G. R. BENNETT.

ROCK DRILL.

APPLICATION FILED JULY 7, 1909.

978,981.

Patented Dec. 20, 1910.

3 SHEETS—SHEET 1.

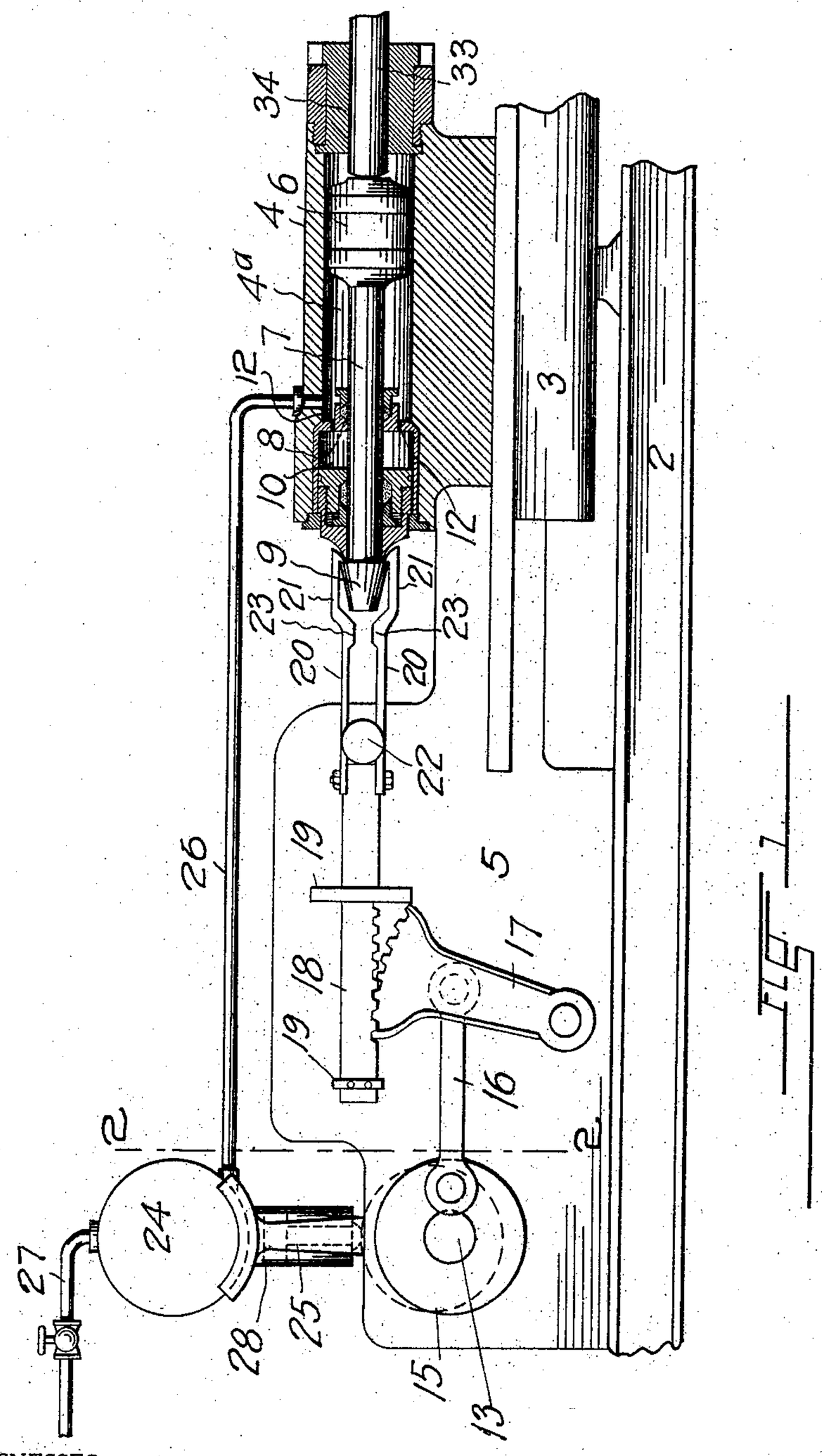

FIG. 1.

