A. B. FOWLER.

HYDROCARBON MOTOR.

APPLICATION FILED AUG. 4, 1902.

989,241. Patented Apr. 11, 1911.

3 SHEETS—SHEET 1.

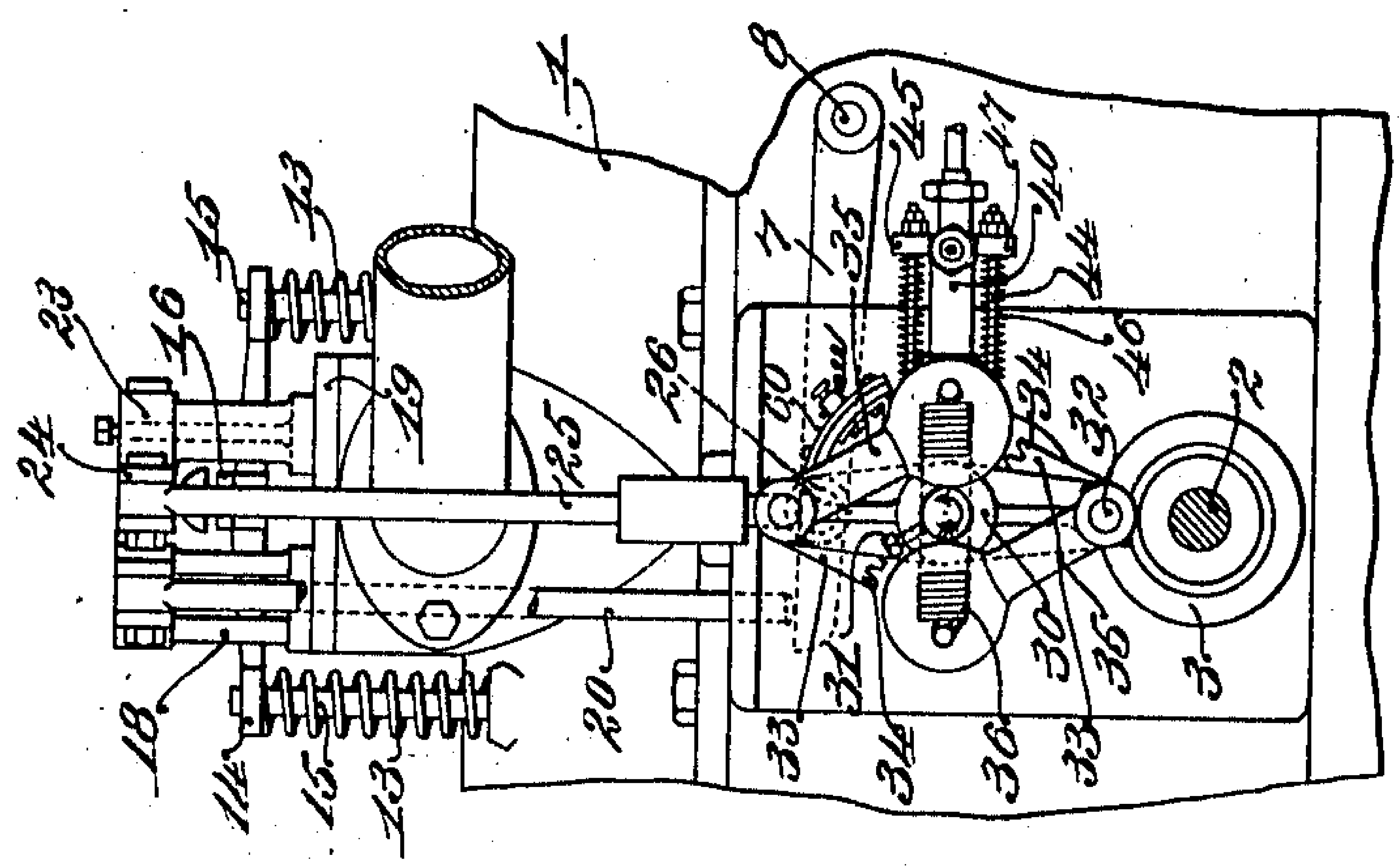

Fig. 2.

