April 19, 1932. G. M. NELL 1,854,856

FLUID PRESSURE TOOL

Filed April 10, 1929

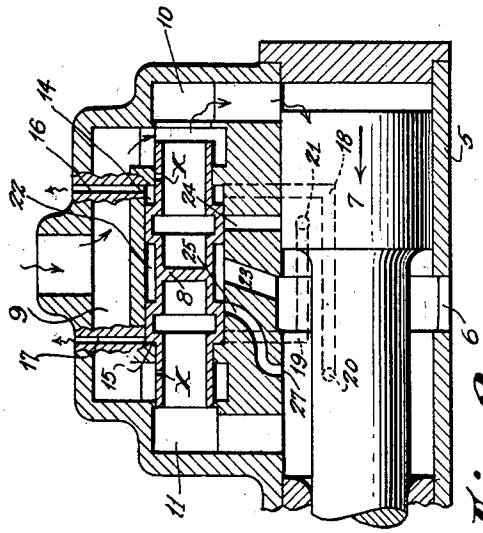

Fig. 2

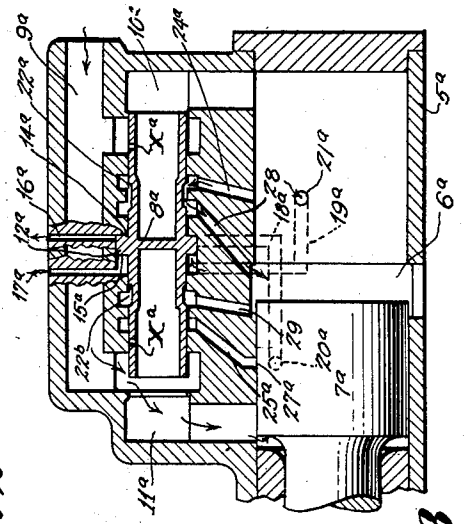

Fig. 3

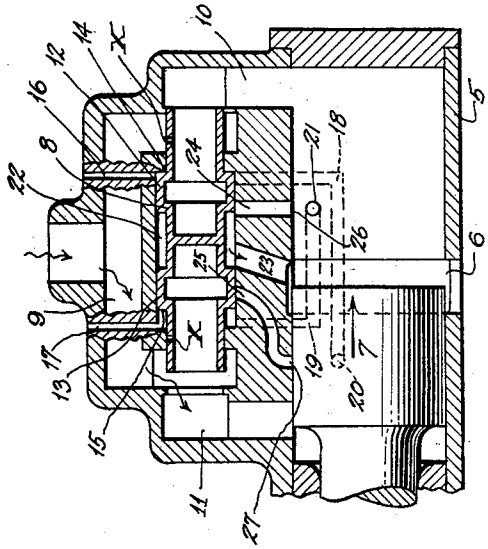

Fig. 1

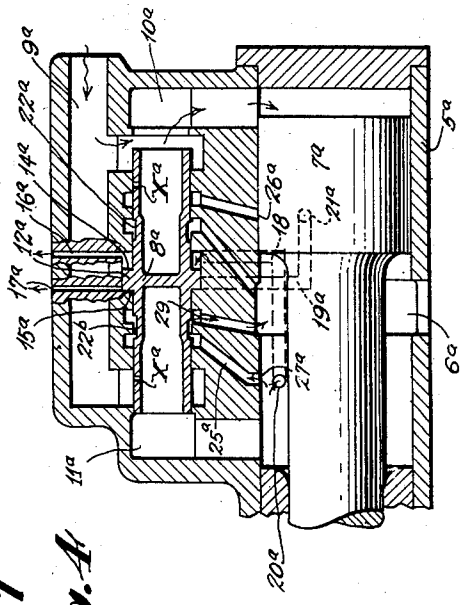

Fig. 4

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UNITED STATES PATENT OFFICE

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FLUID PRESSURE TOOL

Application filed April 10, 1929. Serial No. 353,927.

This invention relates to fluid pressure motors and tools and to the control and distribution of motive fluid in the same through the action of an automatically thrown valve which is arranged to move in timed relation with the reciprocations of the piston.

One object of the invention is to provide an improved valve and porting arrangement for a fluid pressure tool having a piston controlled exhaust. Another object is to make the valve positive in its movement and minimize or entirely avoid "fluttering" of the valve and of the piston. Other objects will be apparent from the detailed description which follows.

In order to illustrate the invention, concrete embodiments thereof are shown in the accompanying drawings, in which:

Fig. 1 is a sectional view through so much of a tool as is necessary to illustrate the invention;

Fig. 2 is a sectional view similar to Fig. 1 showing the parts in different positions; and

Figs. 3 and 4 are sectional views similar to Figs. 1 and 2 respectively but showing a modified construction.

In the embodiment of the invention, shown in Figs. 1 and 2, the fluid pressure motor comprises a cylinder 5 providing a piston chamber with a main exhaust groove and port 6 intermediate its ends adapted to be overrun by a piston 7 reciprocating within the chamber. Movement of piston 7 is controlled by a spool valve 8 supported in a valve chest adjacent to, and in parallelism with, the piston chamber. The valve controls the distribution of motive fluid from inlet chamber 9 to the opposite ends of the piston chamber by opening or cutting off with its ends chambers 10 and 11 respectively. In addition to the opposed pressure areas formed by the ends of the valve, the valve is provided with spaced, radially-projecting flanges 12 and 13 which provide opposed pressure areas 14 and 15 which are of less extent than the end areas of the valve. Continuously open vent ports 16 and 17 communicate with areas 14 and 15 respectively. Cross passages 18 and 19 lead to areas 14 and 15 respectively from ports 20 and 21 in the piston chamber under control of piston head 7, these ports and passages being of considerably greater size than the restricted vents 16 and 17. Space or chamber 22, between valve flanges 12 and 13, is constantly in communication with atmosphere through a passage 23 which may extend to main exhaust groove 6 or directly to atmosphere as desired. Passages 24 and 25, under control of flanges 12 and 13 respectively of the valve, communicate with the piston chamber by ports 26 and 27 at either side of main exhaust 6 and provide auxiliary exhausts for the piston chamber. The span between auxiliary exhaust ports 26 and 27 is greater than the length of the controlling piston head 7.

