No. 626,275. Patented June 6, 1899.

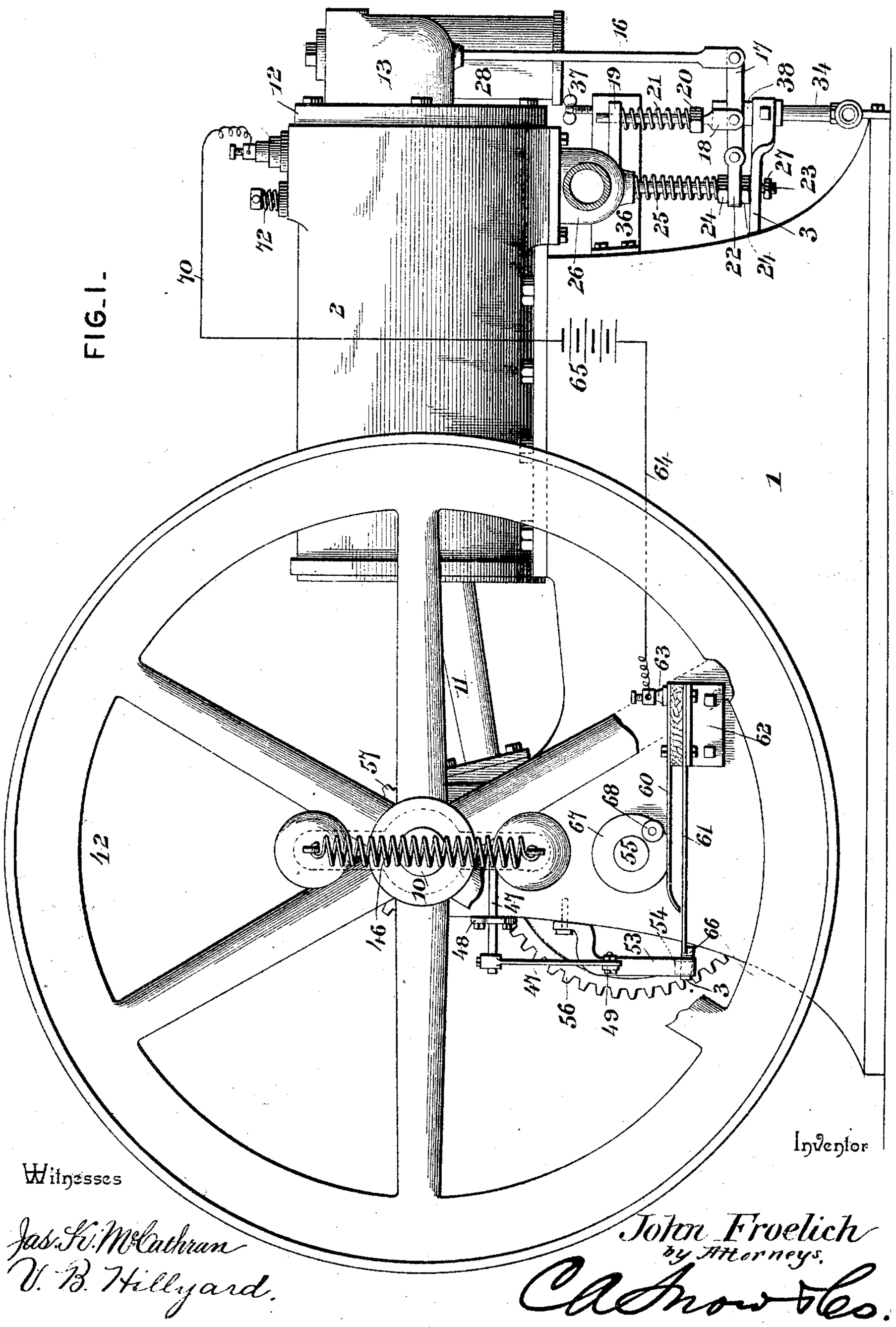
J. FROELICH.

SPEED REGULATOR FOR EXPLOSIVE ENGINES.

(Application filed Dec. 23, 1895.)

(No Model.) 4 Sheets--Sheet 1.

FIG. 1.