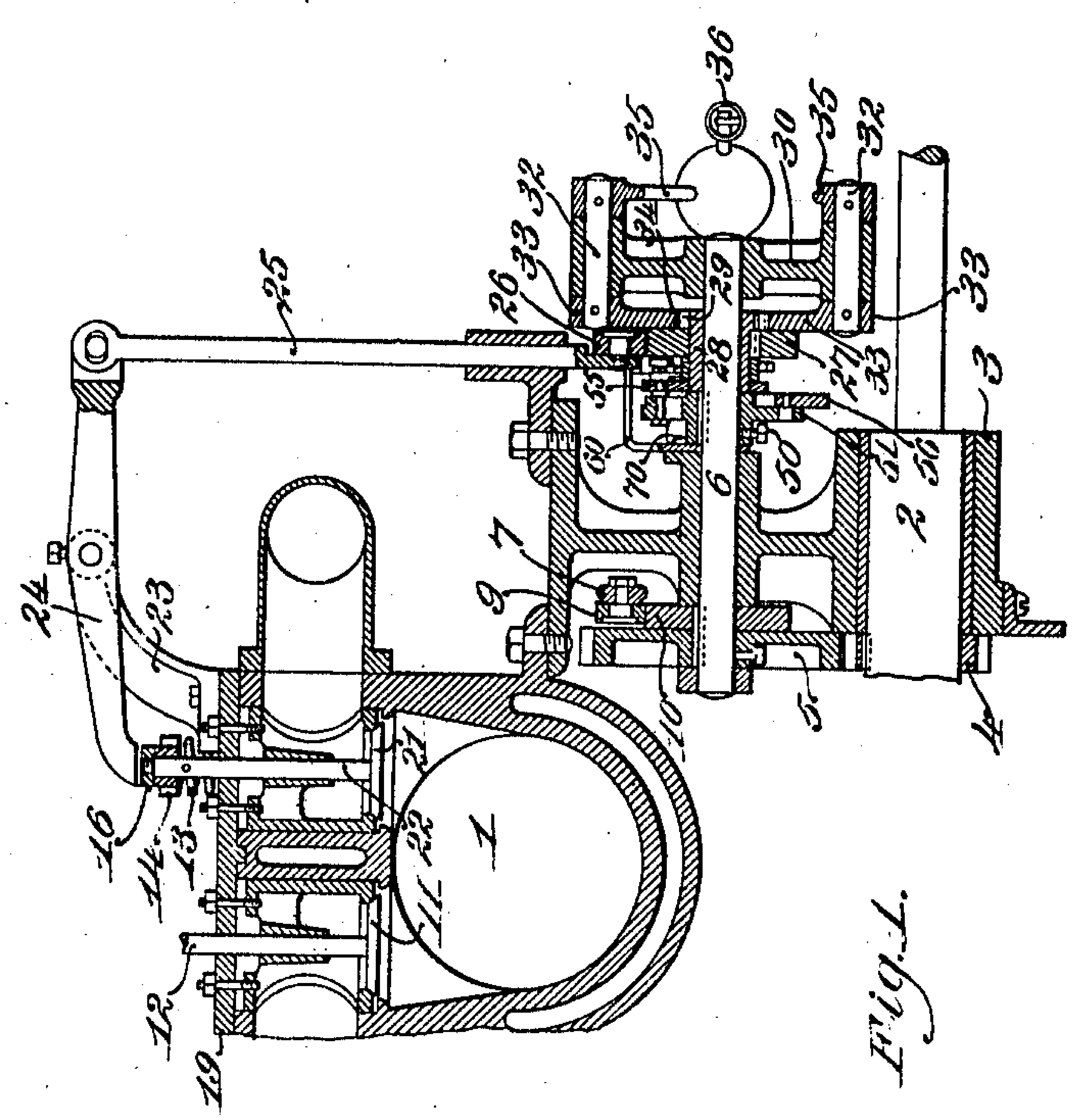

Fig. 1.

