No. 615,884. Patented Dec. 13, 1898.

P. J. OGLE.

PERCUSSIVE DRILLING MACHINE.

(Application filed Dec. 28, 1897.)

(No Model.) 4 Sheets—Sheet 1.

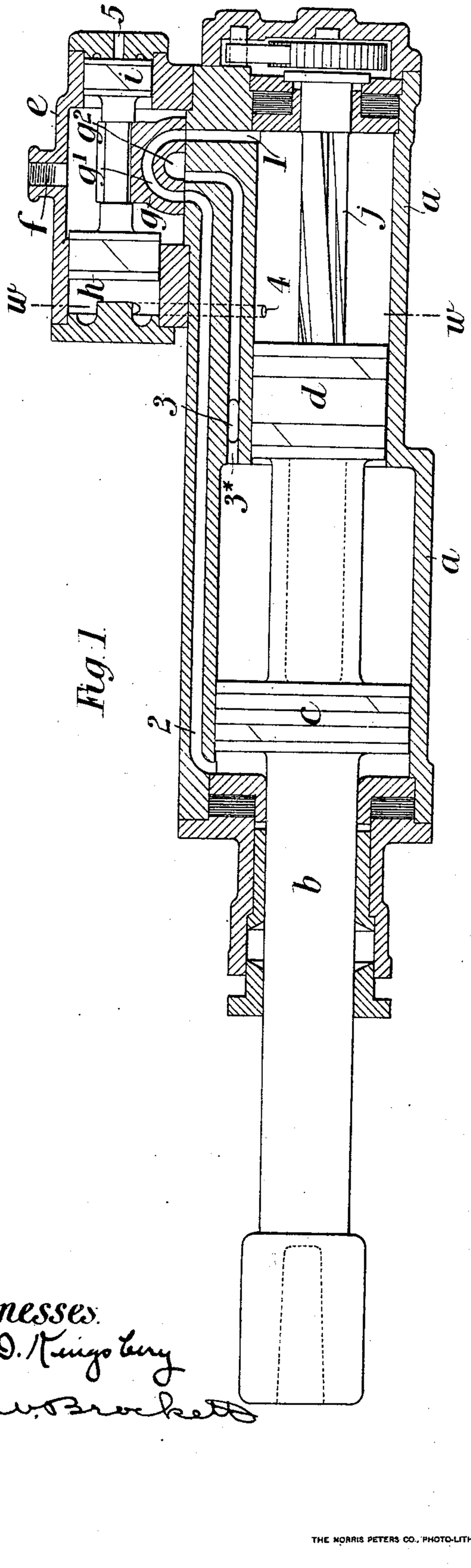


Fig. 1.

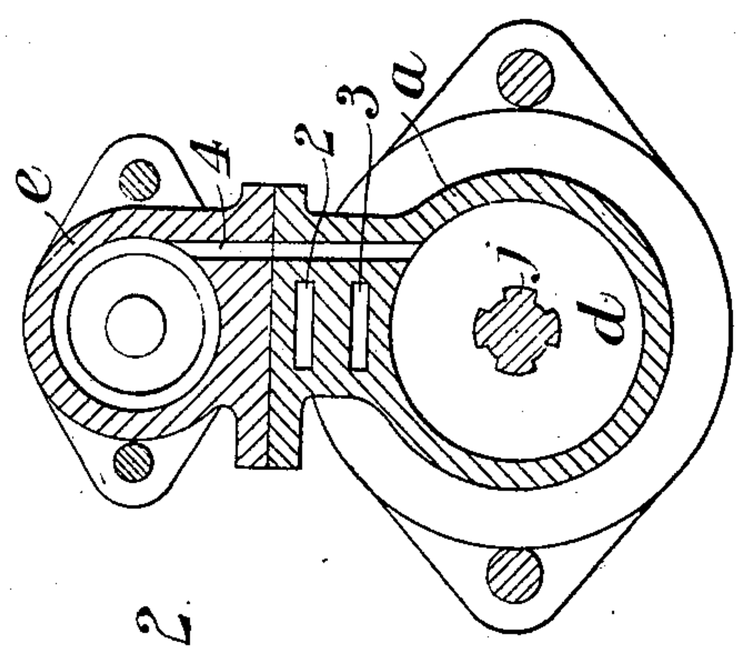


Fig. 2.

