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FLUID OPERATED MACHINE

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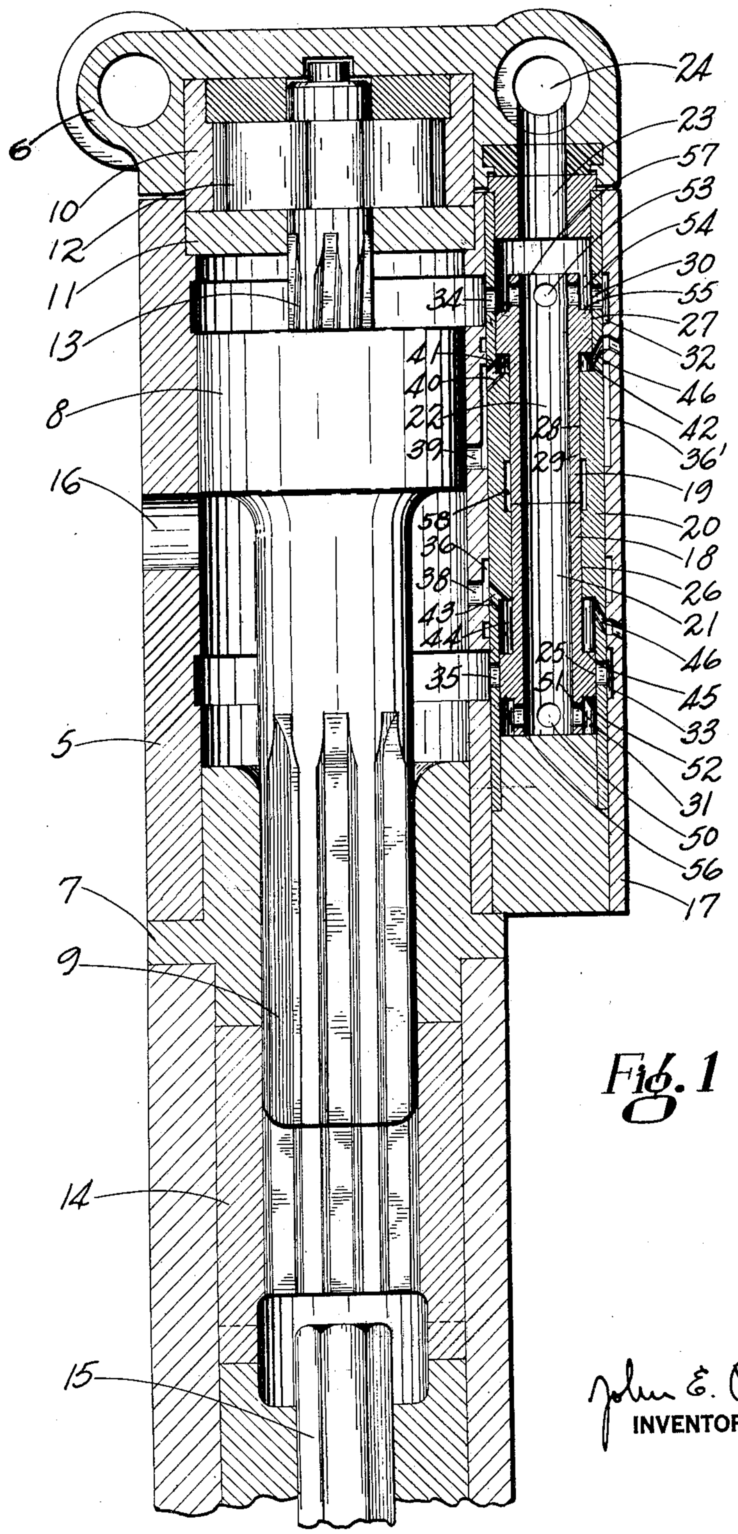

