertically extending driven shaft 23, for free rotation and against axial shifting.

The shaft 23 has a lower polygonal unit engaging head portion 24 with a spring loaded detent engaging rotary ball 25 on one of the sides. The head portion 24 depends below the opening 15 and is cooperatively and releasably engaged in the opening in the unit R, to establish driving engagement therewith and in accordance with the common practice for releasably connecting work engaging parts with torque applying shafts and tools.

The shaft 23 has an upper portion 26 which projects upwardly with the chamber X and carries a driven gear unit 27. The gear unit 27 is an axially inwardly and upwardly convergent conical part, the exterior conical surface of which is at the same angle to the axis of the shaft 23 as the axis of the inlet opening 16 and which surface occurs in predetermined spaced relationship below the axis of said opening 16. The gear unit 27 is provided with a plurality of radially spaced, circumferential, driven bevel gears 28, formed integrally therewith and projecting radially upwardly and outwardly from its conical surface. The gears 28 are of equal pitch and of different diameter.

In the case illustrated, I have shown the unit 27 provided with a small diameter, central gear 28, a large diameter outer gear 28' and an intermediate gear 28''.

The unit 27 is suitably fixed to the shaft 23 in driving engagement therewith. In practice, as shown and to allow for the free flow of fluids through the construction, the unit 27 is provided with annular rows of axially extending circumferentially spaced, flow passages or ports 29 between the adjacent gears formed thereon.

The inlet opening 16 in the housing is provided with a central annular bearing support 30 supported by a spider 31 comprising a plurality circumferentially spaced radially extending spoke-like webs formed integrally with the support 30 and the housing. The support 30 carries an anti-friction bearing 32, which bearing carries an elongate drive shaft 33 for free rotation and against axial shifting and on an axis concentric with the opening 16.

The shaft 33 has an axially outwardly opening drive socket 34 entering its outer end and has an elongate central, polygonal or splined outer shaft receiving opening 35 entering the other or inner end. The inner end of the shaft 33 is spaced radially outwardly from and is disposed toward the axis of the shaft 23.

The opening 17 in the housing carries an anti-friction bearing 36 and an O-ring seal 37. An elongate jack shaft 38 is engaged through the opening 17 in sealing engagement with the seal 37 and in the bearing 36 for rotational support thereby and for axial shifting relative thereto.

The shaft 38 has a forward outer portion projecting freely from the forward exterior side of the housing and on which a manually engageable knob 38' the like is engaged.

The shaft 38 has an elongate, rear, polygonal or splined portion 39 which is slidably engaged in the opening 35 in the shaft 33, in rotary driving engagement therewith.

The central portion of the shaft 38 extends above and across the gear unit 27 in predetermined spaced relationship therefrom and carries a spur drive gear 40.

The gear 40 is fixed on the shaft and is similar in pitch with the gears 28, 28' and 28'', is of sufficient and proper radial or diametric extent to established meshed driving engagement with the gears 28, 28' and 28'' and is slightly less in axial extent than the radial spacing between the gears 28-28' and 28'-28''.

With the structure and relationship of parts set forth above and illustrated in the drawings, it will be apparent that the gears 40, by manual engagement of the knob and axial shifting of the shaft 38 can be selectively shifted into and out of engagement with the driven gears 28, 28' and 28'' to vary the gear ratio between the shaft 33-37 and the shaft 23 and, can be shifted to neutral or disengaged positions between the driven gears, as desired or as circumstances require.

In practice, suitable indexing means N can be provided to releasably return the gear 40 in each of its several selective positions. In the case illustrated, the means N includes spring loaded ball and detent means, between the shafts 33-37, as shown in FIG. 2 of the drawings.

Next, and finally, the housing H is provided with a radially rearwardly and axially upwardly inclined externally threaded nipple 41 at and concentric with the inlet opening and outward of the spider and bearing in said inlet opening.

In practice, the configuration of the housing H, the exact nature and style or type of bearing means and spider supports therefor and other details of construction

of the structure thus far described can be varied to a considerable extent without departing from the spirit of my invention.

