G. H. GILMAN.

FLUID MOTOR.

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1,293,080.

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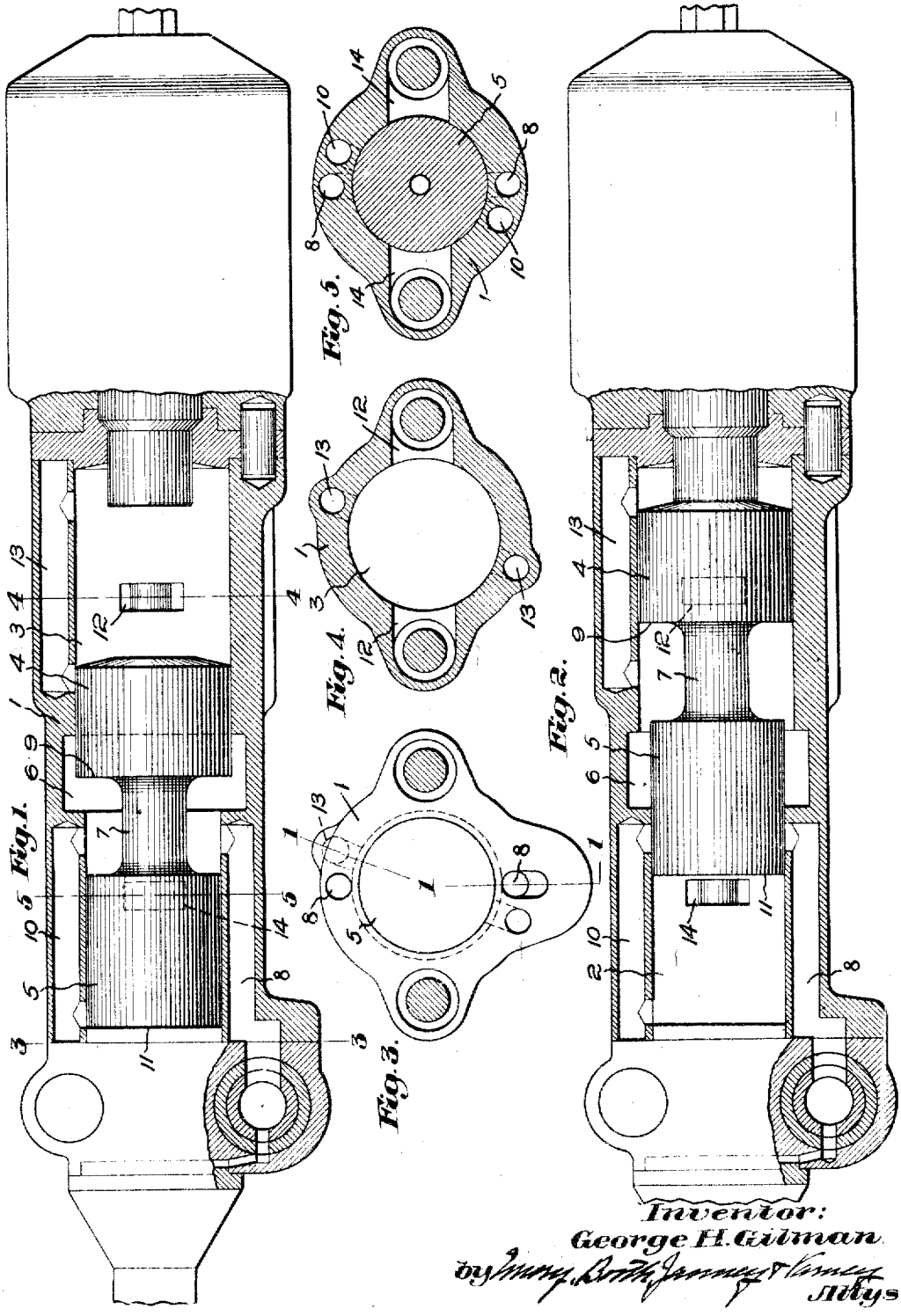


Fig. 1.

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 2.

Inventor:
George H. Gilman
by Munn, Boltz, Jammer & Carey
Attys

UNITED STATES PATENT OFFICE.

GEORGE H. GILMAN, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

FLUID-MOTOR.

1,293,080. Specification of Letters Patent. Patented Feb. 4, 1919.

