No. 759,975. PATENTED MAY 17, 1904.

O. C. DURYEA & M. C. WHITE.

VALVE ACTION FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 28, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

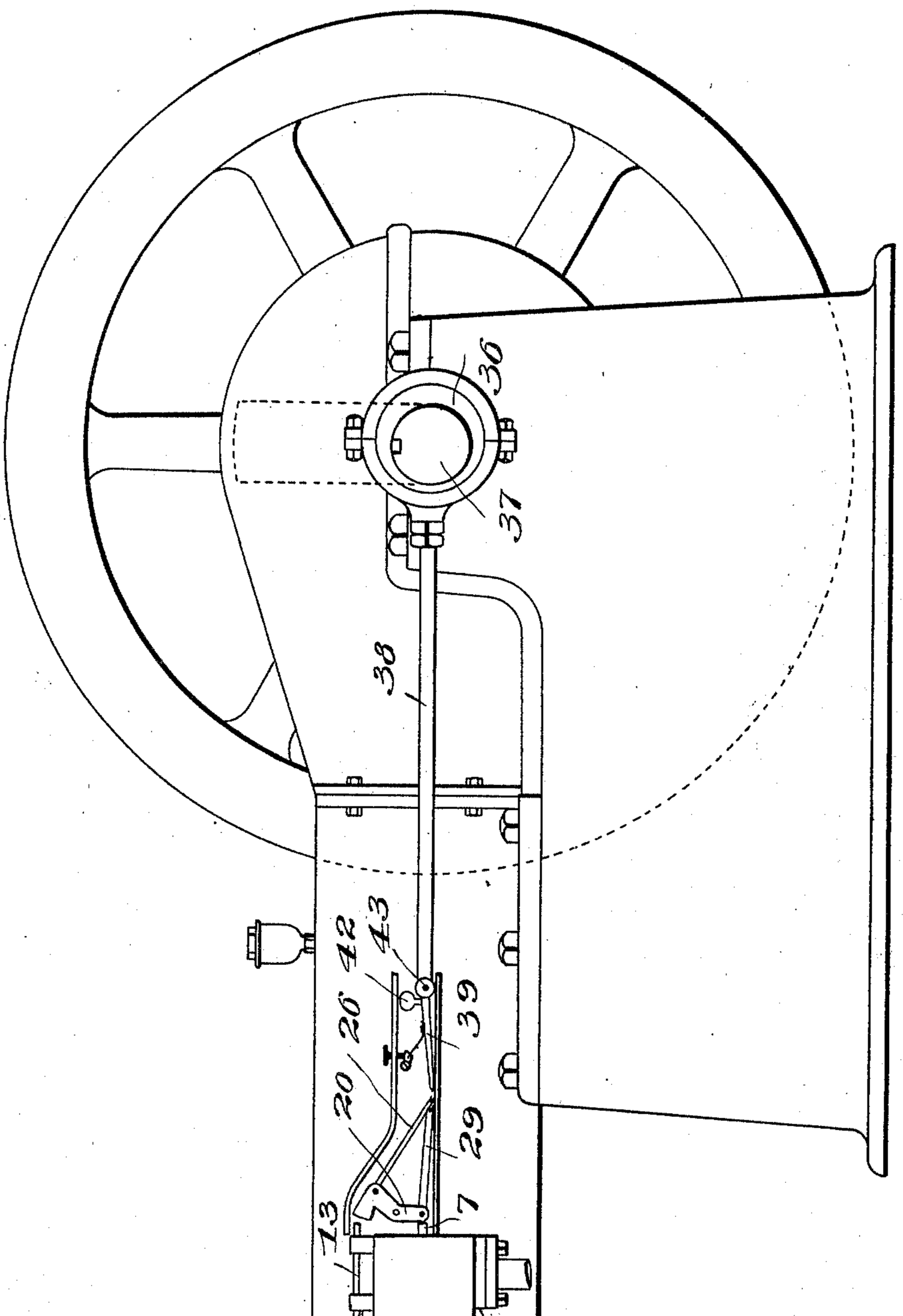

Fig. 1.

Witnesses:
Emma A. Stone,
G. T. Hackley

Inventors:
Otho C. Duryea,
Morris C. White.
by Townsend Bros.
Their Attys.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. II.