Witnesses

Edward S. Day

Alfred H. Hildreth

Inventor

Alfred B. Fowler

by his attorneys

Philipp, Van Everen & Fish

A. B. FOWLER.

HYDROCARBON MOTOR.

APPLICATION FILED AUG. 4 1902.

989,241. Patented Apr. 11, 1911.

3 SHEETS—SHEET 2.

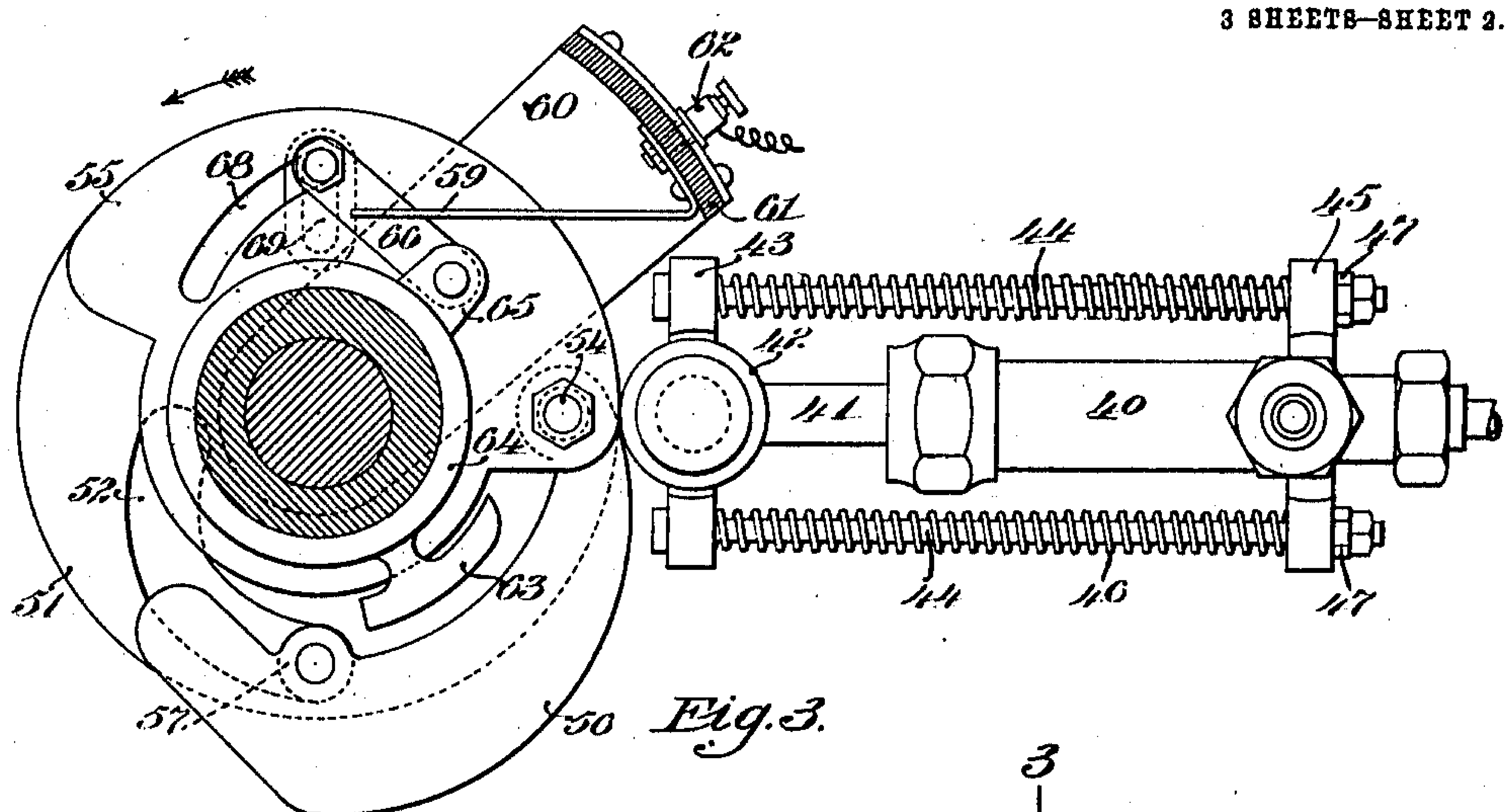

Fig. 3.

