No. 791,846. PATENTED JUNE 6, 1905.

J. WHITELAW.

PNEUMATIC DRILL.

APPLICATION FILED JAN. 21, 1903. RENEWED NOV. 3, 1904.

4 SHEETS—SHEET 1.

Fig. 1.

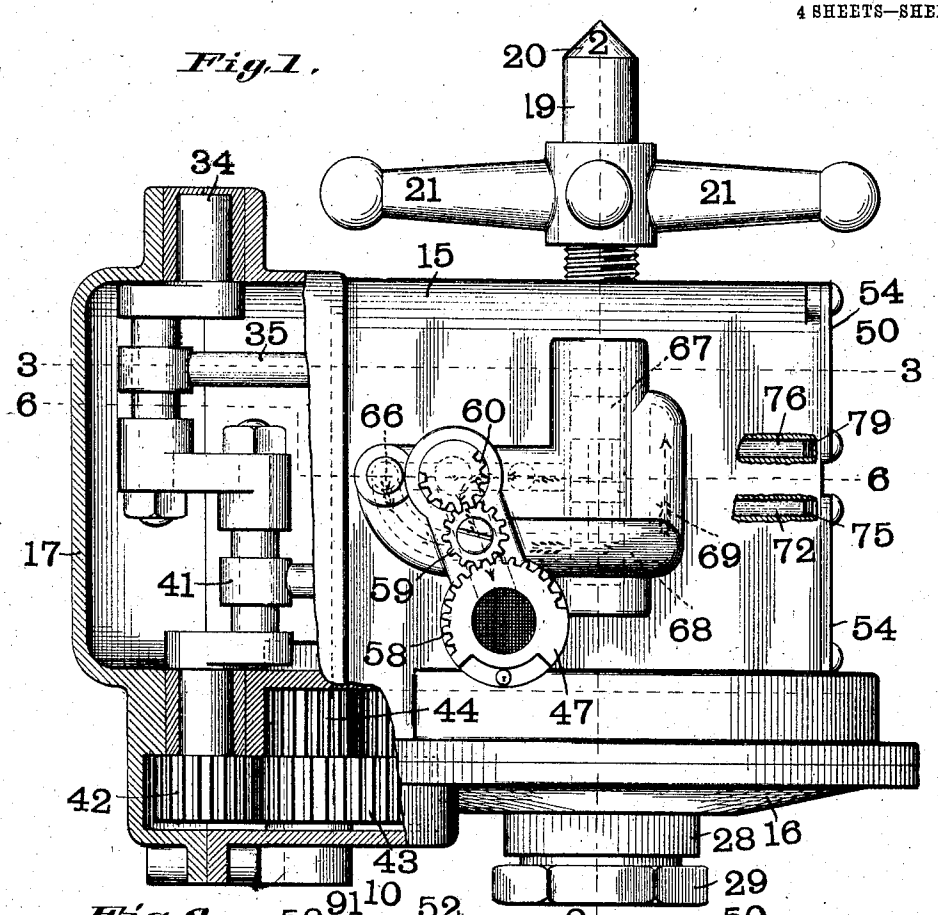
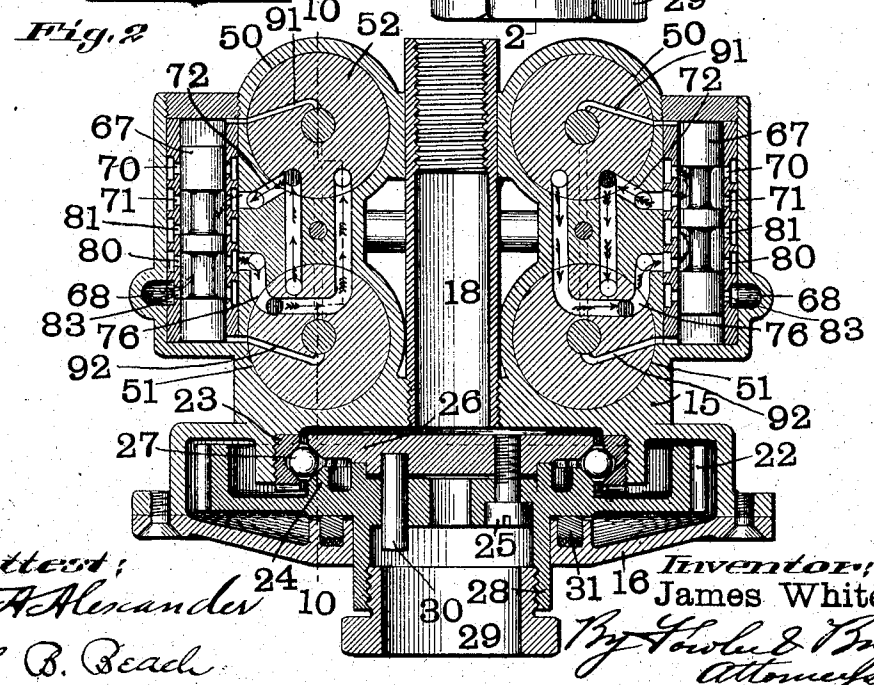


