No. 787,961. PATENTED APR. 25, 1905.

R. TEMPLE.

PNEUMATICALLY ACTUATED TOOL.

APPLICATION FILED AUG. 10, 1903. RENEWED FEB. 16, 1905.

7 SHEETS—SHEET 1.

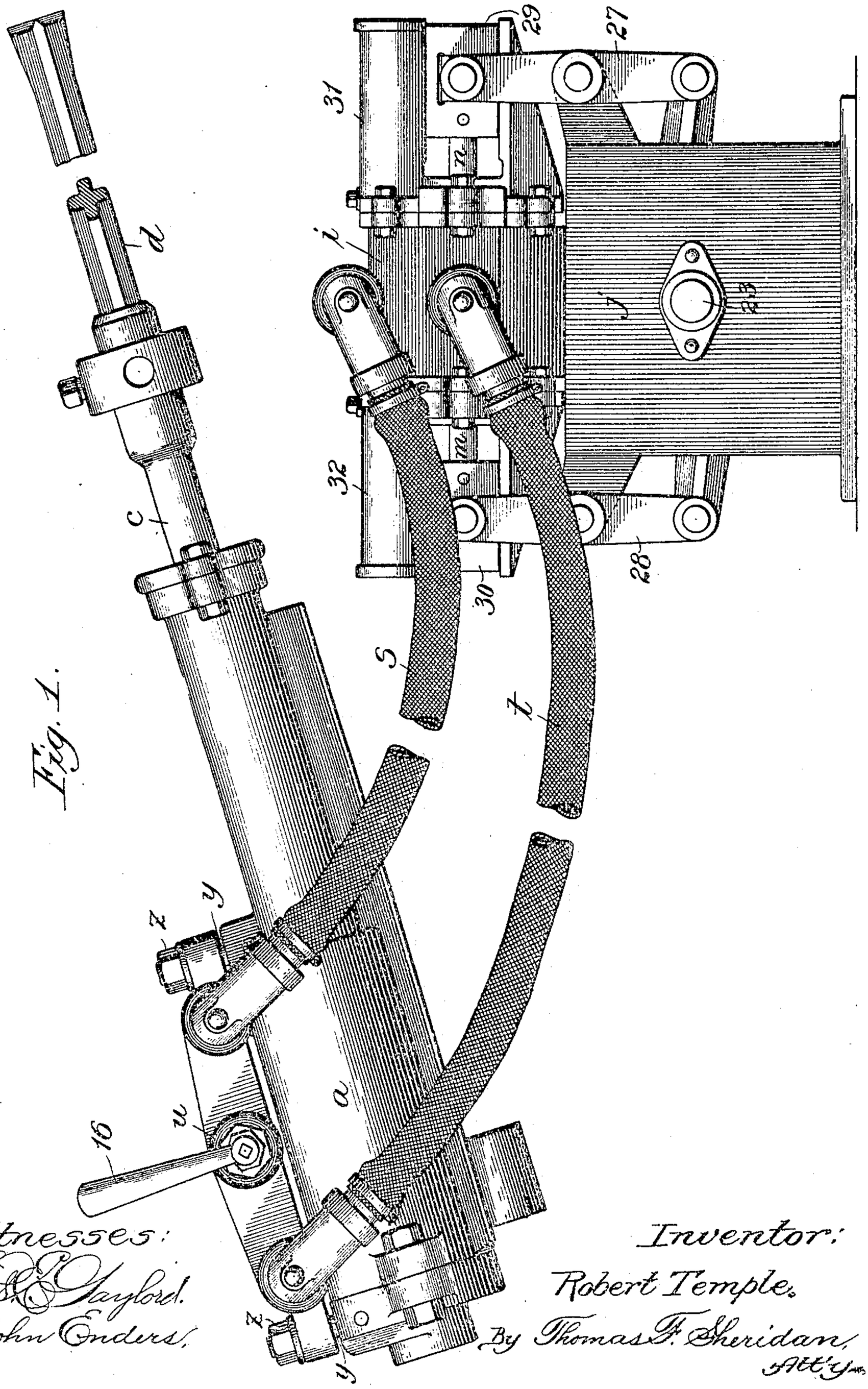

Fig. 1.

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
Robert Temple.
By Thomas F. Sheridan,
Att'y.

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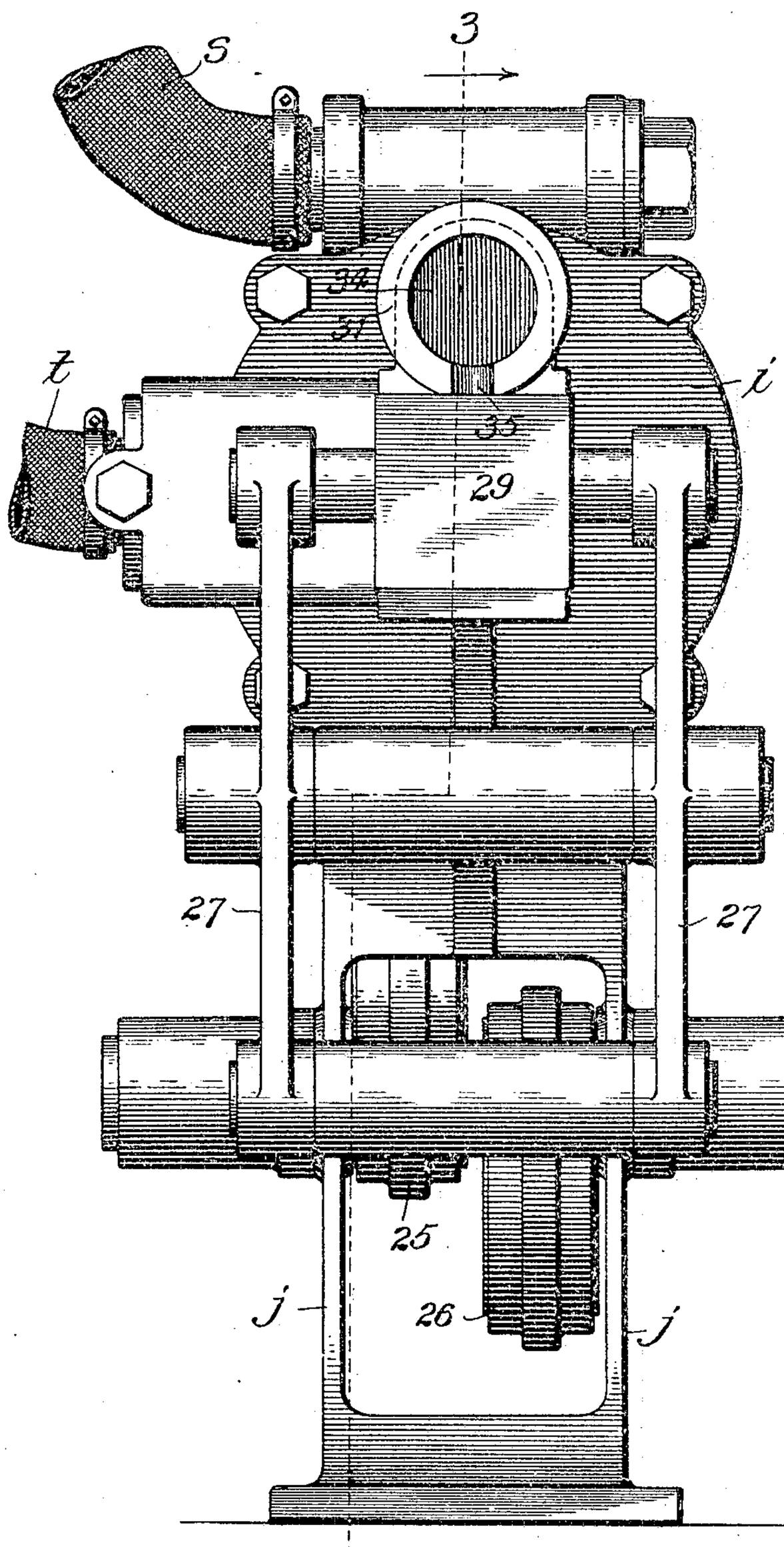

Fig. 2.