The motor unit M is an elongate assembly and includes an elongate cylindrical, tubular, barrel 50 with an internally threaded socket 51 at its forward end engaged on the nipple 41 in the housing H, a threaded socket 52 at its rear end and in which a cap C of the fluid connecting means F is engaged.

The barrel B carries an elongate, resilient, sleeve-like stator S. The stator is preferably established of a resilient rubber-like compound, is bonded to the interior of the barrel and define an elongate, internal, helical, thread-like groove 53 of predetermined pitch. The root of the grooves are preferably radiused or rounded and the crest or helical teeth-like portions of the stator between the grooves are preferably rounded or radiused, as illustrated.

The motor unit M next includes an elongate rotor R' greater in axial extent than the stator S and arranged with and extending longitudinally through the stator. The rotor R' is helicoidal in form, that is, it is helically fluted throughout its major longitudinal extent is dissimilar in pitch with the grooves 53 in the stator and such that it establishes interfering engagement with the helical crest or teeth-like portions of the stator established by the groove 53. The helical fluting or thread-like portions of the rotor are concentric with the rotative axis of the rotor.

The rotor R' is a sectional unit with a tubular central section 56 and streamlined bullet-shaped front and rear end cup-like closure sections 57 and 58 screw threaded in the ends of and closing the central section 56. The front end section 57 has a polygonal forwardly projecting, central drive pin 59 which is slidably engaged in the rearwardly opening socket opening 34 in the shaft 33. The rear section 58 has a central rearwardly projecting axial pin 60 which pin is adapted to engage in a bearing cup in a cap C, as will hereafter be described.

The forward section 57 is provided with one or more substantially radially opening outlet openings 61. The rear portion of the section 56 is provided with one or more substantially radially opening inlet openings 62. The openings 61 and 62 communicate with the interior of the rotor and with the interior of the barrel downstream and upstream of the stator S and serve to effect the flow of fluid into the outer end and out of the forward end of the rotor.

The rotor is next provided with a removable core 65 of interconnected cellular material which material serves to hold or contain a volume of liquid additive, such as soap, buffing compound or the like and cooperates with the openings 61 and 62 to control the rate of flow of fluid into and out of the rotor.

The ports and the core in the rotor and the relationship of the parts in the rotor with the stator, cooperate to define what is best called, chemical dispensing means, and facilitates the introduction and metering of liquid chemicals or additives into the stream of motive fluid flowing through the construction.

The pin 60 on the rear closure section 58 of the rotor is engaged in a central forwardly opening bearing cup 70 in a partition 71 in a closure of cap C engaged in the socket 52 of the barrel partition 71 in the cap is normal to the axis of the motor unit and is provided with a plurality of circumferentially spaced, circumferentially pitched or inclined jet ports 72 which ports are dis-

posed to direct jets of motive fluid flowing forwardly through the cap and into the barrel, toward and onto radially outwardly projecting axially and circumferentially pitched vanes 73 spaced circumferentially about the section 58 of the rotor.

The reaction of jets of fluid flowing from the ports 72 and impinging on the vanes 73 serve to start the rotor in motion when flow through the structure is started and thereafter supplements the function of the rotor to transform the energy of the fluid flow into mechanical rotary motion.

The construction next and finally includes an internally threaded socket 80 at the outer rear end of the closure cap C which socket is adapted to receive and connect with a motive fluid supply such as a water hose W connected with and extending from a pressurized municipal water supply or the like (not shown).

In practice, the motive fluid supply can be air, or other liquid or gas from any suitable source or supply.

With the structure set forth and described above, it will be apparent that the rear cap C can be removed, whereupon the rear section of the rotor is exposed and accessible for removal and replacement for the purpose of filling the rotor with a suitable and desired chemical, additive, if and when such an additive is to be provided and used.

It will be apparent that fluid flowing into and through the unit M into the chamber of the head H drives the rotor R' and that the rotor R' through and by means of the noted shafts and gears, drives the work engaging rotary unit R. It will be further apparent that the motive fluid and the chemical additive, if such an additive is used, flowing from the unit M into the chamber X of the head H flows outwardly through and/or about the rotary unit R.