Witnesses

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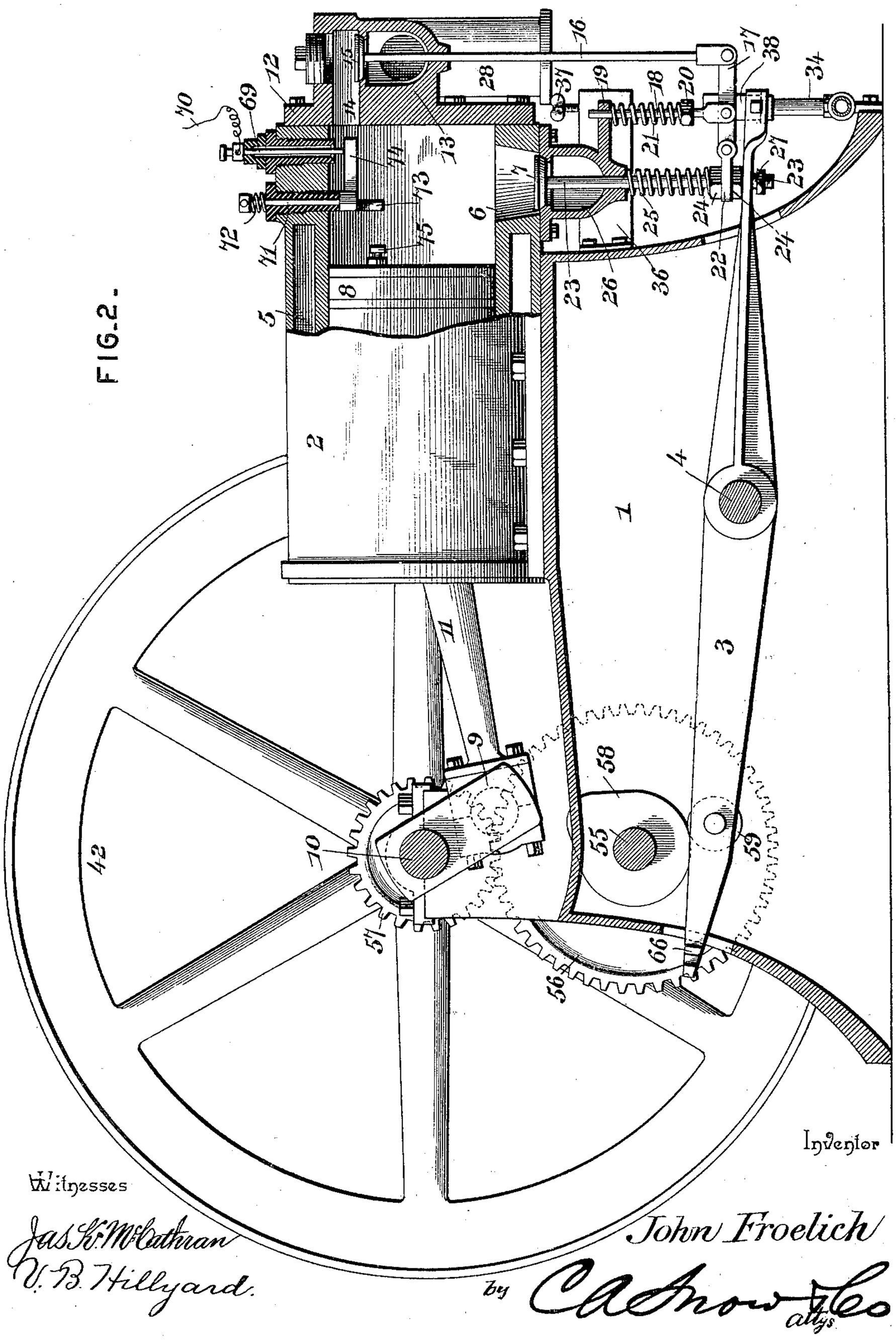
(No Model.) 4 Sheets—Sheet 2.

FIG. 2.



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(No Model.) 4 Sheets—Sheet 3.

FIG. 3.