Witnesses:
J. D. Kingsbury
B. W. Brockett

Inventor:
Percy J. Ogle
By Whittaker & Forest attys.

No. 615,884. Patented Dec. 13, 1898.

P. J. OGLE.

PERCUSSIVE DRILLING MACHINE.

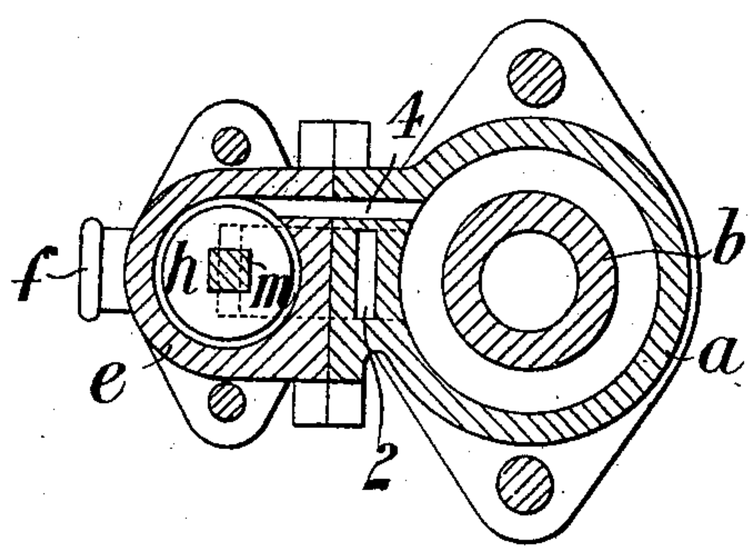
(Application filed Dec. 28, 1897.)

(No Model.)

4 Sheets—Sheet 2.

Fig. 3.

Fig. 4.



Witnesses.
J. D. Montgomery
B. W. Brockett

Inventor.
Percy J. Ogle
By Whitaker & Forrest Attys

No. 615,884. Patented Dec. 13, 1898.

P. J. OGLE.

PERCUSSIVE DRILLING MACHINE.

(Application filed Dec. 28, 1897.)

(No Model.) 4 Sheets—Sheet 3.

