

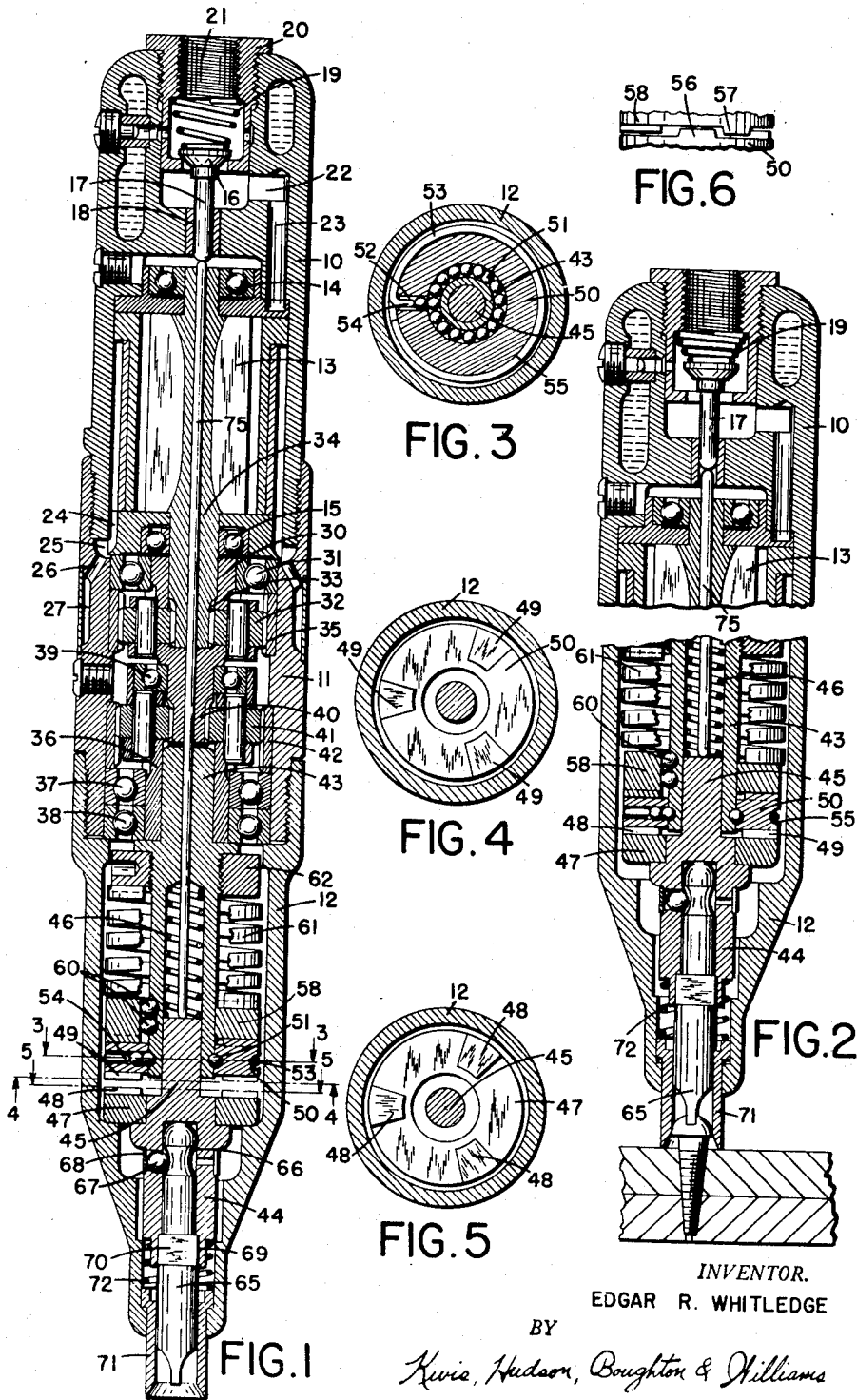
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ROTARY TOOL

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ROTARY TOOL

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This invention relates to improvements in rotary tools, and has to do particularly with automatic control of the driving force of a power actuated hand tool as the tool is moved into or out of operative relation with the work. In the illustrated and preferred embodiment, the invention is incorporated in a compressed air driven rotary tool, the throttle valve of which is located at the rear end of the tool. Control for this valve is effected by means which comprises a longitudinally shiftable rod located axially of the tool and responsive to receding movement of the tool chuck as the tool is pressed against the work.

One of the objects of the invention is the provision of simple and effective means for automatically controlling the application of power in a hand held rotary tool.

Another object is the provision of means for coordinating throttle action and clutch action so as to follow each other in properly timed relation.