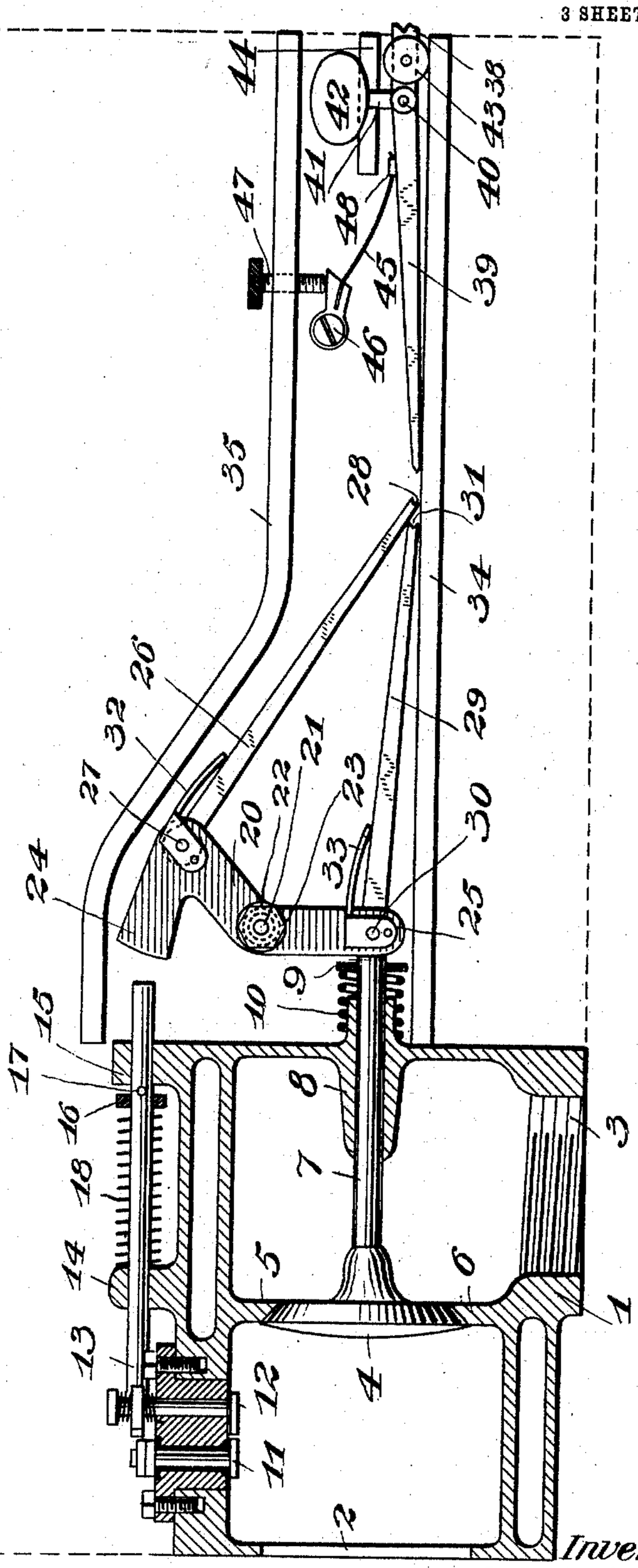

Fig. III.

Witnesses:
Edmund A. Strauss.
H. T. Hackley

Inventors:
Otho C. Duryea
Morris C. White.
by Townsend Bros.
their Attys.