Application filed January 7, 1916. Serial No. 70,864.

To all whom it may concern:

Be it known that I, GEORGE H. GILMAN, a citizen of the United States, and a resident of Claremont, in the county of Sullivan and State of New Hampshire, have invented an Improvement in Fluid-Motors, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention pertains to improvements in direct acting fluid motors and more particularly, though not exclusively, to motors of the valveless type having a reciprocatory percussive piston adapted to impart rapidly recurring blows to the drill steel of a rock drill.

The preferred construction of fluid motor constituting one embodiment of my invention illustrated in the drawings, shows a valveless fluid motor which is simple in construction, rapid and positive in operation, economical of pressure fluid and exceedingly effective as a percussive unit, especially when used in connection with an automatically rotated drill steel and pressure fluid feeding mechanism of any of the well-known types, but preferably of the type shown in my copending application herewith filed.

Referring to the drawings which show a preferred construction of one embodiment of my invention:

Figures 1 and 2 are longitudinal sections of a preferred construction of percussive fluid motor on the lines 1—1—1 of Fig. 3;

Figs. 3, 4 and 5 are transverse sections on the lines 3—3, 4—4, 5—5 respectively of Fig. 1.

Referring to the drawings, I preferably provide, as shown, a cylinder 1 having piston chambers 2 and 3 of different diameters, of which I prefer that the piston chamber 2, of smaller diameter, shall be the rear piston chamber and the piston chamber 3, of larger diameter, shall be the front piston chamber. Coöperating with the cylinder 1 I may provide a piston member comprising a piston head 4 of proper size to work in the piston chamber 3, and a piston portion 5 of proper size to work in the piston chamber 2. It will be noted that when the piston is in the cylinder 1 an intermediate piston chamber 6 is provided.

An important feature of one phase of my invention is novel pressure fluid controlling means whereby all reciprocatory valve members other than the piston itself may be dispensed with, and whereby an exceedingly simple, efficient and economical motor is presented.

In the preferred construction illustrated, I provide the piston with a reduced portion 7 to which I may admit pressure fluid, preferably compressed air, from any suitable source of supply, through an inlet passage 8. The reduced portion 7 is preferably in connection with the intermediate piston chamber 6 so that the pressure fluid acting on the surface 9 of the larger piston head 4 will start the piston on its forward stroke. I prefer to provide a by-pass port 10 so that pressure fluid may flow from the piston chamber 6 to the small piston chamber 2 to act on the rear surface 11 of the small piston head 5 to assist in producing forward movement of the piston. By varying the relative sizes and locations of the openings from the by-pass port 10 into the cylinder and from the inlet port 8 into the cylinder, and by varying the relative proportions of the reduced portion 7, I can provide for admission and cut off of pressure fluid in any desired manner, but I prefer that the inlet port 8 should be closed sufficiently early in the stroke of the piston to provide a period of expansive action of the pressure fluid. I prefer that the opening from the by-pass port 10 shall be closed prior to or coincident with the exhaust of pressure fluid acting on the surface 9 of the piston head 4. I prefer to move the piston on its opposite or return stroke by the expansive action of pressure fluid, and to this end I may provide a return port 13 in the cylinder wall adapted to exhaust pressure fluid from the intermediate piston chamber 6 into the large piston chamber 3. This return port 13 may be in constant communication with the large piston chamber 3 and in intermittent communication with the intermediate chamber 6. I prefer to so arrange this port 13 that it shall be

opened by the piston shortly before the completion of the forward stroke thereof and preferably after communication between the intermediate piston chamber 6 and the by-pass port 10 has been closed.

I prefer that an exhaust port 12 shall exhaust pressure fluid from the piston chamber 3, when the position of the piston is such as to permit such exhaust. I may, as shown, so arrange the effective opening of the inlet port 8 that the supply of live air to the cylinder is cut off early in the forward stroke of the piston, thereby providing a period of pressure fluid expansion in the intermediate piston chamber 6 and preferably also in the piston chamber 3. I prefer to utilize the pressure fluid in the intermediate piston chamber 6 to return the piston, and to this end the return port 13 is preferably arranged as shown to connect the intermediate piston chamber 6 and the front end of the large piston chamber 3 near the end of the stroke of the piston, and the piston chamber 2 provided with an exhaust port 14 to exhaust the pressure fluid behind the piston head 5 and thereby to permit the large effective piston area in the piston chamber 3 to overcome the smaller effective piston area in the intermediate piston chamber 6.