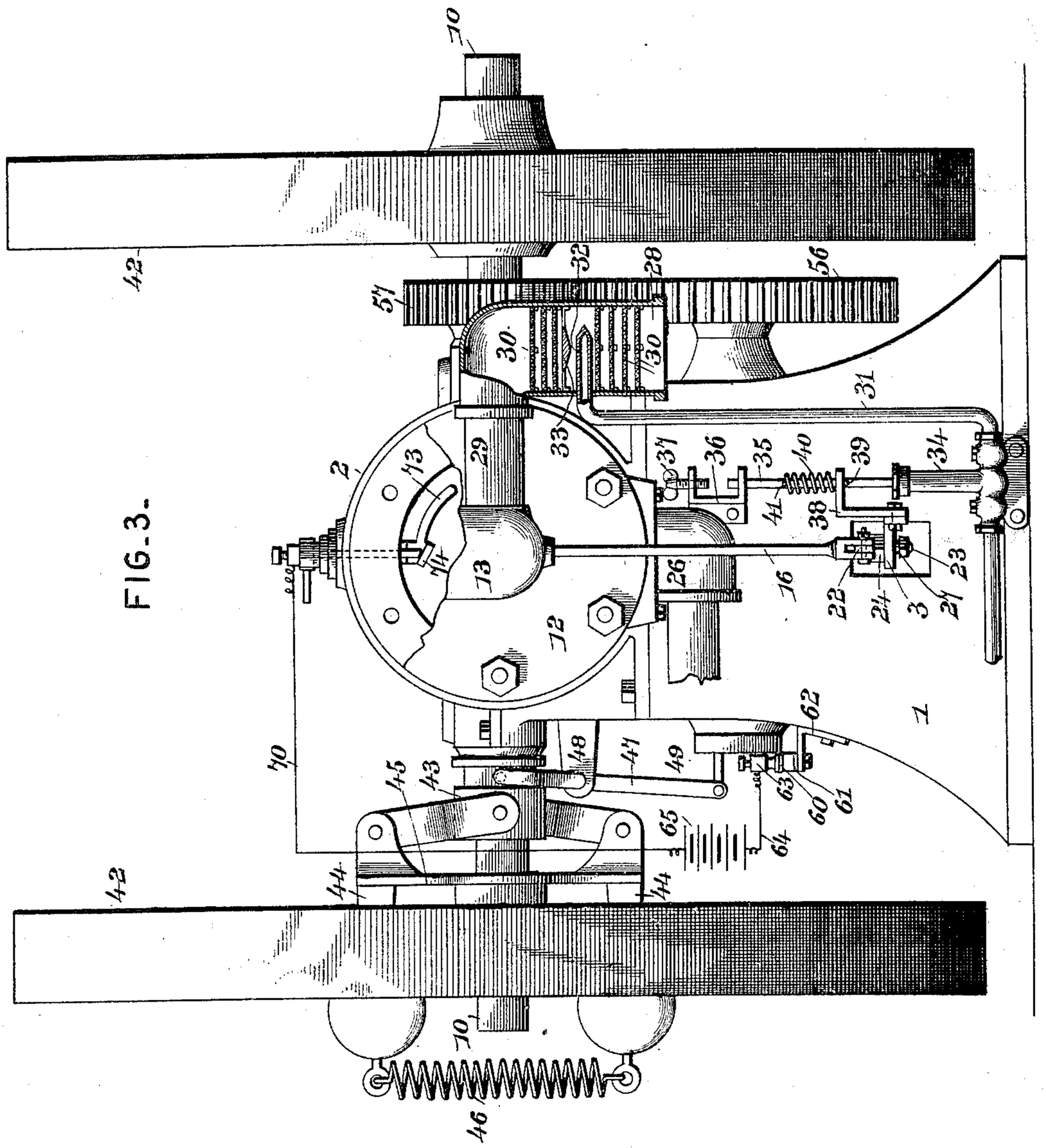

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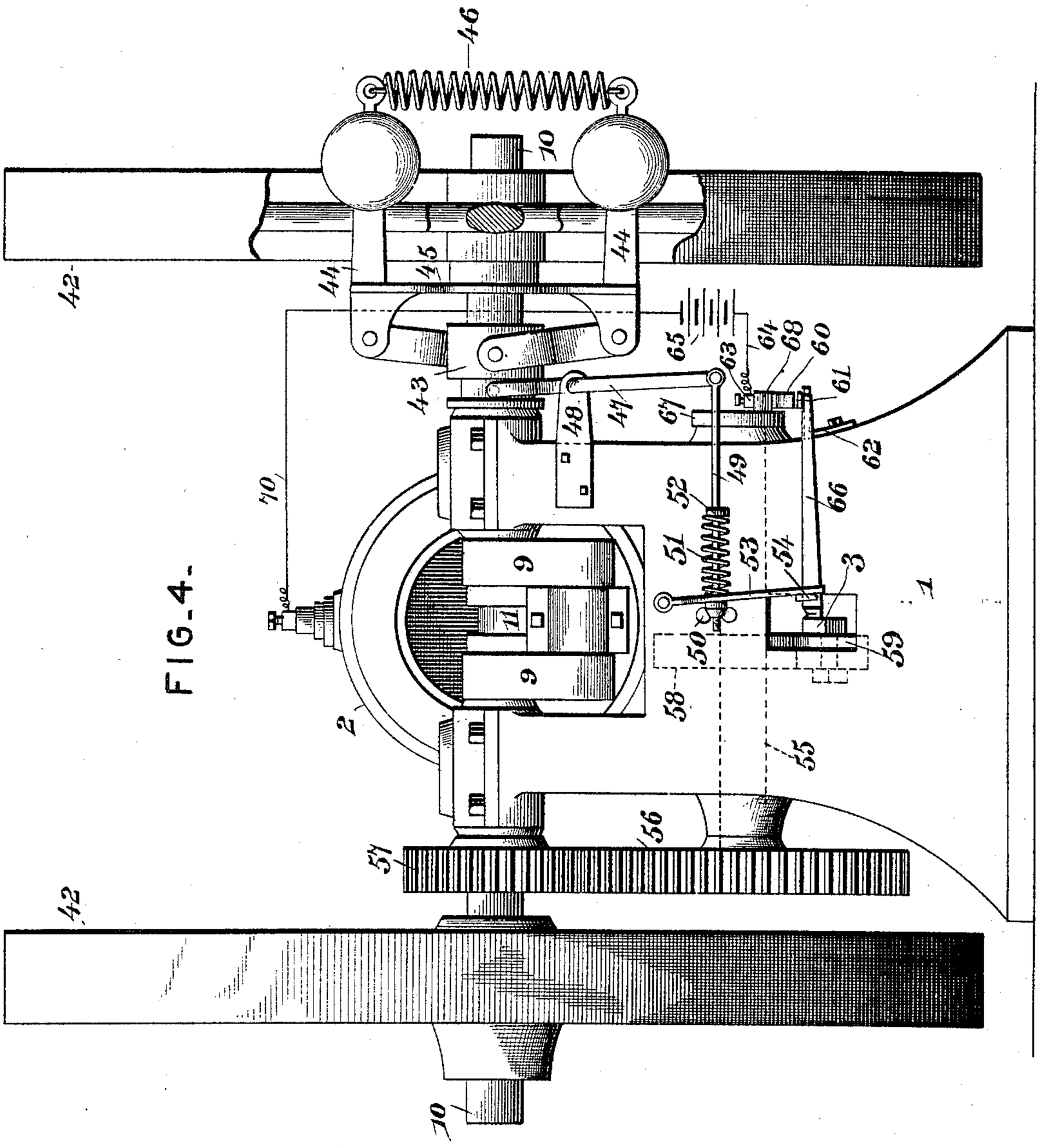
FIG. 4.



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UNITED STATES PATENT OFFICE.

JOHN FROELICH, OF WATERLOO, IOWA.

SPEED-REGULATOR FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 626,275, dated June 6, 1899.

Application filed December 23, 1895. Serial No. 573,074. (No model.)

To all whom it may concern:

Be it known that I, JOHN FROELICH, a citizen of the United States, residing at Waterloo, in the county of Black Hawk and State of Iowa, have invented a new and useful Gas-Engine, of which the following is a specification.

This invention relates to gas or explosive engines, and aims to prevent the flooding of the engine, especially at the first start, when a volatile hydrocarbon is used as the gas-producing agent or primary motive medium; to obviate gumming of the piston, cylinder, and valves; to guard against the waste of electrical energy and the primary motive medium when the engine is running beyond a predetermined speed; to reduce the wear and tear upon the operating parts; to keep the igniting-points cool for preventing premature explosion and consequent loss of fuel and wear of engine; to provide means for charging the engine with only a predetermined amount of hydrocarbon, and, lastly, to improve the general construction of this class of motors and increase their effectiveness and usefulness.

Other objects and advantages are contemplated and will become apparent as the nature of the invention is understood; and to this end the improvement consists in certain details of construction, novel features, and combinations of parts, which hereinafter will be more fully described, illustrated, and claimed.

This improvement is susceptible of various changes in the form, proportion, and the minor details of construction without departing from the principle or sacrificing any of the advantages thereof, and to a full disclosure of the invention an adaptation thereof is shown in the accompanying drawings, in which—

Figure 1 is a side elevation of the improved engine. Fig. 2 is a view similar to Fig. 1, partly in section and having parts broken away. Fig. 3 is a rear end view parts being broken away. Fig. 4 is a front end view having a portion of the right-hand fly-wheel broken away to show the relative disposition of the governor mechanism.