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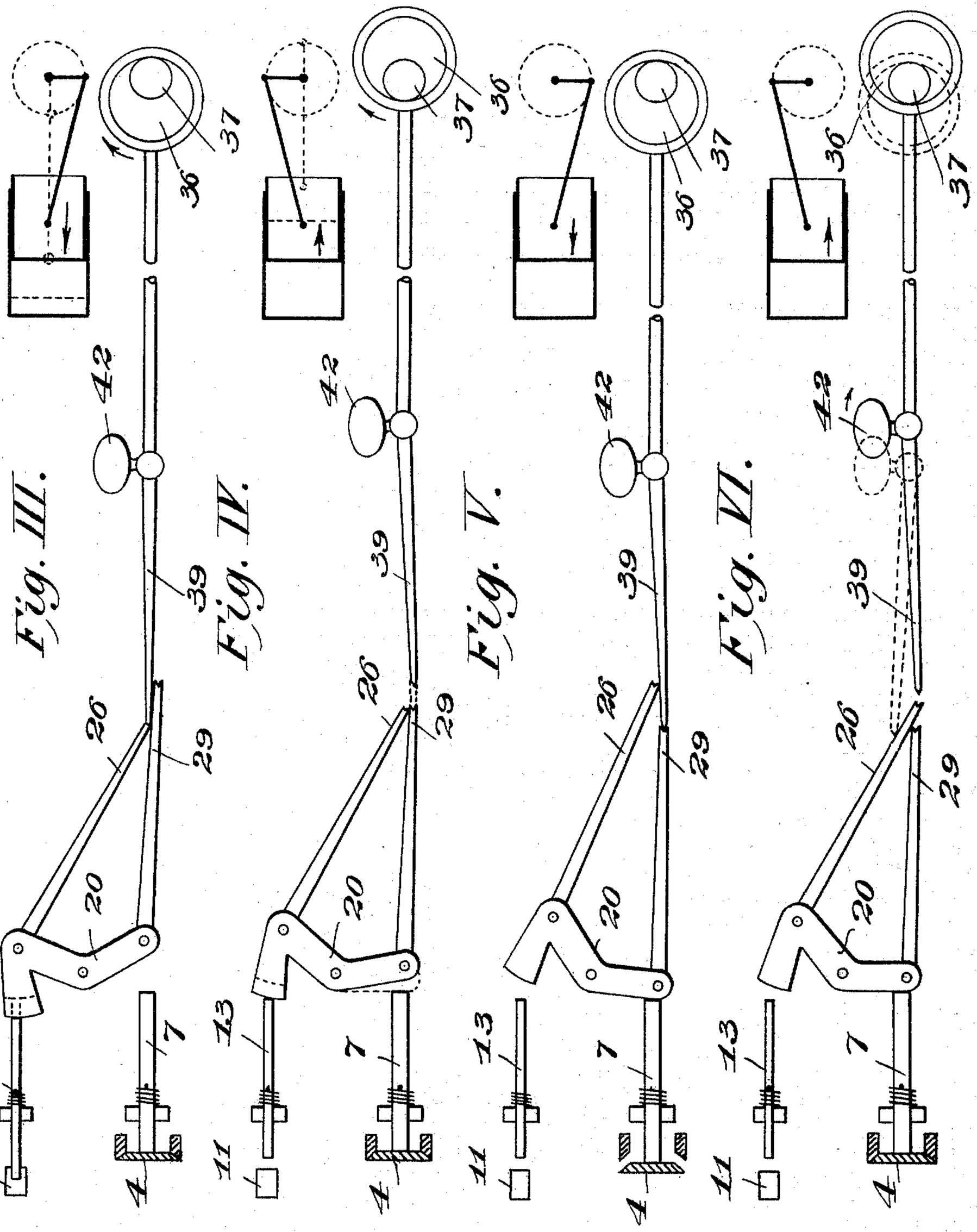
NO MODEL. 3 SHEETS—SHEET 3.



Witnesses:
Edmund A. Strauss.
G. T. Hackley

Inventors:
Otho C. Duryea
Morris C. White.
by Townsend Bros.
Their Attys.

No. 759,975. Patented May 17, 1904.

UNITED STATES PATENT OFFICE.

OTHO C. DURYEA AND MORRIS C. WHITE, OF LOS ANGELES, CALIFORNIA.

VALVE-ACTION FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 759,975, dated May 17, 1904.

Application filed July 28, 1902. Serial No. 117,394. (No model.)

To all whom it may concern:

Be it known that we, OTHO C. DURYEA and MORRIS C. WHITE, both citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Valve-Action for Explosive-Engines, of which the following is a specification.

Our invention relates to means whereby valves—for instance, the exhaust-valve—and the igniting device are operated and the action of the igniter also governed.

One object of our invention is to provide a device of the character described which will be of the utmost simplicity and have a direct and positive action and free from gears, ratchets, or cams and the like, which are noisy in action.

Another object of our invention is to provide a device which will have large compass in governing capacity and regulation and a sensitiveness and quick action which will respond to variations in the load and govern the speed of the engine to a nicety.

Another object of our invention is to dispense with a complicated governing device—such, for instance, as the cumbersome fly-wheel weight or the exposed geared fly-ball device.

Another object is to provide a device which will cause the fewest sparks, and thus allow of the use of a battery-current instead of a dynamo, as the number of sparks are cut down so appreciably that a battery may be employed without becoming quickly exhausted.

