No. 661,300. Patented Nov. 6, 1900.

T. M. & F. L. ANTISELL.

EXPLOSIVE GAS ENGINE.

(Application filed Oct. 5, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

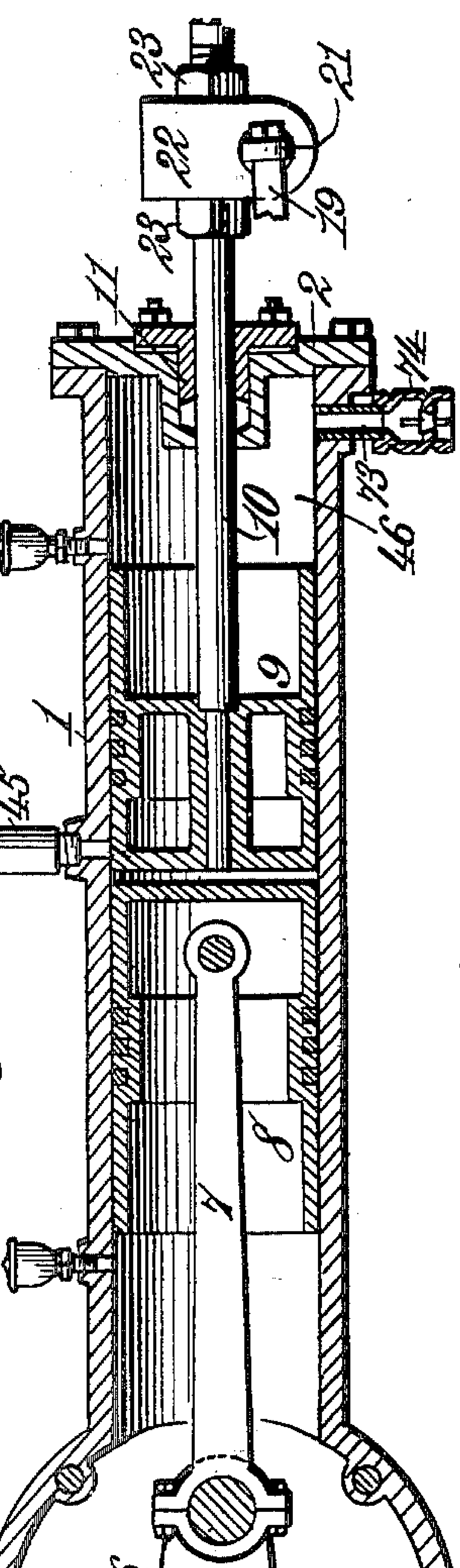
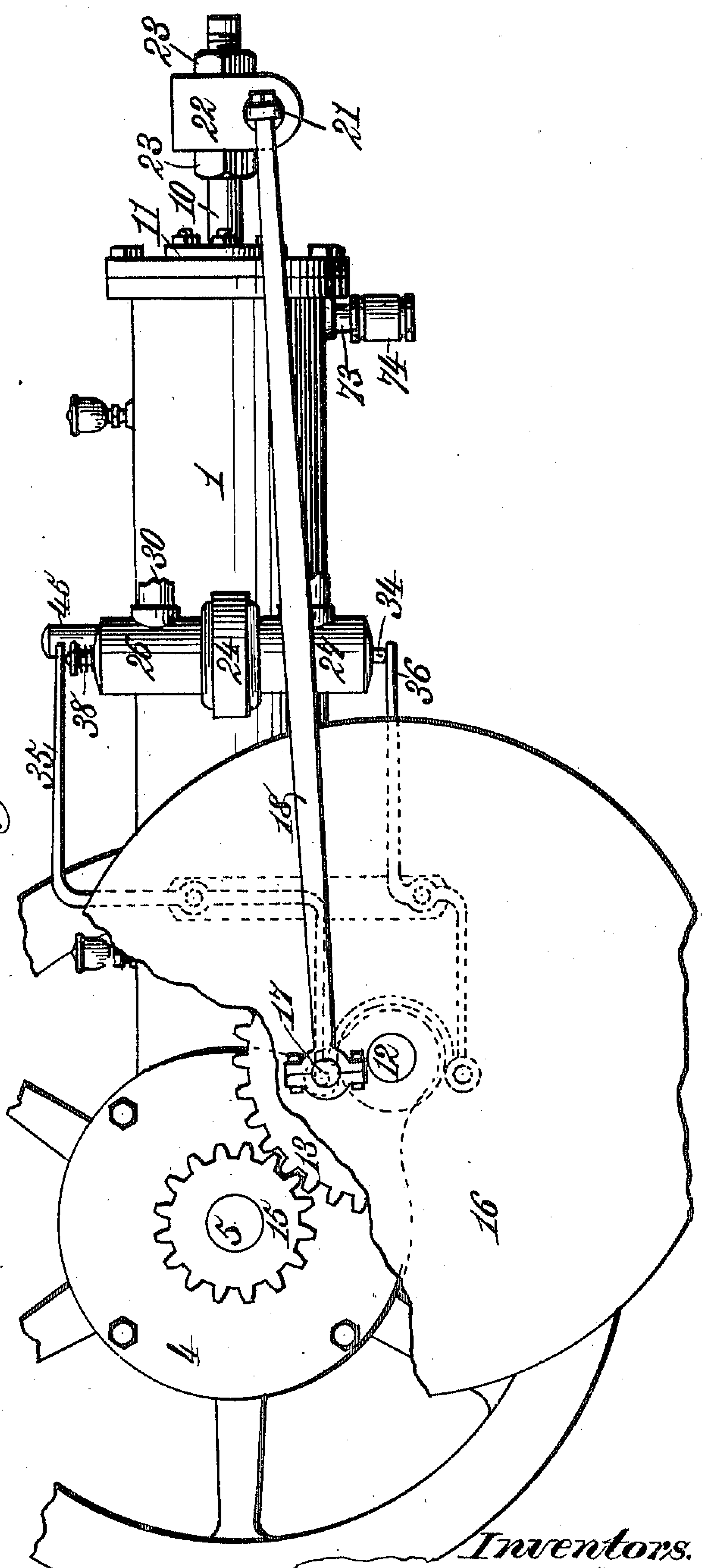