The same numerals of reference denote corresponding and like parts in all the figures of the drawings.

The bed 1 for supporting the cylinder 2 and the operating parts is cast in the usual manner and is preferably hollow, and a lever 3, extending lengthwise of the bed, is fulcrumed about midway of its ends upon a transverse rod 4, and its end portions pass through openings in the end walls of the bed.

The cylinder 2 is formed with double walls, which inclose a space 5, through which circulates a cooling medium in the ordinary way for preventing the overheating of the cylinder when the engine is in operation. This cylinder is bolted or otherwise secured to the bed 1 and is provided at its inner or rear end with a pocket 6, in which operates the eduction-valve 7 and which is designed to receive the residue resulting from the combustion of the explosive mixture, waste oil, and other accumulations, thereby preventing the gumming of the piston 8 and the cylinder. This pocket 6 is located at the bottom side of the cylinder and is cast therein and forms a chamber for the operation of the eduction or exhaust valve.

It is of the utmost importance that the pocket 6 be set in the lower rear end of the explosion-chamber and that it should contain the exhaust-valve 7, as the piston on its return stroke will clear the cylinder of all of the waste product of combustion and dump it into this pocket, from which it will be carried out by the force of the exhaust at such opening of the valve. The cylinder is open at its front end, as usual in this class of motors, and its piston 8 is connected with the crank 9 of the crank-shaft 10 by means of the pitman 11 in the ordinary way. The head 12 for closing the rear end of the cylinder is formed with a chamber 13 and an induction-passage 14, connecting the chamber 13 with the interior of the cylinder at or near the top of the explosion-chamber and directly opposite the igniting-points 69 and 71. The reason for placing this induction-passage in this position is twofold: First, there is a tendency for the points 69 and 71 to become overheated, whereby premature explosion occurs, and by causing a strong current of cold gas to come in contact with these points they will be always kept sufficiently cool to prevent any premature explosion, and, second, after an explosion the waste product arising therefrom will settle in the bottom of the explosion-chamber

and be carried out, as before described; but if the induction-passage be lower down in the explosive-chamber the strong current of gas drawn into the chamber will disturb this waste product and prevent it from being completely carried out through the exhaust-passage, and the result will be that the inside of the cylinder will commence to gum and stop the free action of the piston.

An induction-valve 15 is arranged to interrupt the communication between the chamber 13 and the passage 14 and opens upwardly into the passage 14 and closes against a seat located at the junction of the said passage 14 with the chamber 13. The stem 16 of the induction-valve 15 operates through the lower end of the chamber 13 and is connected at its free end with the extremity of a lever 17, fulcrumed about midway of its ends to a vertically-movable rod 18, working loosely through an arm 19 and having an adjustable nut 20, between which and the arm 19 is confined a coil-spring 21, the latter exerting a downward pressure on the said rod 18. The opposite end of the lever 17 is pivotally connected to the plate 22, which is mounted upon the lower end of the stem 23 of the eduction-valve 7, and this plate 22 is held between jam-nuts 24, adjustably mounted upon the valve-stem 23, so as to admit of the connection of the lever 17 and the stem 23 being varied as required. A coil-spring 25 is mounted upon the valve-stem 23 and is confined between the topmost jam-nut 24 and the lower end of the box 26, secured to the lower side of the cylinder 2, directly opposite the pocket 6, and the purpose of this spring 25 is to hold the eduction-valve 7 upon its seat, which is formed at the upper end of the box 26, although it may be secured to either the bed or cylinder, if found more convenient. The rear end of the lever 3 is connected with the valve-stem 23 and is held between the lowermost jam-nut 24 and a companion nut 27, mounted upon the stem 23 below the lever 3.