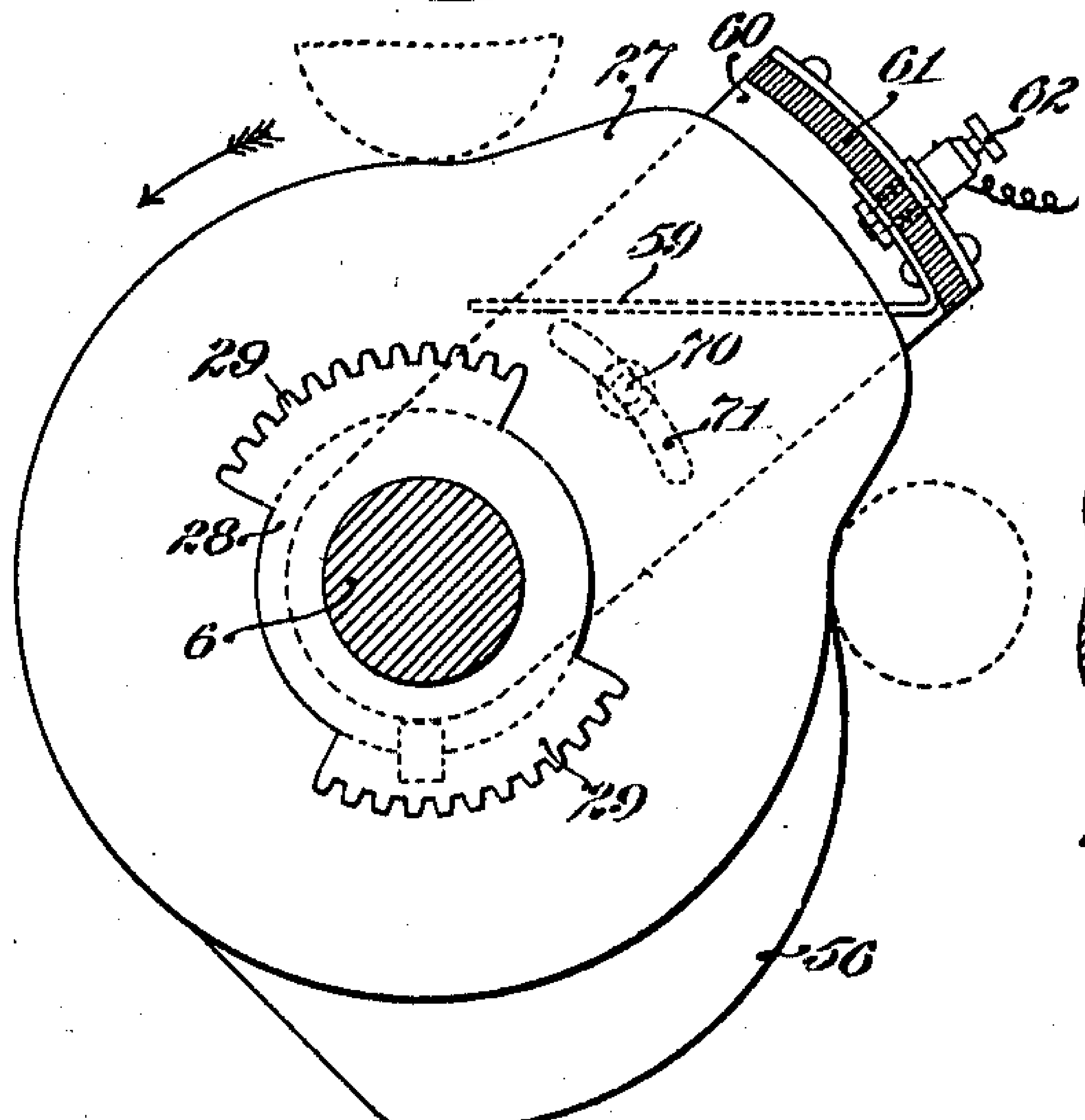

Fig. 4