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
Robert Temple,
By Thomas F. Sheridan,
Att'y.

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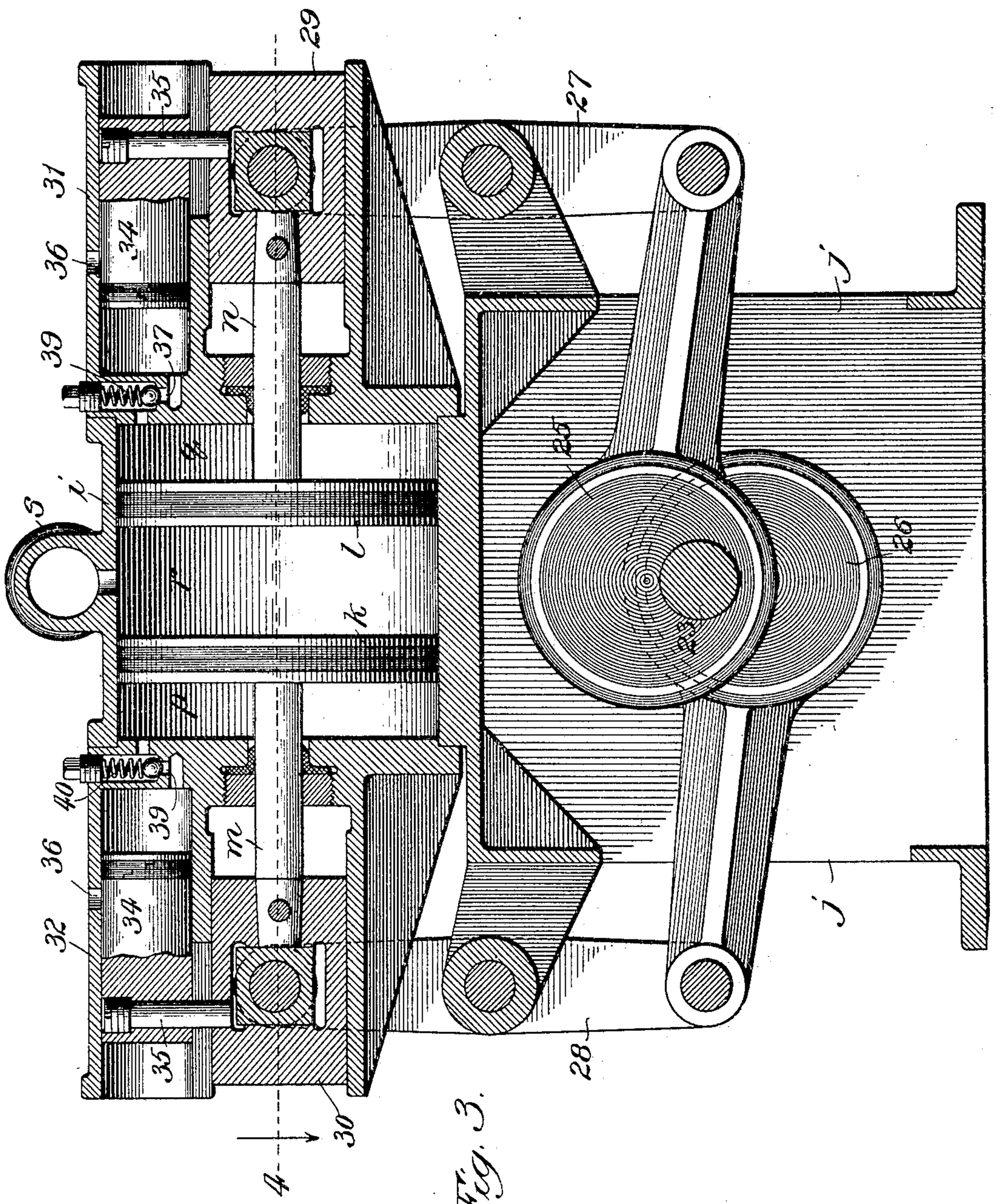

Fig. 3.

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
Robert Temple,
By Thomas F. Sheridan.
Att'y.

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7 SHEETS—SHEET 4.