Fig. 2.



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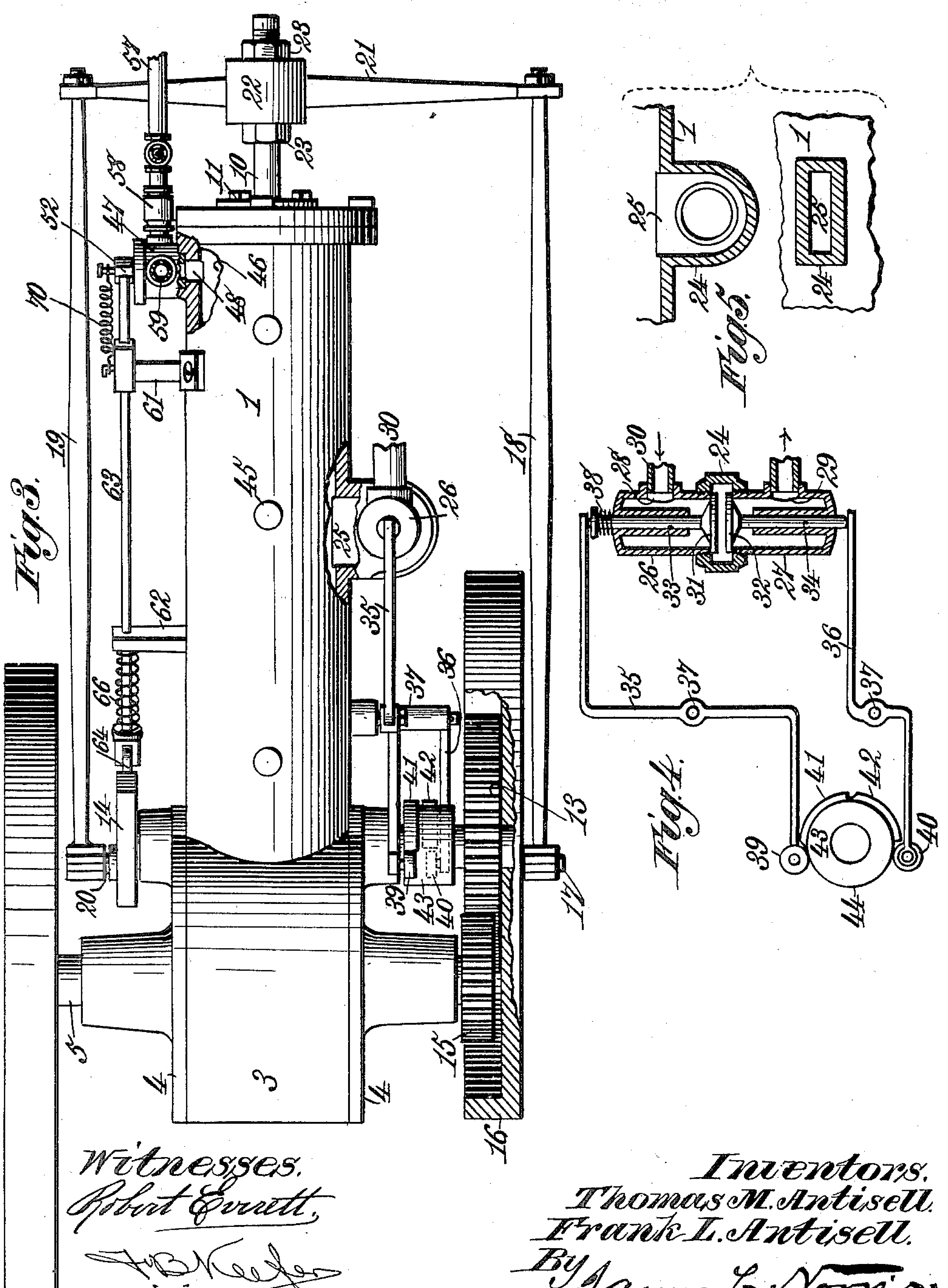
(No Model.) 4 Sheets—Sheet 2.