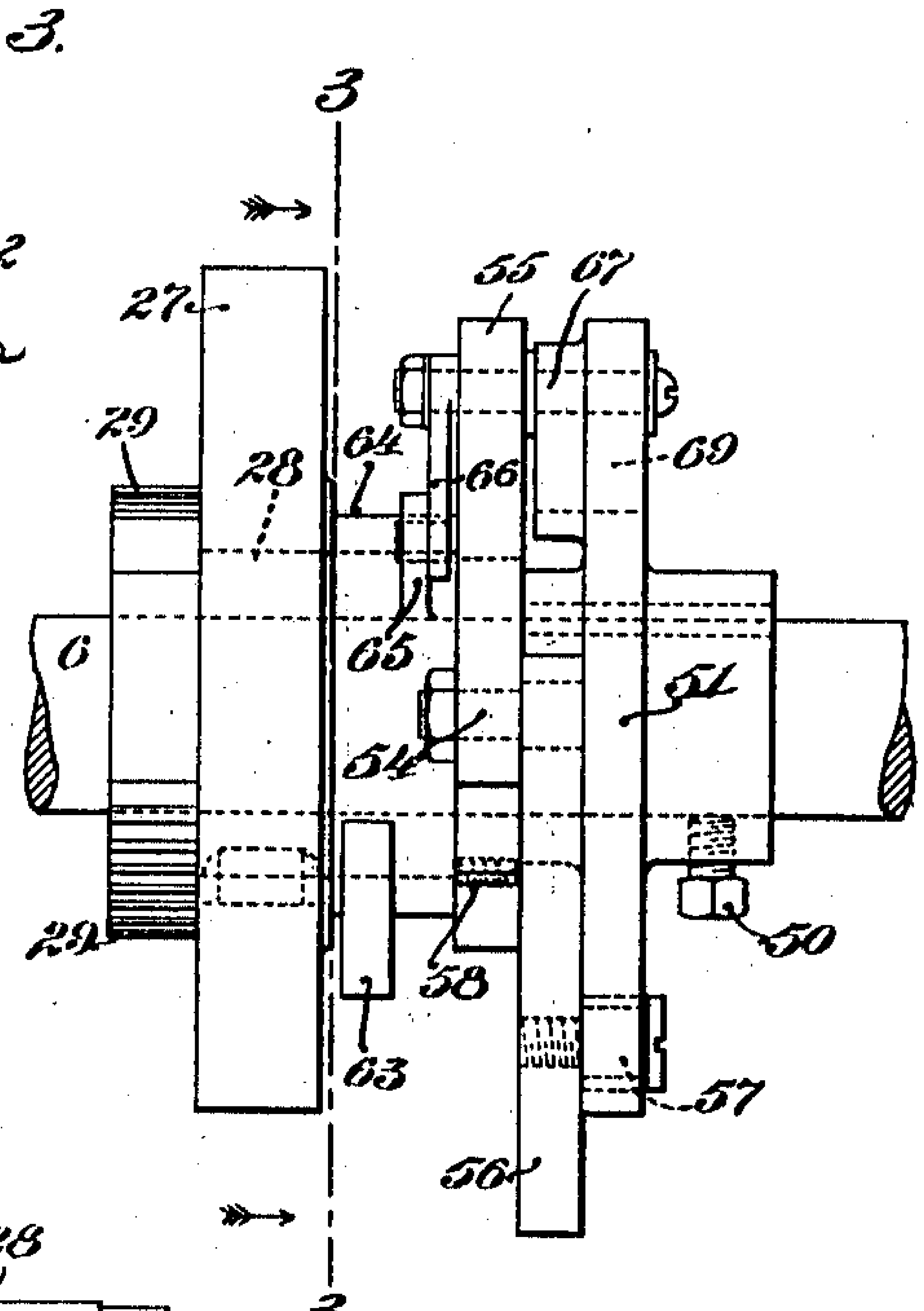

Fig. 5.