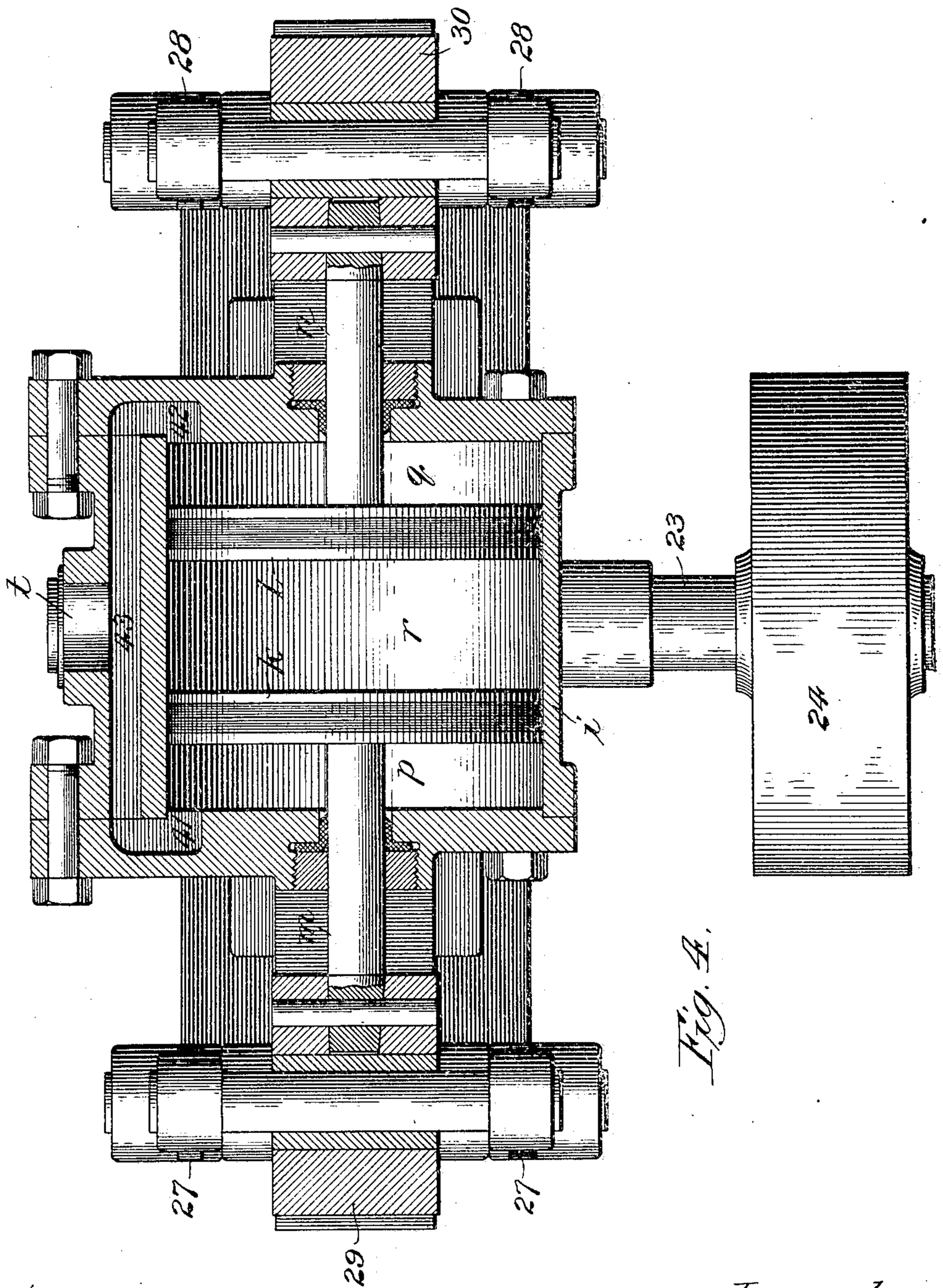

Fig. 4.

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
Robert Temple.
By Thomas F. Sheridan,
Att'y.

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7 SHEETS—SHEET 5.

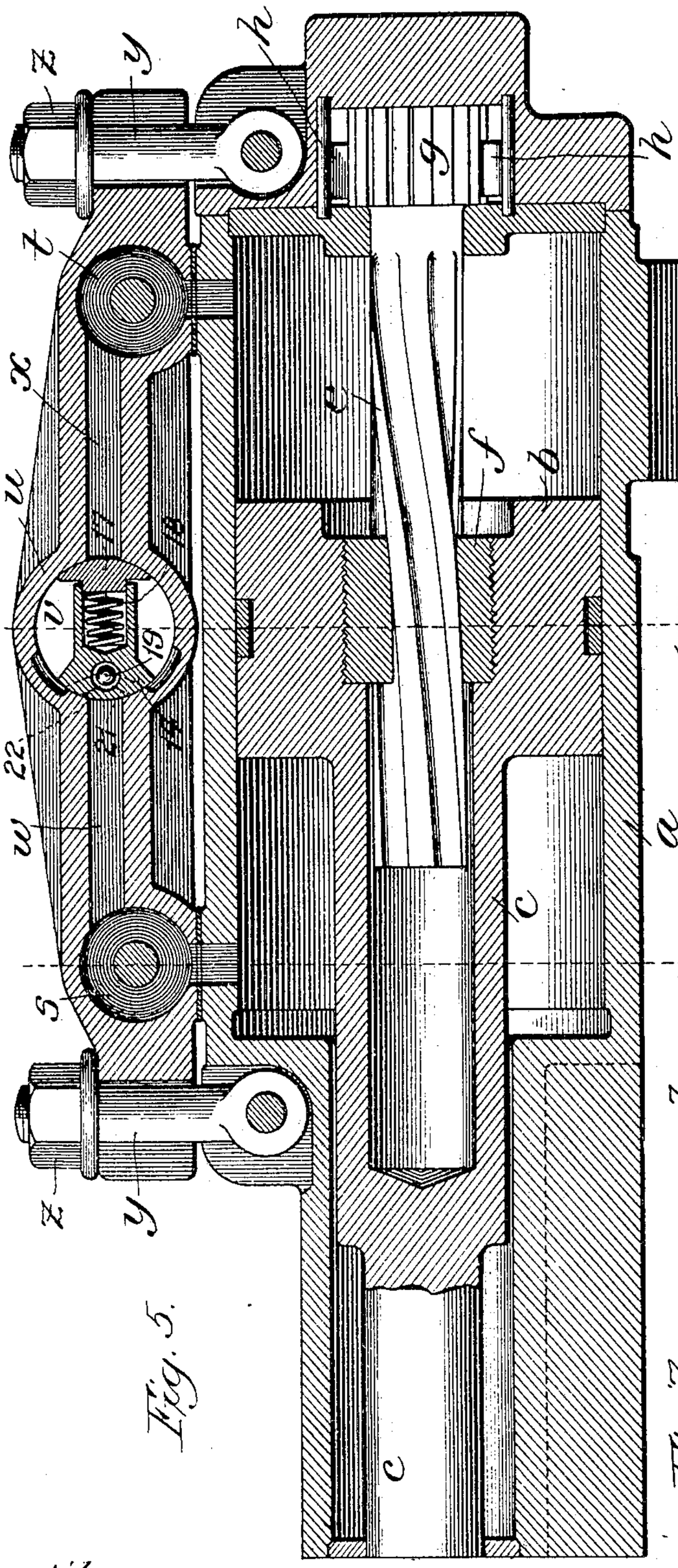

Fig. 5.

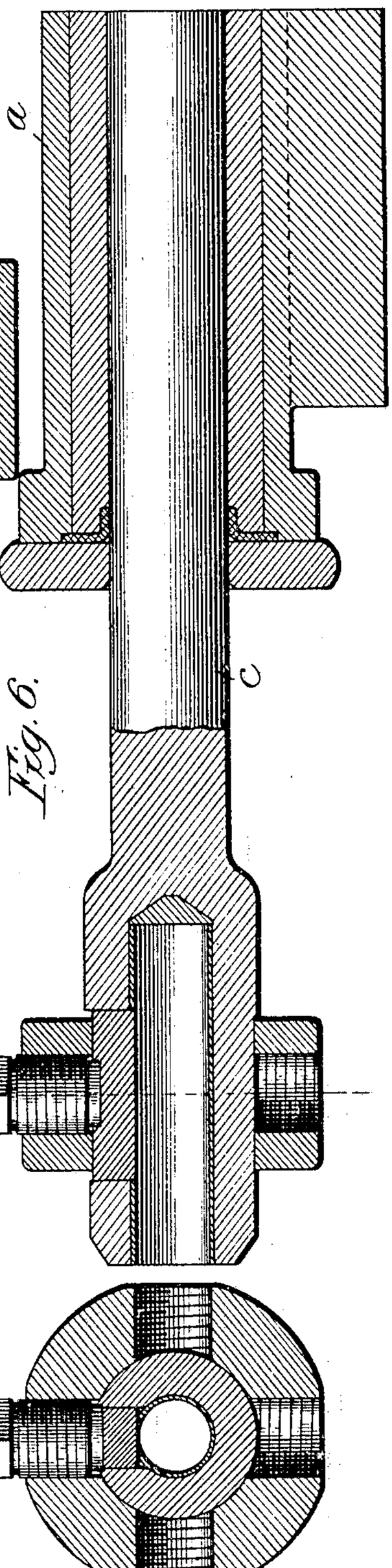

Fig. 6.

Fig. 7.

Witnesses:
Thos. E. Gaylord.
John Enders.

Inventor:
Robert Temple.
By Thomas F. Sheridan,
Att'y.