The carbureter 28 is open at its lower end, and has connection at its upper end with the chamber 13 by means of a short length of pipe 29, and comprises a series of screens 30, upon which the volatile hydrocarbon is disseminated, so as to be taken up by the air on its passage through the carbureter to the engine. A pipe 31 leads into the carbureter and has a small opening 32 for the discharge of the hydrocarbon, and a spreader 33 is located directly opposite the opening 32 to diffuse the hydrocarbon in the carbureter and spread it over the screens 30. The pipe 31 communicates with a suitable fount or reservoir of oil and is provided in its length with a pump 34 of any approved and desired construction and which is designed to force a measured charge or quantity of oil into the carbureter to produce an explosive mixture with the air passing therethrough and which is drawn into the cylinder and utilized to drive the engine. The pump-rod 35 passes through one arm of a bracket 36 and is limited in its upward movement by a set-screw 37, let into the other arm of the said bracket, and by properly positioning the set-screw 37 the stroke of the pump and the consequent charge of oil to be delivered to the carbureter are regulated. An L-shaped arm 38 is secured to the extremity of the lever 3, and its horizontal portion receives the pump-rod 35, which is capable of operating loosely therethrough. Beneath the horizontal part of the arm 38 there is inserted in the pump-rod 35 a pin 39, against which the arm 38 impinges and operates the pump-rod in its downward stroke. A coil-spring 40 encircles the pump-rod 35 and is confined between the horizontal portion of the arm 38 and a pin 41. Thus it will be seen that provision is had for the full upward movement of the lever 3, even though the pump-rod 35 impinges against the lower end of the set-screw 37, because when the limit of the upward movement of the pump-rod is reached the outer end of the lever 3 can move upward, serving only to compress the spring 40, as will be readily understood.

The crank-shaft 10 is supplied with fly-wheels 42, which are sufficiently heavy to cause the engine to run steady and uniform and in which sufficient power is stored for performing efficient work and at the same time returning the piston to an initial position to receive the force attendant upon the explosion of the gaseous mixture in the rear end or explosion-chamber of the cylinder.

A collar 43 is loosely mounted upon one end of the crank-shaft 10, and weighted arms 44, fulcrumed to a plate 45, rotatable with the adjacent fly-wheel, have connection with the collar 43 and are adapted to move the latter on the crank-shaft so as to cut the engine off from its supply or source of motive power and at the same time prevent the closing of the igniter-circuit and the operation of the valves when the engine is running beyond a predetermined speed. A coil-spring 46 connects the outer ends of the weighted arms 44 and serves to return them to a normal position when the engine is not running. A lever 47, of convenient construction and disposition, has connection at its upper end with the collar 43 and is fulcrumed between its ends to a bracket 48, attached to the bed 1, and its lower end is connected with a rod 49, extending horizontally and having its inner end threaded and supplied with an adjusting-nut 50, by means of which the speed of the engine, in conjunction with the weighted arms 44, is controlled. A coiled spring 51 is mounted upon the rod 49, and its terminals abut against a stop 52 and a vibrating arm 53, the rod 49 passing loosely through the part 53 and controlling the movements thereof. A lateral extension 54 is provided at one side of the vibrating arm 53 and is adapted to engage over a corresponding portion of the lever 3 to hold the latter at the limit of its downward movement and out of action when the engine has

acquired an abnormal speed. Under normal conditions the vibrating arm 53 is held out of the path of the lever 3, so as not to interfere with its movements, and as the relative position of the vibrating arm can be varied by moving the adjusting-nut 50 it is obvious that the speed of the engine can be controlled by a proper adjustment of the said nut 50.

A shaft 55 is journaled to the bed and extends parallel with the crank-shaft 10 and is provided at one end with a gear-wheel 56, which meshes with a pinion 57, secured upon the crank-shaft 10, and a cam 58, secured upon the shaft 55, engaging with a roller 59, journaled to a side of the lever 3, vibrates the latter upon the rod 4, thereby serving to operate the parts depending for their movement upon the lever 3. An electric-circuit-closing device is conveniently located and is shown disposed at one side of the bed and comprises two electric spring-terminals 60 and 61, mounted upon a bracket 62, secured to the bed of the machine. The spring-terminal 60 is electrically insulated from the machine and is provided with a binding-post 63, to which the wire 64 is attached for conveying the current from one pole of a battery or electric generator 65. The spring-terminal 61 is in electrical communication with the engine and is attached at its outer or front end to an arm 66, projecting laterally from the front end of the lever 3. A disk or plate 67 is attached to that end of the shaft 55 opposite to the gear-wheel 56 and is provided with a roller 68, which is adapted to engage with the spring-terminal 60 and bring the same into electrical contact with the spring-terminal 61 and close the circuit, so that at the proper time the spark is produced to effect an explosion of the gaseous mixture and impel the piston forward in the cylinder. In the event of the engine acquiring an abnormal speed the governor or the weighted arms 44 will fly outward at their weighted ends and through the connections herein described move the arm 53 so that when the front end of the lever 3 is depressed by the cam 58 the said arm 53 will engage with the lever 3 and hold it depressed at its front end and out of the path of the cam 58, so that the engine can run without actuating the lever 3. As the front end of the lever 3 is depressed it carries the front portion of the spring-terminal 61 along with it, so that a downward movement of the spring-terminal 60 under the action of the roller 68 will not effect a closing of the circuit. Hence there is no waste of electrical energy during the interval occupied by the machine in slowing down and acquiring its normal speed. At such times when the speed of the engine exceeds the required number of revolutions per minute the front end of the lever 3 is held depressed and its rear end correspondingly elevated. Hence the eduction-valve 7 is maintained in open relation, the pump remains inactive, and the compression of the spring 21 reacts and exerts a downward pressure upon the stem 16, holding the induction-valve 15 firmly on its seat. Thus it will be seen that the cylinder is not supplied with any motive medium, and the eduction-valve being open the piston can reciprocate freely in the cylinder without creating a vacuum or exerting any tendency to unseat the induction-valve.