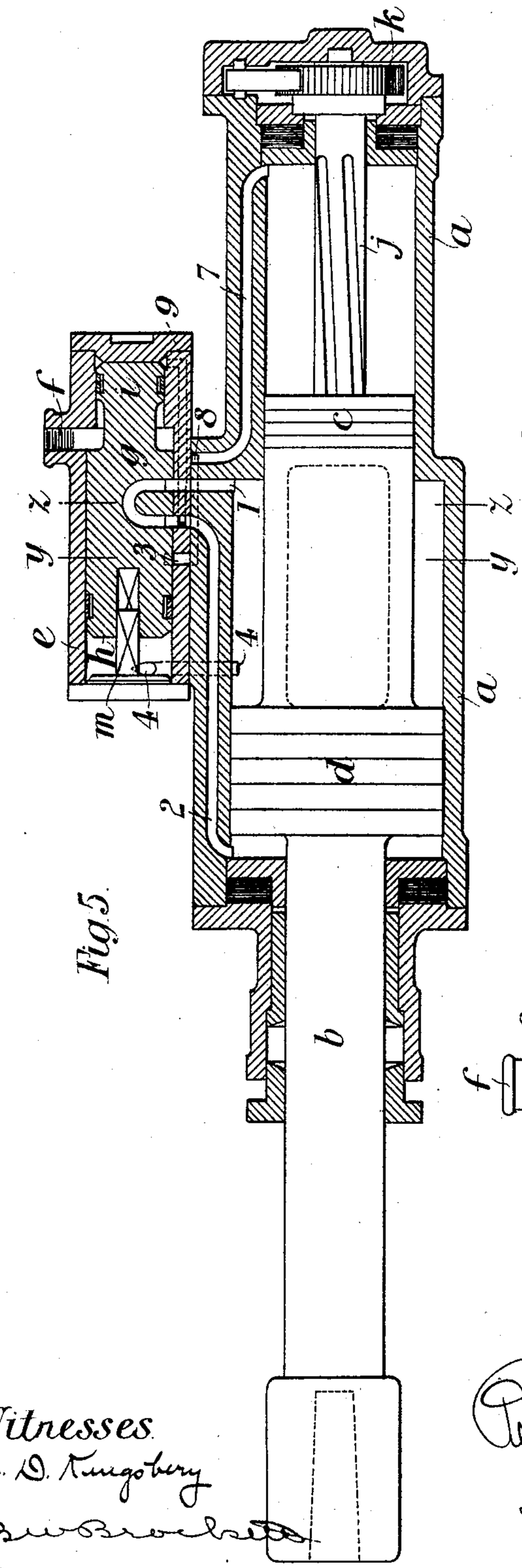


Fig. 5.

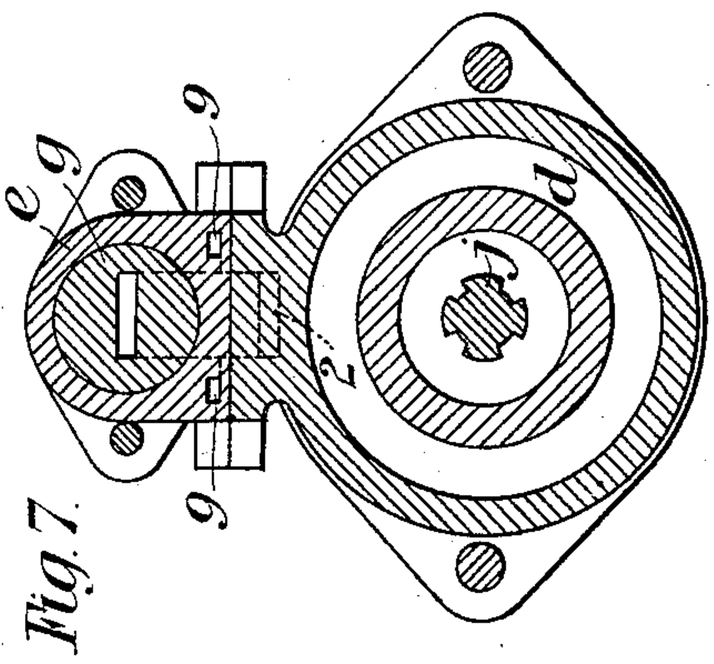


Fig. 7.