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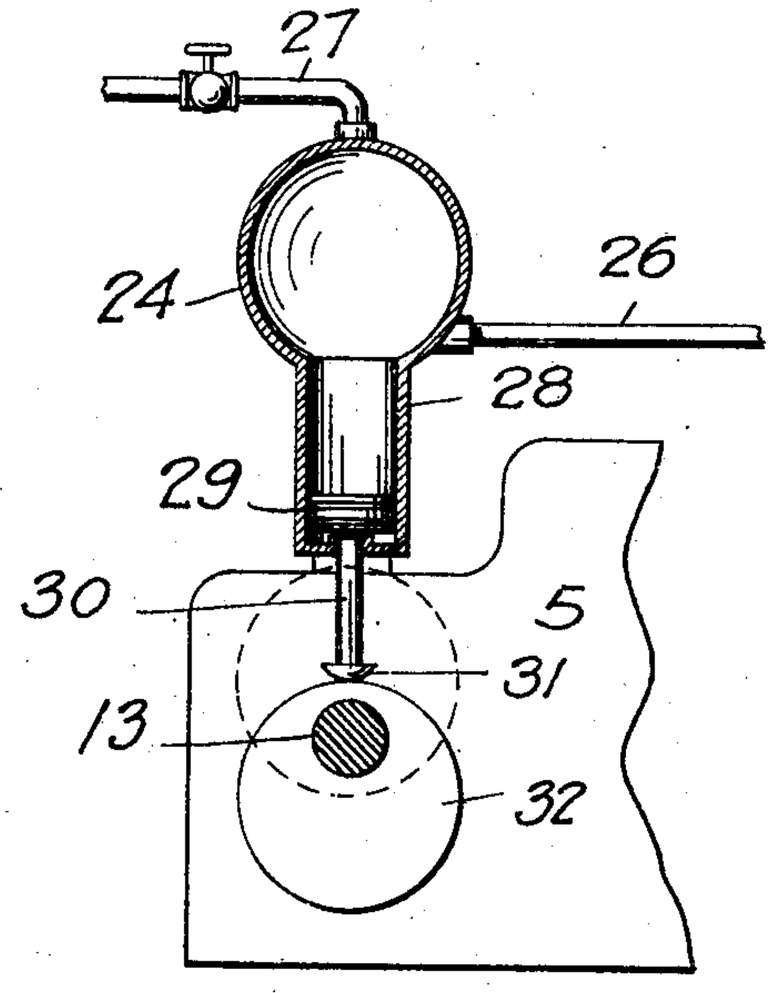