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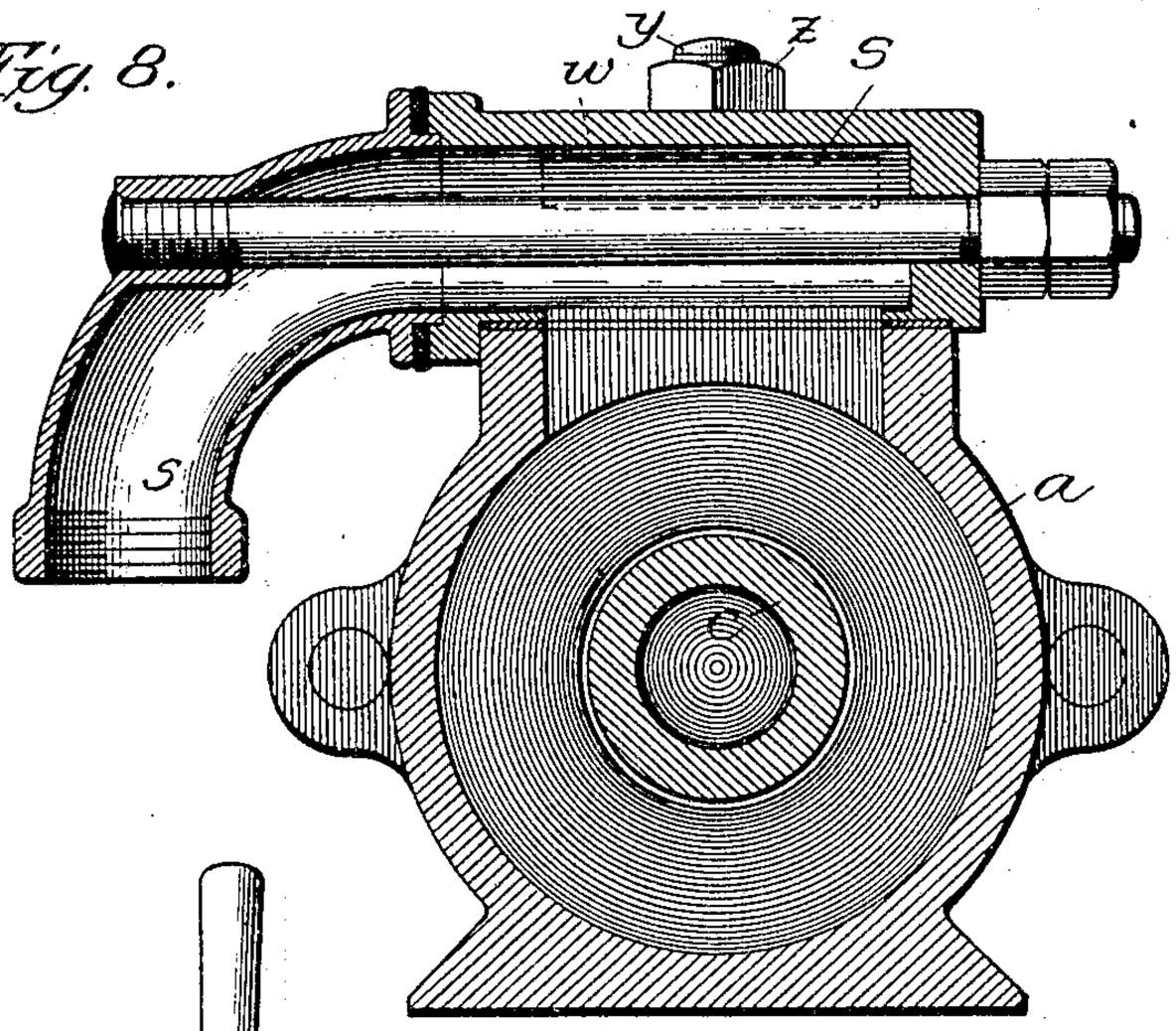
7 SHEETS—SHEET 6.

Fig. 8.



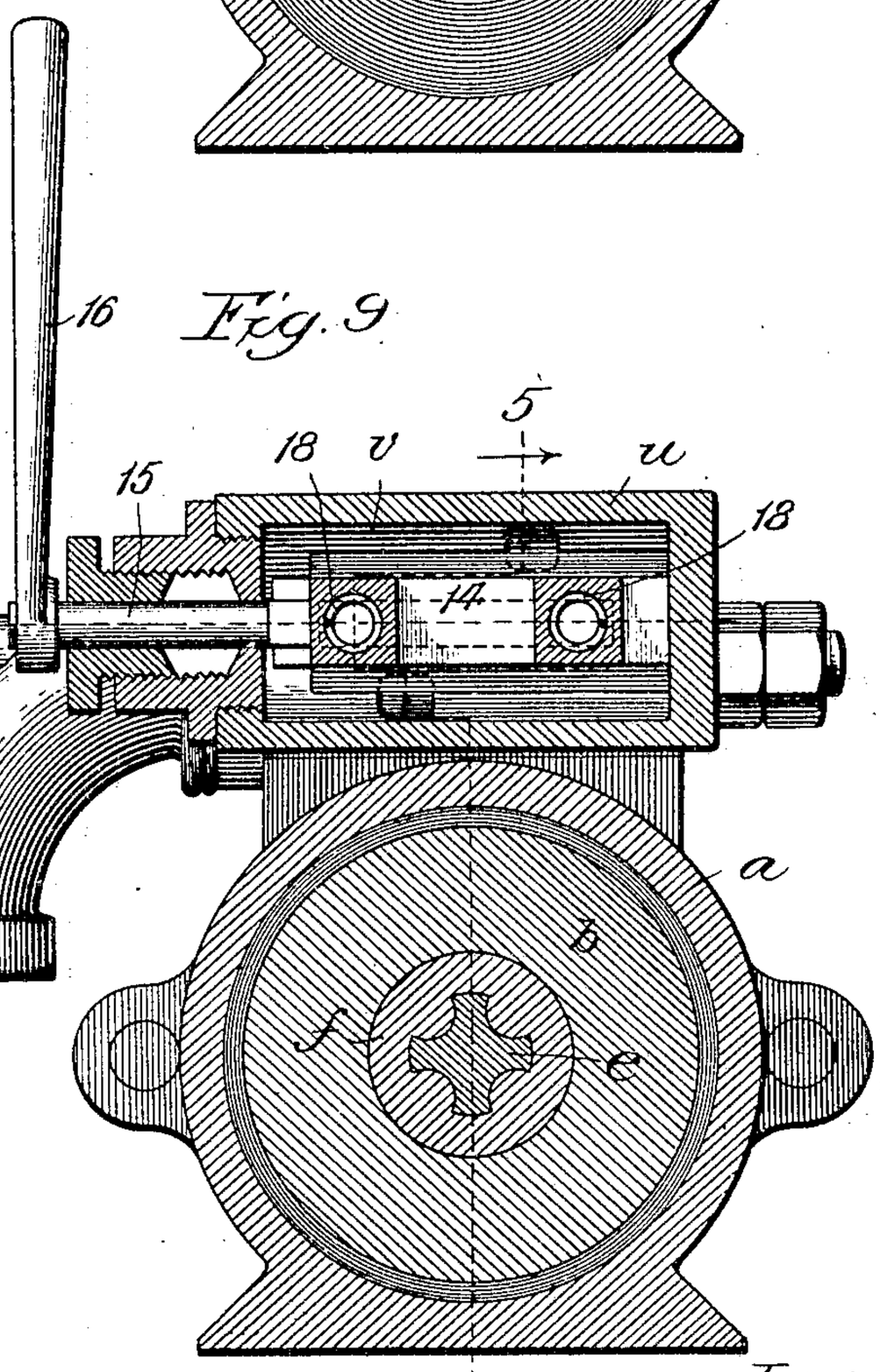


Fig. 9

Witnesses:
Chas. E. Gaylord.
John Enders.