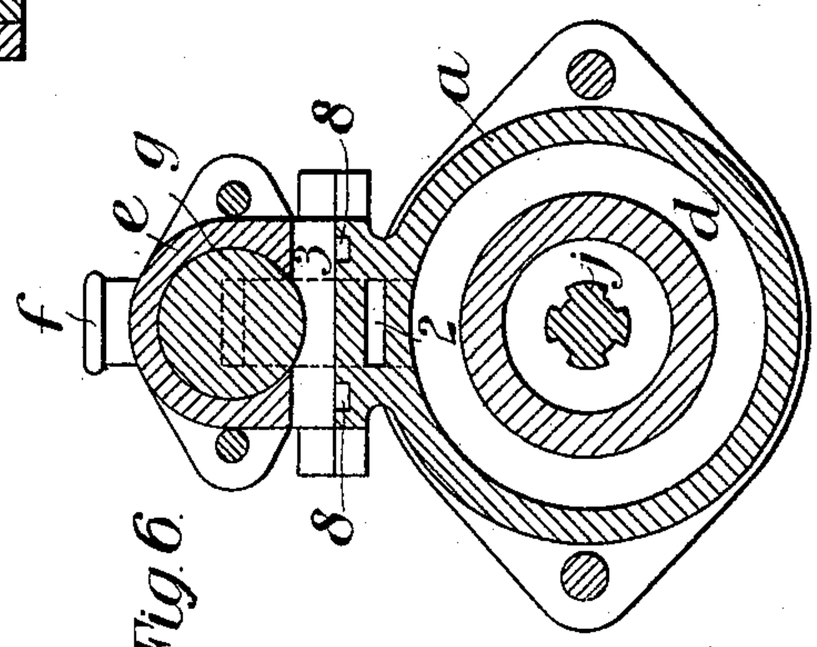


Fig. 6.

Witnesses.
J. D. Tingobery
B. W. Brockett

Percy J. Ogle Inventor.
By Whittaker & Prost Attys.

No. 615,884. Patented Dec. 13, 1898.

P. J. OGLE.

PERCUSSIVE DRILLING MACHINE.

(Application filed Dec. 28, 1897.)

(No Model.) 4 Sheets—Sheet 4.

Fig 8.

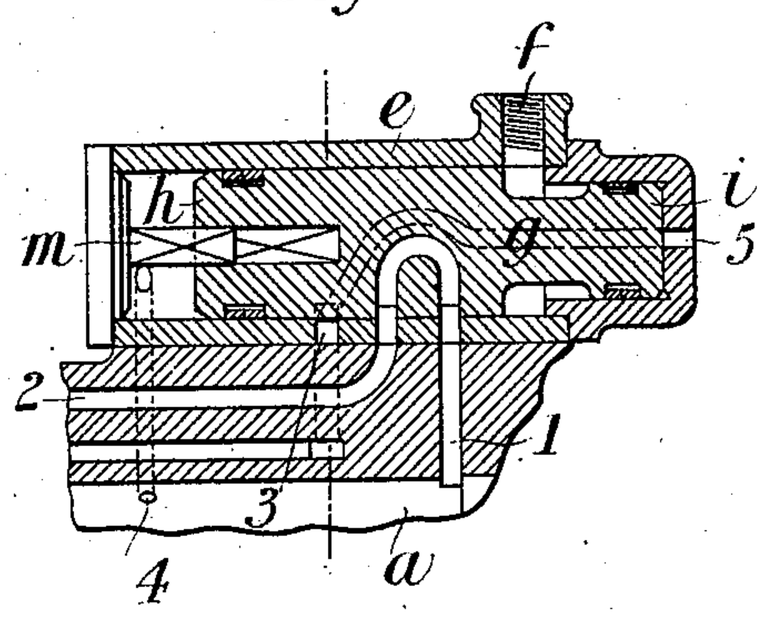


Fig 9.

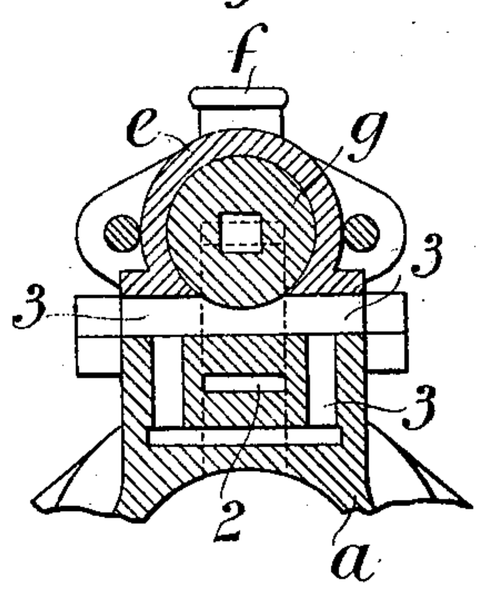


Fig 10.