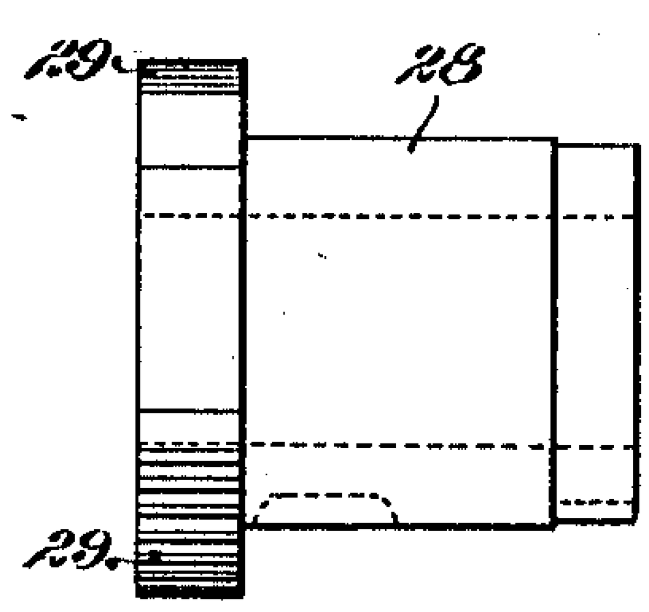

Fig. 6.

Witnesses

Edward S. Day

Alfred H. Hildreth

Inventor

Alfred B. Fowler

by his Attorneys

Phillips Van Everen & Fish

A. B. FOWLER.
HYDROCARBON MOTOR.
APPLICATION FILED AUG. 4, 1902.

989,241. Patented Apr. 11, 1911.

3 SHEETS—SHEET 3.

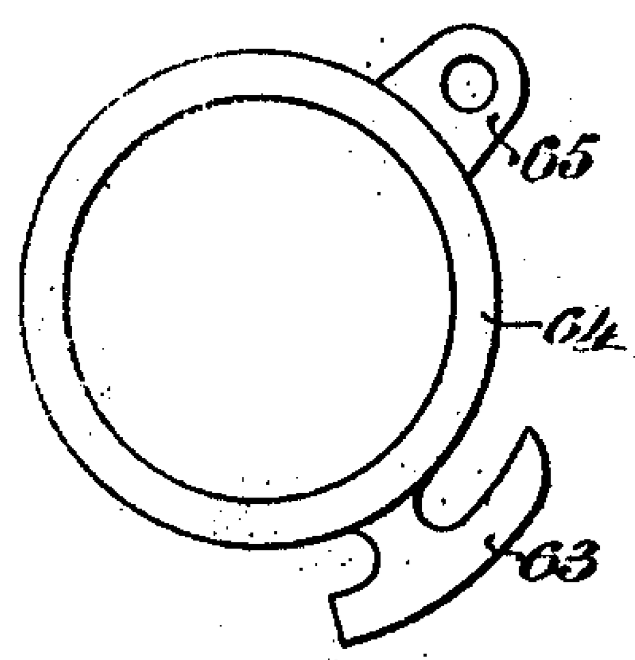

Fig. 7.

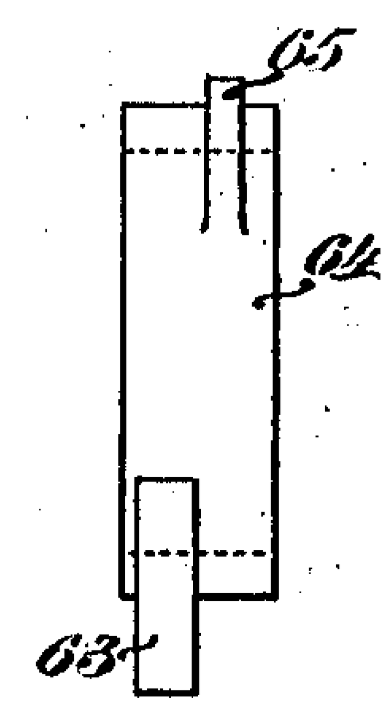

Fig. 8.