Inventor:
Robert Temple,
By Thomas F. Sheridan,
Att'y.

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7 SHEETS—SHEET 7.

Fig. 10.

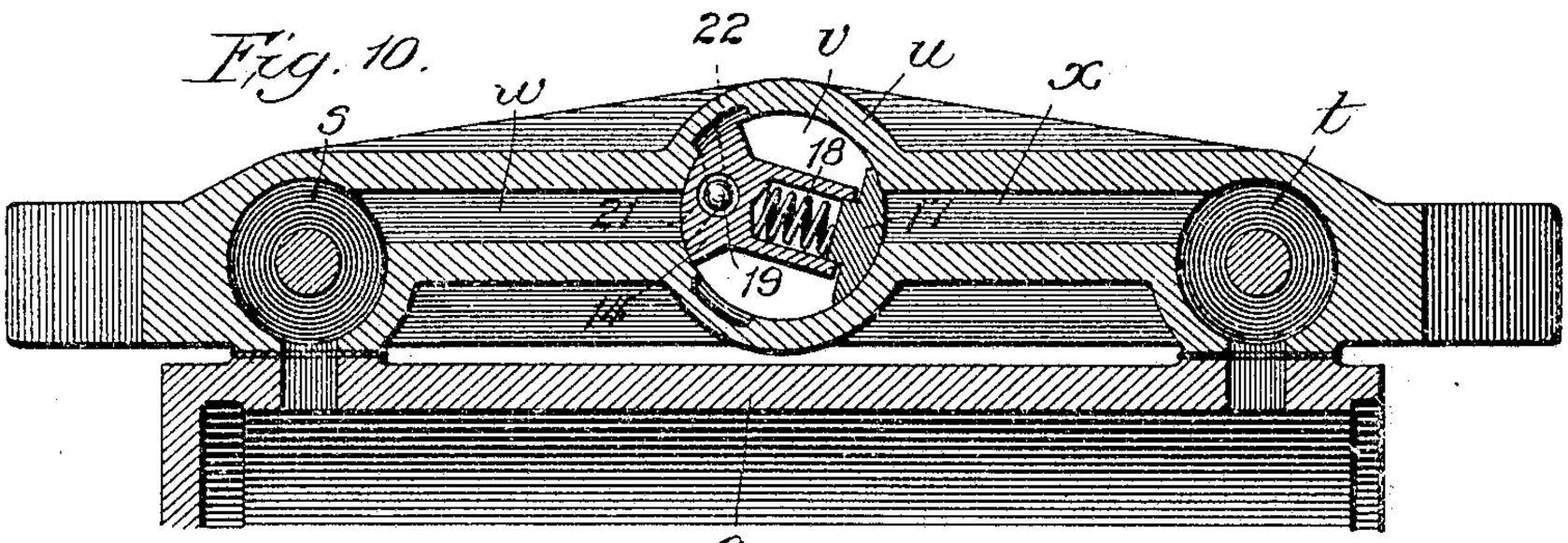


Fig. 11.

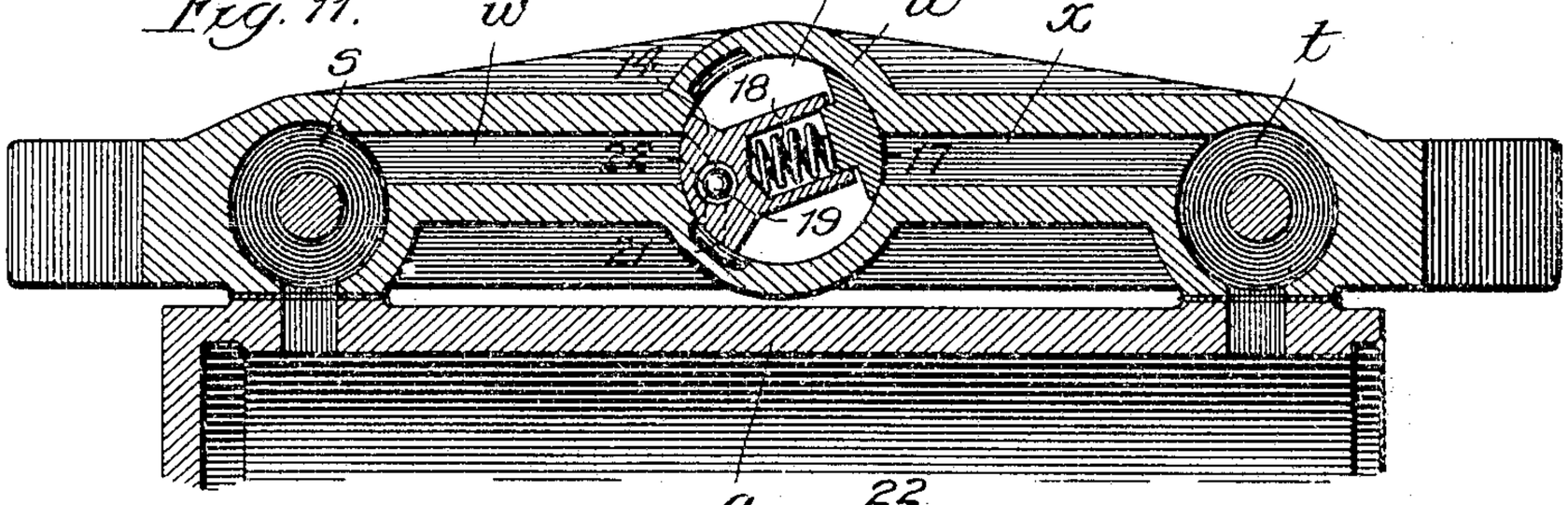


Fig. 12.