Another object is to provide a device which operates with the least amount of action, the device remaining inactive during the greater part of a revolution of the engine. The device is quiescent during a governing stroke, its inaction causing the governing function.

Another object is to provide a device which is extremely compact and protected from injury and from dust and grit, which will be very durable, and which can be economically manufactured and adapted for various forms of engines.

Referring to the drawings, Figure I is a side elevation of an explosive-engine which is equipped with our valve-action, a cover which ordinarily incloses the valve-action being removed. Fig. II is an enlarged detail view showing the valve-action and also a section of the explosion-chamber of an engine. Figs. III, IV, V, and VI, inclusive, are diagrams which illustrate various positions of the valve-action and corresponding positions of the engine-piston. Fig. VII is a sectional view through the rock-arm, showing the spring for frictionally holding the rock-arm in position.

1 is a casing of an explosion-chamber, which may be provided with an inlet-passage 2 and an outlet-passage 3.

4 is an exhaust-valve which rests upon a seat 5, formed in a wall 6 in the interior of the explosion-chamber. Extending from the exhaust-valve 4 is a stem 7, which is supported by an extension 8 from the explosion-chamber. The valve-stem 7 carries a collar 9, and interposed between the collar 9 and the exterior of the explosion-chamber is a coil-spring 10, which serves to normally hold the valve closed, as shown in Fig. II.

11 is a stationary electrode, which extends into the upper portion of the explosion-chamber, and 12 is a movable electrode which is pivotally mounted near the stationary electrode. The electrode 12 is actuated by a rod 13, which is slidably mounted in extensions 14 and 15, which project from the upper wall of the explosion-chamber. 16 is a washer carried by the rod and held in place thereon by means of a pin 17. Interposed between the washer 16 and the extension 14 is a coiled spring 18, which serves to hold the rod 13 retracted, as shown, and thereby holds the electrode 12 out of contact with the electrode 11 in the position shown in Fig. II, in which position the pin 17 bears against the extension 15. We have not deemed it necessary to show the construction of the igniter in further detail, as such devices are well known, and we make no claim to any particular form of igniter, a sufficient portion being here given for a clear understanding of our invention.

20 is a rock-arm pivoted on a pin 21 to the wall of the cylinder and adjacent to the ex-

plosion-chamber. The rock-arm 20 is held in position on the pin 21 by means of a nut 22. Interposed between the nut 22 and the rock-arm 20 is a coil-spring 23, having two or three turns of wire, which serves to frictionally hold the rock-arm in any position into which it is moved and prevents the rock-arm from being jarred from position or from inertial movement. The rock-arm 20 has an upper arm 24, which is movable into contact with the igniter-rod 13 and which actuates the same in one direction. The rock-arm is also provided with a lower arm 25, which is movable into contact with the valve-stem 7 for actuating the same. The arm 26 is pivoted at 27 to the rock-arm. The free end of the arm 26 is preferably notched, as at 28.

29 is an arm pivoted at 30 to the rock-arm and is provided at its free end with a notch 31.

32 is a spring carried by the rock-arm, which extends over and bears against the upper surface of the arm 26 and serves to hold the free end depressed and at times bearing against the free end of the arm 29.

33 is a spring carried by the rock-arm 20, which projects over and bears against the upper surface of the arm 29 and tends to hold the free end of the arm 29 against the upper surface of a horizontal wall 34, which is formed on the exterior of the cylinder of the engine. 35 is another wall above the wall 34 and serves to inclose the mechanism.

Referring to Fig. I, 36 is an eccentric carried by the engine-shaft 37. 38 is an eccentric-rod which extends between the walls 34 and 35. 39 is an operating-rod which is pivoted at 40 to the end of the eccentric-rod 38. Extending from the operating-rod 39 is a short arm 41, which carries a weight 42, which forms an inertia device, the operation of which will hereinafter be described. 43 is a roller which carries the end of the eccentric-rod 38, the roller riding upon the wall 34. 44 is a short wall which lies parallel to the wall 34 and slightly above the roller 43 and forms a guide to confine the roller to a straight path. The free end of the operating-rod 39 has a tapered or chisel edge which bears against the upper surface of the wall 34, upon which it slides when reciprocated by the eccentric-rod 38. The operating-rod 39 is yieldingly held against the wall 34, preferably by means of a flat spring 45, which is carried by a pivoted arm 46. 47 is a regulating-screw, which passes through the wall 35, the lower end of the screw bearing against the pivoted arm 46. One end of the spring 45 may carry a shoe 48, which may bear against the upper face of the operating-rod 39. By raising or moving the screw 47 the pressure of the spring against the operating-rod may be adjusted.

