A. B. FOWLER.

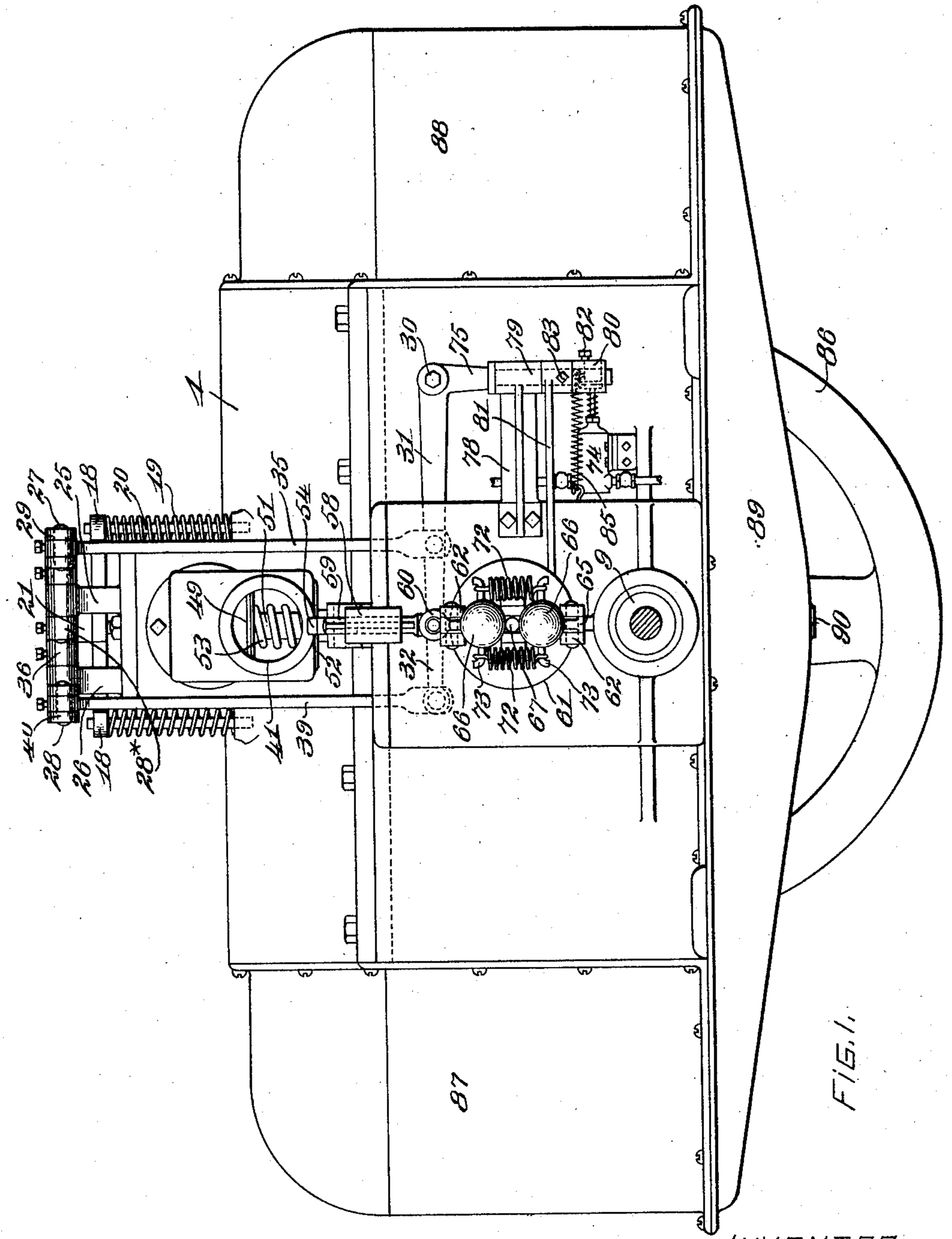
HYDROCARBON MOTOR.

APPLICATION FILED SEPT. 9, 1901.