FIG. 3

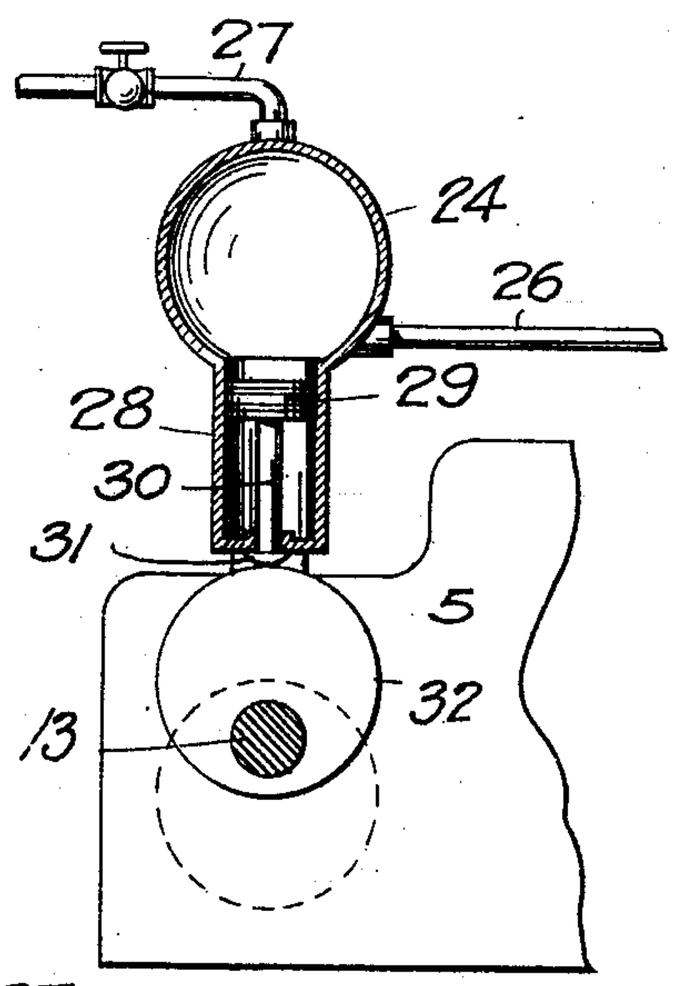

FIG. 4

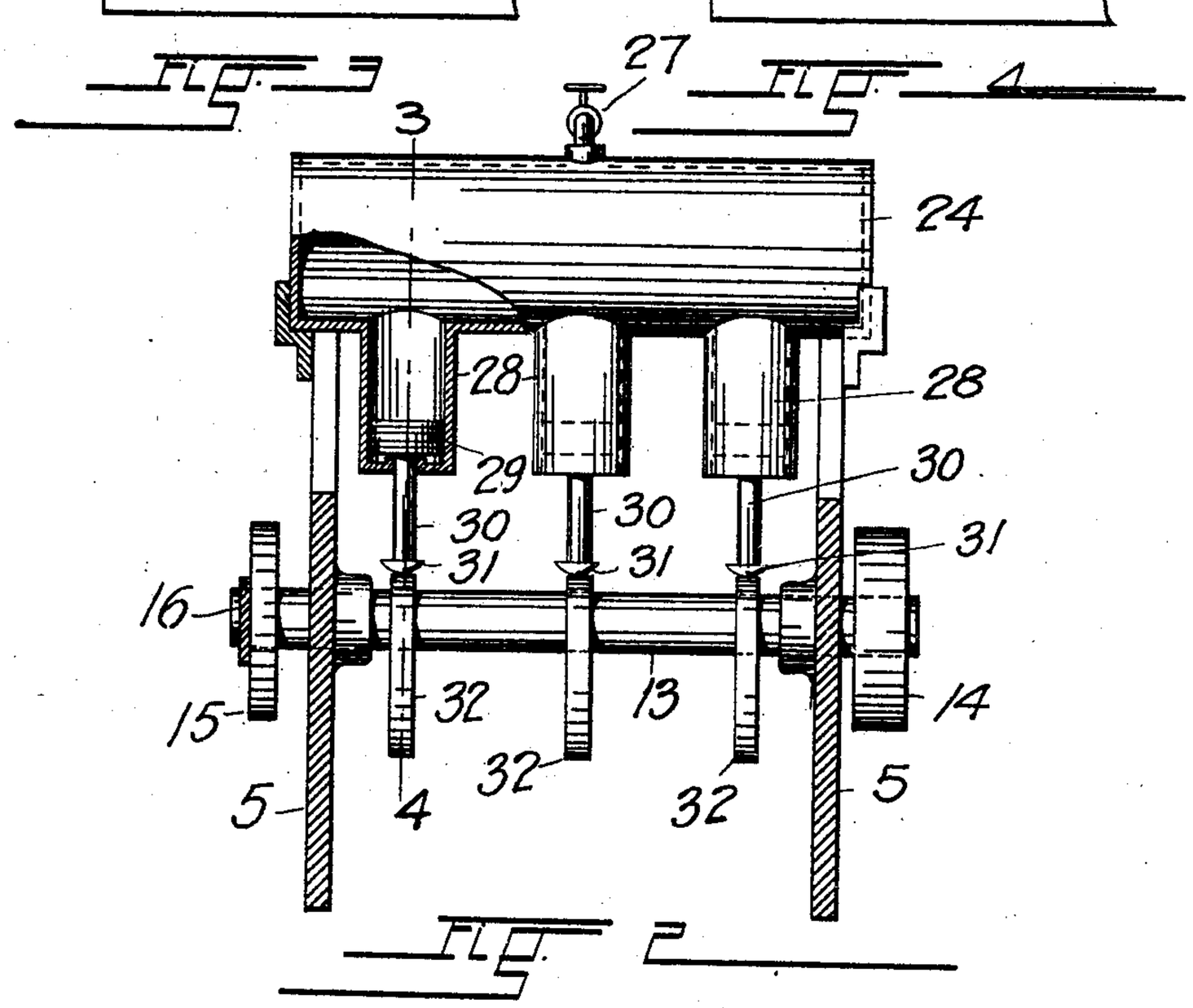

FIG. 2

WITNESSES:

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3 SHEETS—SHEET 3.