When the unit R is a brush the motive fluid is water and the additive is soap, it will be apparent that a mixture of soap and water is dispensed from the construction through and about the brush and onto a related piece of work in a most efficient manner to effect cleaning of the work.

When the unit R is an abrasive disc and air or water is employed as the motive fluid, the motive fluid is discharged in such a manner as to blow or wash findings away from the unit R or to most effectively allow for wet sanding or polishing.

In practice, the fluid connecting means can include a manually operable valve means to shut off and/or meter the flow of motive fluid with and through the motor. In FIG. 5 of the drawings, I have shown the means F' comprising a cap C' similar to the cap C, but slightly longer, and having manually operable valving means V incorporated therein.

The valving means V is arranged between the socket 80' of the cap, in which a fluid supply hose of the like is engaged and the ports 72' and is shown as involving a spherical valving member 85 engaged in a spherical cavity 86 in the cap and with which the socket 80' and ports 72' communicate. The valving member has a flow passage 87 extending through it and has an operating stem 88 projecting radially outwardly therefrom. The stem 88 projects through an opening 89 in the cap and has an operating handle 90 fixed thereto. By rotating the valve member, by means of the handle 90, the passage 87 therein can be shifted into and out of alignment and communication with the socket 80' and ports 72' to meter the flow of fluid into and through the motor

and thereby control the speed of the motor or to selectively shut off the flow of fluid, to stop the motor, as desired and as circumstances require.

The valve means V is shown provided with a primary O-ring seal 91 at the downstream side of the valve member, about the ports 72' and a secondary O-ring seal 92 about the stem.

It will be apparent that the cap C' illustrated in FIG. 5 and described above is interchangeable with the cap C shown in FIG. 2 of the drawings.

In practice, a modified head H' such as is shown in FIG. 6 of the drawings can be substituted for the head H shown in FIGS. 1, 2 and 3 of the drawings.

The head H' provides for a rotary work-engaging part R² (such as a rotary saw blade) on an axis concentric with the motor M.

The head H' has a threaded rearend portion 93 which is adapted to be cooperatively engaged in the front end of the barrel of the motor and has a central longitudinal shaft 33' extending through it. The shaft 33' has a polygonal socket 34' entering the rearend to receive the drive pin 59 of the motor. The rear portion of the shaft 33' is rotatably supported by a bearing 32' in a bearing support 30' carried by a spider 31' with the housing H'. The forward portion of the shaft 33' projects through and outwardly from the forward end of the housing H' and is supported by a bearing 36' carried by the housing. An O-ring seal 37', carried by the housing seals about the shaft.

The forward or front end of the shaft is shown provided with a Jacobs chuck 95, which chuck engages a hold a shaft 96 on saw or work engaging part R².

Finally, the head H' is provided with a plurality of outlet openings 97 spaced circumferentially about the shaft 33', communicating with the chamber X' defined by the housing and disposed and opening to direct jets of the fluid exhausted by the motor M toward and/or onto the part R² and/or onto a piece of related work.

The construction that I provide and which has been described above can be made in any desired size. If the construction is to be used in the medical and dental arts, it must be made small and compact. In such a case, the overall axial extent of the construction can be 4 to 6 inches long and have a major diametric extent of less than three-quarter inches. If the construction is to be used in heavy industry, it can be several feet in longitudinal extent and have a major diametric extent of 6 inches or more, as desired and as circumstances require.

Having described but one typical preferred form and carrying out of my invention, I do not wish to be limited to the specific details herein set forth but wish to reserve to myself any modifications or variations which may appear to those skilled in the art and which fall within the scope of the following claims.

Having described my invention, I claim:

1. A rotary tool of the character referred to including an elongate, manually engageable barrel with front and rear ends, a cap with a fluid inlet opening and having connecting means on the rear end of the barrel, a helical fluid motor with a forwardly projecting drive pin within the barrel including an elongate tubular resilient stator with a spiraled groove fixed in the barrel and a concentric helically fluted rotor extending through the stator and bearing supported at its opposite ends and having said drive pin mounted thereon adjacent the forward end of said barrel, a housing fixed to the front end

of the barrel and defining a chamber in communication with the front end of the barrel and motor, an outlet opening in the housing spaced forward of the barrel, a driven shaft concentric with and bearing supported within the outlet opening, drive means between the drive pin and the driven shaft and a work engaging rotary part releasably engaged on said driven shaft outside of the housing adjacent said outlet openings.