Fig. 1

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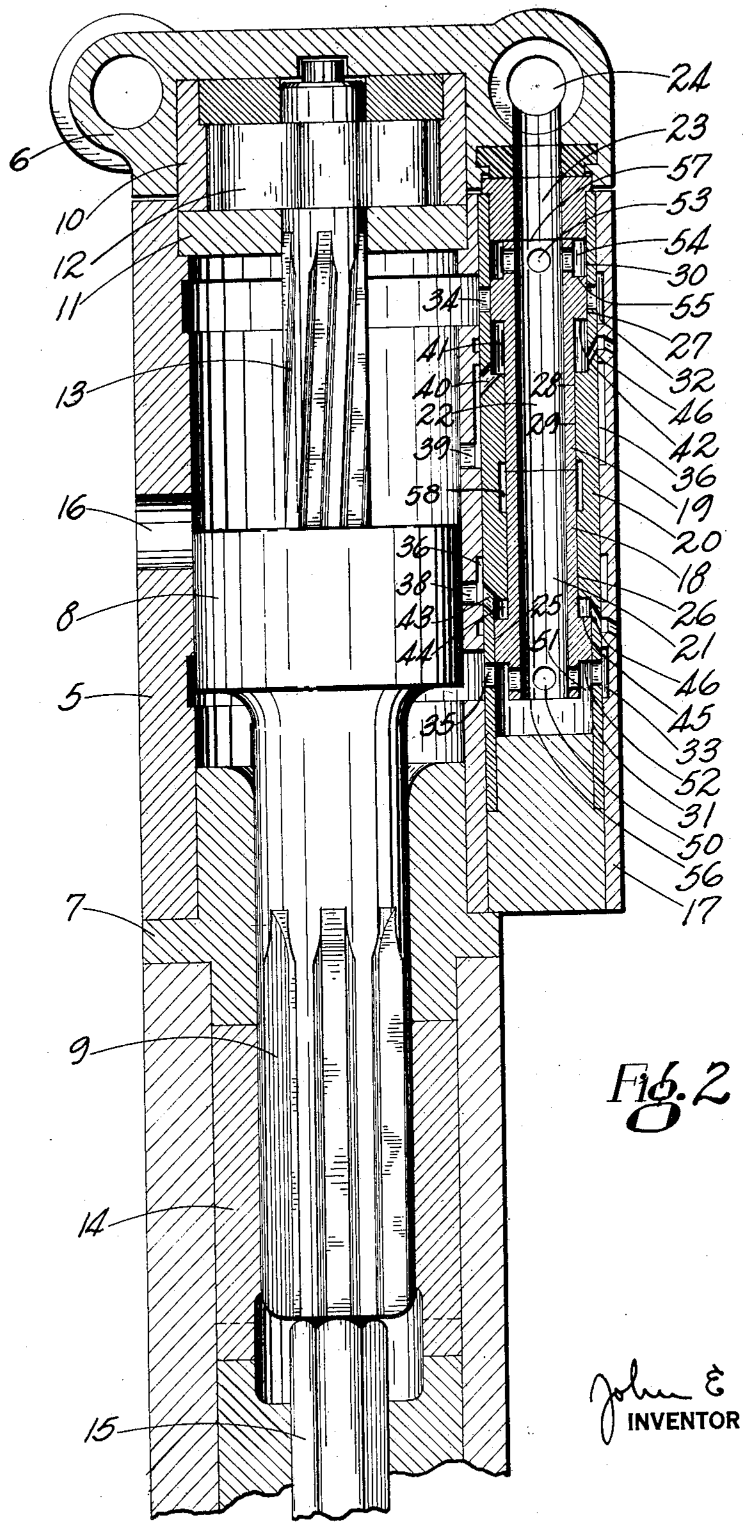

Fig. 2

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FLUID OPERATED MACHINE

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2 Claims. (Cl. 121—18)

This invention relates to fluid operated machines of the hammer type, and more specifically to an improved organization of valvular mechanism.

One object of my invention is to provide a sleeve valve for a fluid actuated machine having means actuated by live motive fluid for throwing and holding the valve.

Other objects are to construct a valve of this type in such a manner as to facilitate manufacture and assembly, and to provide a sectional valve adapted to be held together by fluid pressure for unitary operation.

Other objects of this invention will be apparent from the following detailed description wherein similar characters of reference designate corresponding parts and wherein:—

Fig. 1 is a vertical section of a rock drill, partly broken away, constructed in accordance with this invention, showing the relation assumed by the parts at the initial movement of the blow-stroke of the piston.

Fig. 2 is a vertical section, partly broken away, of a rock drill constructed in accordance with this invention, showing the relation assumed by the parts at that point when the piston has reached the extreme position of the blow-stroke.

With reference to the drawings I have illustrated a rock drill of the usual type comprising a cylinder 5, a rear head 6, and a forward head 7, which are secured together in the usual manner by tie-bolts (not shown).

A piston 8, having a splined stem 9, is reciprocally mounted in the cylinder 5. A rotation mechanism including a ratchet ring 10 secured by the head 6 against a plate 11 seated in the cylinder and a plurality of pawls 12 carried by a rifled bar 13, is arranged to rotate the drill steel in the usual manner. The rifled bar 13 enters a rifled axial opening in the piston 8, and the splined stem 9 co-operates with a chuck 14 to impart the rotary motion of the piston to the drill steel 15. An exhaust port 16 is formed through the wall of the cylinder 5 and is arranged to be controlled by the piston.