998,334.

Patented July 18, 1911.

4 SHEETS—SHEET 1.



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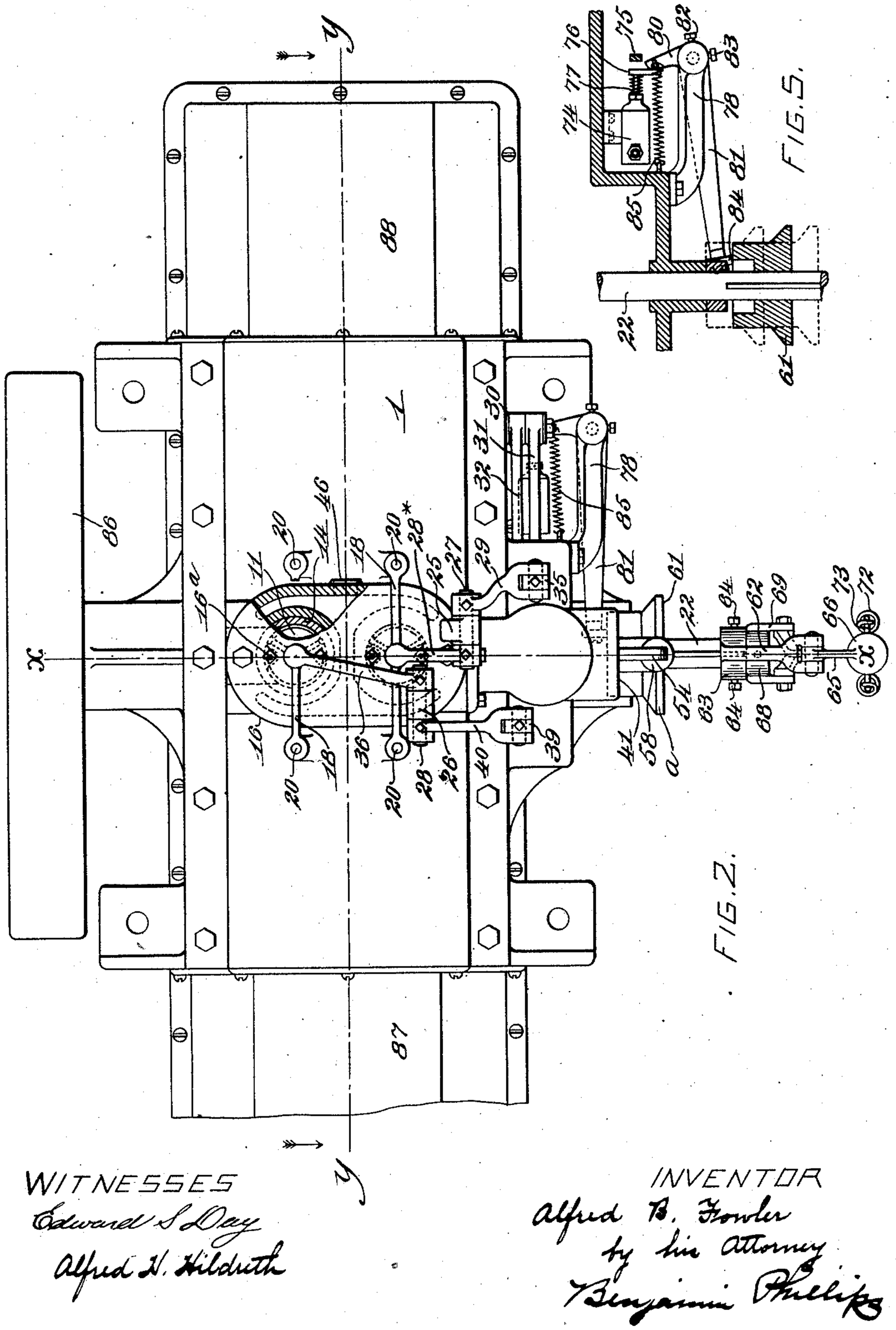

FIG. 2.