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 3

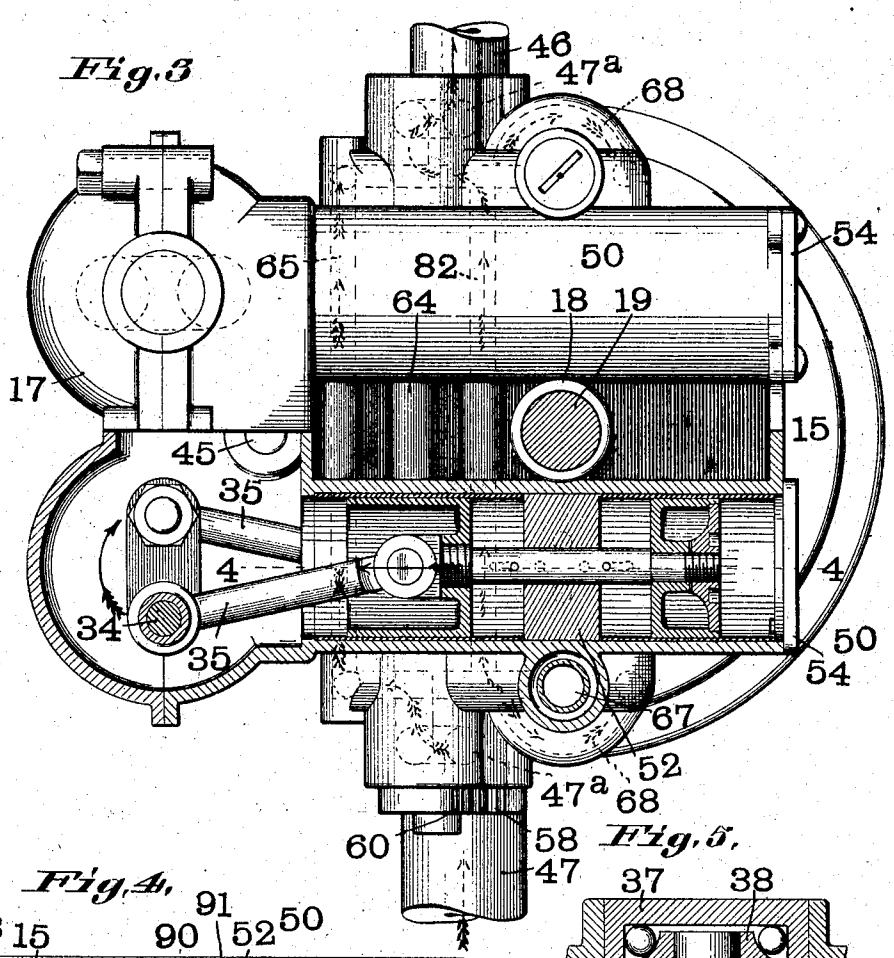


Fig. 4.