The exterior wall of the cylinder is formed with a hollow cylindrical enlargement 17 which houses the valve mechanism. A pair of abutting hollow valve sections 18 and 19 are slidably mounted within a sleeve 20 which is secured in the cylindrical enlargement 17. The valve sections 18 and 19 are provided with interior coaxial bores 21 and 22 respectively of uniform diameters aligned with the motive fluid supply passage which is controlled by the throttle valve 24. The exterior surface of the valve section 18 is provided with cylindrical lands 25 and 26 of reduced diameters, respectively, and the valve section 19 is similarly formed with lands 27 and 28 of successively reduced diameters.

The sleeve 20 is formed with a bore 29 arranged to fit the lands 26 and 28, and counter bores 30 and 31 of increased diameter to fit lands 25 and 27 respectively.

Intermediate its ends, the sleeve 20, is provided with an internal circumferential recess 58 within which the inner ends of the valve members 18 and 19 are moved in abutting relation and are held in this relation by the pressure of motive fluid. It is therefore obvious that the lower internal portion of the sleeve 20 accomodating the valve section 18 does not have to be concentric with the similar upper portion of the sleeve accomodating the valve section 19, thus facilitating the internal machining of the sleeve as well as allowing the replacement of one of the valve sections without the other.

The interior surface of the hollow enlargement 17 is provided with an annular groove 32 opening into the rearward end of the cylinder 5, and a similar groove 33 opening into the forward end thereof. A series of apertures 34 in the sleeve 20 open into the groove 32, and the apertures 35 open into the groove 33. Grooves 36 and 36′ formed in the interior wall of the enlargement 17 communicate with the interior of the cylinder 5 through ports 38 and 39, respectively. A port 40 leads from the groove 36′ into an annular space 41 between the outer ends of the counterbore 30 and the shoulder 42 which joins the lands 27 and 28. A port 43 through the sleeve 20 opens into the groove 36 and the annular space 44 between the outer end of the counter bore 31 and the shoulder 45 which joins the lands 25 and 26. The shoulders 42 and 45 serve as shifting areas in the operation of the valve. Vents 46 of substantially smaller cross sectional area than the ports 40 and 43 lead from the annular space 41 and 44 to the atmosphere.

A plurality of ports 50 open through the valve member 18 adjacent one end thereof and are arranged to communicate with the annular recess 51 which is defined by the counterbore 31, shoulder 52 between the lands 25 and 26 and the land 25. Similarly the port 53 opens through the valve member 19 adjacent the end thereof and are arranged to communicate with the annular recess 54 which is defined by the counterbore 30, shoulder 55 between the lands 28 and 27, and the land 28. The shoulders 52 and 55 serve as holding areas in the operation of the valve. Surfaces 56 and 57 in the ends of the valve members 18 and 19 respectively are adapted to receive fluid pressure thereagainst relative to the position of the valve members.

In constructing the valve mechanism the sleeve 20 is bored, counterbored from each end, and drilled to form the ports. The outer surface of the sleeve is machined to provide a fluid tight engagement with the inner surface of the enlargement 17 and the sleeve is assembled therewithin. This assembly is greatly facilitated by the arrangement of the ports since all the fluid passages through the sleeve open into annular grooves in the interior surface of the enlargement 17, the relative circumferential position of the sleeve and enlargement being therefore immaterial.

The valve section 18 and 19 are then machined to size and slipped into the sleeve 20 from the opposite ends thereof. The circumferential relation of the valve members and the sleeve is also immaterial since the ports 50 and 53 open into annular chambers. The inner end of the valve members 18 and 19 are moved into abutting relation and are held in this relation by the pressure of motive fluid.

In operation fluid pressure is admitted through the inlet passage 23. Assuming that the parts are in the position shown in Figure 1, the pressure fluid passes through the apertures 34 into the groove 32 and thence into the rearward end of the cylinder 5 to drive the piston 8 forwardly. The pressure fluid also passes through the bores 21 and 22 and ports 50 and 53 in each respective valve member 18 and 19 and against the shoulders 52 and 55 of the valve members to press the same toward each other. The apertures 35 leading to the forward end of the cylinder are closed by the land 25 of the valve member 18. Since the combined areas 57 on the end of the valve and 55 which are exposed to fluid pressure are greater than the shoulder 52, the valve will be held in its forward position as shown in Figure 1.

As the piston moves forwardly through the cylinder the port 39 is uncovered, allowing live motive fluid to flow into the groove 36′ through the port 40 into the annular space 41. A portion of the fluid escapes to the atmosphere through the vent 46, the differential areas of the inlet 40 and outlet 46 creating an intermediate pressure acting against the shoulder 42. The area of the shoulder 42 is equivalent to the area of the shoulder 55, thus the pressure exerted on this last shoulder will be balanced by the pressure exerted on the shoulder 42. The area of the shoulder 52 of the valve member 18 is greater than the area 57, and such shoulder being constantly subjected to the action of the pressure fluid overcomes the pressure upon the area 57, and consequently causes the valve to move to the position shown in Fig. 2. It will be seen that the pressure exerted upon the constantly exposed shifting area 55, cooperating with the holding area 57 to hold the valve forwardly, is balanced by the pressure exerted upon the kicking area 42, and that the shifting of the valve is accomplished by the pressure exerted upon the shifting area 52 overcoming the pressure upon the holding area 57.