FIG. 5.

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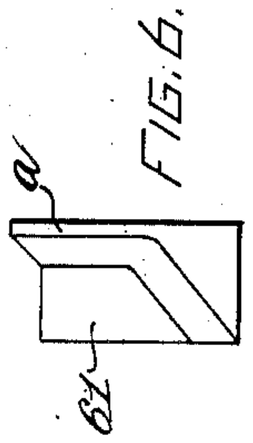

FIG. 4.

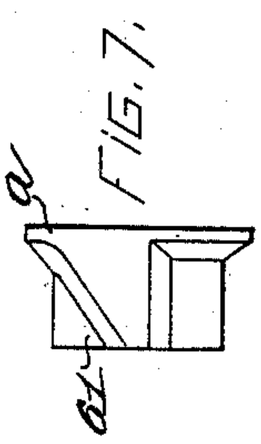

FIG. 5.

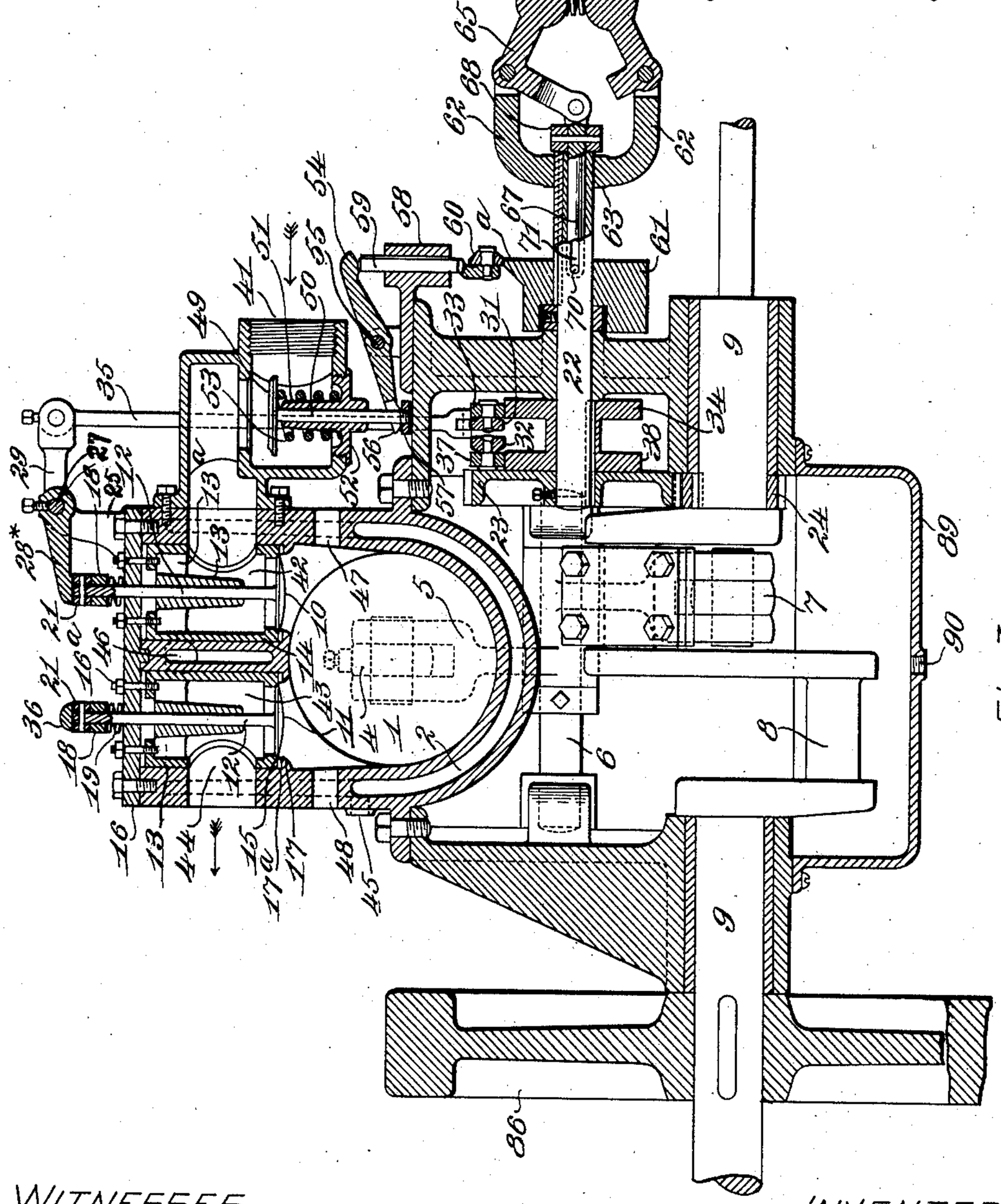

FIG. 3.

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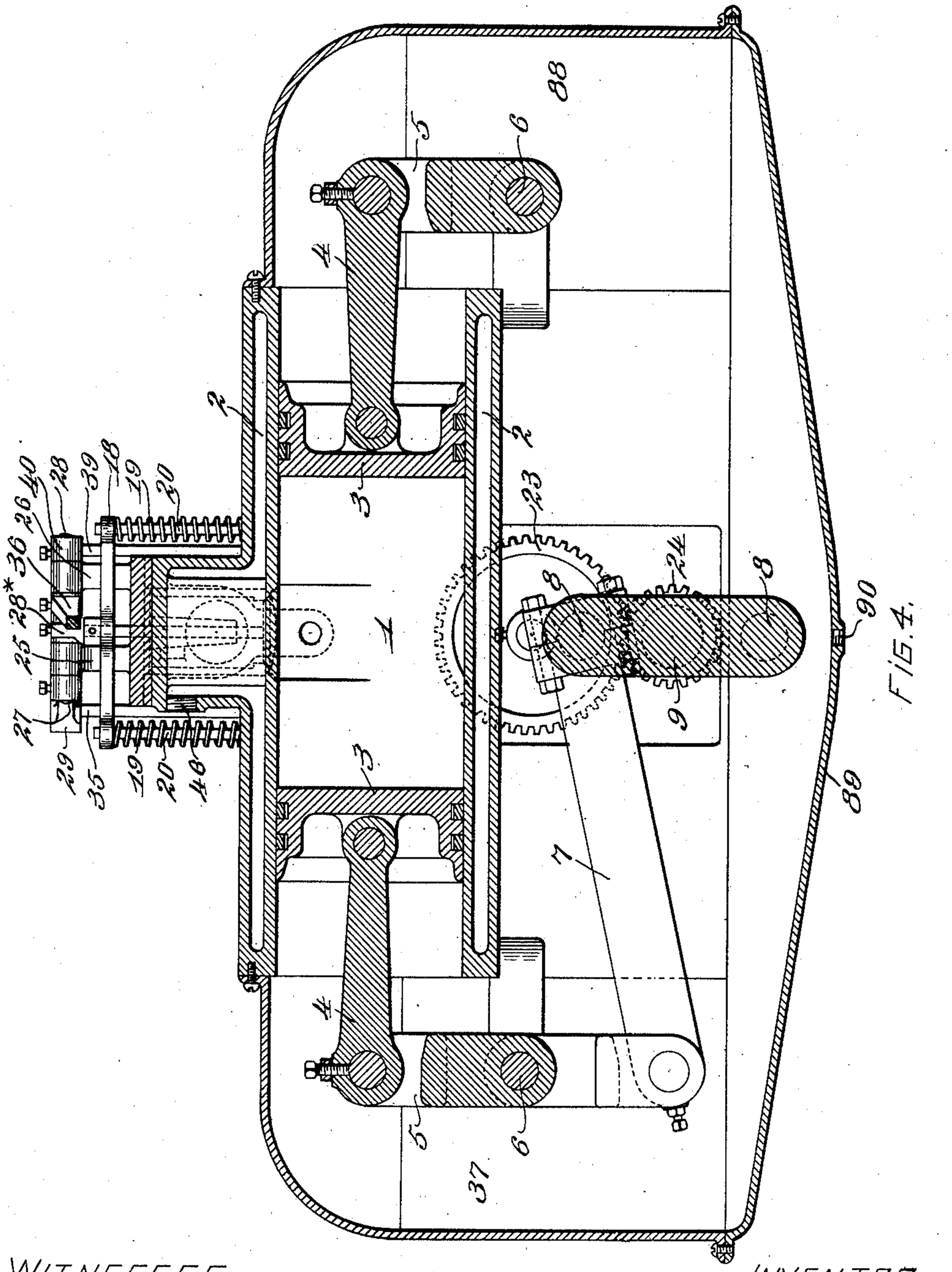