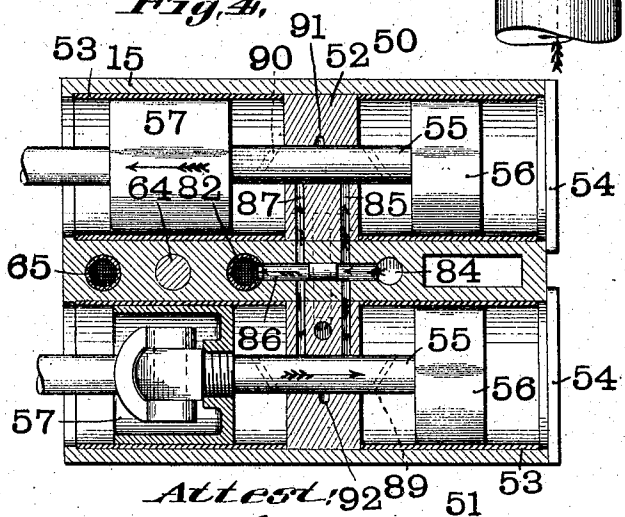
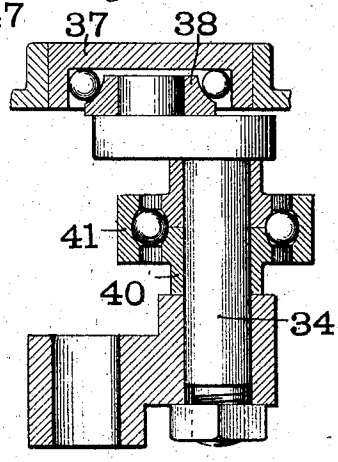


Fig. 5.



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4 SHEETS—SHEET 3.

Fig. 6.