Still another object is the provision, in connection with a clutch adapted to slip when resistance to rotation reaches a predetermined value, of means comprising a removable clutch housing and an adjusting collar exposed for actuation when the housing is removed.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawing, in which

Fig. 1 is an axial sectional view of a power driven screwdriver embodying the invention, with the parts in their idle position.

Fig. 2 is a similar fragmental view with the parts in operative position.

Figs. 3, 4 and 5 are cross-sectional views taken substantially on the lines 3—3, 4—4 and 5—5 of Fig. 1, looking in the directions of the arrows, and

Fig. 6 is a fragmental elevational view of the inner or slip clutch.

In the embodiment of the invention illustrated in the drawing the tool comprises an upper or outer motor casing 10 of cylindrical form, an intermediate cylindrical gear casing 11 and a clutch housing 12 also of cylindrical form, which is removably threaded onto the casing 11.

A fluid motor 13 of conventional form is rotatably mounted in bearings 14 and 15 carried by casing 10. A throttle valve 16 of poppet form is axially disposed within the upper or outer end of the casing 10, and has a stem 17 which is slidable in a bushing 18 axially positioned in the casing. Valve 16 is urged toward its seat by a coil spring

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19 which bears at one end against the valve head and at the other end against a shoulder formed in a fitting 20 which is threadably mounted at the outer extremity of casing 10 and is internally threaded at 21 to receive a hose connection through which compressed air may be delivered to the tool. When the valve is open pressure fluid may flow through passages 22 and 23 to the motor, while exhaust takes place through ports 24 and an annular groove 25 in casing 10 and through ports 26 and an annular passage 27 in casing member 11, from which it is discharged to atmosphere by a lateral port, not shown.

In the casing member 11 I mount reduction gearing of the planetary type. Any conventional planetary gearing may be employed, but as illustrated herein reduction is effected by a tandem or two stage planet gearing, the upper or first stage comprising a planet carrier 30 mounted at its upper end in a ball bearing 31. In carrier 30 there are two or more planet gears 32 which are driven by a pinion 33 formed in the lower extremity of the hub 34 of the fluid motor. The planet gears 32 also mesh with a fixed internal gear 35 carried by casing 11. A secondary planet carrier 36 is mounted at its lower end in ball bearings 37 and 38 carried by casing member 11, the two planet carriers being rotatable relative to each other with a ball bearing 39 interposed between them. The lower end of carrier 30 has teeth cut therein to form a pinion 40 which meshes with planet gears 41 in carrier 36, these latter planet gears running upon an internal gear 42 mounted in casing 11.

43 is a clutch shaft axially disposed and non-rotatably mounted in carrier 36, as by means of splines or a press fit. A tool chuck 44 centrally disposed in the lower part of housing 12 has a spindle 45 which is rotatably and slidably mounted in the hollow lower end of shaft 43. A coil spring 46 within the hollow shaft tends to move the chuck 44 downwardly as viewed in the drawing. In a shouldered recess on the chuck 44 there is fixed a clutch member 47 having a plurality of dogs 48 that are adapted to engage dogs 49 on the lower side of a clutch member 50 which is mounted for rotary movement only upon the lower extremity of clutch shaft 43. This mounting may be effected by means of steel balls 51 running in registering annular grooves formed partly in the hollow shaft 43 and partly in the member 50. In the assembly of the tool the member 50 is properly positioned upon the shaft 43 and the balls are dropped into the registering grooves by way of a radial passage 52. To hold

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the balls in place a spring ring 53, having a prong 54 at one end extending into passage 52, is mounted in an external groove 55, see Fig. 3.

Clutch member 50, in addition to the dogs 49 on its lower surface, carries on its upper surface one or more dogs 56 with beveled sides which are adapted to engage one or more beveled dogs 57 on a clutch member 58 which is slidable upon shaft 43 but is held from rotation with respect to the shaft by a pair of balls 60 disposed in registering grooves in the member 58 and in the shaft 43. Clutch member 58 is urged toward clutch member 50 by a coil spring 61 which bears also against a collar 62 that is threaded onto shaft 43. As will be apparent from the drawing, this adjusting collar 62 is exposed to view and operation when the clutch housing 12 is removed by unscrewing it from the casing 11.

Tool chuck 44 is adapted to receive a screw-driver bit 65 or any other small tool to be rotated. The shank of the bit has a groove 66 formed therein. A ball 67 carried by the chuck and urged inwardly by a split ring 68 serves to hold the bit against longitudinal movement, while driving force is transmitted to the bit by a socket 69 of polygonal shape receiving a similarly shaped portion 70 of the bit.

In order to guide the bit to the work I mount a shouldered sleeve 71 in housing 12 surrounding bit 32 and normally pressed outwardly of the housing by a light coil spring 72 which yields readily as the bit moves toward the work.