It will be noticed that the ports are preferably so located as to permit "running by" of the piston owing to its inertia.

The operation of the preferred embodiment of my invention illustrated, is as follows:

Assuming the piston to be in the position shown in Fig. 1, pressure fluid admitted through the inlet port 8 acts on the intermediate pressure area 9 and after passing through the by-pass port 10 acts on the rear pressure area 11 to drive the piston forward. The smaller piston head 5 soon closes the inlet port 8 and the piston continues forward by the expansive action of the pressure fluid on the pressure areas 9 and 11.

Substantially simultaneously with the closure of the port 8, the port 10 is preferably closed. Thus there is a period of pressure expansion provided in the piston chamber 2 and in the piston chamber 6. The expansion in the piston chamber 2, however, is much more rapid and complete than in the piston chamber 6, for the air in the latter increases but little in volume as the piston advances.

After the piston head 4 passes the opening in the return port 13, the slightly expanded pressure fluid in the piston chamber 6 is opened into the piston chamber 3, the expanded pressure fluid in the chamber 2 having been exhausted through the exhaust port 14. The effective pressure area of the piston in the intermediate pressure chamber 6 need not be exhausted except through the piston chamber 3, for the effective pressure area of the intermediate piston chamber is preferably, as shown, of relatively small area. Thus the expansion of pressure fluid in the chamber 3 will move the piston back to the position shown in Fig. 1, when the cycle of operation will be repeated.

As shown in Figs. 3, 4 and 5, I prefer to use plural by-pass, return and exhaust ports; each set of ports preferably being divided between opposite sides of the cylinder so that the impact and pressure circumferentially is balanced on the piston, thus preventing undue pressure between the cylinder and piston in any one direction and so reducing the tendency of both to become worn.

The preferred arrangement of ports illustrated, provides a single period of pressure fluid admission, in a single charge, to actuate one complete cycle of operation of the motor. When the piston closes the inlet port 8, all the pressure fluid in the cylinder is impelling the piston forward, yet no additional pressure fluid need be admitted to return the piston. I find that I can produce most satisfactory results by making the piston head 4 but little larger than the piston head 5, thus providing but little effective pressure on the pressure surface 9 and utilizing the reduced portion 7 as a pressure fluid conveying chamber in so far as it carries the pressure fluid from the point of cut-off of the inlet port 8 to the return port 13.

It will be understood that while I have shown and described a preferred construction of my invention, changes involving omission, substitution, alteration, and reversal of elements, may be made without departing from the scope of my invention, which is best expressed in the following claims:

1. A valveless percussive fluid motor comprising, in combination, a cylinder, its piston, a lateral fluid inlet controlled by said piston, and coöperating pressure fluid delivering means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of pressure fluid during each cycle of reciprocation of said piston in said cylinder.

2. A valveless percussive fluid motor comprising, in combination, a cylinder, its piston, a lateral fluid inlet controlled by said piston, and piston controlled pressure fluid distributing means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of pressure fluid during each cycle of reciprocation of said piston in said cylinder.

3. A valveless percussive fluid motor comprising, in combination, a cylinder, a piston therein having a plurality of heads and an intermediate chamber, a lateral inlet for admitting fluid to said intermediate cham-

ber, said inlet being opened and closed by said piston, and pressure fluid delivering means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of fluid during each cycle of reciprocation of said piston in said cylinder.

4. A valveless percussive fluid motor comprising, in combination, a cylinder, a piston therein having a plurality of heads and an intermediate reduced portion, a lateral fluid inlet opened and closed by one of said heads, and pressure fluid delivering means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of pressure fluid during each cycle of reciprocation of said piston in said cylinder.

5. A valveless percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having heads fitting said cylinder portions respectively, a lateral fluid inlet opened and closed by one of said heads, and pressure fluid delivering means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of pressure fluid during each cycle of reciprocation of said piston in said cylinder.

6. A valveless percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having heads fitting said cylinder portions respectively, a lateral fluid inlet opened and closed by one of said heads, and pressure fluid delivering means for alternately distributing in opposite directions to the opposite ends of said cylinder a single charge of pressure fluid during each cycle of reciprocation of said piston in said cylinder.