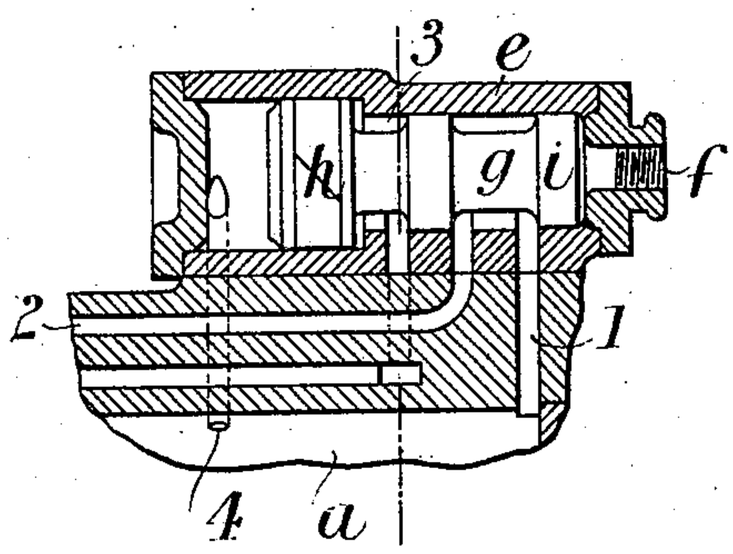
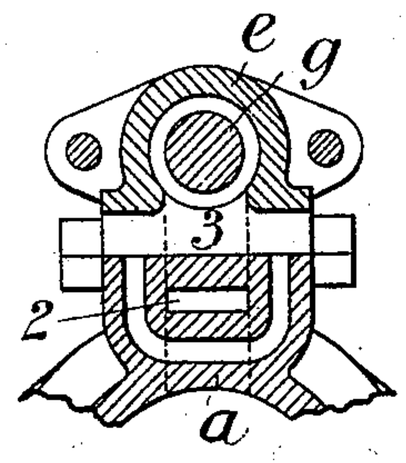


Fig 11.



Witnesses.
J. D. Dougherty
B. D. Brockett.

Percy J. Ogle Inventor.
By Wright Brown Quinby & Otis Attys.

UNITED STATES PATENT OFFICE.

PERCY JOHN OGLE, OF LONDON, ENGLAND.

PERCUSSIVE DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 615,884, dated December 13, 1898.

Application filed December 28, 1897. Serial No. 664,069. (No model.)

To all whom it may concern:

Be it known that I, PERCY JOHN OGLE, a subject of the Queen of Great Britain, residing at London, England, have invented certain new and useful Improvements in and Connected with Percussive Drilling-Machines, (for which I have obtained patents in Great Britain, No. 15,668, dated September 15, 1891; in France, No. 220,949, dated April 15, 1892; in Germany, No. 67,344, dated April 17, 1892; in Cape of Good Hope, Folio, No. 760, dated May 6, 1892; in Natal, dated May 10, 1892; in Transvaal, No. 381, dated May 17, 1892; in Victoria, No. 9,653, dated May 19, 1892; in South Australia, No. 2,226, dated May 23, 1892; in New South Wales, No. 3,768, dated May 23, 1892; in Queensland, No. 2,071, dated May 25, 1892; in New Zealand, No. 5,581, dated June 2, 1892; in Canada, No. 39,782, dated August 11, 1892, and in India, registered No. 114 of 1892, dated August 19, 1892,) of which the following is a specification.

This invention relates to improvements in percussive drilling-machines whereby I am enabled to use the compressed air or other motive fluid which has driven the piston in one direction for driving it in the opposite direction, thereby effecting considerable economy in motive fluid.

In carrying out my invention I employ two pistons (hereinafter referred to as "working" pistons) of different areas on the drill-spindle, and I advantageously employ a valve which is operated by the pressure of the motive fluid, (hereinafter referred to as "air,") the said valve being arranged in conjunction with two pistons of different areas.