2. A structure as set forth in claim 1 including chemical dispensing means comprising a core of interconnected cellular material within the rotor, fluid inlet ports in the rotor at its rear end and communicating with the core and the interior of the barrel longitudinally rearward of the stator and fluid outlet ports in the rotor at its front end and communicating with the core and the interior of the barrel longitudinally forward of the stator.

3. A structure as set forth in claim 1 wherein said drive means includes a driven gear on the driven shaft within the housing, a drive shaft in the housing driven by said pin and a drive gear driven by said drive shaft and engaging the driven gear.

4. A structure as set forth in claim 1 including chemical dispensing means comprising a core of interconnected cellular material within the rotor, fluid inlet ports in the rotor at its rear end and communicating with the core and the interior of the barrel longitudinally rearward of the stator and fluid outlet ports in the rotor at its front end and communicating with the core and the interior of the barrel longitudinally forward of the stator, said drive means includes a driven gear on the driven shaft within the housing, a drive shaft in the housing driven by said pin and a drive gear driven by said drive shaft and engaging the driven gear.

5. A structure as set forth in claim 1 wherein said drive means includes a gear part with a plurality of radially spaced driven gears and fixed on said driven shaft within the housing, a drive shaft with the housing concentric with the rotor and connected with the pin, an elongate jack-shaft in axial alignment with the drive shaft with a rear end in axially shiftably rotary driving engagement with the drive shaft, a front end portion rotatably and slidably engaged through a front opening in the housing and manually engageable at the exterior of said housing and a drive gear on the jack shaft selectively engageable with the driven gears upon normal axial shifting of the jack shaft.

6. A structure as set forth in claim 1 wherein said drive means includes a gear part with a plurality of radially spaced driven gears and fixed on said driven shaft within the housing, a drive shaft with the housing concentric with the rotor and connected with the pin, an elongate jack-shaft in axial alignment with the drive shaft with a rear end in axially shiftably rotary driving engagement with the drive shaft, a front end portion rotatably and slidably engaged through a front opening in the housing and manually engageable at the exterior of said housing and a drive gear on the jack shaft selectively engageable with the driven gears upon normal axial shifting of the jack shaft, said structure further including chemical dispensing means comprising a core of interconnected cellular material within the rotor, fluid inlet ports in the rotor at its rear end and communicating with the core and the interior of the barrel longitudinally rearward of the stator and fluid outlet ports in the rotor at its front end and communicating with the

core and the interior of the barrel longitudinally forward of the stator.

7. A structure as set forth in claim 6 wherein said drive gear is a bevel gear, said gear part is a conical part with said drive gears being bevel gears on the conical surface thereof, the driven gears being spaced radially from each other a distance greater than the axial extent of the drive gear whereby said gear means is out of driving engagement when said drive gear is positioned between adjacent driven gears.

8. A structure as set forth in claim 7 wherein the rear end of the barrel, rearward of the rotor has a partition with circumferentially spaced forwardly and circumferentially disposed jet ports and said rotor has circumferentially spaced radially outwardly projecting helically pitched vanes with surfaced opposing said jet ports, whereby jets of fluid flowing forwardly through the jet

ports impinging upon the vane to impart rotary forces onto and through the rotor.

9. A structure as set forth in claim 1 wherein the rear end of the barrel, rearward of the rotor has a partition with circumferentially spaced forwardly and circumferentially disposed jet ports and said rotor has circumferentially spaced radially outwardly projecting helically pitched vanes with surfaced opposing said jet ports whereby jets of fluid flowing forwardly through the jet ports impinging upon the vane to impart rotary forces onto and through the rotor.

10. A structure as set forth in claim 1 which further includes manually operable valve means to meter the flow of motive fluid into and through the construction whereby operation of the construction can be stopped and started and its speed controlled.

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