In order to operate the throttle valve 16 automatically, I provide axial bores through the hub 34 of the motor, through planet carrier 40 and through clutch shaft 43, and in these aligned bores I mount a rod 75 with sufficient clearance to permit it to slide readily, this rod being adapted to bear at one end against the stem 17 of the throttle valve and at the other end against the spindle 45 of the tool chuck 44. Obviously, when the tool is pressed toward the work by the operator and the tool chuck moves into the housing 12 against the action of spring 46, it shifts the rod 75 upwardly as viewed in the drawing and opens the throttle valve. Conversely, when the operator withdraws the tool spring 46 moves the spindle 45 outwardly of the housing, and the spring 19 closes the valve.

The general operation of the tool will be obvious to those skilled in the art from the foregoing description of its construction. However, it should be noted that there is a definite coordination of movements of the clutch 47, 50 and the throttle valve; that is when member 47 starts to move toward member 50 the throttle valve is immediately opened to a slight extent, whereupon pressure fluid starts the motor 13 turning shaft 43 and turning clutch member 58 by means of balls 60, this clutch member being held by spring 61 in driving relation with clutch member 50. Hence when the dogs 48 come into the path of dogs 49 the latter are already turning and smooth engagement of these outer clutch members is assured. When resistance to rotation of the tool chuck reaches a predetermined value, spring 61 yields sufficiently to permit the beveled dogs 56 on clutch member 50 to move upwardly the dogs 57 on clutch member 58.

As dogs 56 ride over dogs 57 a clicking noise results which notifies the operator that the screw or the like has been driven home. He then removes the tool from the work, stopping the slipping action of the inner clutch members 50, 58 and enabling the spring 46 to separate the outer

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clutch members 50, 47. Before the dogs 48 and 49 are out of engagement completely the relative movement of clutch member 47 away from clutch member 50 permits rod 75 to move downwardly and causes the throttle valve to approach its seat, cutting down the flow of pressure fluid accordingly and facilitating the complete separation of clutch members 47, 50.

In the foregoing description I have necessarily gone into detail somewhat in order to explain fully the particular embodiment of the invention herein illustrated, but I desire it to be understood that the details of the disclosure herein are not to be construed as amounting to limitations, except as they may be included in the appended claims.

Having thus described my invention, I claim:

1. In a power tool, a motor, a clutch assembly comprising a driving clutch member operatively connected with said motor and a driven clutch member relatively movable toward and away from said driving member, a sliding bearing for said driven clutch member enabling its movement relative to said driving clutch member, power control means located at the rear end of the tool, and actuating means therefor adapted to be shifted by said driven member for causing said power control means to set in motion said motor as the clutch members come into engaging relation, said actuating means comprising a longitudinally slidable rod extending axially of and through said clutch assembly and motor.

2. In a power tool, a rotary fluid motor, a clutch assembly comprising a driving clutch member operatively connected with said motor and a driven clutch member relatively movable toward and away from said driving member, a sliding bearing for said driven clutch member enabling its movement relative to said driving clutch member, a throttle valve located at the rear end of the tool, and actuating means therefor adapted to be shifted by said driven member for opening the throttle valve as the clutch members come into engaging relation, said actuating means comprising a longitudinally slidable rod extending axially of and through said clutch assembly and motor.

3. In a power tool, a rotary fluid motor, a clutch assembly comprising a driving clutch member operatively connected with said motor and a driven clutch member relatively movable toward and away from said driving member, a sliding bearing for said driven clutch member enabling its movement relative to said driving clutch member, an axially disposed longitudinally movable throttle valve located at the rear end of the tool, and actuating means for said valve adapted to be shifted by said driven member for opening the throttle valve as the clutch members come into engaging relation, said actuating means comprising a longitudinally slidable rod disposed axially of said clutch assembly and motor.

4. In a power tool, a rotary fluid motor, a clutch assembly comprising a driving clutch member operatively connected with said motor and a driven clutch member relatively movable toward and away from said driving member, a sliding bearing for said driven clutch member enabling its movement relative to said driving clutch member, an axially disposed throttle valve located at the rear end of the tool, spring means for biasing said valve toward closed position, and valve actuating means comprising a longitudinally slidable rod extending axially through said clutch assembly and motor and adapted to be

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shifted by said driven member for opening the throttle valve as the clutch members come into engaging relation.

5. In a power tool, a rotary fluid motor comprising a central hub, a gear carrier rotatably supported in alignment with said hub, a driven shaft in alignment with said hub and carrier, rotation transmitting means between said hub and shaft including gears operatively carried by said carrier, said hub, carrier and shaft having axial bores therethrough, a tool chuck slidable with respect to said shaft into and out of operative engagement therewith, a throttle valve located at the rear end of the tool, and a rod slidably mounted in said axial bores adapted to

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be shifted by said chuck for opening or closing said throttle valve.

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