A pin 69 projects into the upper rear end of the cylinder and terminates in line with the induction-passage 14 for the purposes hereinbefore stated and is connected by a wire 70 with the other pole of the battery or electric generator 65 and is electrically insulated from the cylinder and engine. A post 71 extends parallel with the pin 69 and is adapted to turn in a bearing in the cylinder and is held in a normal position by a coil-spring 72, which is secured at its opposite ends to the post 71 and a fixed part of the engine, so that upon turning the post 71 the spring 72 will be subjected to tension, and upon releasing the post 71 the spring 72, regaining itself, will return the post to its initial position. A circuit-closer is attached to the lower end of the post 71 and comprises two arms 73 and 74, which are disposed at approximately right angles to each other, the arm 74 projecting rearwardly and engaging with the pin 69 and the arm 73 curving to conform to the wall of the cylinder and adapted to be struck by an adjustable stop 75, provided on the inner or rear face of the piston 8.

The operation of the engine is as follows: To start the engine, the pump-rod 35 is operated by hand till the screens are filled with the proper amount of hydrocarbon for charging the engine, any surplus hydrocarbon dropping through the lower open end of the carbureter, thereby preventing any flooding of the engine at the start, which is often done in this class of engines. The crank-shaft is then partially turned by applying force to one or the other of the fly-wheels, and the piston is caused to move from the rear end of the cylinder toward the front thereof and creates a vacuum, which will cause the induction-valve to open and admit the explosive mixture from the carbureter through the induction-passage 14 against the igniting-points 69 and 74 in the cylinder. It will be observed that I take advantage of the fact that when liquids are changed to a gaseous state heat is absorbed, and by placing the igniting-points of the parts 69 and 71 at the inner end of the induction-passage 14 the current of inflowing gas will come directly in contact with these points and always keep them cool, thereby preventing any premature explosion and consequent waste of fuel. On the return of the piston the induction-valve will close and the explosive mixture within the cylinder will be compressed, and as the piston reaches the limit of its return stroke the stop 75 thereof will engage with the arm 73 of the circuit-closer and cause the arm 74 to leave the pin 69, and thereby produce an electric spark, which will

explode the mixture and drive the piston forward. On the return stroke of the piston the lever 3 will be operated so as to open the eduction-valve, thereby providing for the escape of the confined gases and residue or impurities left after the explosion, and thus keeping the explosion-chamber clean and preventing any clogging or gumming of the piston or cylinder. On the forward stroke of the piston the operation just described will be repeated. On the upward movement of the rear end of the lever 3 the arm 38 will press upward against the spring 40, which in turn engages with the pin 41 and raises the pump-rod 35 till it comes in contact with the stop 37, at which time the pump is charged with a measured quantity of oil. If the lever 3 has not completed its stroke, then it may continue by simply compressing the spring 40, and on the descent of the rear end of the lever 3 the pump-rod will be depressed and force the measured quantity of oil into the carbureter, where it will be diffused over the screens 30 to be taken up by the air passing therethrough on its way to the cylinder. If from any cause the speed of the engine be accelerated and exceed a predetermined number of revolutions, the governor will operate the loose collar and lever 47, throwing the vibrating piece 53 into the path of the lever 3, which will always keep open the eduction-valve, stop the pump, and shut off the electric current, thereby preventing an unnecessary waste of energy and material and relieving the actuating mechanism from undue wear. If desired to change the speed of the engine while it is in motion, it is simply necessary to turn the thumb-screw 50.