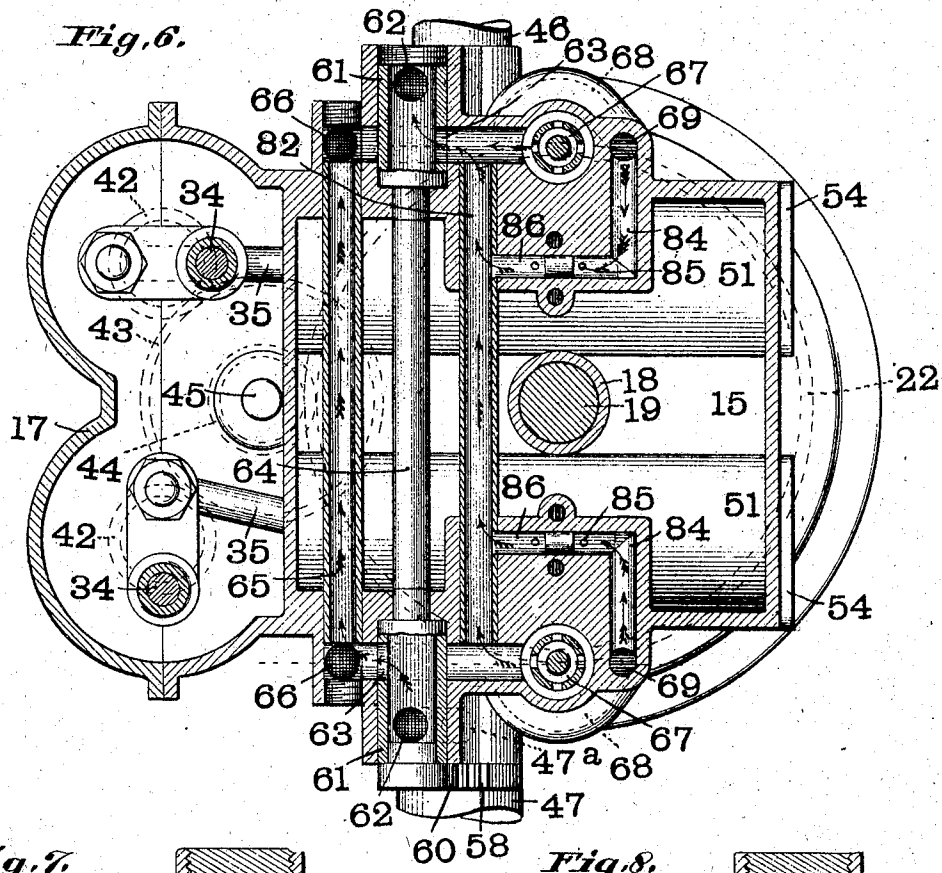


Fig. 7.

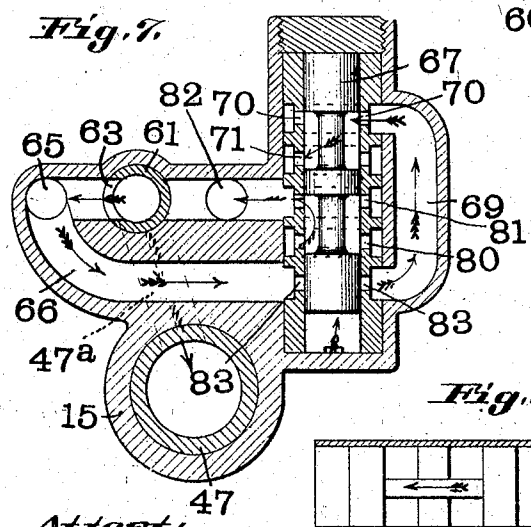


Fig. 8.

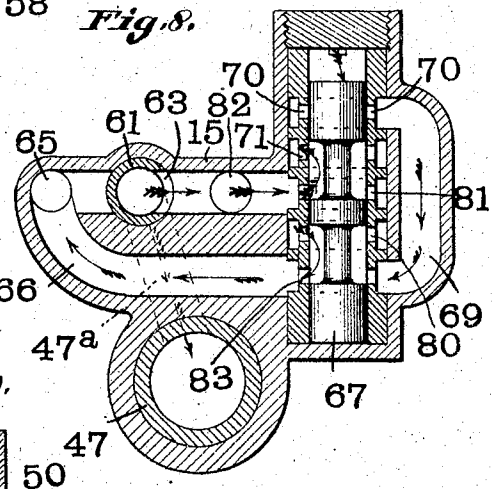
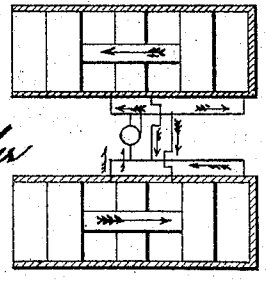


Fig. 9.



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4 SHEETS—SHEET 4.

Fig. 10.