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(No Model.) 4 Sheets—Sheet 3.

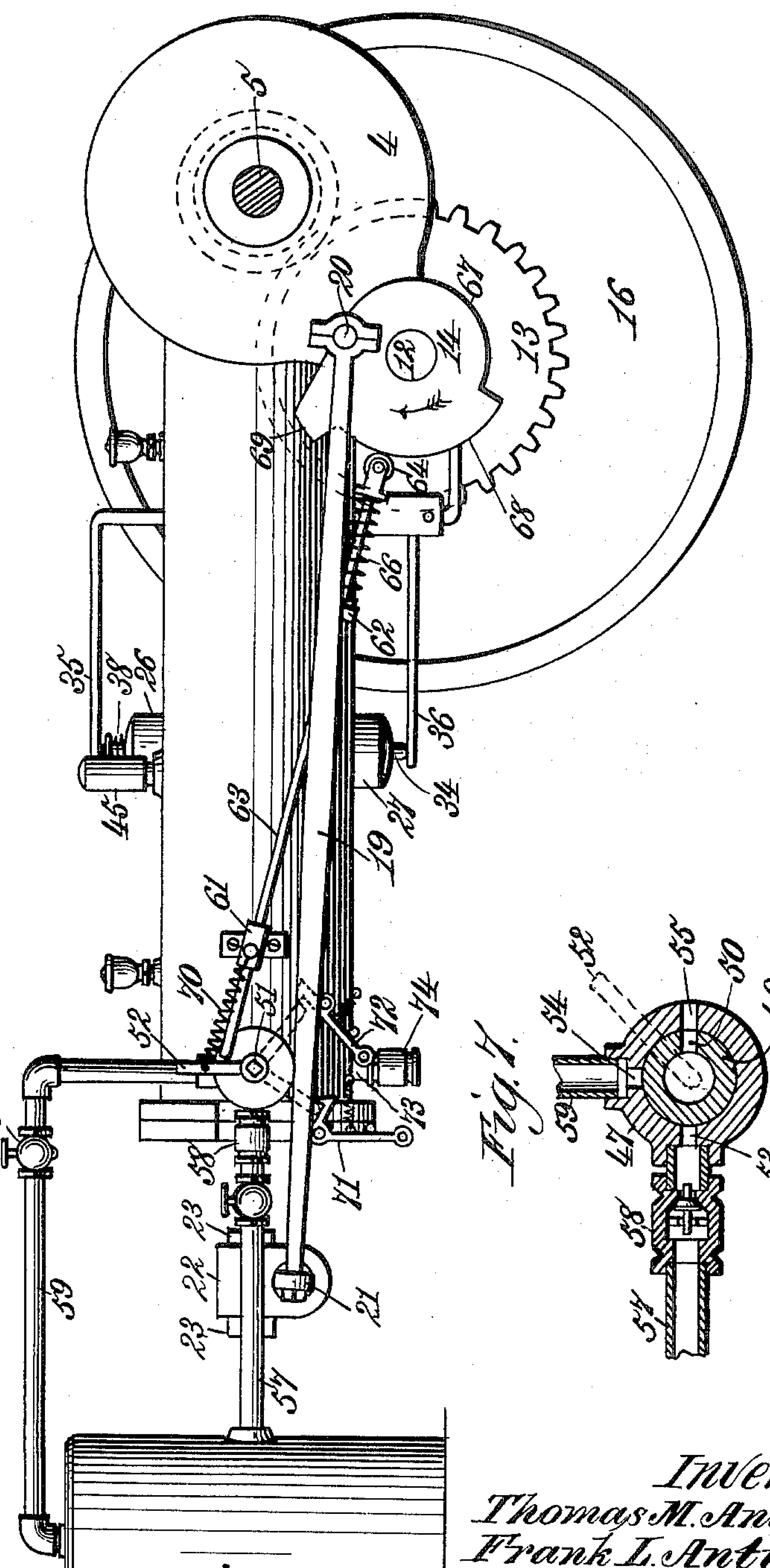

Fig. 6.

Fig. 7.