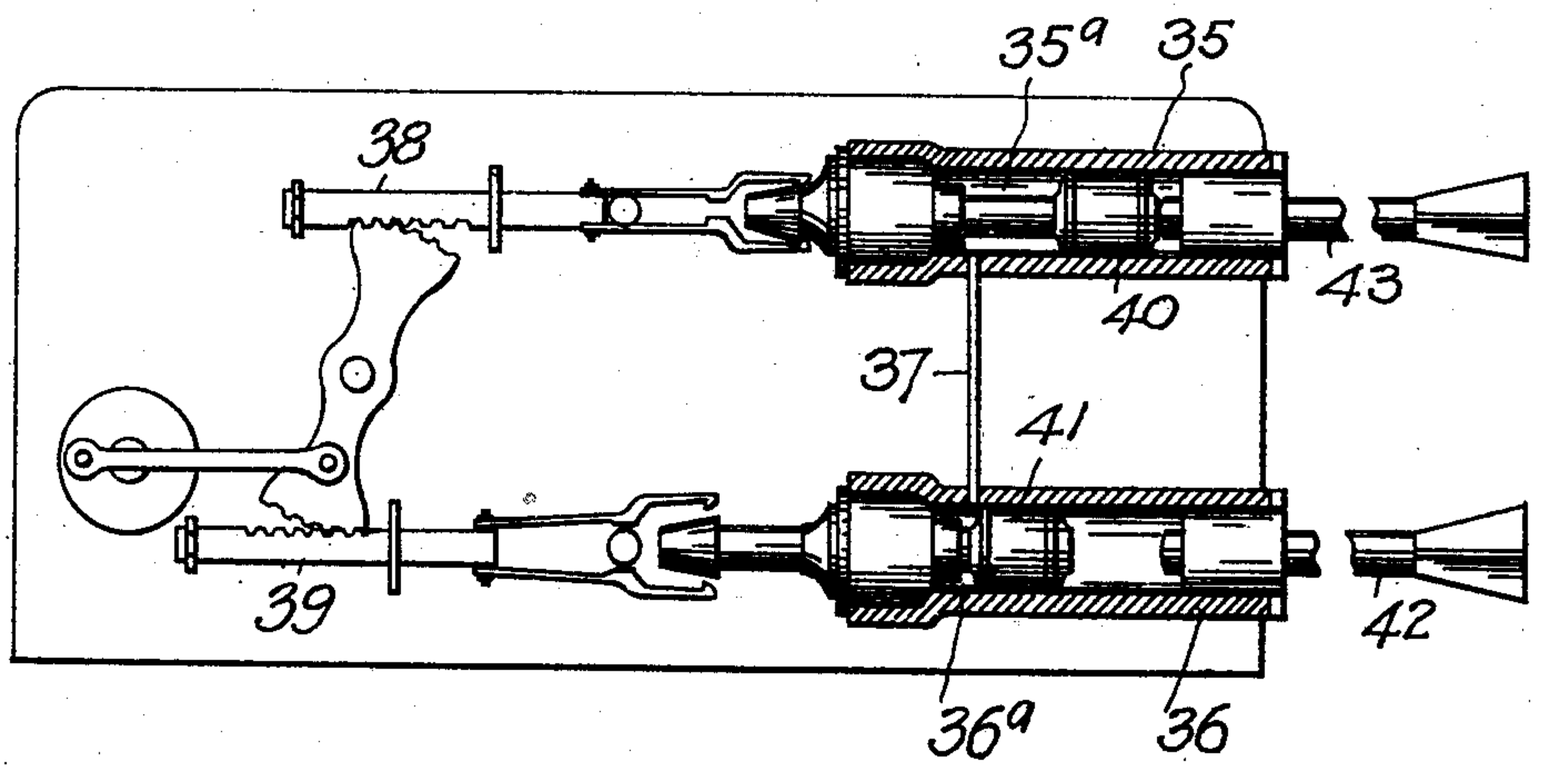

FIG. 5.