As the valve moves, the land 27 of the valve member 19 slides over and closes the aperture 34, thereby cutting off the supply of fluid to the rear end of the cylinder, and the land 25 of the valve member 18 uncovers the aperture 35 admitting fluid to the forward end of the cylinder as illustrated in Fig. 2.

The piston 8 continues its forward movement under inertia and uncovers the exhaust port 16, exhausting the rearward end of the cylinder to the atmosphere. The stem 9 then delivers the blow of the piston to the drill steel 15 and the piston commences its rearward movement under the influence of the fluid admitted through the apertures 35.

As the piston moves rearwardly the port 38 is uncovered, admitting motive fluid through the port 43 into the chamber 44. The pressure thereby established against the shoulder 45 balances the pressure exerted upon the equivalent area 52. The area of the shoulder 55 of the valve member 19 is greater than the area 56, and such area being constantly subjected to the action of the pressure fluid will overcome the pressure exerted upon the area 56, and cause the valve to move in the position illustrated in Fig. 1 to begin another cycle of the operation.

The exhaust port 16 is located substantially closer to the lower end of the piston stroke than to the upper in order that live air will be admitted to the lower end of the cylinder after the piston has delivered its blow to the drill, and will be admitted to the upper end in ample time to check the upward movement of the piston and prevent the same from striking plate 11.

While the foregoing description is necessarily of a detailed character, it is to be understood that the specific terminology employed is not to be construed as restrictive or limiting, and it is to be further understood that various rearrangements of parts and modifications may be resorted to without departing from the scope or spirit of the invention as claimed herein.

I claim:

1. In a fluid actuated tool, a cylinder having a piston reciprocably mounted therein, a sleeve within the wall of said cylinder, a fluid actuated valve reciprocably mounted within said sleeve being formed of a plurality of similar hollowed members through which pressure fluid is free to flow, said members being held in abutting relation by the action of the pressure fluid thereon, ports through said sleeve controlled by said valve for alternatively admitting pressure fluid to the ends of said cylinder to actuate said piston, an exhaust port through the wall of said cylinder through which pressure fluid may exhaust to atmosphere, opposed valve holding areas alternatively subjected to the action of the pressure fluid to hold said valve in operative position, opposed valve shifting areas, ports through each of said members for constantly admitting pressure fluid to said opposed valve shifting areas, opposed valve kicking areas alternatively subjected to the action of the pressure fluid from said cylinder to balance the pressure exerted upon one of said valve shifting areas and allow the pressure exerted upon the other of said shifting areas to overcome the pressure upon one of said holding areas to actuate the valve, the pressure acting upon said kicking areas being admitted thereto through passages controlled by said piston, a recess within said sleeve within which the abutting ends of said members are disposed, permitting thereby a variation in the concentricity of the sleeve which accommodates each of said members without affecting the operation of said valve.

2. In a fluid actuated tool, a cylinder having a piston reciprocable therein, a bore within the wall of said cylinder, a sleeve within said bore

within which there is reciprocably mounted a fluid actuated valve formed of a plurality of similar hollowed members through which pressure fluid is free to flow, said members being held in abutting relation by the action of the pressure fluid thereon, ports through said sleeve controlled by said valve for alternatively admitting pressure fluid to the ends of said cylinder to actuate said piston, an exhaust port through the wall of said cylinder through which pressure fluid may exhaust to atmosphere after acting upon said piston, opposed valve holding areas alternatively subjected to the action of the pressure fluid to hold said valve in operative position, opposed valve shifting areas, ports through each of said members for constantly admitting pressure fluid to said opposed valve shifting areas, opposed valve kicking areas alternatively subjected to the action of the pressure fluid from said cylinder to balance the pressure exerted upon one of said valve shifting areas and allow the pressure exerted upon the other of said shifting areas to overcome the pressure upon one of the holding areas to actuate the valve, the pressure acting upon said kicking areas being admitted thereto from the cylinder through passage in said sleeve and said cylinder and controlled by said piston, a recess within said sleeve within which the abutting ends of said members are disposed permitting thereby a variation in the concentricity of the sleeve accommodating each of said members without affecting the operation of said valve and means within said bore whereby the different ports through said sleeve may remain in communication with said cylinder irrespective of the lateral position of said sleeve within said bore.

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