The operation of the device is as follows: The operating-rod 39 is reciprocated by means of the eccentric-rod 38 and has a stroke of unvarying length and alternately comes into engagement with the arms 26 and 29 and operates the same, as will be described. Referring to Fig. III, the rock-arm 20 is shown as having moved the igniter-rod 13 into a position such that when the igniter-rod moves to the right a short distance a spark will be caused. In this figure the igniter is shown diagrammatically, the igniter-rod 13 contacting direct with the stationary electrode 11. When the rock-arm is in this position, the chisel end of the operating-rod 39 engages the notched end 28 of the arm 26. When the rock-arm is in this position, the engine is in the position shown in the heavy black lines, the piston being in the middle of its compression-stroke. As soon as the piston has reached the position indicated in dotted lines, Fig. III, the gas is compressed and ready for ignition. The eccentric will have moved far enough in the direction of the arrow to retract the operating-rod 39 and allow the igniter-rod 13 to be moved to the right by the spring 18, the rock-arm being moved by means of the igniter-rod. As soon as the igniter-rod 13 is retracted sufficiently the movable electrode breaks contact with the stationary electrode and a spark is produced. Fig. IV shows the position of the rock-arm after having been retracted by the igniter-rod 13, in which position the arms 26 and 29 have their notched ends lying close together. The cylinder-diagram in this figure shows the piston in the middle of its working stroke, and the eccentric-rod is in its relative position, which is its extreme retracted position, to the right. As soon as the piston has reached the position shown in dotted lines, Fig. IV, the eccentric will have moved sufficiently to bring the operating-rod 39 into engagement with the arm 29 and will thereby push the rock-arm into contact with the exhaust-valve stem, and when the piston has reached the end of its working stroke, as shown in dotted lines, the rock-arm 20 will be in the position shown in dotted lines, Fig. IV, in contact with the exhaust-valve stem 7. Further movement of the piston during its return stroke will move the eccentric and raise the exhaust-valve from its seat. The valve being raised from its seat during the first half of the stroke and being gradually retracted toward its seat during the last half of the stroke, at the end of the stroke the valve will be fully closed. Fig. V shows the position of the parts when the valve is in its extreme open position, the piston having advanced through half of its stroke. As the operating-rod 39 advances the arm 29 the end of the arm 26 bears against and rides upon the upper edge of the rod 39. Fig. VI shows the piston in the middle of its suction-stroke, the operating-rod 39 having been retracted by the eccentric to its extreme position, and the rock-arm 20 has been moved into the

position shown, the arm 26 extending over the end of the rod 29 and resting upon the wall 34 and in position to be engaged by the operating-rod 39 when the latter advances. When the speed of the engine rises above a certain point, the weight 42 is rocked in the direction of the arrow and the rod 39 is shifted or tilted upwardly, so that as the rod 39 moves along it is shunted and its chisel end fails to catch the notch 28 and the end rides upon the inclined upper surface of the arm 26, as shown in dotted lines, Fig. VI. When this occurs, the rock-arm is not actuated, but stands still in its position shown, Fig. VI, and during that stroke of the engine no spark is produced, and the charge is compressed, but not ignited. The inertia of the fly-wheel of the engine causes continued operation of the engine, and the operating-rod 39 is retracted, and inasmuch as no force has been applied to the piston the speed will fall somewhat. When the operating-rod 39 is moved in its working direction, or to the left, the weight 42 will not act to raise the rod 39, but will allow it to remain against the wall 34, so that the operating-rod 39 will come into engagement with the notched end 28 of the arm 26 and cause the rock-arm 20 to be rocked in a direction to advance the igniter-rod 13 and cause an ignition.

The end of the arm 26 is comparatively thin, while the end of the arm 29 is considerably thicker, so that the end of the operating-rod 39 will catch the notch 31 should the operating-rod be tilted during the exhaust-stroke. The arm 29 is made sufficiently thin so that when the operating-rod is tilted by the governor the operating-rod will escape the notch 28. This construction secures the proper working of the exhaust-valve, the governing effect being applied only to the igniter in this embodiment.