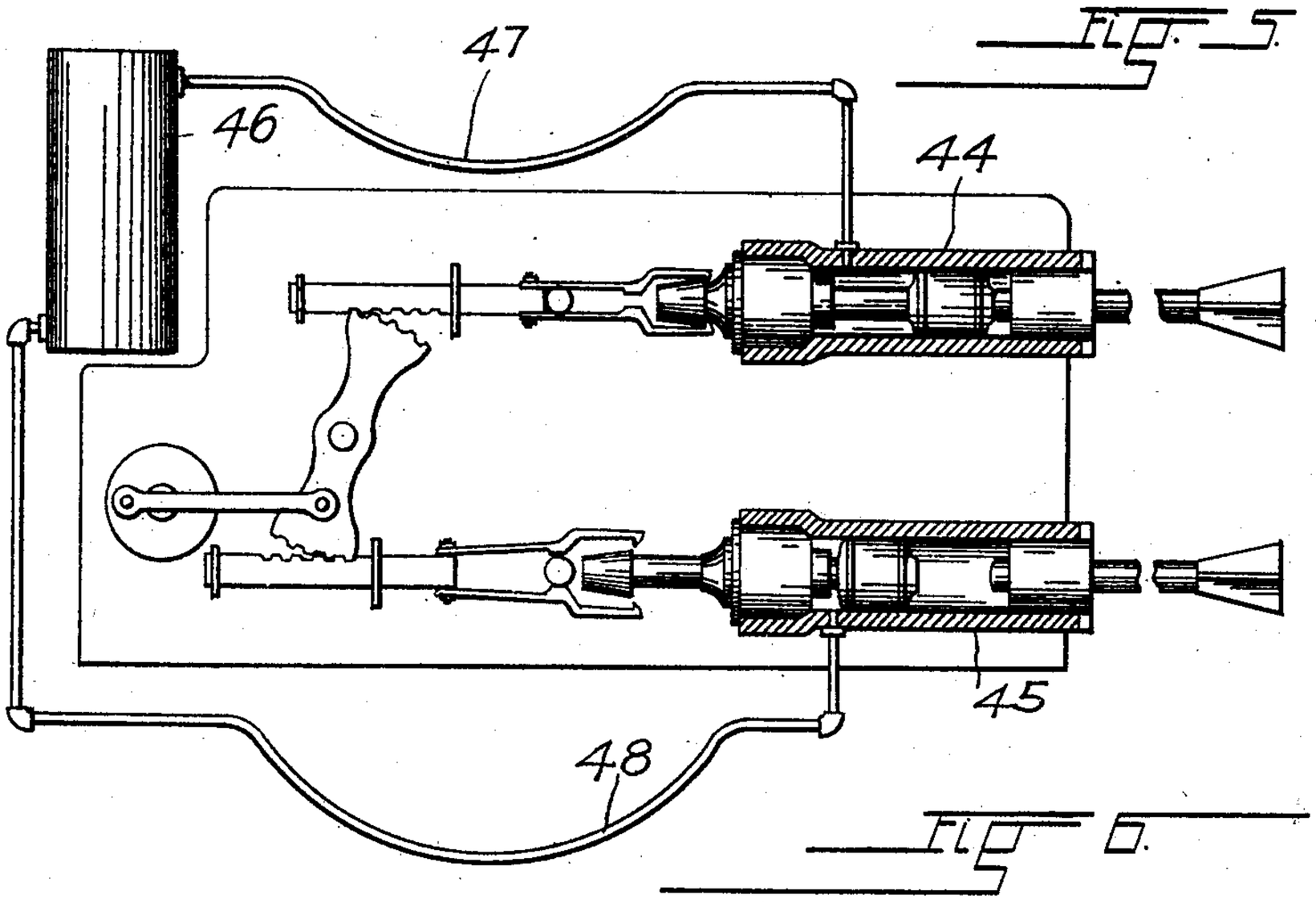

FIG. 6.

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UNITED STATES PATENT OFFICE.

GEORGE R. BENNETT, OF DENVER, COLORADO.

ROCK-DRILL.

978,981. Specification of Letters Patent. **Patented Dec. 20, 1910.**

Application filed July 7, 1909. Serial No. 506,287.

To all whom it may concern:

Be it known that I, GEORGE R. BENNETT, a citizen of the United States of America, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Rock-Drills, of which the following is a specification.

This invention relates to improvements in rock drills and more particularly to the class characterized by a housing inclosing a reciprocating hammer or piston which is actuated by means of fluid under pressure to deliver a succession of impacting blows upon the shank of a drill or other tool, longitudinally movably introduced into one of the ends of the housing.

The objects of the present invention, which is applicable to fluid pressure engines in which the piston forms part of the reciprocating tool, as well as to the class of instruments above described, reside; firstly; in the provision of a normally closed reservoir or other store of fluid under pressure, such as compressed air, which being in continuous communication with one end of the housing in which the hammer or other element has a reciprocating movement, will deaden the shocks and vibrations to which the engine is subject, by absorption of the reactive force, ordinarily exerted upon the stationary parts of the mechanism through the agency of the body of motive fluid by which said element was propelled, when the latter impinges upon the tool; and secondly; in the provision of a device in which a body of expansible motive fluid is applied to act repeatedly upon the reciprocating hammer or piston during its effective stroke, without being exhausted or replenished (except to compensate for leakage by reason of defective joints), and without being compressed or otherwise varied during the movement of the said hammer or piston in the opposite direction.