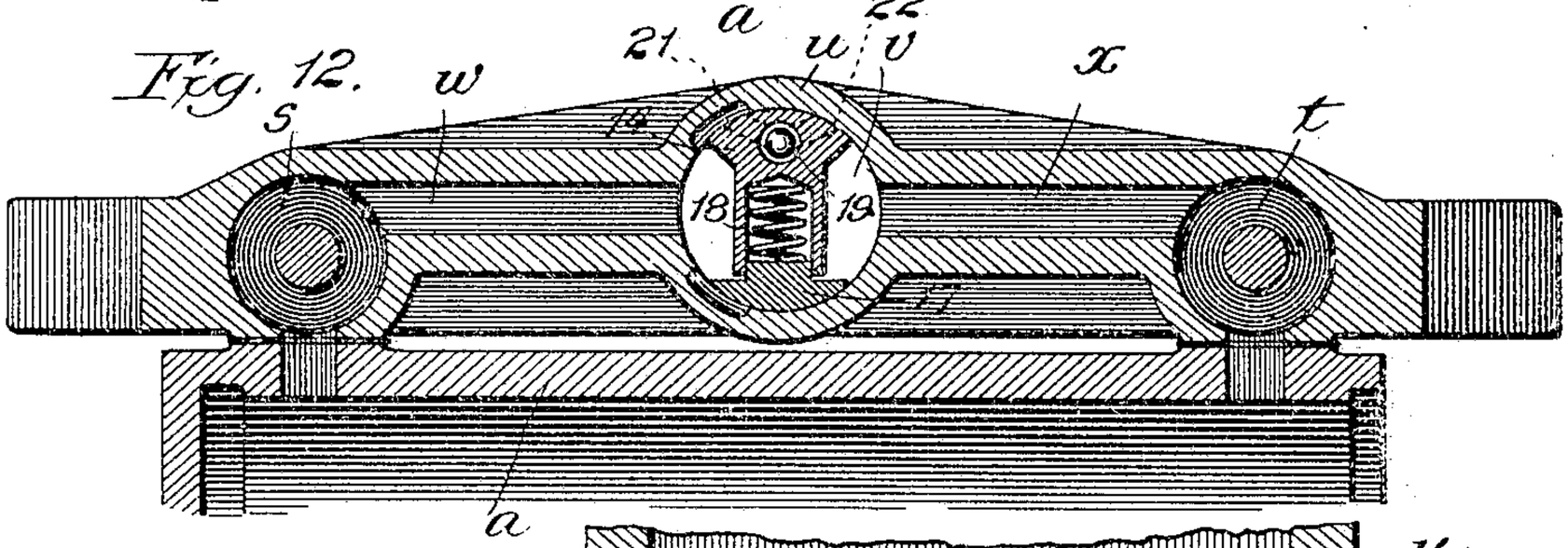
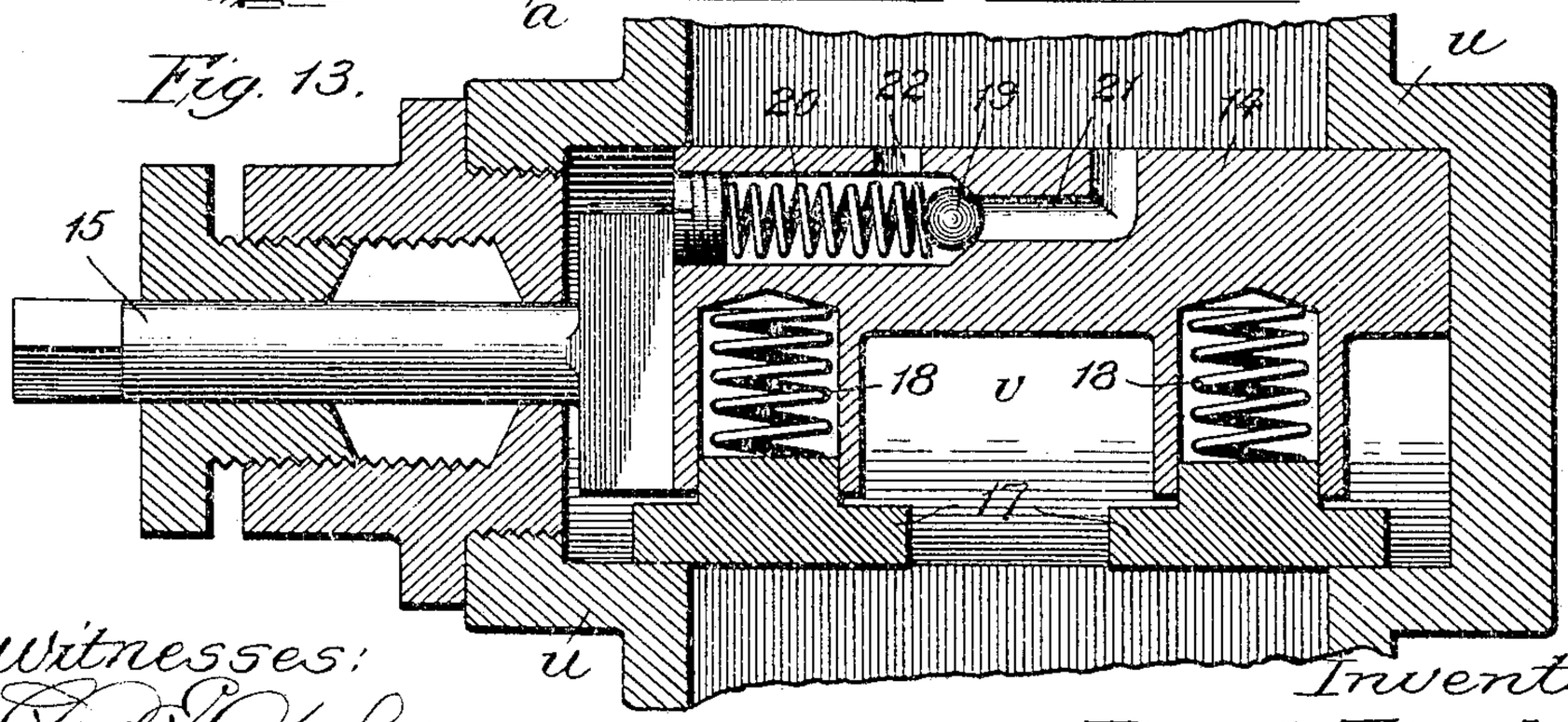


Fig. 13.



Witnesses:
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John Enders.

Inventor:
Robert Temple,
By Thomas F. Sheridan,
Att'y.

No. 787,961. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

ROBERT TEMPLE, OF DENVER, COLORADO, ASSIGNOR TO THE TEMPLE GAS ENGINE & MACHINE COMPANY, OF DENVER, COLORADO, A CORPORATION OF COLORADO.

PNEUMATICALLY-ACTUATED TOOL.

SPECIFICATION forming part of Letters Patent No. 787,961, dated April 25, 1905.

Application filed August 10, 1903. Renewed February 16, 1905. Serial No. 245,879.

To all whom it may concern:

Be it known that I, ROBERT TEMPLE, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Pneumatically-Actuated Tools, of which the following is a specification.

The invention relates to that class of tools which are capable of being actuated by means of fluid under pressure, preferably compressed air, and particularly to the means by which a circuit of compressed air is maintained for the purpose of pulsating the desired tool, all of which will more fully hereinafter appear.

The principal object of the invention is to provide simple, economical, and efficient means for pneumatically pulsating or actuating any desired reciprocating tool.

Other objects of the invention will appear from an examination of the drawings and the following description and claims.

The invention consists in the features, combinations, and details of construction hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of one type of tool as it appears when constructed in accordance with these improvements; Fig. 2, an enlarged end elevation of the pulsating-engine detached from the other parts; Fig. 3, a longitudinal sectional elevation taken on line 3 of Fig. 2 looking in the direction of the arrow; Fig. 4, a plan sectional view taken on line 4 of Fig. 3 looking in the direction of the arrow; Fig. 5, an enlarged sectional detail of the reciprocating tool-cylinder and other parts, taken on line 5 of Fig. 9 looking in the direction of the arrow; Fig. 6, a sectional view forming a combination of Fig. 5; Fig. 7, a cross-sectional detail taken on line 7 of Fig. 6 looking in the direction of the arrow; Figs. 8 and 9, cross-sectional views taken on lines 8 and 9, respectively, of Fig. 5 looking in the direction of the arrows. Figs. 10, 11, and 12 are cross-sectional views of the controlling-valve casing, showing the valve-chamber and controlling-valve therein in different positions, as more fully hereinafter appears; and Fig. 13, an enlarged longitudinal sectional view of the controlling-valve mechanism.