7. A valveless percussive fluid motor comprising, in combination, a cylinder having a plurality of pressure chambers therein and an intermediate pressure chamber, a piston movable in said cylinder, a fluid inlet for admitting fluid to said intermediate chamber and including a port opened and closed by said piston, and coöperating pressure fluid delivering means for alternately distributing fluid from said intermediate chamber in opposite directions to the opposite ends of said cylinder.

8. A valveless percussive fluid motor comprising, in combination, a cylinder having a plurality of pressure chambers of different cross sectional area and an intermediate pressure chamber, a piston movable in said cylinder having a plurality of heads of different cross sectional area, a fluid inlet for admitting fluid to said intermediate chamber and including a port opened and closed by said piston, and coöperating pressure fluid delivering means for alternately distributing fluid from said intermediate chamber in opposite directions to the opposite ends of said cylinder.

9. A valveless percussive fluid motor comprising, in combination, a cylinder having a plurality of pressure chambers therein and an intermediate pressure chamber, a piston movable in said cylinder having a plurality of heads, a fluid inlet for admitting fluid to said intermediate chamber and including a port alternately opened and closed by one of said heads, and coöperating pressure fluid delivering means for alternately distributing fluid from said intermediate chamber in opposite directions to the opposite ends of said cylinder.

10. A valveless percussive fluid motor comprising, in combination, a cylinder having a plurality of pressure chambers therein and an intermediate pressure chamber, a piston movable in said cylinder having a plurality of heads, a fluid inlet for admitting fluid to said intermediate chamber and including a port alternately opened and closed by one of said heads, and coöperating fluid delivering means opened and closed by different heads for alternately distributing fluid from said intermediate chamber in opposite directions to the opposite ends of said cylinder.

11. A valveless percussive fluid motor comprising, in combination, a cylinder and its piston, said piston and cylinder presenting a plurality of pressure chambers and an intermediate pressure chamber, a fluid inlet for admitting fluid to said intermediate chamber and including a port opened and closed by said piston, and coöperating pressure fluid delivering means whereby during movement of said piston in one direction said intermediate pressure chamber is alternately connected with each of said other pressure chambers.

12. A valveless percussive fluid motor comprising, in combination, a cylinder and its piston, said piston and cylinder presenting a plurality of pressure chambers and an intermediate pressure chamber, initial pressure fluid admission means opened and closed by said piston, and coöperating conduit means for connecting said intermediate pressure chamber with one of said pressure chambers and with the other pressure chamber after closure of said initial pressure fluid admission means.

13. A percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said piston and cylinder presenting a large pressure chamber, a smaller pressure chamber, and an intermediate pressure chamber, initial pressure fluid admission means opened and closed by said piston, and coöperating conduit means for connect-

ing said intermediate pressure chamber with one of said pressure chambers and with the other pressure chamber after closure of said initial pressure fluid admission means.

14. A percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said piston and cylinder presenting a large pressure chamber, a small pressure chamber, and an intermediate pressure chamber, initial pressure fluid admission means opened and closed by said piston and communicating through said intermediate chamber with a communicating pressure chamber, and coöperating conduit means whereby during movement of said piston in one direction said communicating pressure chamber is cut off from and the other pressure chamber connected to said intermediate chamber.

15. A valveless percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said piston and cylinder presenting a large pressure chamber, a smaller pressure chamber, and an intermediate pressure chamber, initial pressure fluid admission means opened and closed by said piston for admitting fluid to said intermediate pressure chamber, and coöperating conduit means for connecting said intermediate pressure chamber with one of said pressure chambers and with the other pressure chamber after closure of said initial pressure fluid admission means.

16. A valveless percussive fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said piston and cylinder presenting a large pressure chamber, a smaller pressure chamber, and an intermediate pressure chamber, initial pressure fluid admission means delivering a predetermined volume of pressure fluid to said intermediate pressure chamber and one of said pressure chambers, and conduit means effecti e after closure of said admission means and relatively little expansion of said pressure fluid in said intermediate pressure chamber, to admit said pressure fluid from said intermediate pressure chamber into the other of said pressure chambers to reverse the direction of reciprocation of said piston.