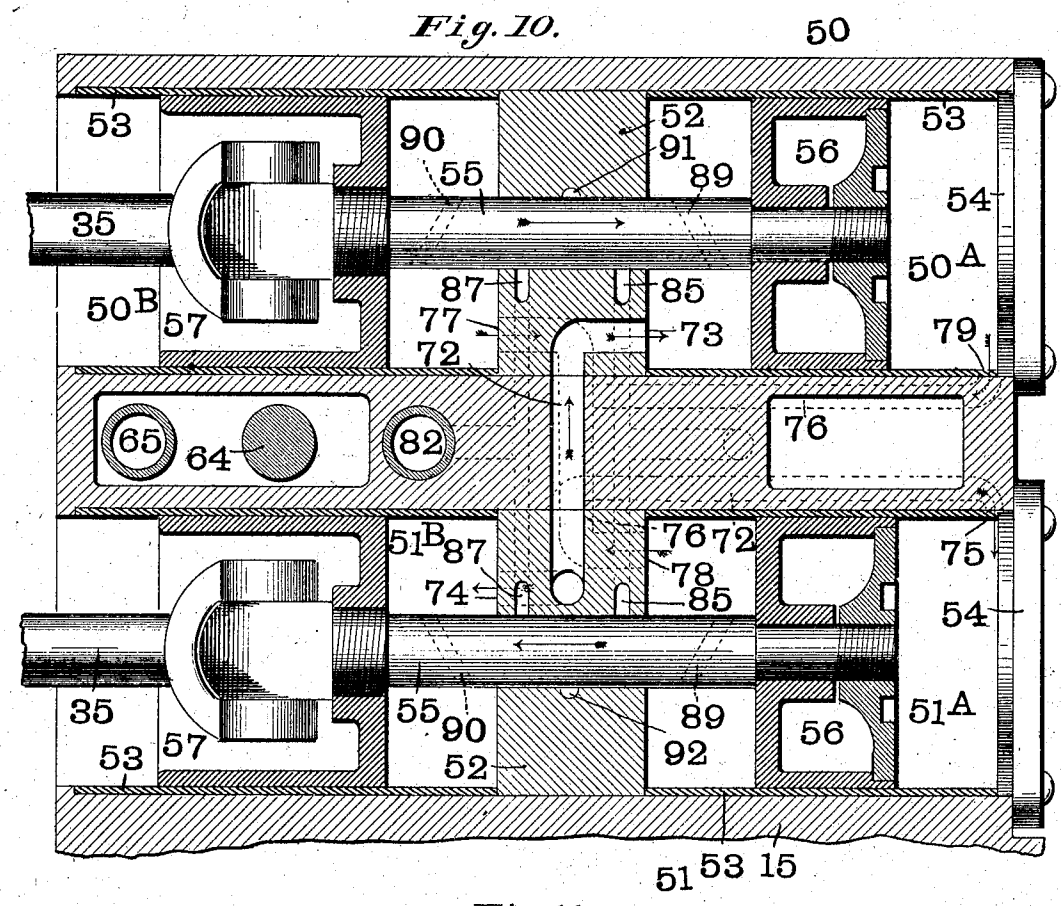
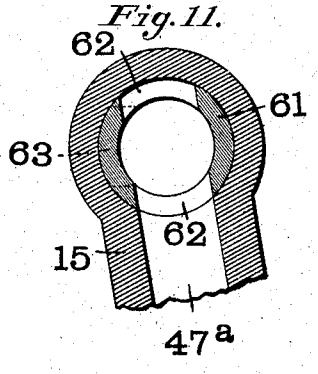


Fig. 11.



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No. 791,846. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

JAMES WHITELAW, OF ST. LOUIS, MISSOURI.

PNEUMATIC DRILL.

SPECIFICATION forming part of Letters Patent No. 791,846, dated June 6, 1905.

Application filed January 21, 1903. Renewed November 3, 1904. Serial No. 231,202.

To all whom it may concern:

Be it known that I, JAMES WHITELAW, a citizen of the United States, residing in the city of St. Louis, in the State of Missouri, have invented a certain new and useful Fluid-Motor for Drills or the Like, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to fluid-motors, and more particularly to those in which a plurality of cylinders and pistons are carried in a portable casing and act upon a common spindle to drive a drill or other rotary tool.

My invention consists, in part, in a motor for drills or the like consisting of two sets of cylinders, the cylinders of each set being arranged in tandem and consisting of a single-acting cylinder and double-acting cylinder, pistons in said cylinder, and means for admitting motive fluid to both cylinders of one set and to the double-acting cylinder of the other set and exhausting the motive fluid from the double-acting cylinder of said first-named set and from both cylinders of said second-named set.

My invention also consists in numerous other novel features and details of construction, all of which will be described in the following specification and pointed out in the claims affixed hereto.