FIG. 4.

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ALFRED B. FOWLER, OF CENTRAL FALLS, RHODE ISLAND.

HYDROCARBON-MOTOR.

998,334. Specification of Letters Patent. **Patented July 18, 1911.**

Application filed September 9, 1901. Serial No. 74,799.

To all whom it may concern:

Be it known that I, ALFRED B. FOWLER, a citizen of the United States, residing at Central Falls, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Hydrocarbon-Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to hydrocarbon motors.

The object of the present invention is to reorganize and improve the above class of motors, and more particularly to construct a hydro-carbon motor in which the quantity of explosive mixture admitted to the cylinder shall be accurately and economically measured in order to maintain the speed substantially constant.

At the present time it is considered good practice to govern the power and maintain the speed of hydro-carbon motors constant by varying the quantity but not the quality (except in so far as is necessary to insure ignition when the degree of compression is considerably reduced) of the charges which are exploded in the cylinder at each impulse stroke of the piston, and to the class of motors employing this method of control belongs the motor of the present application.

In the present invention I accomplish the desired result by providing an independent cut-off valve located in the supply pipe which shall be held open for a longer or shorter period of time during the intake stroke of the piston, according to the speed of the motor. An inlet valve is also provided which admits to the cylinder the exact charge measured out by the cut-off valve. This inlet valve is shown as a positively opened valve, but may be of the ordinary pressure opened type as the cut-off valve controls the quantity of mixture. I have also provided an oil pump, and, in order that the quality of the explosive mixture shall remain constant, have provided means whereby the quantity of the fuel or oil supplied by said pump shall be varied in substantially the same ratio as is the quantity of air drawn into the carbureter, that is, as is the time during which the cut-off valve remains open.

In the accompanying drawings which illustrate a preferred form of my invention, Figure 1 is a side elevation of my improved hydro-carbon motor; Fig. 2 a top plan; Fig. 3 a vertical section on the line *x—x*, Fig. 2, looking toward the right; Fig. 4 a longitudinal section on line *y—y* Fig. 2; Fig. 5 is a detail view partly in section, showing the pump and its stroke-controlling devices; Fig. 6 is an elevation of the cut-off valve actuating cam in the same position as in Fig. 3, and Fig. 7 is a bottom plan view of the same cam.

1 represents the cylinder of the motor which is provided with the water jacket 2. Arranged to reciprocate in the cylinder are the two pistons 3, the charge being admitted to the cylinder and ignited between them. Connecting rods 4 are pivotally connected at one end to the pistons and at the other to the oscillating links 5, which are pivotally supported upon the studs 6.

7 represents the crank rods which transmit motion from the oscillating links 5 to the cranks 8 on the motor shaft 9.

As shown in Fig. 3, the inlet and outlet valves 10 and 11, respectively, are identical in construction, being provided with a spindle 12 and arranged to have vertical movement in a bearing formed in the boss or hub 13 rigidly supported by the spider arms 13ª projected from the valve seat members 14. These members at their lower ends are provided with the valve seats 15 and are secured at their upper ends to the valve chest cover 16 by means of the tap bolts 16ª. The valve seat members are supported by the flanges 17 projected from the walls of the valve chambers and by means of the packing or gasket 17ª all danger of ignition of the gas in the inlet valve chamber and supply pipe is avoided.