Having thus described the invention, what is claimed as new is—

1. In an explosive-engine, means for supplying a measured quantity of the volatile hydrocarbon to the engine, consisting of a force-pump having a protruding plunger-rod, an adjustable stop set to engage said rod for limiting its upward movement, a lever for operating said pump both in its upward and downward movements, and a spring confined around the rod and between a stop thereon and the lever, whereby the lever is permitted to finish its upward stroke after having forced said rod to the required distance, substantially in the manner set forth for the purpose described.

2. In an explosive-engine, the combination with the cylinder, and a carbureter communicating with the cylinder, of a pump for charging the carbureter with a hydrocarbon in measured quantities, an actuating-lever operatively connected with the pump-rod, a spring mounted upon the pump-rod and confined between a stop thereon and the actuating-lever connection for transmitting power from the said actuating-lever to the pump-rod, and an adjustable stop set to engage with the pump-rod for regulating the stroke of the pump, substantially in the manner set forth for the purpose described.

3. In an explosive-engine, the combination of a cylinder, a head closing the rear end of the cylinder and formed with a chamber and a communicating passage, an induction-valve normally closing the said passage, a carbureter having connection with the said passage and provided with a bank of screens, an oil-pump having a pipe extending within the carbureter among the screens thereof and having a discharge-opening, a spreader located opposite the discharge-opening for diffusing the oil over the screens, and a lever for simultaneously operating the oil-pump and the induction-valve, substantially as set forth.

4. In an explosive-engine, the combination with the cylinder having inlet and outlet ports, and induction and eduction valves normally closing the respective ports, of a lever fulcrumed between its ends upon a yielding or spring-actuated support and having its opposite ends connected with the stems of the respective induction and eduction valves, a second lever operatively connected with the stem of the eduction-valve, and actuating mechanism for the said lever, substantially as set forth.

5. In an explosive-engine, the combination of a cylinder, eduction and induction valves closing openings leading thereto, a lever fulcrumed between its ends upon a yielding or spring-actuated support and having its opposite ends connected with the stems of the eduction and induction valves, a spring normally exerting a pressure on the stem of the eduction-valve to maintain the latter in closed relation, a lever operatively connected with the stem of the eduction-valve, and actuating mechanism for the last-mentioned lever, substantially as and for the purpose set forth.

6. In an explosive-engine, the combination of a cylinder, a carbureter, an induction-valve for controlling the communication between the cylinder and carbureter, an eduction-valve, a lever mounted between its ends upon a yielding support and having its ends connected with the stems of the induction and eduction valves, an operating-lever connected with the stem of the eduction-valve, a pump for charging the carbureter with a measured quantity of hydrocarbon and having connection with the aforesaid operating-lever, and actuating mechanism for the operating-lever, substantially as set forth.

7. In an explosive-engine, the combination with the cylinder, the igniting and power-supplying provisions, of an operating-lever, a movable arm, a governor mechanism for operating the movable arm to project it across the path of the said operating-lever to hold the latter out of working position at such times when the engine is running beyond a given speed, a lever fulcrumed between its ends and having connection at one end with the governor mechanism, a rod having piv-

otal connection with the opposite end of the lever and operating loosely through the movable arm, a spring mounted upon the rod and bearing against one side of the said movable arm, and a stop carried by the rod and adapted to engage with the opposite side of the said arm, substantially as set forth for the purpose described.

8. In combination, a cylinder, a carbureter connected with the cylinder, a pump for charging the carbureter with a measured quantity of hydrocarbon, induction and eduction valves, a lever mounted between its ends upon a yielding support and having its ends connected with the stems of the induction and eduction valves, an operating-lever connected with the stem of the eduction-valve and adapted to operate the pump, a movable arm, a governor mechanism for projecting the movable arm within the path of the operating-lever, a rod having connection with the governor mechanism and passing loosely through the movable arm, a spring mounted upon the rod and adapted to bear against one side of the movable arm, and an adjustable stop mounted upon the said rod and acting in opposition to the spring and adapted to engage with the opposite side of the movable arm, substantially as and for the purpose set forth.

9. In an explosive-engine, the combination of the cylinder, means for supplying an explosive mixture thereto, induction and eduction valves, an operating-lever, a vibrating arm, a governor mechanism, a rod having connection with the governor mechanism and passing loosely through the vibrating arm, a spring mounted upon the said rod and bearing against one side of the vibrating arm, and an adjustable stop mounted upon the aforesaid rod and bearing against the opposite side of the vibrating arm, and acting in opposition to the spring, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JOHN FROELICH.

Witnesses:

THOS. F. MAGUIRE,

FRANK ANDERSON.