In the accompanying drawings, which illustrate one form of drill made in accordance with my invention, Figure 1 is a side elevation, a part of the casing being shown in section. Fig. 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is partly a top plan view and partly a section on the line 3 3 of Fig. 1. Fig. 4 is a section on the line 4 4 of Fig. 3. Fig. 5 is an enlarged view showing a detail of construction. Fig. 6 is a section on the line 6 6 of Fig. 1. Figs. 7 and 8 are enlarged sectional views showing the valve mechanism in two different positions. Fig. 9 is a diagrammatic view. Fig. 10 is an enlarged section on the line 10 10 of Fig. 2, and Fig. 11 is an enlarged sectional view showing a detail of construction.

Like marks of reference refer to similar parts in the several views of the drawings.

The casing consists of three parts—a main or body portion 15, which contains the cylinders and valve mechanism, a bottom cap 16, which incloses the master-wheel, and an end cap 17, which incloses the crank-shafts. Secured centrally in the main portion 15 of the casing is an internally-threaded tube 18, in which is a threaded stem 19, on the upper end of which is formed a conical bearing 20. The stem 19 is provided with a star-handle 21 for feeding the drill in the usual manner. Within the lower cap 16 is the master-wheel 22, which is supported as best shown in Fig. 2. Secured in the lower end of the body 15 is a ring 23, which is provided with a ball-race. The master-wheel is provided with a cone 24 and has secured to it by means of screws 25 a second cone 26. Between these two cones 25 and 26 and the ring 23 the balls 27 are placed, so as to form a ball-bearing for the master-wheel.

Projecting downwardly from the master-wheel 22 is a short spindle 28, provided with a nut 29 for securing the drill or other tool in position. The master-wheel is also preferably provided with a downwardly-projecting pin or pins 30 for engaging with the upper end of the drill or other tool.

Placed between the cap 16 and the lower face of the master-wheel 22 is a packing 31 for forming a tight joint, so that the cap may contain oil to lubricate the working parts.

Journaled between the end cap 17 and the body 15 are two crank-shafts 34, to which are attached the connecting-rods 35 of the pistons. In order to reduce friction in the crank-shafts, they may be provided with ball-bearings, as shown in Fig. 5, the balls being placed between end caps 37 and cones 38 on the end of the shaft and also between cones 40 upon the shafts and the straps 41 of the connecting-rods 35.

Secured to the lower end of each of the crank-shafts 34 is a spur-wheel 42. These spur-wheels 42 are connected to the master-

wheel 22 by means of a compound gear consisting of a large sprocket-wheel 43 and a small sprocket-wheel 44, rigidly secured together and turning loosely upon a pin 45, carried by the body and the lower cap 16. The large spur-wheel 43 meshes with the two gear-wheels 42 and the small spur-wheel 44 meshes with the master-wheel 22.

The casing is provided with a pair of handles 46 and 47. The handle 46 at the right-hand side of the drill is hollow for the exhaust of the motive fluid and is rigidly connected to the casing. The handle 47 at the left-hand side of the drill is also hollow for the admission of the motive fluid, but is made rotatable, so as to control the supply of the fluid, as will be hereinafter described.

The main casing 15 is provided with four cylindrical openings, an upper opening 50 and a lower opening 51 being formed in each side of the casing. Each of the cylindrical openings is divided into two compartments by means of a partition 52. The partition 52 divides each of the upper openings 50 into cylinders 50^A and 50^B and divides each of the lower openings 51 into cylinders 51^A and 51^B, Fig. 10. At each end of the partition is placed a lining 53, of bronze or other metal. The linings 53 are held in position by heads 54. The linings 53 not only hold the partitions 52 firmly in position, but also enable the cylinder to be renewed when it becomes worn by removing the old linings and substituting new ones. Passing centrally through each of the partitions 54 is a piston-rod 55, to the rear end of which is secured a double-acting piston 56 and to the front end a single-acting piston 57. The four cylinders 50^A 50^B, 51^A and 51^B constitute two sets of cylinders, the cylinders of each set being dependent upon each other, inasmuch as their pistons are connected to a common piston-rod and must move in unison, while the cylinders of the two sets are independent, inasmuch as their pistons are not directly connected and do not move in unison. The front ends of the piston-rods are pivoted to the connecting-rods 35, hereinbefore described. The connecting-rod 35 is pivoted to the piston-rod 55 at a point within the piston 57, so that said piston, in addition to its function as a piston, also acts as a cross-head for the piston-rod.