The operation of the motor is as follows: With the parts in the position shown in Fig. 1, live motive fluid from inlet 9 moves past the forward end of the valve into a chamber 11 and thence into the forward end of the piston chamber driving piston 7 rearwardly, the rear end of the valve shutting off communication between inlet 9 and chamber 10. The rear end of the piston chamber is open to exhaust both through the main exhaust 6 and auxiliary port 26. Accordingly, low or substantially atmospheric pressure obtains upon the opposed areas 14, 15, and the rear end of the valve, the valve being held in its position by the pressure of the entering motive fluid on the forward end of the valve. As the piston moves rearwardly, it first closes main exhaust 6 whereupon the air in the rear end of the piston chamber continues to escape through auxiliary exhaust 26, passage 24, chamber 22, passage 23, and exhaust 6. Shortly thereafter piston 7 uncovers ports 20 and 27, the latter with its connecting passage 25 is sealed by flange 13 of the valve but motive fluid from the piston chambers enters port 20 and passes through passage 18 to be effective against area 14 in spite of the small vent 16. However, since the extent of area 14 is less than the opposed end area of the valve, the latter does not move. In its further movement, piston 7 closes auxiliary exhaust 24 whereupon the air trapped in the rearward end of the piston chamber and compressed by the piston develops pressure upon the rear

end of the valve and shifts the latter to the forward position shown in Fig. 2, just before, or at about the time when, piston 7 overruns main exhaust 6, thereby venting the forward end of the piston chamber. Motive fluid from inlet 9 then passes the rear end of the valve through chamber 10 into the rear end of the piston chamber driving the piston forwardly. As piston 7 on its forward movement closes main exhaust 6, the pressure ahead of the piston continues to escape through auxiliary exhaust port 27, passage 25, valve chamber 22, passage 23, and main exhaust 6. Shortly thereafter port 21 is uncovered admitting motive fluid from the rear end of the piston chamber through passage 19 against valve area 15 but by reason of the smallness of the same the valve does not move but is partially placed in balance. On closing auxiliary exhaust port 27, the piston compresses the air trapped in the forward end of the piston chamber and this pressure on the forward end of the valve, plus the pressure already on area 15, throws the valve to the position shown in Fig. 1 at about the time that the piston strikes its blow and opens main exhaust port 6, thus completing the cycle. If necessary or desirable to provide a greater quantity of fluid to be trapped and compressed, valve 8 may have restricted ports therethrough, as indicated at *x*.

Figs. 3 and 4 show an alternative design of the valve in which the smaller balancing valve faces or areas 14*a* and 15*a* are placed on opposite sides of a single, central, radial flange 12*a* and the auxiliary exhaust means on the valve consist of annular grooves or recesses 22*a* and 22*b* which establish communication between auxiliary exhaust passages 24*a* and 28 when the valve is in its rearward position (Fig. 3) and between auxiliary exhaust passages 25*a* and 29 when the valve is in its forward position, respectively (Fig. 4). The cycle of operation of the motor shown in Figs. 3 and 4 is the same as that shown in Figs. 1 and 2 and corresponding parts, ports, and passages are indicated by the same numerals as used in Figs. 1 and 2 with the addition of the letter "*a*".

It is to be noted that piston controlled ports 21 and 24, as well as 20 and 27 of the form shown in Figs. 1 and 2, and ports 26*a* and 21*a*, as well as 27*a* and 20*a* of the form shown in Figs. 3 and 4, are in line with one another transversely on the opposite sides of main exhaust 6 and 6*a*. For the purpose of preventing a tendency to dead centering or fluttering of either the piston or the valve, or both, it is one of the important features of this invention that the spread of auxiliary exhaust ports 26, 27 or 26*a*, 27*a* or at least the outer edges of the same shall be greater than the length of the piston head, so that both cannot be covered thereby simultaneously. The spread of the ports 20, 21 or 20*a*, 21*a* leading to the small balancing areas of the valve, may be greater, equal to, or less than the length of the piston head depending upon the desired timing of the throw of the valve.

While the invention has been herein disclosed in what are now considered to be preferred forms, it is to be understood that the invention is not limited to the specific details thereof but covers all changes, modifications, and adaptations within the scope of the appended claim.

I claim as my invention:

A fluid pressure tool comprising a cylinder providing a piston chamber having an exhaust port, a piston reciprocable in said chamber and arranged to overrun said port in both directions, a valve chest, a valve reciprocable in said chest and controlling with its ends the distribution of motive fluid to said piston chamber, said valve having a central radial flange providing opposed areas less in extent than the end areas, continuously open vents of limited size for said smaller areas, cross ports under control of said piston extending from said piston chamber to said smaller areas, auxiliary exhaust means for said piston chamber under control of both said valve and said piston including grooves in the exterior of said valve on opposite sides of said flange and ports in said piston chamber on either side of said main exhaust port, the span of said auxiliary exhaust ports being greater than the length of the control head of said piston and spaced from the ends of the piston chamber to cause the valve to be shifted by air trapped and compressed by the piston at the end of its stroke.

Signed by me at Detroit, in the county of Wayne and State of Michigan, this 4 day of April, 1929.

GUSTAVE M. NELL.