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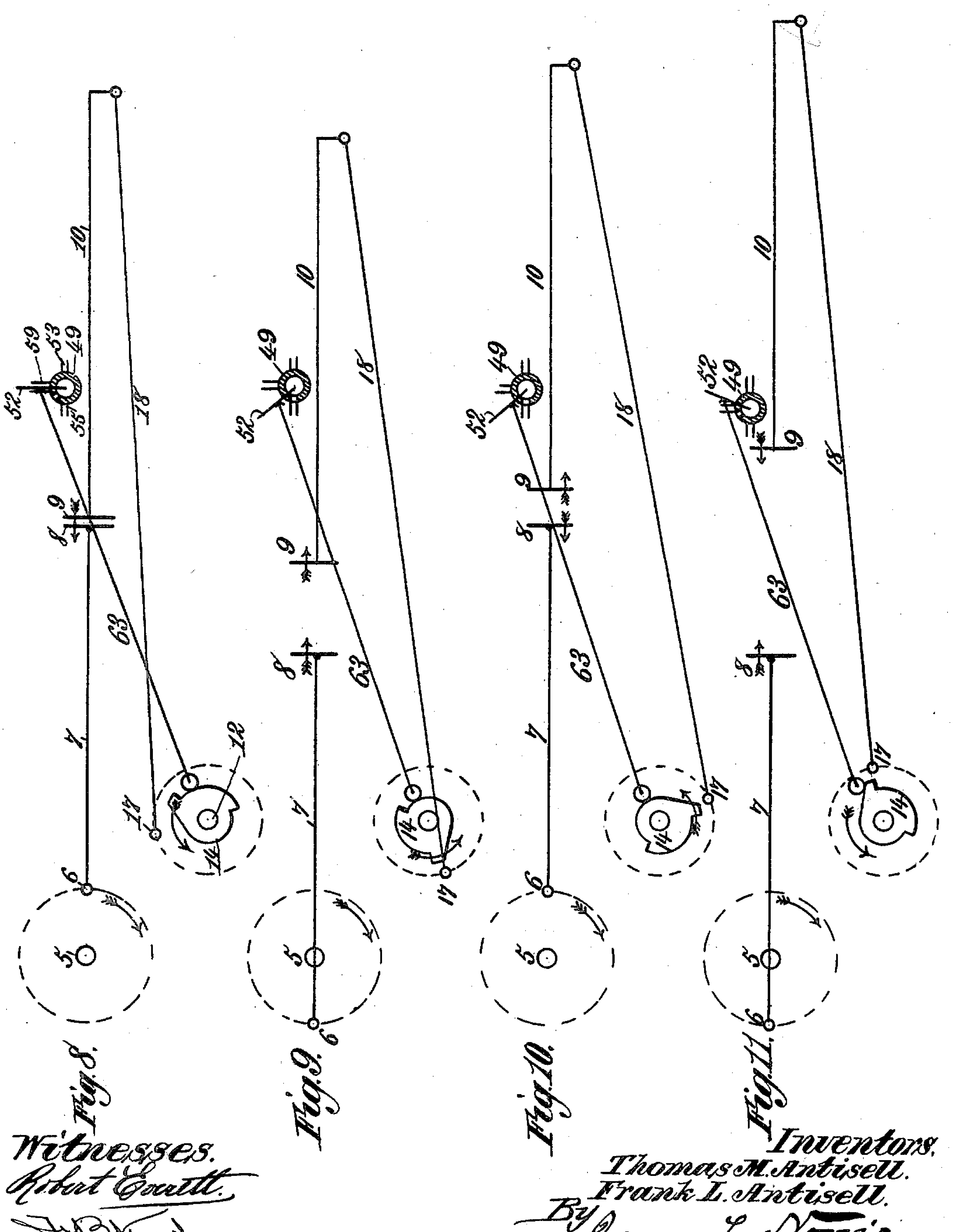
(No Model.) 4 Sheets—Sheet 4.



Witnesses.
Robert Everett.
J. B. Keefer

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UNITED STATES PATENT OFFICE.

THOMAS M. ANTISELL AND FRANK L. ANTISELL, OF MATAWAN, NEW JERSEY.

EXPLOSIVE-GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 661,300, dated November 6, 1900.

Application filed October 5, 1899. Serial No. 732,661. (No model.)

To all whom it may concern:

Be it known that we, THOMAS M. ANTISELL and FRANK L. ANTISELL, citizens of the United States, residing at Matawan, in the county of Monmouth and State of New Jersey, have invented new and useful Improvements in Explosive-Gas Engines, of which the following is a specification.

This invention relates to explosive-gas engines, and especially to such engines designed for the propulsion of automobiles or horseless vehicles.

The present invention is of that type of explosive-gas engines wherein are employed a single cylinder and two pistons reciprocating in the cylinder at different speeds, but geared together in such manner that they coöperate to drive a shaft common to both; and it has for its objects, first, to provide in such an engine improved means whereby a cushion, such as compressed air, is formed and utilized for more equally distributing the power generated by the explosive force of the gas; second, to combine with such an engine improved means whereby the engine is caused to compress and store up a body of air which is utilized as a source of energy to aid in the propulsion of the engine when traveling up steep gradients, and, lastly, to provide certain other improvements and to increase the efficiency of this class of engines generally.