The end of the rotary handle 46 is provided with teeth 58, which engage with an idle wheel 59, that in turn engages with teeth 60, formed on the end of a rotary valve 61. This valve is tubular in form and is provided with a pair of opposite openings 62, as shown in Fig. 11. It is also provided with an opening 63, for purposes which will be hereinafter described. This valve is connected, by means of a shaft 64, with a similar valve at the right side of the drill. The valve 61 at the right side of the drill differs from the one already described in having the passage 63 formed at the opposite side of the valve. The hollow handle 47 communicates, through a passage 47^a and through one of the openings 62, with the interior of the valve 61 and thence through the openings 63 with a pipe 65, leading to the right-hand side of the drill. The pipe 65 communicates, through passages 66, with cylinder-valves 67 at each side of the casing 15. Each of the passages 66 communicates, through a passage 68, passing around the valve 57, with a passage 69, leading to the upper portion of the valve. When the valve is in the position shown in Fig. 7, the passage 69 communicates, through ports 70 and 71, with a passage 72, formed in the casing. This passage 72 is provided with ports 73, 74, and 75, communicating with one end of the upper cylinder 50 and with both ends of the lower cylinder 51.

76 is a passage similar to the passage 73 and provided with ports 77, 78, and 79, opening into the respective cylinders. When the valve is in the position shown in Fig. 7, the passage 76 communicates, through ports 80 and 81, with a pipe 82, leading across the drill. When the valve is in the position shown in Fig. 8, the passage 76 communicates, through the port 80 and a port 83, with the passage 68, leading around the valve, and consequently with the passages 66 and 69. The pipe 82 communicates, through the openings 63 and 62 in the valve 61 at the right-hand side of the drill, with the hollow handle 46. The passage 69 is also in communication with a passage 84, (best shown in Fig. 6,) which in turn communicates with two ports leading into the partitions 54. The exhaust-pipe 82 communicates, by means of a passage 86, with ports 87, similar to the ports 85. Formed in the piston-rods 55 are ports 89 and 90, adapted to place the ports 85 and 87 alternately in communication with a port 91, leading to the upper end of the valve 67. The ports 89 and 90 in the piston-rod of the lower cylinder are adapted to place the ports 85 and 87 alternately in communication with a port 92, which communicates with the lower end of the valve 67.

The operation of my drill is as follows: Supposing the valves 61 to be in the position shown in Fig. 6 and the valve 67 at the left-hand end of the drill to be in the position shown in Fig. 7, the motive fluid enters through the hollow handle 47 and thence passes through the passage 47^a and one of the openings 62 into the valve 61. The fluid thence passes out through the opening 63 into the pipe 65, and a portion of it passes across to the right-hand side of the drill. As the mechanism at each side of the drill is duplicated, only that at the left-hand side will now be described. Another portion of the air passes down through the passage 66 and around the valve 67 through the passage 68 and the passage 69. The fluid then passes through ports 70 and 71 to the