The valves are normally held in their raised or closed position by means of the cross bars 18 which are pressed upwardly to engage a collar 21 on the upper end of the valve spindles by the spiral springs 19 mounted upon the vertical guide rods 20. The valves are positively opened in unchanging time relation in the cycle of operation of the motor by means of cams mounted upon a shaft 22 which carries at one end the gear 23 meshing with the gear 24 mounted upon the driving shaft 9. Gear 23 is twice the diameter of gear 24 so that shaft 22 is rotated just half the speed of the main driving shaft of the motor which is of the Otto or four-cycle type. Rising

from the cover 16 of the valve chest are the arms or brackets 25 and 26 in which are mounted the short rock shafts 27 and 28, respectively. Upon one end of shaft 27 is rigidly secured the valve actuating arm 28* while upon the other end of said shaft is secured the arm 29. Pivotally supported upon the stud 30 fixedly mounted in the frame of the machine are the levers 31 and 32. Lever 31 carries at its extremity the cam roll 33 which engages the cam 34. The connecting rod 35 pivotally connected at one end to the arm 29 and at the other to the lever 31 transmits to the valve actuating arm 28* the vertical oscillations imparted to the lever 31 by the cam 34, causing the inlet valve 10 to open and to close at the predetermined times. The outlet valve 11 is actuated by a similar train of mechanism comprising the valve actuating arm 36, the cam actuated lever 32 bearing the cam roll 37 which engages the cam 38 and the connecting rod 39 pivotally connected at one end to the lever 32 and at the other to lever 40. Cams 38 and 34 as shown in Fig. 3 are made integral and are keyed upon the shaft 22.

The explosive gases are conducted from a carbureter (not shown) through a supply pipe 41 into the inlet chamber 42 and thence into the cylinder. The burned gases pass from the cylinder into the outlet chamber 43, and through the exhaust opening 44 into the exhaust pipe (not shown) and are discharged into the air at some convenient point. It will be noted that the valve chambers are water jacketed (see Fig. 2) thus reducing the temperature of the explosive mixture as well as preventing excessive heating of the valves. 45 is the inlet opening for the water and 46 the outlet, circulation being maintained in any suitable manner. An ignition device of any usual or suitable form (not shown) is mounted in the aperture 47 in the wall of the cylinder. Opposite the aperture 47 is a second aperture 48 adapted to receive in the usual manner a plug of suitable transparent material so that the action of the ignition device as well as the quality of the combustion may be observed.

It will be noted that the inlet and outlet valves are positively opened once for every two revolutions of the driving shaft 9, the times of opening and of closing being unvarying. In order, therefore, to vary the quantity of explosive mixture supplied to the cylinder I have provided a cut-off valve in the supply pipe which shall be held open during the intake stroke of the pistons for a longer or shorter period of time according as the power demanded is greater or less. This cut-off valve is shown at 49 and is provided with the valve spindle 50 mounted in the boss 51 of the screw plug 52 secured in the supply pipe 41. The spiral spring 53 acts normally to raise or close said valve. In this connection it will be noted that the suction stroke of the pistons tends to close the cut-off valve and hold it closed thus assisting the spring 53 in its action and permitting the use of a weaker spring with a correspondingly diminished absorption of power by, and wear of, the valve actuating mechanism. The valve is opened by means of a lever 54 pivoted at 55, the forked end 56 of which engages the collar 57 secured to the lower end of the valve spindle 50. Vertically movable in a bearing in the bracket 58 is the rod 59 carrying at its lower end the cam roll 60 and engaging at its upper end the pivoted lever 54. 61 is a cam disk which is splined upon shaft 22, being held to rotate therewith, but longitudinally movable thereon. This cam disk, as shown in Figs. 6 and 7, is provided with a cam surface of varying peripheral length one portion *a*, of said disk being circular. By means of a governing device, shortly to be described the cam disk 61 is moved longitudinally on shaft 22, bringing different portions of said disk under the cam roll 60 and varying the length of time during the revolution of the shaft 22 that the cam roll is raised and the cut-off valve 49 is held open. In Fig. 3 the cam disk is shown in the position which it occupies when the motor is developing its maximum power, the cam roll at such a time riding upon the cylindrical portion *a*, of the cam disk and holding the cut-off valve 49 open all of the time.