To these ends the invention consists in the features and in the construction, combination, and arrangement of parts hereinafter described, and particularly pointed out in the claims following the description, reference being had to the accompanying drawings, forming a part of this specification, wherein—

Figure 1 is a vertical central longitudinal sectional view of the cylinder and pistons. Fig. 2 is a view in elevation thereof, illustrating the means for gearing the pistons together and for actuating the inlet and exhaust valves. Fig. 3 is a top plan view, partly broken away, of the parts shown in Fig. 2. Fig. 4 is a detail sectional view of the inlet and exhaust valves and the means for actuating them. Fig. 5 is a detail sectional view of the valve casing and port. Fig. 6 is a view in elevation illustrating the means for storing up compressed air and utilizing it as an auxiliary source of energy for operating the engine, and Fig. 7 is a detail sectional view of the valve controlling the air. Figs. 8 to 11 are diagrammatic views illustrating the movements of the pistons.

Before proceeding to describe the invention in detail it should be explained that the engine works in cycles of four operations, as follows: First, suction of inflammable charge; second, compression of charge; third, explosion of the charge and operative stroke of the pistons, and, fourth, exhaust of the burned gases, the pistons being arranged and operating in such manner that the ratio of compression of the gases before ignition shall be less than the ratio of expansion after explosion, and whereby nearly the entire volume of burned gases is exhausted from the cylinder after each explosion.

Referring to the drawings, the numeral 1 indicates the cylinder of uniform diameter throughout its length and closed air-tight at one end by a cylinder-head 2. The other end of the cylinder is made in the form of a circular casing 3, to the opposite sides of which are bolted cover-plates 4. Journaled centrally in the cover-plates is the main shaft 5, which is cranked, as at 6, and journaled on said cranked portion is one end of a piston-rod 7, the other end of which is pivotally connected to one of the pistons 8. To the other piston 9 is rigidly attached one end of a piston-rod 10, the opposite end of which passes through a stuffing-box 11, arranged centrally in the cylinder-head 2.

Journaled in suitable bearings beneath the cylinder is a shaft 12, on one end of which is fixed a gear-wheel 13 and on the opposite end a cam-wheel 14, the gear-wheel 13 engaging a gear-wheel 15 of one-half its size fixed on the end of the main shaft 5. Also fixed on the shaft 12 is a fly-wheel 16, which may in practice be formed with or attached to the gear-wheel 13, and fitted eccentrically in the fly-wheel is a wrist-pin 17, on which is journaled one end of a connecting-rod 18. A corresponding connecting-rod 19 is in like manner connected at one end to a wrist-pin 20, fixed in the cam-wheel 14, and the other ends of said connecting-rods are attached to a cross-beam

21, journaled in a head-block 22 on the free or outer end of the piston-rod 10. The head-block is adjustably held in place on the piston-rod 10 by two nuts 23, threaded onto the piston-rod on each side of the cross-head.

The piston 8 moves at double the speed of the piston 9, or, in other words, while the piston 8 is making one full stroke the piston 9 is making but one-half a stroke. Hence the ratio of the diameters of the said gear-wheels is as two is to one, whereby the pistons coöperate to drive the main shaft 5. This will be better understood by referring to the diagrams illustrated in Figs. 8 to 11, wherein Fig. 8 shows the position the pistons are in after a charge of gas has been exploded and exhausted and the suction-stroke is about to take place to draw in a fresh charge of gas. When in this position, the pistons, as shown, will nearly be in contact with each other. The pistons will then both move in the same direction or toward the left; but as the piston 8 moves twice as fast as the piston 9 they will be in position shown in Fig. 9 at the end of the next cycle and during this movement will have drawn in a charge of gas. The pistons next move in the opposite direction, or toward the right, and as the piston 8 moves twice as fast as the piston 9, as before explained, they will approach each other until they assume the position shown in Fig. 10, during which movement the charge of gas is compressed. When the pistons are in this position, the charge is ignited, the explosion forcing the pistons apart to the position shown in Fig. 11. This movement of the pistons constitutes their effective stroke, and they then move toward each other to exhaust the burned gases until they return to the position shown in Fig. 8.