The invention consists to this end in providing a housing the air space of which is at all times in communication with a reservoir of expansible motive fluid such as air under compression, and in the provision of means whereby the capacity of said reservoir is increased and decreased in inverse ratio to the variations in the longitudinal extent of said space due to the reciprocating movement of the hammer. As a result of this arrangement the hammer may be retracted against the pressure of fluid contained within the housing, without varying its density while when, at the end of its stroke, the said hammer is released the motive fluid will by the force of its expansion, drive it forward against the tool, and subsequently relieve the engine from the jars resulting from reaction.

An embodiment of the invention is shown in the accompanying drawings in the various views of which like parts are similarly designated and in which—

Figure 1, represents a sectional elevation of the engine, Fig. 2, a sectional view taken along the line 2—2 Fig. 1, Figs. 3, and 4, transverse sections taken along the line 3—4 Fig. 2, showing the moving parts in their opposite, extreme positions, Fig. 5, a modified construction, in which a second engine is substituted for the reservoir and compensating means, and Fig. 6, a second modification including two engines whose housings are in continuous communication with a reservoir of motive fluid.

My improved rock drill consists, briefly, of a cylindrical housing, a hammer fitted for reciprocation therein, a tool upon which said hammer impinges, a device for retracting the element against the fluid pressure and a means for releasing the same at the termination of its rearward stroke.

Referring to the drawings by numerical reference characters, 4 designates the cylindrical housing which, in this case is connected with a movement-carrying frame 5, and is slidably supported upon the trough-shaped member 3 of the stationary base 2.