The governor for moving the cam disk 61 comprises the arms 62 projected from the sleeve 63 which is secured upon the shaft 22 by means of the set screws 64, the bent levers 65 pivotally mounted in the bifurcated ends of the arms 62 and carrying at their extremity the weights or balls 66, the sliding rod 67 mounted within the hollow end of the shaft 22, and the collar or sleeve 68 secured to said rod and provided with the bosses 69 to which the inner ends of the bent levers 65 are pivotally connected. A pin 70 passing through the cam disk 61 and the sliding rod 67 causes the disk to move longitudinally on the shaft 22 with the sliding rod 67, slots 71 being formed in the shaft 22 through which the pin passes. Tension springs 72 mounted upon the hooks 73 secured in the weights or balls 66 act normally to hold said balls close together, thereby causing the cam disk to assume the position shown in Fig. 3. As the speed of the motor increases, the balls tend to move apart owing to their centrifugal action, turning the bent levers 65 upon their supports and moving the rod and cam disk outwardly from the motor thus decreasing the length of time the cut-off valve 49 remains open and thereby reducing the charge admitted to the cylinder.

74 is the oil pump mounted upon a bracket projected from the frame of the motor and is positively actuated to make its power stroke by means of the arm 75 projected from the hub of the lever 31, and engaging the end 76 of the piston rod, the return or idle stroke being made by the spring 77. In order that the amount of oil or fuel thrown into the carbureter (which is not shown) shall be proportional to the quantity of air drawn therethrough during the in-take stroke of the piston of the motor, I have provided means for varying the length of the stroke of the oil pump piston as the length of time the cut-off valve 49 remains open is varied to maintain the motor at constant speed. Projected from the frame of the motor is the bracket 78 which carries in a vertical bearing the headed shaft 79 upon which are mounted the levers 80 and 81, being secured thereon by means of the set screws 82 and 83 respectively. Lever 80 is provided at its end with a cam face which engages the projecting end 76 of the oil pump piston rod and acts as a stop to limit the return stroke of said rod. Lever 81 carries at its end the roll 84 which bears upon the inner face of the cam disk 61, being held in contact therewith by means of the spring 85 secured at one end to the frame of the motor and at the other to the lever 80. As is shown in Fig. 5, the length of stroke of the oil pump piston will be diminished when the cam disk 61 is moved outwardly by the governor, thus reducing the quantity of oil supplied to the carbureter in substantially the same proportion as the quantity of gas drawn into the cylinder is diminished.

A balance wheel or fly wheel 86 is mounted upon the shaft 9 as is customary in this class of motors. Casings 87 and 88 inclose the ends of the motor, the bottom also being inclosed by the casing 89. An opening 90 is provided at the lowest point of this bottom casing through which the oil in which the cranks dip at each revolution may be drawn off.

The operation of my improved motor is as follows:—Assuming the parts to be in the position as shown in Fig. 4, that is, after ignition of the charge and while the pistons are moving apart, the links 5 will at that time be rocked about their pivotal supports, the connecting rods 7 imparting the impulse to the cranks and rotating the shaft 9. As soon as the pistons reach the limit of their movement away from each other, the outlet valve 11 is opened and the burned gases are discharged from the cylinder during the return stroke of the pistons. The pistons now begin to move apart again and the inlet valve 10 is opened, the cut-off valve 49 being open at the same time. Assuming that the motor is not developing its maximum power, the said cut-off valve remains open during only a portion of the intake stroke of the pistons, its time of closing being controlled by the governing device. At the time the inlet valve opens, the oil pump is caused to make its power stroke, the length of said stroke being varied according as the length of time the cut-off valve remains open is greater or less. The inlet valve then closes, the idle stroke of the pump takes place, and the charge in the cylinder is compressed. The charge is then ignited, the pistons begin to move apart again, and the cycle is repeated. If the motor be working at its maximum power the cam disk 61 will be in the position shown in Fig. 3, the cut-off valve remaining open all of the time and the oil pump working with its longest possible stroke.