For illustrating and describing these improvements I have chosen a rock-drill and operating mechanisms as showing one type of machine to which these improvements are applicable. It will be understood, however, that the improvements may be used in connection with any kind of a reciprocating tool without involving any change in construction or arrangement so far as the spirit of the invention is concerned.

In the art to which this invention relates it is well known that in the use of a rock-drill, for instance, the drill is shoved forward under tremendous pressure and has to go forward a certain predetermined amount before it can be retracted, so that when operating in certain kinds of rock the engine will sometimes give but a short blow and refuse to move backwardly. This invention, therefore, is intended primarily to be an improvement on such type of engines, in that instead of using compressed air and exhausting it a circuit of air under pressure is maintained, which pulsates the reciprocating tool and which can be used to move the same backward and forward at any position of its stroke, all of which will more fully hereinafter appear.

In constructing a tool in accordance with these improvements and describing first the reciprocating tool-piston I provide a cylinder portion *a*, in which a reciprocating piston *b* is movably mounted. This reciprocating piston is provided with a piston-rod *c*, which extends outwardly through the front wall of the cylinder, as shown in Fig. 6, and to which any desired tool—in this instance the rock-drill *d*—may be secured, as shown in Fig. 1. In order to give the piston a step-by-step rotation during such reciprocations, a rifle-bar *e* is provided and rotatably mounted in the rear wall of the piston. The body of this rifle-bar engages with a rifled nut *f* in said piston, and the head is provided with ratchet-teeth *g* on its circumference engaged by dogs or pawls *h*, which permit it to be rotated in

but one direction only and compel the step-by-step rotation of the piston and attached tool in the other direction. To furnish a circuit of air for this reciprocating tool-cylinder and reciprocate its piston, a pulsating-engine is provided having a cylinder portion *i* mounted upon a base portion *j*. This cylinder portion is preferably provided with two reciprocating or pulsating pistons *k* and *l* to obtain a mechanical balance, which in turn are provided with piston-rods *m* and *n*, respectively, projecting through opposite heads of the pulsating-cylinder. This pulsating-cylinder or the chambers *p*, *q*, and *r* thereof, which are formed at each end of and between the pulsating pistons, are connected with both ends of the reciprocating tool-cylinder by means of flexible tubes *s* and *t*, all of which permit independent movements of the tool without disturbing the engine. The flexible tube *s* connects the chamber *r* of the pulsating-tool with the chamber at the left-hand end of the reciprocating tool-piston, as shown in Fig. 5, while the flexible tube *t* connects both of the chambers *p* and *q* with the chamber at the right-hand end of the reciprocating tool-piston, as shown in Fig. 5. The result is that as the pulsating pistons come together air in the chamber *r* of the pulsating-engine is forced out through pipe *s* to the left-hand or front side of the tool-piston, while the chambers *p* and *q* of the pulsating-engine are being enlarged, thus permitting the air in the right-hand or rear end of the reciprocating tool-piston to be exhausted or forced into chambers *p* and *q* of the engine to maintain the circuit of air, the advantage of which will be apparent to those skilled in the art. It is desirable to have this circuit of air under control—that is, to maintain or equalize the pressure at both ends of the pulsating pistons and reciprocating tool-piston as well or to transfer a portion of the air under pressure from the chamber at one end of the tool-cylinder to the chamber at the other end of the tool-cylinder whenever desirable or necessary so to do. In order so to do, a controlling-valve casing *u* is provided with a supplementary passage formed by a valve-chamber *v* and passages *w* and *x*, which are connected with the flexible pipes *s* and *t*, and with the same detachably secured to the tool-cylinder (see Fig. 5) by means of the eyebolts *y* and nuts *z*. In this valve-chamber is arranged a rotary controlling-valve 14, the stem 15 of which extends out through one wall thereof and is provided with a handle portion 16. This controlling-valve is provided with one solid curved surface and two yielding buttons 17, diametrically opposite and held at their outer limit of motion by means of the coiled springs 18. The controlling-valve is further provided with a ball check-valve 19, held upon its seat by means of a coiled spring 20. The ball-valve closes a passage 21, and the chamber in which said ball-valve operates is provided with a passage 22. The construction is such that when the parts are arranged as shown in Fig. 10 the air will enter the passage *w* from the pipe *s* through the passage 21 underneath the ball-valve, so that when such air under pressure exceeds a certain amount—that is, if the pressure in the pipe *s* is in excess of that in the pipe *t*—the compressed air will raise the ball check-valve 19 and permit a portion thereof to flow through passage 22 out of the valve-chamber *v* and passage *x* into pipe *t* and from either or both such pipes will flow into both the chambers in the reciprocating tool-cylinder, thus equalizing the pressure therein, as well as in the different chambers of the pulsating engine-cylinder. When the rotary valve is rotated in a reverse direction to the position shown in Fig. 11, the reverse is true—that is, any excess of fluid-pressure in pipe *t* will flow through from passage *x*, through passage 21, raise the ball-valve, pass out through passage 22 into passage *w*, and thence into pipe *s*. When it is desired to stop the pulsations of the reciprocating tool altogether, the controlling-valve is moved to the position shown in Fig. 12, and a short circuit of air is formed through the flexible tubes and passages in the valve-casing. Again, the operator can vibrate this controlling-valve at any time he desires and limit the pulsations of the reciprocating tool-piston at any time desired or modify the length and force of its stroke, all of which will appear from an examination of the drawings.

It is necessary to use some prime mover to operate the mobile parts of the pulsating-engine, and in order so to do I prefer to provide such engine with a shaft 23, which in turn is provided with a driven pulley 24, arranged to be connected with any desired prime mover, such as a steam-engine or electric motor. This driving-shaft is provided with a pair of eccentrics 25 and 26, that are connected with levers 27 and 28, engaging cross-heads 29 and 30. These cross-heads are respectively connected with the piston-rods *n* and *m*, so as to reciprocate the same. In other words, the rotations of the driving-shaft by means of this eccentric and lever mechanisms are converted into reciprocating motions of the pulsating pistons.

It is desirable to furnish the chambers in this pulsating-engine with fluid under pressure—viz., compressed air—and I prefer to prime these chambers with compressed air by means of compressing-engines attached thereto and formed as follows: Compressing-cylinders 31 and 32 are provided, in which pistons 33 and 34 reciprocate. The reciprocations of these pistons are obtained by connecting each piston with one of the cross-heads by means of screw-threaded pins 35. Each compressing-cylinder is provided with an inlet-port 36, arranged in such relation that the

compressing-pistons alternately open and close the same to admit air and after its admission to compress it. Each of the chambers in these compressing-cylinders is connected with the chambers *p* and *q* of the pulsating-engine by means of the passages 37 and 38, in which spring-pressed ball check-valves 39 and 40 are arranged. It will be seen, therefore, that when air under pressure is obtained in either or both of these compressing-chambers they will raise the ball-valve against tension of the coil-springs and permit compressed air to flow into both chambers *p* and *q*, from which it may flow out through the ports 41 and 42 into the passage 43 and out through the pipe *t* to one end of the tool-cylinder. The chamber *r* of the pulsating-engine may be charged with air by placing the rotary controlling-valve in the position shown in Fig. 12. After equalization of the charging has taken place the valve may be thrown in either of the positions shown in Figs. 10 and 11 and equalization maintained. It will be understood that the positions of the compressing-pistons are so timed that they provide a compressing-chamber of a certain size at the finish of their strokes, so that compressed air up to a certain pressure only is provided, which will build up and maintain a certain predetermined pressure in the pulsating-engine at all times.