A piston here shown as a hammer 6, fitted for reciprocation within the bore of the cylinder, has a stock 7 which projects through a stuffing box 8 at the rear end of the housing and terminates in a conoidal head 9. The stuffing box above referred to, is formed in a piston movably fitted in a compression chamber 10, which communicates with the housing by means of small valve-controlled apertures 12 and whose function is to provide an air cushion to arrest excessive for-

ward movement of the hammer, when the resistance to the progress of the tool is diminished by reason of a soft strata in the rock upon which it acts or other cause.

The mechanism by which the hammer is retracted against the fluid pressure and subsequently released, includes a shaft 13 which being revolubly mounted upon the frame 5, carries at one of its ends, a pulley 14 by which it may be connected with a suitable source of power, and at its opposite end, a crank-disk 15 whose wrist connects, by means of a pitman 16, with an oscillatory segment 17, the peripheral teeth of which mesh with those of a rack 18. This rack which is slidably supported on the frame 5 in bearings 19, is provided with two jaws 20, the hooked extremities 21 of which are adapted to engage the head 9 of the hammer-stock, so as to draw it rearwardly against the pressure exerted upon the hammer by the motive fluid.

A roller 22 secured upon the frame between the resilient members 20, serves, in cooperation with beveled bosses 23 on the jaws, to separate the latter for the purpose of releasing the hammer at the termination of its rearward stroke.

The normally closed reservoir 24 containing the motive fluid which actuates the engine, is, in the construction shown in Figs. 1 to 3 of the drawings supported upon chairs 25 on the movable frame 5, and connected with the air-space 4^a of the housing 4 at its rearmost end, by means of a pipe 26.

A valve-controlled pipe 27 serves to connect the reservoir with a compressor or other source of expansible fluid for the purpose of filling it at the initial point of the operation or of replenishing it, when by leakage, the density of the fluid contained therein is reduced below a predetermined degree.

When, by action of the mechanism, the piston is retracted against the pressure of the fluid in its housing and the therewith continuously communicating reservoir, said fluid would be compressed beyond its normal density, were it not for the provision of compensating devices, the construction of which will now be described.

In communication with the reservoir at its lower portion, are several cylindrical pocket 28 whose combined capacities are approximately equal to that of the air-space 4^a of the housing 4.

Pistons 29, fitted within the pockets, are secured upon the ends of rods 30, which at their lower extremities, are supported upon the peripheral edges of cam-disks 32, eccentrically mounted upon the shaft 13.

When the hammer 6 is in its foremost position, in which it engages the tool, the cams are in the position shown in Fig. 4 of the drawings, and the pistons 29, occupy, in consequence, the upper portions of the respective pockets 28. During the rearward movement of the hammer the disks revolving with the shaft 13, allow the pistons to move downwardly, impelled by pressure of the fluid contained in the reservoir, with the result that the capacity of the latter is increased in ratio to the decrease in volume of the air space 4^a of the housing and the fluid normally contained within the latter, is forced into the reservoir without variation in its density. After the hammer 6 has, by the expansive force of the fluid, engaged the tool 33 movable in the cheek 34 in the fore-end of the housing, the pistons 29 are, by action of the revolving cams, again moved upwardly to compress the fluid to its original density, before the hammer is retracted by the rack whose jaws automatically engage the head 9 of the piston-stock at the end of its forward stroke.