To enable my invention to be fully understood, I will describe the same by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a percussive drilling-machine in which live air—that is to say, air at its full pressure—drives the drill-spindle outward; and Fig. 2 is a section of the same on the line *w w*, Fig. 1. Fig. 3 is a similar view of a drilling-machine in which the live air moves the drill-spindle inward; and Fig. 4 is a section on the line *x x*, Fig. 3. Fig. 5 is a longitudinal section of a percussive drilling-machine, illustrating a modification hereinafter described; and Figs. 6 and 7 are sectional views on the lines *y y* and *z z*, respectively, of Fig. 5. Figs. 8 and 9 are sectional views at right angles to each other of a valve arrangement which may be used in lieu of the valve arrangement shown in Fig. 1; and Figs. 10 and 11 are views similar to Figs. 8 and 9, respectively, of another modification.

Similar letters and numerals of reference indicate corresponding parts in the several figures.

a indicates the working cylinder of the drill, and *b* the drill-spindle, having the two pistons *c d* secured to it and working in the cylinder *a*.

e is the valve-box, having the aperture *f* for the admission of the motive fluid, and *g* is the valve, arranged in conjunction with two pistons *h i* of different areas.

1, 2, and 3 indicate, respectively, the port or passage through which the live air enters that part of the cylinder in which it operates and through which it escapes after having completed its work, the port or passage for conveying the expanded air to that part of the cylinder in which it operates and then again returning it to be exhausted, and the port or passage for conveying the said exhaust-air to the atmosphere.

4 indicates a passage between that portion of the cylinder in which the live air operates and the part of the valve-chamber behind the valve-piston of larger area, and 5 indicates a passage connecting the rear end of the valve-box with the atmosphere.

j indicates the twist-bar, having a ratchet-wheel *k* and pawl *l* in conjunction with it for causing the rotation of the drill-spindle in a well-known manner.

The valve *g* is arranged to place the ports 1 and 2 and 2 and 3 alternately in communication and also to open port 1 to the air-supply.

In the arrangement of my invention shown in Fig. 1 the valve *g*, which is actuated by a rod between the two pistons *h i*, is provided with two passages g' g^2, the former of which serves to place the passages 1 and 2 in communication and the latter the passages 2 and 3.

The operation of the machine or apparatus shown in Figs. 1 and 2 is as follows: Assume the valve *g* to be in such a position that the

passage 1 will be in communication with the air under pressure in the interior of the valve-chamber *e* and the passages 2 and 3 in communication through the passage g^2 in the valve. The result of this position will be that the air under pressure will flow through the passage 1 and act against the piston *d* to force the drill-spindle *b* outward to the position shown in Fig. 1. Immediately, however, that the piston *d* commences to uncover the passage 4 a portion of the air in the cylinder passes through the said passage into the valve-chamber behind the piston *h*, and owing to the fact that the area upon which this air acts is much greater than the difference between the areas of the two pistons with which the live air is in contact and that there is no resistance at the rear of the smaller valve-piston *i*, owing to the passage 5 communicating with the atmosphere, the said air from the cylinder acts upon the valve-piston *h* and moves the same to the position also shown in Fig. 1. The result of this movement of the valve is that the passage 1 is cut off from communication with the interior of the valve-chamber and placed in communication with the passage 2, whereby the two ends of the cylinder are placed in communication, so that the air which has previously acted in one end of the cylinder to force the drill-spindle outward is now free to expand (through the passage 1, the passage g' in the valve, and the passage 2) into the opposite end of the cylinder, where it acts upon the piston *c* of larger area than the piston *d*, thereby moving the drill-spindle backward. When during this backward movement the piston *d* has passed and again uncovered the passage 4, the space behind the valve-piston *h* is placed in communication with the space between the pistons *c d*, which latter space is also in communication with the atmosphere through the passage 3*, communicating with the exhaust, so that owing to the difference in the areas of the piston *h* and the piston *i* of the valve *g* the pressure of the air moves the said valve to uncover the port 1 and place the ports 2 and 3 again in communication, when live air again acts upon the piston *d* and the air which had acted upon the piston *c* passes to the exhaust.

The object of placing the space between the pistons in communication with the atmosphere through the exhaust-passage is that during the outward stroke of the said pistons pure air escaping from the cylinder shall enter the said space instead of dusty air, as would be the case if the said space was placed in direct communication with the atmosphere.