passage 72. By the passage 72 it will be delivered through port 73 to the front end of the double-acting piston 56 of the upper cylinder and through the ports 74 and 75 to the rear end of the single-acting piston 57 and double-acting piston 58 of the lower cylinder. This will force the piston-rods in the direction indicated by their arrows in Fig. 10. At the same time the air will be exhausted from the rear ends of the single-acting piston 57 and double-acting piston 56 of the upper cylinder and from the front end of the double-acting piston of the lower cylinder through the ports 77, 78, and 79. The air then flows through the passage 76 to the valve 67 and passing through ports 80 and 81 passes into the tube 82 and across the drill, whence it passes out through the openings 63 and 62 in the valve 61 and enters the exhaust-handle 46. As soon as the pistons have completed their stroke the port 90 in the piston-rod of the upper cylinder will place the supply in communication with the port 91, leading to the top of the valve 67, and the port 89 of the lower piston-rod will place the exhaust-port 85 in communication with the port 92, leading to the lower end of the valve 67, and the said valve will be reversed, thus placing the ports 73, 74, and 75 in communication with the exhaust and placing the ports 77, 78, and 79 in communication with the supply, thus driving the pistons in the opposite direction to the one indicated by the arrows in Fig. 10. In this way the drill continues to run as long as air is supplied through the handle 47. When it is desired to stop the drill, the handle 47 is rotated, so as to take the opening 62 out of communication with the passage 47^a, leading from the handle. The drill will then stop. By continuing the rotation of the handle 47 until the opposite opening 62 is brought into communication with the passage 47^a the position of the openings 63 will be reversed, that at the left-hand end of the drill being put in communication with the pipe 82 and that of the right hand being put in communication with the pipe 65. The supply and exhaust in the drill will thus be reversed and the drill will run in the opposite direction.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a fluid-motor, two sets of cylinders, the cylinders of each set being arranged in tandem and consisting of a single-acting cylinder and double-acting cylinder, pistons in said cylinders, and means for admitting motive fluid to both cylinders of one set and to the double-acting cylinder of the other set and exhausting the motive fluid from the double-acting cylinder of said first-named set and from both cylinders of said second-named set.

2. In a fluid-motor, two sets of cylinders, the cylinders of each set being arranged tandem and consisting of a single-acting cylinder and double-acting cylinder, pistons in said cylinders, and a fluid-actuated valve for admitting motive fluid to both cylinders of one set and to the double-acting cylinder of the other set and exhausting the motive fluid from the double-acting cylinder of said first-named set and from both cylinders of said second-named set.

3. In a fluid-motor, a single-acting piston and a double-acting piston arranged in tandem on a common piston-rod, means for admitting live fluid to both pistons, and mechanism transmitting power from said pistons.

4. In a fluid-motor, a single-acting piston and a double-acting piston arranged in tandem, a single valve admitting live fluid to both of said pistons, and mechanism transmitting power from said pistons.

5. In a fluid-motor, a double-acting piston, a single-acting piston arranged in tandem therewith and acting as a cross-head therefor, means for admitting live fluid to both pistons, and mechanism transmitting power from said pistons.

6. In a fluid-motor, two pairs of pistons, the pistons of each pair being arranged in tandem, a fluid-supply, a single fluid-actuated valve admitting live fluid directly from said supply to both pistons of each set, and mechanism transmitting power from said pistons.

7. In a fluid-motor, a housing, a piston-rod, a pair of pistons mounted on said rod, a fluid-actuated valve for supplying motive fluid to said pistons, and ports in said piston-rod for controlling the supply of fluid to said valve.

8. In a fluid-motor, a housing, a pair of piston-rods, two pistons mounted on each of said rods, a fluid-actuated valve controlling the supply and exhaust of motive fluid to and from said pistons, ports in one of said piston-rods controlling the supply and exhaust to one end of said valve, and ports in the other of said piston-rods controlling the supply and exhaust to the other end of said valve.

9. In a motor for drills or the like, a portable housing, a cylinder in said housing, a partition in said cylinder, a removable lining at each end of said partition, means for holding said lining in position, and pistons for said cylinder.

10. In a fluid-motor, a cylinder, a lining in each end of said cylinder, a partition between said linings and held in place thereby, and pistons for said cylinder.

In testimony whereof I have hereunto set my hand and affixed my seal in the presence of the two subscribing witnesses.

JAMES WHITELAW. [L. S.]

Witnesses:
A. C. FOWLER,
J. H. BRYSON.