In the herein-described construction the ignition may occur at the end of the next stroke, provided the speed has reduced sufficiently to allow of the operating-rod tilting to normal position in contact with the guide 34. It will be seen that this gives a much more effective control than where two revolutions are required to again actuate the igniter, as the engine when under a heavy load may lose considerable speed in going through two revolutions, whereas in our device the change of speed is less than half of which occurs in other types of governors before the effect of the governor takes place. This secures a more even speed of the engine.

It is obvious that various forms of igniters may be used in connection with this device. The device may also be adapted to operate valves other than the one shown, and it is evident that a great many changes and variations may be made in the herein-described embodiment without departing from the spirit of our invention.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means independent of the rock-arm and valve for moving said rock-arm alternately into connection with said igniter and said valve, and means inertially controlled for preventing the movement of said rock-arm into connection with said igniter when the speed of the engine varies, said rock-arm being intermediate the igniter and said last means.

2. In combination with an explosive-engine, an igniter, a valve, a rock-arm for actuating said igniter and valve, mechanism operated by the engine and movable into engagement with said rock-arm for oscillating the same, and means for shunting said mechanism to prevent said rock-arm from oscillating when the speed of the engine varies.

3. In combination with an explosive-engine, an igniter, a valve, a rock-arm inertially controlled, means operated by the engine for oscillating said rock-arm, and means operated by said rock-arm for actuating said igniter and said valve.

4. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by the engine for oscillating said rock-arm, means operated by said rock-arm for actuating said igniter and said valve, and means operating inertially for controlling the first-named means.

5. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and said valve, means for yieldingly holding said rock-arm in various positions, and means operated by the engine for operating said rock-arm.

6. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and said valve, means for yieldingly holding said rock-arm in various positions, means operated by the engine for operating said rock-arm, and means operating inertially for controlling the latter means.

7. In combination with an explosive-engine, an igniter, a valve, a rock-arm pivotally mounted near said igniter and said valve, connections between said igniter and said valve and said rock-arm, a spring bearing against said rock-arm near its pivotal support, and means operated by the engine for oscillating said rock-arm and thereby actuating said igniter and said valve.

8. In combination with an explosive-engine, an igniter, a valve, a rock-arm pivotally mounted near said igniter and said valve, connections between said igniter and said valve

and said rock-arm, a spring bearing against said rock-arm near its pivotal support, means operated by the engine for oscillating said rock-arm and thereby actuating said igniter and said valve, and means operated inertially for controlling the first-named means.

9. In combination with an explosive-engine, an igniter, a valve, a rock-arm pivotally mounted near said igniter and said valve, means in the path of movement of one end of said rock-arm but unconnected therewith for actuating said igniter, and means in the path of movement of the other end of said rock-arm, but unconnected therewith for actuating said valve, arms pivotally attached to opposite ends of said rock-arm and means operated by the engine and movable into contact with said arms alternately for controlling said rock-arm.

10. In combination with an explosive-engine, an igniter, a valve, a rock-arm pivotally mounted near said igniter and said valve, means operated by said rock-arm for actuating said igniter and said valve, arms flexibly attached to opposite ends of said rock-arm, means operated by the engine and movable into contact with said arms alternately for controlling said rock-arm, and means operated inertially for controlling the latter means.

11. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and said valve and igniter respectively, arms flexibly attached at opposite ends of said rock-arm and means operated by the engine and movable into contact alternately with said arms for actuating the same.

12. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and said valve and igniter respectively, arms flexibly attached at opposite ends of said rock-arm, means operated by the engine and movable into contact alternately with said arms for actuating the same, and means operated inertially for controlling the latter means.

13. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means controlled by one end of said rock-arm but unconnected therewith for actuating said igniter, and means controlled by the other end of the rock-arm but unconnected therewith for actuating said valve, arms flexibly connected at opposite ends of said rock-arm, a guide for the free ends of said arms, and means controlled by the engine for actuating alternately each of said arms.

14. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means controlled by said rock-arm for actuating said igniter and said valve, arms flexibly connected at opposite ends of said rock-arm, a guide for the free ends of said arms, means controlled by the engine for actuating alternately each of said arms, and means operating inertially for controlling the latter means.

15. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means controlled by one end of said rock-arm for actuating said igniter, and means controlled by the other end of the rock-arm for actuating said valve, arms pivotally connected at opposite ends of said rock-arm, a guide for the free ends of said arms, means for yieldingly holding said arms against said guide, and means operated by the engine for actuating said arms alternately.

16. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means controlled by said rock-arm for actuating said igniter and said valve, arms pivotally connected at opposite ends of said rock-arm, a guide for the free ends of said arms, means for yieldingly holding said arms against said guide, means operated by the engine for actuating said arms alternately, and means operating inertially for controlling the latter-named means.

17. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and said valve, arms pivoted to said rock-arm, a guide for the free end of said pivoted arms, means yieldingly holding said arms against said guide, means operated by the engine for actuating said arms alternately, and means operating inertially for controlling the latter-named means.

18. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by the rock-arm for actuating said igniter and said valve, free-ended arms pivoted to the rock-arm, a guide for said arms, and means operated by the engine for pushing said arms and thereby actuating the rock-arm.

19. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and said valve, arms extending laterally from said rock-arm and pivoted thereto, a guide for said arms, means operated by the engine for pushing said arms longitudinally, and means operating inertially for controlling the first-named means, and means for automatically shunting said rod by the notched ends of the arms.

20. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by the rock-arm for actuating said igniter and said valve, arms pivotally connected to opposite ends of said rock-arm, the free ends of said arms having notches, and an operating-rod connected with the engine and movable into engagement with said arms for actuating the same, and means for automatically shunting said rod by the notched ends of the arms during a single stroke.

21. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by the rock-arm for actuating said igniter and said valve, arms pivotally connected to opposite ends of said rock-arm, the free ends of said arms having notches; an operating-rod connected with the engine and movable into engagement with said arms for actuating the same, and means operating inertially for controlling said operating-rod.

22. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by the rock-arm for actuating said igniter and said valve, arms pivotally connected at opposite ends of said rock-arm, a guide extending transversely of said rock-arm, said arms bearing against said guide, and an operating-rod connected to the engine, the free end of said operating-rod bearing against said guide, and means for automatically tilting said rod away from the ends of the arms.

23. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections from said igniter and said valve in the paths of movement of the ends of the rock-arm, arms pivotally connected at opposite ends of said rock-arm, a guide extending transversely of said rock-arm, said arms bearing against said guide, and an operating-rod connected to the engine, the free end of said operating-rod having a tapered end bearing against said guide.

24. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for operating said igniter and said valve, arms pivotally connected at opposite ends of said rock-arm, a guide extending transversely of said rock-arm, said arms bearing against said guide, an operating-rod connected to the engine, the free end of said operating-rod having a tapered end bearing against said guide, and means operating inertially for controlling said operating-rod.

25. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and valve, means operated by the engine for controlling said rock-arm, and a weight rigidly attached to said means and above the same.

26. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and the igniter and valve, said rock-arm being movable into and out of engagement with each of said connections, means operated by the engine for operating said rock-arm and thereby actuating the igniter and valve, and means operating inertially for controlling the latter means.

27. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and the igniter and valve, said rock-arm being movable into and out of engagement with each of said connections, arms pivotally connected at opposite ends of said rock-arm and extending laterally therefrom, and means operated by the engine and movable into engagement alternately with each of said arms for actuating the same.

28. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and the igniter and valve, said rock-arm being movable into and out of engagement with each of said connections, arms pivotally connected at opposite ends of said rock-arm and extending laterally therefrom, means operated by the engine and movable into engagement alternately with said arms for pushing the same, and means operating inertially for controlling the latter means.

29. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm, and the igniter and valve, said rock-arm being movable into and out of engagement with each of said connections, arms pivotally connected at opposite ends of said rock-arm, an operating-rod pivotally connected with the engine, and means for guiding said operating-rod into contact with said arms.

30. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and the igniter and the valve, said rock-arm being movable into and out of engagement with each of said connections, arms pivotally connected at opposite ends of said rock-arm, an operating-rod pivotally connected with the engine, means for guiding said operating-rod into contact with said arms, and means operated by inertia for controlling said operating-rod.

31. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm and the igniter and valve, each of said connections lying in the path of movement of said rock-arm, arms pivotally connected to opposite ends of said rock-arm, a guide extending transversely of said rock-arm, means for yieldingly holding said arms against said guide, an operating-rod pivotally connected to the engine, and a weight rigidly attached to said operating-rod and lying above the pivotal support of said operating-rod.

32. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections intermediate said rock-arm, and the igniter and the valve, each of said connections lying in the path of movement of said rock-arm, arms pivotally connected to opposite ends of said rock-arm, a guide extending transversely of said rock-arm, means for yieldingly holding said arms against said guide, an operating-rod pivotally connected to the engine, a weight rigidly attached to said operating-rod and lying above the pivotal support

of said operating-rod, and means operating inertially for controlling said operating-rod.

33. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections from said igniter and said valve extending into the path of movement of said rock-arm, arms pivotally connected to said rock-arm, a guide extending transversely of said rock-arm, a spring carried by said rock-arm pressing against one of said arms for holding the same against said guide, an operating-rod connected to the engine, said operating-rod being movable into contact with the ends of said arms alternately for pushing the same, and means operating inertially for tilting said operating-rod.

34. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and valve, arms pivotally connected at opposite ends of said rock-arm, a guide extending transversely of said rock-arm, one of said arms bearing against said guide and lying substantially parallel with said guide, the free end of the other arm having a path of movement near the free end of the first arm, an acute angle being formed between the two arms at their free ends, means operated by the engine and movable into engagement with said arms for actuating the same and thereby the igniter and valve, and means operating inertially for controlling the latter means.

35. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and valve, an arm pivotally connected to said rock-arm and extending substantially longitudinally of said valve, means operated by the engine and movable against the end of said arm for moving said arm longitudinally and thereby actuating said valve, and means operating automatically for guiding the latter-named means at alternate strokes in a different path.

36. In combination with an explosive-engine, an igniter, a valve, a rock-arm, means operated by said rock-arm for actuating said igniter and valve, an arm pivotally connected to said rock-arm and extending substantially longitudinally of said valve, means operated by the engine and movable against the end of said arm for moving said arm longitudinally and thereby actuating said valve, and means operating automatically for guiding the first-named means at alternate strokes in a different path.

37. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections extending from said igniter and valve into the path of movement of said rock-arm, arms connected at opposite ends of said rock-arm and extending transversely of said rock-arm, the free ends of said arms having paths of movement parallel and near each other, an operating-rod pivotally connected to the engine, and extending substantially longitudinally of both of said arms, a guide extending transversely of said rock-arm the free ends of said arms bearing against said guide, and means yieldingly holding the free end of said operating-rod against said guide.

38. In combination with an explosive-engine, an igniter, a valve, a rock-arm, connections extending from said igniter and said valve into the path of movement of said rock-arm, arms connected at opposite ends of said rock-arm and extending transversely of said rock-arm, the free ends of said arms being near each other, an operating-rod pivotally connected to the engine, and extending substantially longitudinally of both of said arms, a guide extending transversely of said rock-arm, the free ends of said arms bearing against said guide, and adjustable means for yieldingly holding the free end of said operating-rod against said guide.

39. In combination with an explosive-engine including an eccentric-rod, an igniter, a valve, a rock-arm, an operating-rod pivotally connected to the eccentric-rod of said engine, a support for said rod, a roller mounted on the end of said eccentric-rod near the pivotal support of said operating-rod, a guide extending longitudinally of said eccentric-rod, means operating inertially for controlling the operating position of said operating-rod, and means intermediate said igniter and valve and said rock-arm for operating the valve and igniter, said latter means being controlled by the rock-arm.

40. In combination with an explosive-engine, an igniter, a valve, means for operating said igniter and valve, a plurality of arms connected to said means, the end of one arm being thicker than the other, and an operating-rod, means for guiding the free ends of said arms and causing first one and then another of the arms to be interposed in the path of movement of the operating-rod and means for actuating the operating-rod.

41. In combination with an explosive-engine, means for controlling the operation of the engine embracing a plurality of arms, an operating-rod, means for interposing first one and then another of the arms in the path of movement of the operating-rod, and a weight carried by the operating-rod and lying above the pivoted end of the rod.

42. In combination with an explosive-engine, an igniter, a valve, a rock-arm pivotally mounted near said igniter and said valve, means operated by said rock-arm for actuating said igniter and said valve, arms flexibly attached at opposite ends of said rock-arm, the end of one of said arms being larger than the end of the other arm, and means operated by the engine for actuating said arms.

43. In combination with an explosive-en-

gine, an igniter, a valve, a rock-arm, arms flexibly attached to opposite ends of said rock-arm, means operated by the engine for contacting alternately with said arms and thereby operating said rock-arm, said igniter and said valve, and means operating inertially for shunting the last-named means by one of said arms but not the other.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 14th day of July, 1902.

OTHO C. DURYEA.
MORRIS C. WHITE.

Witnesses:
G. T. HACKLEY,
F. M. TOWNSEND.