Although I have shown and described the inlet valve as positively opened, I do not limit myself to such a construction as it is evident that this valve may be opened by the excess of pressure in the supply chamber over that in the cylinder during the suction stroke of the pistons. Nor is my invention limited in its broadest aspects to any particular method of varying the time the cut-off valve remains open, although in the present application it is shown and described as opening always at the same time in the cycle of operation of the motor, the time of closing being variable. I also believe that I am the first to combine with a variably actuated cut-off valve independent of the inlet valve an oil pump which automatically varies the quantity of oil supplied to the carbureter in substantially the same ratio as the length of time the cut-off valve remains open is varied, so that the quality of the mixture drawn into the cylinder is maintained substantially constant.

Having thus described the construction and mode of operation of my improved hydro-carbon motor, I claim as new and desire to secure by Letters Patent of the United States:—

1. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet passage, an oil pump, means for actuating the pump, an outwardly opening puppet valve in the inlet passage, a cam for opening the valve, means controlled by the speed of the motor for varying the length of time said valve remains open, and means connected to said cam for varying the quantity of oil supplied by the pump, substantially as described.

2. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet passage an outwardly opening puppet valve in the inlet pipe, means for opening the valve, an oil pump, means for actuating the pump, and

means controlled by the speed of the motor for varying in substantially the same proportion the length of time the valve remains open and the length of stroke of the oil pump, substantially as described.

3. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet passage, an outwardly opening puppet valve in the inlet passage, an oil pump, means for actuating the pump, a graduated cam for opening the valve, means controlled by the speed of the motor for moving the cam to positions to vary the length of time the valve remains open, and mechanism controlled by the cam movement for simultaneously varying the quantity of oil supplied by the pump, substantially as described.

4. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet port, an inlet valve closing the same, means for opening the said valve and holding it open during the entire intake stroke, an inlet pipe for conducting explosive mixture to the inlet port, a puppet valve for closing the said pipe arranged to open outwardly, and means controlled by the speed of the engine for opening the puppet valve widely at the beginning of the intake stroke of the piston, and for closing the said valve suddenly during the intake stroke at a point varying with the speed of the engine, substantially as described.

5. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an exhaust port, an exhaust valve governing the same, an inlet passage, an inwardly opening puppet valve closing the same, means for opening and closing the said valve at fixed times in the operation of the motor, an outwardly opening puppet valve in the inlet passage and means controlled by the speed of the motor for opening the said outwardly opening valve at a fixed time in the operation of the motor and for closing it at a variable time, according to the speed of the motor, substantially as described.

6. A four-cycle hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet passage, an inwardly-opening puppet valve normally closing the same but opening at alternate out-strokes of the piston to admit explosive mixture, an outwardly-opening puppet valve in the inlet passage, and means controlled by the speed of the motor for opening said outwardly-opening valve in unison with the inwardly-opening valve and for closing it at a variable time thereafter according to the speed of the motor, substantially as described.

7. A hydro-carbon motor, having in combination a cylinder, a piston arranged to reciprocate therein, a supply pipe for explosive mixture, a valve located in the supply pipe and opening outwardly, means for opening the valve, and means controlled by the speed of the motor for varying the length of time the valve remains open without substantially varying the extent to which it is opened, substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

ALFRED B. FOWLER.

Witnesses:
ALFRED H. HILDRETH,
FRED O. FISH.