In this type of machine it will be seen that a circuit of air can be furnished by the pulsating-engine of any desired elasticity, so as to provide for practically a solid impact at high pressures and an elastic impact at medium pressures. In the medium pressures the reciprocating tool is first retained until its inertia is overcome by the pressure behind it, when it is released to be driven forward with a rapid pulsation and strike a quick and effective blow. It will also be seen that with a pulsating engine constructed in accordance with these improvements and combined with a reciprocating tool of any desired type almost any kind of work can be done—work which requires light rapid strokes, work that requires medium speedy strokes with elastic heavy blows, and work that requires heavy forceful blows of solid impact with very little yielding resistance—all of which will be understood and appreciated by those skilled in the art.

From the foregoing description of construction and operation it will be seen that the cylinder in which the pulsating pistons are operated and the cylinder in which the tool-piston is operated have each both sides connected with both sides of the other cylinder, so as to form a closed circuit throughout of air under pressure. Stated otherwise, both ends of the pulsating engine-cylinder—that is, at each side of the pulsating-pistons therein—are connected with the corresponding ends of the tool-cylinder and at both sdies of the reciprocating tool-piston therein, so that any air which leaks past one piston or the other will remain in the system and not be lost, merely effecting the differential pressure, which can be regulated or controlled by the controlling-valve mechanism hereinbefore described. This is an important step in the economy of the art in that it saves the expense of generating motive fluid to make up that which is lost, all of which will be understood and appreciated by those skilled in the art.

I claim—

1. In mechanisms of the class described, the combination of a pulsating engine-cylinder, piston mechanism movably mounted therein, a tool-cylinder, piston mechanism reciprocatingly mounted therein and dividing the tool-cylinder into two chambers, tubular mechanism connecting the chambers of the tool-cylinder and pulsating engine-cylinder together, a passage connecting both chambers of the tool-cylinder together, check-valve mechanism in such passage, and a manually-operatable controlling-valve for throwing the check-valve mechanism into and out of operative position, substantially as described.

2. In mechanisms of the class described, the combination of a pulsating engine-cylinder, piston mechanism reciprocatingly mounted therein, a tool-cylinder, reciprocating piston mechanism therein and dividing the tool-cylinder into two chambers, tubular mechanism connecting the chambers of the tool and pulsating engine cylinders together, a passage connecting both chambers of the tool-cylinder together, and a manually-operatable controlling-valve provided with a check-valved passage mounted in the last-named passage, substantially as described.

3. In mechanisms of the class described, the combination of a pulsating engine-cylinder, piston mechanism reciprocatingly mounted therein, a tool-cylinder connected with the pulsating engine-cylinder, a reciprocating piston movably mounted in the tool-cylinder and dividing the same into two chambers, a passage connecting both ends of the tool-cylinder together, check-valve mechanism in said passage, and means for moving said check-valves so as to reverse the direction of flow of air from one chamber of the tool-cylinder to the other and vice versa, substantially as described.

4. In mechanisms of the class described, the combination of a pulsating engine-cylinder mechanism, reciprocating piston mechanism movably mounted therein and providing in connection therewith a plurality of generating-chambers, a tool-cylinder, a reciprocating piston mounted therein and dividing the same into two chambers, tubular mechanism connecting both chambers of the tool-cylinder with the several chambers of the pulsating engine-cylinder mechanism, a passage connecting both ends of the tool-cylinder to-

gether, a manually-operated controlling-valve mounted therein and provided with automatic check-valve mechanism arranged to be moved into three positions—one position which connects both ends of the tool-cylinder together so as to permit an excess of compressed air to pass from one end of the tool-cylinder to the other and when moved in a second position to reverse the arrangement and permit any excess of compressed air in the last-named end of the tool-cylinder to pass to the first-named end, and a third position where all connection between both ends of the tool-cylinder is cut of, substantially as described.

5. In mechanisms of the class described, the combination of a pulsating engine-cylinder, reciprocating piston mechanism movably mounted therein and dividing the same into a plurality of generating-chambers, a tool-cylinder, a reciprocating piston mounted therein and dividing the same into two chambers, tubular mechanism connecting both chambers of the tool-cylinder with the several chambers of the pulsating engine-cylinder, a supplementary passage connecting both ends of the tool-cylinder and thereby the tubular connections between the same and the pulsating engine-cylinder, a manually-operated controlling-valve mounted therein and provided with automatic check-valve mechanism arranged to be moved into three positions—one position which connects both ends of the tool-cylinder together so as to permit an excess of compressed air to pass from one end of the tool-cylinder to the other and when moved in a second position to reverse the arrangement and permit any excess of compressed air in the last-named end of the tool-cylinder to pass to the first-named end, and a third position where all connection between both ends of the tool-cylinder is cut off, substantially as described.

6. In mechanisms of the class described, the combination of a pulsating engine-cylinder, reciprocating piston mechanisms movably mounted therein and dividing the same into a plurality of generating-chambers, a tool-cylinder, a reciprocating piston mounted therein and dividing the same into two chambers, tubular mechanism connecting both chambers of the tool-cylinder with the several chambers of the pulsating engine-cylinder, a supplementary passage connecting both ends of the tool-cylinder and thereby the tubular connections between the same and the pulsating engine-cylinder, a manually-operated controlling-valve mounted therein and provided with automatic check-valve mechanism arranged to be moved into three positions—one position which connects both ends of the tool-cylinder together so as to permit an excess of compressed air to pass from end of the tool-cylinder to the other and when moved in a second position to reverse the arrangement and permit any excess of compressed air in the last-named end of the tool-cylinder to pass to the first-named end, and a third position where all connection between both ends of the tool-cylinder is cut off, and a controlling-valve casing *u* detachably secured to the tool-cylinder and having therein the supplementary passage above named, substantially as described.

7. In tools of the class described, the combination of a tool-cylinder, a reciprocating piston therein provided with a piston-rod extending out therefrom to which any desired tool may be secured, a pulsating engine-cylinder, two reciprocating pistons mounted therein and provided with a piston-rod extending out through opposite ends of the engine-cylinder, cross-heads on such piston-rods, eccentric and lever mechanism for operating said cross-heads and thereby the pulsating pistons, two flexible tubes connecting the chambers formed by the pistons in the pulsating engine-cylinder with each end of the reciprocating tool-piston, controlling-valve mechanism arranged in the connections between the two cylinders to control the circuit of air and govern the pulsations of the reciprocating tool-piston, a compressing-cylinder connected with the pulsating engine-cylinder, a reciprocating piston therein connected with the cross-head mechanism so as to be moved thereby and prime or build up and maintain the fluid-pressure in the pulsating engine-cylinder, and check-valve mechanism arranged in the connections between the compressing and pulsating engine-cylinder, substantially as described.

ROBERT TEMPLE.

Witnesses:
THOMAS F. SHERIDAN,
HARRY IRWIN CROMER.