In the foregoing description I have referred to the live air as being used for moving the working piston outward; but it is to be understood that it may also be used for moving the drill-spindle inward. This arrangement is especially applicable in the case of a drill which may be required to work in a vertical position, when, as the combined weights of the drill-spindle and connected pistons serve to assist in imparting force to the blow, the expanding air may be used for driving the drill outward, the live air being employed for lifting the drill. Such an arrangement is shown in Figs. 3 and 4, where the two pistons are represented as being of the same diameter, but of different working areas, and the passage 1 is placed at the lower end of the cylinder and the passage 2 in communication with the upper end. The valve shown in connection with this modification is formed integral with its pistons; but in order to prevent the valve from turning upon its axis I arrange at one end of the valve-chamber a square or other guide *m*, upon which the valve and its pistons slide, as shown. Also the valve is provided with only a single passage, through which the ports 1 and 2 and 2 and 3 are alternately placed in communication. The operation of this apparatus is substantially the same as that hereinbefore described. In the drawings the ports are shown in the position which they occupy after the supply of live air to the bottom of the cylinder has been cut off and the valve moved to place the passages 1 and 2 in communication. The air from the lower end of the cylinder now passes to the upper end of the same and, acting upon the piston *c*, which has a relatively larger area than the piston *d*, drives the same downward to impart the blow, the force of which is augmented by the weight of the drill-spindle and pistons. When the piston *d* during the downward movement of the drill-spindle has passed the end of the passage 4, the air under pressure behind the piston *h* flows into the space between the two pistons *c* and *d* and thence into the atmosphere through the hole 6, whereby the air entering through the aperture *f*, owing to the unequal areas of the opposing faces of the pistons *h* and *i*, moves the valve *g*, as hereinbefore described, to place the passages 2 and 3 in communication and the passage 1 in communication with the air-supply *f*. The live air then acts upon the piston *d* to raise the drill-spindle, and the air behind the piston *c* passes to the exhaust-port 3. The hole 6, in addition to serving the purpose referred to above, also serves to prevent the piston *d* from being forcibly driven against the front cover of the cylinder, as after the drill-spindle has moved a certain distance and before the piston *d* reaches the said cover the hole 6 is uncovered by the piston *c*, thereby allowing the air-pressure to escape.

Instead of introducing high-pressure air at one end of the working cylinder and allowing it to act expansively in the other end thereof I may provide for introducing the live air between the two pistons or in the middle of the cylinder. This arrangement I have shown in Figs. 5, 6, and 7, wherein the piston *d* is designed to be acted upon at one side by the live air and upon the other side by the ex-

panding air, the space behind the piston *c* in this case communicating with the atmosphere through the passages 7 and 8 and the exhaust-passage 3. The arrangement of the valve also in this case is similar to that in the modification last described. In the operation of this apparatus the live air, entering through the passage 1 after driving the drill-spindle in one direction by acting upon the side of the piston *d* of smaller working area, passes through the passages 1 and 2 to the side of the piston *d* of larger working area and moves the said piston in the reverse direction. In this modification also the space behind the smaller valve-piston instead of being placed directly in communication with the atmosphere is placed in communication with the passage 2 through the passage 9, so that after the piston *d* during its inward movement has passed the passage 4 the pressure of the air at the two ends of the valve *g* will be equalized, and the latter is therefore free to move under the pressure entering through the aperture *f*.

It is to be understood that I may use any form of valve mechanism in connection with my invention, whether such valve mechanism is operated by mechanical means or by the air-pressure.

In Figs. 8 and 9 I have shown how the valve represented in Figs. 3 and 5 may be used in conjunction with the drill shown in Fig. 1, and these figures will be understood without further description, as the letters and numerals denoting the parts in these figures are the same as those denoting corresponding parts in other figures.