17. A valveless percussive fluid motor comprising, in combination, a cylinder and its piston, said cylinder and piston presenting a plurality of pressure chambers and an intermediate pressure chamber, initial pressure fluid admission means including a port opened and closed by said piston and communicating with said intermediate chamber, and valveless pressure fluid distributing means controlled by said piston whereby fluid from said intermediate chamber is alternately conducted to and expanded in opposite ends of said cylinder.

18. A valveless percussive fluid motor comprising, in combination, a cylinder and its piston, said cylinder and piston presenting a plurality of pressure chambers of different cross sectional areas and an intermediate pressure chamber, initial pressure fluid admission means including a port opened and closed by said piston and communicating with said intermediate chamber, and valveless pressure fluid distributing means controlled by said piston whereby fluid from said intermediate chamber is alternately conducted to and expanded in opposite ends of said cylinder.

19. A valveless pressure fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said cylinder and piston presenting a large piston chamber, a smaller piston chamber, and an intermedite piston chamber between the two, piston controlled communicating means between said intermediate chamber and one of the other pressure chambers, and coöperating pressure fluid distributing means providing for the transfer in one direction of a predetermined charge of pressure fluid in said intermediate piston chamber to actuate said piston in the opposite direction.

20. A pressure fluid motor comprising, in combination, a cylinder comprising portions of different cross sectional area, a piston having portions fitting said cylinder portions respectively, said cylinder and piston presenting a large piston chamber, a smaller piston chamber, and an intermediate piston chamber between the two, pressure fluid supply means controlled by the piston for admitting pressure fluid to said intermediate piston chamber, conduit means for conducting pressure fluid from said intermediate piston chamber to one of said other piston chambers to actuate said piston in one direction, and means effective after closure of said conduit means to admit pressure fluid from said intermediate chamber to the other of said piston chambers.

21. A pressure fluid motor comprising, in combination, a cylinder, its piston, a plurality of simultaneously effective pressure fluid admission ports arranged at different points circumferentially of said cylinder intermediate its ends, and coöperating pressure fluid delivering means for alternately distributing to the opposite ends of said cylinder a single charge of pressure fluid for each cycle of reciprocation of said piston in said cylinder.

22. A pressure fluid motor comprising, in combination, a cylinder, its piston, coöperat-

ing pressure fluid controlling means for admitting to said cylinder intermediate its ends a single charge of pressure fluid for each cycle of reciprocation of said piston in said cylinder and for distributing said charge alternately to the opposite ends of said cylinder, and a plurality of simultaneously effective pressure fluid exhaust ports arranged at different points circumferentially of said cylinder.

23. A pressure fluid motor comprising, in combination, a cylinder, its piston, coöperating pressure fluid controlling means for admitting to said cylinder intermediate its ends a single charge of pressure fluid for each cycle of reciprocation of said piston in said cylinder and for distributing said charge alternately to the opposite ends of said cylinder, said means including a plurality of simultaneously effective pressure fluid admission and exhaust ports arranged at different points circumferentially of said cylinder.

24. A pressure fluid motor comprising, in combination, a cylinder, its piston, coöperating pressure fluid controlling means for admitting to said cylinder intermediate its ends a single charge of pressure fluid for each cycle of reciprocation of said piston in said cylinder and for distributing said charge alternately to the opposite ends of said cylinder, said means including a plurality of simultaneously effective piston-controlled pressure fluid admission ports arranged at different points circumferentially of said cylinder.

25. A pressure fluid motor comprising, in combination, a cylinder, its piston, coöperating pressure fluid controlling means for admitting to said cylinder intermediate its ends a single charge of pressure fluid for each cycle of reciprocation of said piston in said cylinder and for distributing said charge alternately to the opposite ends of said cylinder, said means including a plurality of piston-controlled pressure fluid conducting ports arranged in substantially balanced relation at different points circumferentially of said cylinder.

26. In a percussive tool, a cylinder having a bore of two cross sectional areas and an intermediate groove of greater area, a piston hammer movable therein having an enlarged striking head and a smaller rear head, said piston having front, rear, and intermediate pressure surfaces of different areas, and means controlled by said piston and including a communication between said groove and the source of supply for admitting pressure to said last two surfaces to propel the piston in one direction and subsequently admitting pressure from said groove to said front pressure surface to propel the piston in the opposite direction while closing communication between said groove and the source of supply.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE H. GILMAN.

Witnesses:

DOUGLAS M. BARCLAY,

WILLIAM BARCLAY.