It will be understood that by increasing the size of the reservoir relative to that of the air-space 4^a of the housing, the pockets 28 or whatever compensating means may be employed, are made comparatively smaller and while in theory, means for increasing the capacity of the reservoir are indispensable to retain the fluid contained therein, at a uniform degree of pressure during the instroke of the hammer, practical demonstrations have proven that, if the difference in the sizes of the reservoir and the housing is made sufficiently large, the increase in density of the fluid in the reservoir is so slight as to be barely noticeable on a pressure-gauge. Compensating means may therefore be omitted in such a case, as the slight increase in density of the air contained in the reservoir will not materially affect the successful operation of the hammer, while the primary object of the store of expansible fluid, that is, the absorption of the reactive force, when the hammer engages the tool 33, is accomplished irrespective thereof. It will furthermore be observed that the construction of my improved engine, as hereinabove described, may be simplified by the substitution of one larger cylinder for the multiplicity of pockets shown in Fig. 1, and by a proportionate increase in eccentricity of the cam disk supporting its piston, and should the work for which the engine is designed be of a character to permit the simultaneous operation of two or more drills, the said cylinder may be made part of a second engine, similar to the one above described, without impairment to the merits of the invention or departure from the principle thereof. An embodiment of such a modification has been shown in Fig. 5 of the drawings in which the numerals 35 and 36 designate the two engines whose air spaces 35^a and 36^a are connected by a conduit 37 and whose racks 38 and 39 are adjusted to actuate the reciprocating hammers 40 and 41

alternately. When the parts are in the position shown in the drawings, and the hammer 41 is released, it will impinge upon the tool 42 impelled by the expansive action of the fluid which being contained in the two communicating air spaces, will by its volume absorb the reactive force, and thus relieve the stationary parts of the engines from shocks and vibrations. Closely following the impact of the hammer 41, the other hammer 40 is retracted to compress the fluid in its original degree of density until released at the termination of its rearward stroke when the above operation is repeated, in reverse order. By adjusting the parts so that the one hammer will be released prior to the impact of the other hammer upon the respective tool, the reactive force upon the body of fluid will act upon the first named hammer and thereby augment the force with which it is impelled against the drill.

In the construction shown in Fig. 6, two alternately operating engines 44 and 45 are connected with one closed reservoir 46, the decrease in capacity of the air space in one being compensated by the proportionate increase in volume of the other. The reactive forces are, in this case, absorbed in the reservoir which is preferably separate from the engines, and connected therewith by flexible conduits 47 and 48. It will be understood that in this construction, any even number of engines may be connected with the reservoir, provided that the number in which the hammers are retracted at one time, is equal to that in which they move in the opposite direction.

As the operation of my invention has been referred to at intervals in the course of the foregoing description, no further explanation is deemed necessary at this point and it will be understood that I do not limit myself to the precise construction of the engine herein set forth, since various changes in the form, proportion and minor details, may be resorted to without departing from the spirit of the invention.

Having thus described my invention, what I claim is:—

1. The combination, with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, and means for varying the capacity of said reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element, to maintain the fluid in said space at a substantially constant pressure.

2. The combination, with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, and means for varying the capacity of said reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element to maintain the fluid in said space at a substantially constant pressure.

3. The combination with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, means for retracting said reciprocating element against the pressure of the fluid, means for releasing said reciprocating element at a predetermined point in its stroke, and means for varying the capacity of said reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element to maintain the fluid in said space at a substantially constant pressure.

4. The combination, with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, said reservoir having a pocket in communication with its interior, means for retracting said reciprocating element against the pressure of the fluid, means for releasing said reciprocating element at a predetermined point in its stroke, and means for varying the extent of the portion of said pocket in communication with said reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element.

5. The combination, with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, said reservoir having a pocket in communication with its interior, means for retracting said reciprocating element against the pressure of the fluid, and means for varying the extent of the portion of said pocket in communication with said reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element.

6. The combination, with a housing and a reciprocatory element fitted therein, of a reservoir of expansible motive fluid in continuous communication with the space in said housing at one side of said reciprocating element, said reservoir having pockets in communication with its interior, a rotary shaft, means actuated by the movement of said shaft for retracting said reciprocating element against the pressure of the fluid, means for releasing said reciprocating element at a predetermined point of its stroke, pistons fitted for reciprocation in said pockets, and

means on said shaft for actuating said pistons to vary the extent of the portions of said pockets in communication with the interior of the reservoir with relation to the variations in the extent of the space in said housing due to the movement of said reciprocating element.

In testimony whereof I have affixed my signature in presence of two witnesses.

GEORGE R. BENNETT.

Witnesses:
G. J. ROLLANDET,
M. L. GEARY.