The valve mechanism by means of which the described cycle of movements of the pistons is obtained is constructed and arranged as follows: Cast on one side of the cylinder is a sleeve or collar 24, which communicates by means of a rectangular port 25, formed in the side of the cylinder, with the interior of the latter. The upper and lower ends of the sleeve 24 are interiorly threaded, and screwed therein are two short tubes 26 and 27, which are closed at their outer ends and are respectively provided with ports 28 and 29, the port 28 being for the admission of gas and the port 29 being an exhaust-port. The gas is conveyed to the port 28 by a pipe 30, leading from a suitable carbureter (not shown) or any other suitable source of supply. Arranged within the sleeve 24 are two valves 31 and 32, which are adapted to respectively seat against the ends of the tubes 26 and 27 and which are respectively provided with stems 33 and 34, that extend through the ends of the tubes. The end of the valve-stem 33 is engaged by the free end of a bell-crank lever 35, and the end of the valve-stem 34 is engaged by the free end of a corresponding bell-crank lever 36. Said bell-crank levers are pivoted intermediate their ends, as at 37, and their free ends, or those ends in engagement with the valve-stems, are made resilient, whereby they bear on the valve-stems with a yielding pressure. A coiled spring 38 is arranged between the headed outer end of the valve-stem 33 and the end of the tube 26 and acts to normally hold the valve 31 closed against its seat against the pressure of the gas. Journaled on the ends of the bell-crank levers 35 and 36 are friction-rollers 39 and 40, which are respectively adapted to be engaged by segmental cams 41 and 42, formed on the periphery of a wheel 43, fixed on the shaft 12. As shown most clearly in Fig. 3 of the drawings, the bell-crank levers 35 and 36 are pivoted, so as to oscillate in different vertical planes, and the cams 41 and 42 are correspondingly formed on the opposite sides of the face of the wheel 43. As shown, each of said cams extends one-quarter around the circumference of the cam-wheel and are so arranged that their adjacent ends would be intersected by a straight line drawn transversely across the periphery of the cam-wheel. When both rollers 39 and 40 are in engagement with the circular face or low portion 44 of the cam-wheel, the valves will be closed, as shown in Fig. 4, the valve 31 being held to its seat by the coiled spring 38 and the valve 32 being held to its seat by gravity.

Let it now be assumed that the pistons have just discharged the burned gases resulting from a previous explosion and are in the position shown in Fig. 8. Then the parts of the valve mechanism will be in the position shown in Fig. 4. As the pistons commence to move to assume the position shown in Fig. 9, however, the roller 39 will be engaged by the cam 41, and the valve 31 will be forced down against the valve 32 by the bell-crank lever 35 and will be held thereagainst during one-quarter revolution of the cam-wheel 43 or until the pistons are in the position shown in Fig. 9. While the valve 31 is in this position and while the pistons are assuming the position shown in Fig. 9 the gas will be drawn through the port 30, tube 26, and port 25 into the cylinder; but the instant the pistons reach the position shown in Fig. 9 the cam 41 passes from beneath the roller 39, and the spring 38 thereupon lifts the valve 31 to its seat and shuts off the further admission of gas. During the next quarter-revolution of the cam-wheel 43, or while the pistons are moving from the position shown in Fig. 9 to that shown in Fig. 10, the rollers 39 and 40 will be in engagement with the low portion of the cam-wheel and both valves will be closed in the manner before described, and hence the charge of gas in the cylinder will be compressed and will be in readiness for ignition. The compressed charge of gas is ignited by an igniter 45, which forms no part of the present invention and is not therefore described or shown in detail. The gas is ignited while the pistons are in the position shown in Fig. 10, and the explosion forces the pistons apart to the position shown in Fig. 11, during which movement of the pistons the cam-wheel makes another quarter of a revolution, with the rollers 39 and 40 still in engagement with the low portion of the cam-wheel and the valves consequently closed. When the pistons commence to return to the position shown in Fig. 9, however, the cam 42 engages the roller 40, whereby the valve 32 is lifted and forced against the valve 31 and is held in this position for one-quarter of a revolution of the cam-wheel, which corresponds to the length of the cam 42 and to the movement of the pistons from the position shown in Fig. 11 to that shown in Fig. 9, and during such movement of the pistons, therefore, the burned gases will be discharged through the port 25, tube 27, and exhaust-port 29. When the pistons have returned to the position shown in Fig. 8, the parts of the valve mechanism will return to the positions shown in Fig. 4 in readiness for the admission of a fresh charge of gas when the pistons commence their next stroke in the manner before described.

It will be noted that at the time the gas is exploded, or when the pistons are in the position shown in Fig. 10, the connection between the connecting-rod 18, actuated by the piston 9 and the gear-wheel 13, (the fly-wheel 16 and gear-wheel 13 being preferably formed in one or connected together, as before explained,) is at the point where the movement of the piston will exert its most effective force on the gear-wheel, while the piston-rod 7 of the piston 8 is on the dead-center; but as soon as the piston 9 has moved the gear-wheel 12 a very slight distance the piston-rod 7 will be thrown off the dead-center and the piston 8 will then be thrust forward by the explosive force of the gas and will communicate its movement to the crank-shaft 5. In this manner both pistons will operate to transmit the energy developed by the explosion to the work to be accomplished by the engine. The momentum of the fly-wheel 16 will operate to move the pistons through the cycle of movements occurring between the explosions; but such movements are further effected and the energy developed by the explosions is more uniformly distributed and over a greater period of each cycle by closing the end of the cylinder by means of the head 2, thereby forming an air-tight chamber 46 in rear of the piston 9. Hence when the two pistons are thrust apart by the explosion of the gas to the position shown in Fig. 11 the air in the chamber 46 will be compressed, and when the pistons on their next stroke move to assume the position shown in Fig. 8 the compressed air in the chamber 46 will expand and exert its expansive force in propelling the piston 9 forward. In this manner the piston 9 is positively driven by a propulsive force in opposite directions. The air compressed by the piston 9 is further utilized as an auxiliary propelling agency in the following manner:

The numeral 47 indicates a cylindrical valve-casing formed on or attached to the chamber end 46 of the cylinder and communicating with the interior of the latter by a port 48. Rotatably arranged in said valve-casing is a hollow cylindrical valve 49, communicating at one end with the port 48 and provided in its side with a port 50. The valve 49 is provided with a stem 51, which projects through the outer end of the valve-casing and is provided with a lever 52, by means of which the valve may be turned. The valve-casing is provided with three ports 53, 54, and 55, each of which is adapted to register with the valve-port 50, the said ports being formed at angles of ninety degrees to one another, as most clearly shown in Fig. 7 of the drawings.

The numeral 56 indicates a tank which communicates with the port 53 by a pipe 57, in which is arranged a check-valve 58, and also communicates with the port 54 by a pipe 59, in which is arranged a hand-operated valve 60. Arranged to reciprocate in fixed guides or bearings 61 and 62 is a rod 63, one end of which is provided with a roller 64 and the other end thereof is adapted to engage the valve-lever 52. The roller 64 is held in constant engagement with a cam 14 by a coiled spring 66, said cam being fixed on the shaft 12. As shown most clearly in Figs. 6 and 8 to 11, inclusive, approximately one-half of the circumference of the cam is formed plain or circular, as at 67, while the remaining portion consists of an arc-shaped portion 68, having a radius of greater length than the portion 67 and terminating in a radially-extending beveled projection 69. The valve-lever 52 is held in engagement with the end of the rod 63 by a coiled spring 70, one end of which is attached to the valve-lever and the other end to any suitable fixed support—as the guide 61, for example. Pivoted latches 71 and 72 are arranged in such manner that they operate to engage the end of the valve-lever 52 and hold the latter and the valve 49 fixed in certain positions, as will hereinafter be explained.

The arrangement of parts immediately above described is such that when the pistons are in the position shown in Fig. 8 the roller 64 will be in engagement with the intermediate portion 68 of the cam 65, and hence the rod 63 will move the valve 49 into such position that the port 50 will lie intermediate the ports 54 and 55 and there will be no communication between the chamber 46 and the atmosphere. As the pistons move to the position shown in Fig. 9, however, to draw in a charge of gas the piston 9 draws in a charge of air through an inlet hereinafter described, and during the latter part of such movement the roller drops onto the low portion 67 of the cam and the spring 70 turns the valve so that the port 50 registers with the port 55 and puts the chamber 46 into communication with the atmosphere, and the piston 9 draws into said chamber a charge of air. As the pistons move to the position shown in Fig. 10 the roller 64 continues in engagement with the low portion of the cam and the valve remains in its described position. Hence the piston 9 expels the charge of air previously drawn in. As the pistons assume the position shown in Fig. 11, however, after the explosion the roller 64 rides up on the high portion 69 of the cam, and at the moment the pistons commence to approach each other to assume the position shown in Fig. 8 the valve will be turned so as to throw the port 50 into register with the port 54, thereby admitting a charge of compressed air from the tank 56 into the chamber 46 behind the piston 9 and forcing the latter forward into the position shown in Fig. 8, and as the air is cut off from said chamber as the pistons move to the position shown in Fig. 9 the charge of compressed air will act by its expansive force to move the piston 9 to the last-described position. At the end of this movement of the pistons the port 50 will be again thrown into register with the port 55 to permit the air to exhaust. In practice the aid of the charge of compressed air in the tank will only be needed on certain occasions when an increased load is placed upon the engine—as, for example, when the vehicle is ascending a hill. Ordinarily the valve-lever will be thrown by hand into position to be held by the latch 72, when the port 50 will lie diametrically opposite the port 54, and hence there will be no communication between the chamber 46 and the atmosphere. At such time the piston 9 will alternately compress the air in the chamber 46 and permit it to expand in the manner and for the purpose heretofore described.