In the arrangement of valve shown in Figs. 10 and 11 the air instead of being introduced between the valve-pistons *h i* is introduced at one end of the valve-chamber opposite to the piston *i* and is moved in one direction to uncover the passage 1 by the live-air pressure upon it. The movement in the reverse direction is effected by the air-pressure from the cylinder through the passage 4, the area of the piston *h* being so proportioned to that of the piston *i* that the pressure on the piston *h* will be greater than upon the piston *i* when communication is made with the cylinder by the piston *d* uncovering the port 4. In this case the space behind the piston *h* is always open to the atmosphere, and preferably through the exhaust, as shown, in order to prevent the entrance of dusty air.

In order to prevent the entrance of dusty air into the valve-chamber through the passage 5, I connect the said passage with the exhaust-passage by a suitable pipe, or I may form a passage through the piston *i*, as indicated by dotted lines in Fig. 8, communicating with the exhaust-passage, in which case the passage 5 may be dispensed with.

Having now particularly described the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a drilling-machine, the combination with the cylinder, of a piston therein having two working faces for moving the piston in opposite directions, a valve-casing communicating with the cylinder, a valve in said casing, a piston for moving said valve, working in said valve-casing and provided with two faces of different areas, means for admitting the motive fluid under initial pressure to the valve-casing adjacent to the face of said valve-piston of lesser area and means for conducting the expanded fluid from the cylinder directly to said valve-piston adjacent to the face of greater area, whereby the valve will be moved in one direction by the fluid under initial pressure and in the opposite direction by the expanded fluid under reduced pressure, substantially as described.

2. In a drilling-machine, the combination with the cylinder, of a piston therein having two working faces for moving the piston in opposite directions, a valve-casing provided with ports communicating with the cylinder, a valve for said ports provided with two pistons of different areas, means for admitting the fluid under initial pressure to the valve-casing between said pistons, and means for admitting the expanded fluid in the cylinder in rear of the larger of said valve-pistons whereby the valve is moved in one direction by the fluid under initial pressure and in the other direction by the expanded fluid in the cylinder at reduced pressure, substantially as described.

3. In a drilling-machine, the combination with the cylinder, of a piston therein having two working faces for moving the piston in opposite directions, a valve-casing provided with ports communicating with the cylinder, a valve in said casing engaging said ports, and provided with two pistons of different diameters working in said valve-casing, the smaller of said pistons having its rear face in communication with the atmosphere, means for admitting the fluid under initial pressure to the valve-casing between said pistons, said cylinder and valve-casing being provided with a passage extending directly from the cylinder to the rear face of the larger valve-piston and having its communication with the cylinder located in the path of the piston, whereby the valve is operated in one direction by the fluid at initial pressure and in the other direction at its pressure after being expanded in the cylinder, substantially as described.

4. In a drilling-machine, the combination with the cylinder, of a piston having two working faces, for moving the piston in opposite directions, a controlling-valve provided with means for admitting the motive fluid in rear of one of said faces, and for conveying the expanded fluid to the rear of the other face, said valve being provided with two cylinders and pistons, one of said cylinders being in communication with the atmosphere, and means for establishing a connection be-

tween the main cylinder and the other of said valve-cylinders, at the conclusion of each stroke and an inlet for motive fluid intermediate the two valve-pistons, substantially as described.

5. In a drilling-machine, the combination with the cylinder, of a piston provided with two working faces, for moving the piston in opposite directions, means for conveying the expanded motive fluid from one working face to the other, a controlling-valve provided with two cylinders and piston of different areas, the larger of said cylinders communicating with the working cylinder and the other with the atmosphere and means for admitting the motive fluid intermediate said valve-pistons, whereby said valve will be moved in one direction by the motive fluid under its initial pressure, and in the opposite direction by the motive fluid under its expanded pressure, substantially as described.

6. In a drilling-machine, the combination with the cylinder, of a piston provided with working faces of different diameters, and reduced portions between said faces, the portion of said cylinder between said working faces being in constant communication with the exhaust whereby pure air free from dust and other foreign matter will be drawn into said cylinder, substantially as described.

PERCY JOHN OGLE.

Witnesses:
G. F. REDFERN,
JOHN E. BOUSFIELD.