To store up the compressed air in the tank 56, the valve 60 is first closed and the valve-lever 52 then turned into position to be held by the latch 71, when the port 50 will register with the port 53. The piston 9 will then alternately operate to draw a charge of air into the chamber 46 through a pipe 73, provided with a check-valve 74, and expel the charge through the pipe 57 into the tank. When the air has been sufficiently charged into the reservoir, the valve-lever is again turned into position to be engaged by the latch 72 and is held in this position until the stored body of air is needed to aid in propelling the engine, when the operator throws the valve-lever by hand into the position shown by full lines in Fig. 6 and opens the valve 60, whereupon the compressed air operates to drive the piston 9 in the manner before described. In practice the valve 49 will be turned into position to store up the compressed air when the vehicle is moving downgrade, and the compressed air will be admitted to the cylinder to actuate the piston 9 as the vehicle moves on upgrades.

While the engine has been described and is especially designed for propelling vehicles, it will of course be understood that it may be used for various purposes and especially where the load placed upon the engine is variable.

While we have shown and described in this application an arrangement of multiple pistons working at different speeds and a special valve mechanism for controlling the admission of the gas and exhaust of the burned gases, we make no claim thereto in the present application, the same being shown and described merely because it is necessary to do so to render clear the operation of the engine.

Having described our invention, what is claimed is—

1. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, an air-inlet communicating with the interior of the air-chamber, an outwardly-closing check-valve in the air-inlet, an air-outlet communicating with the atmosphere, a compressed-air tank, means for alternately conveying the compressed air from the tank into the air-chamber and exhausting it from the latter to actuate the piston, means for throwing the tank out of communication with the air-chamber, and means for closing the air-outlet at will, the arrangement being such that air may be alternately compressed and expanded in the air-chamber to act as a cushion for the piston, may be compressed and stored in the tank, or may be conveyed from the tank and alternately admitted to and exhausted from the air-chamber to aid the gas in actuating the piston, all at the will of the operator, substantially as described.

2. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, an air-inlet communicating with the interior of the air-chamber, an outwardly-closing check-valve in said inlet, an air-outlet communicating with the atmosphere, a compressed-air tank, means for alternately conveying the compressed air from the tank into the air-chamber and exhausting it therefrom to actuate the piston, means for throwing the tank out of communication with the air-chamber, and means for opening and closing the air-outlet at will, the arrangement being such that the air may be alternately drawn in and expelled from the air-chamber, may be alternately compressed and expanded in said chamber to form a cushion for the piston, may be compressed and stored in the tank, or may be conveyed from the tank and alternately admitted to and exhausted from the air-chamber to aid the gas in actuating the piston, all at the will of the operator, substantially as described.

3. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, a compressed-air tank, a three-way-valve casing having one port for conveying air compressed in the air-chamber to the tank, another port for conveying compressed air from the tank to the air-chamber, and a third port communicating with the atmosphere, a valve arranged in said casing having a single port communicating with the air-chamber, and means for throwing said valve-port into communication with either of the three ports in the casing and for throwing it out of communication with all three of them, substantially as described and for the purpose specified.

4. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, a compressed-air tank, a three-way-valve casing having one port for conveying air compressed in the air-chamber to the tank, another port for conveying compressed air from the tank to the air-chamber, and a third port communicating with the atmosphere, a valve arranged in said casing having a single port communicating with the air-chamber, means for throwing said valve-port by hand into communication with the port leading to the tank or out of communication with all three of said ports, and mechanism automatically actuated by the engine for alternately throwing the valve-port into communication with the port leading from the tank and with the port leading to the atmosphere, substantially as described.

5. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, a compressed-air tank, a three-way-valve casing having one port for conveying air compressed in the air-chamber to the tank, another port for conveying compressed air from the tank to the air-chamber, and a third port leading to the atmosphere, a rotatable valve arranged in the casing and having a single port leading to the air-chamber, a lever on the valve for turning said valve to throw its port into register with any one of the three ports in the valve-casing or out of register with all of them, substantially as described and for the purpose specified.

6. In a gas explosive-engine, the combination with a cylinder, of a piston arranged therein, said cylinder having a gas-explosion chamber on one side of the piston and an air-compressing chamber on the other side thereof, a compressed-air tank, a three-way-valve casing having one port for conveying air compressed in the air-chamber to the tank, another port for conveying compressed air from the tank to the air-chamber, and a third port leading to the atmosphere, a rotatable valve arranged in said casing and having a single port communicating with the air-chamber and also arranged to register with either of the ports in the casing or be thrown out of register with all of them, a handle on the valve, a reciprocating rod arranged to engage said handle to alternately throw the valve-port into register with the port leading from the tank and the port leading to the atmosphere, a cam arranged on the engine-shaft for reciprocating the rod, a spring for holding the valve-lever in engagement with the rod, and pivoted latches for holding the valve-lever to maintain the valve-port in communication with the port leading to the tank or out of communication with all three ports, substantially as described.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

THOMAS M. ANTISELL.
FRANK L. ANTISELL.

Witnesses:
J. ARTHUR McDERMOTT,
A. BARTLETT ANTISELL.