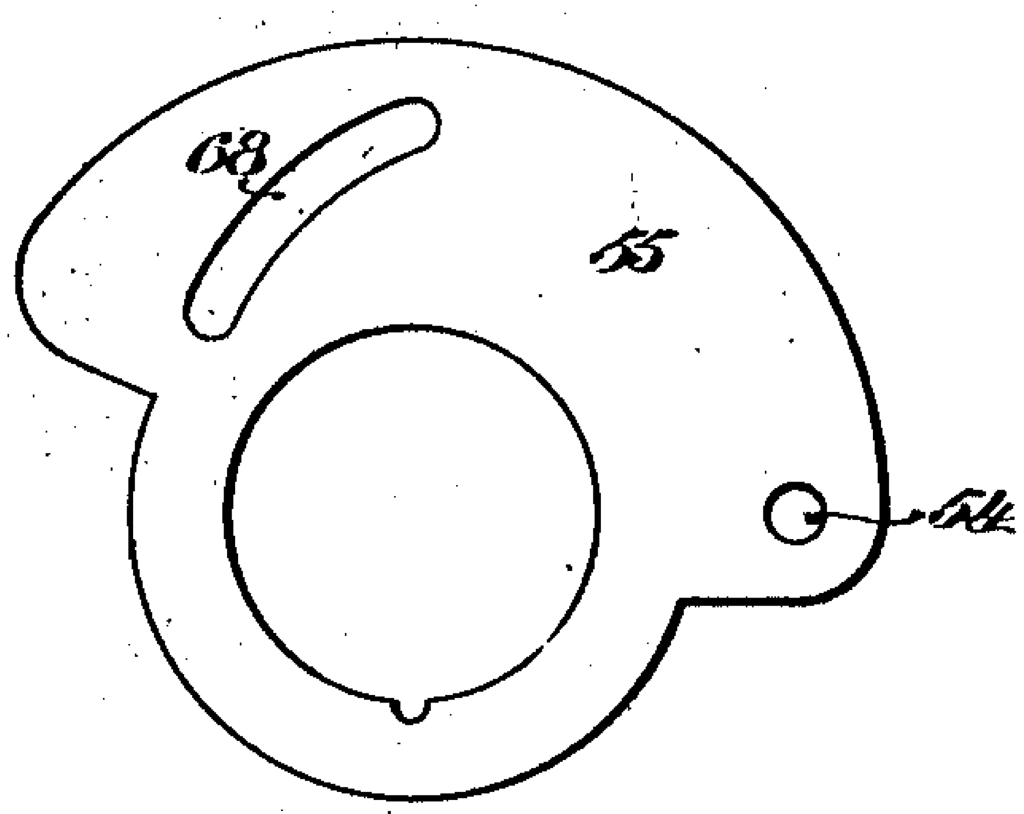

Fig. 9.

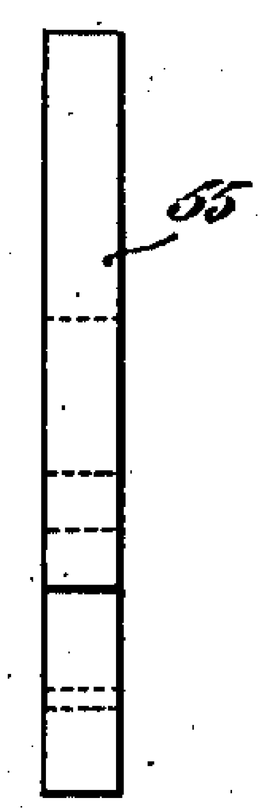

Fig. 10.

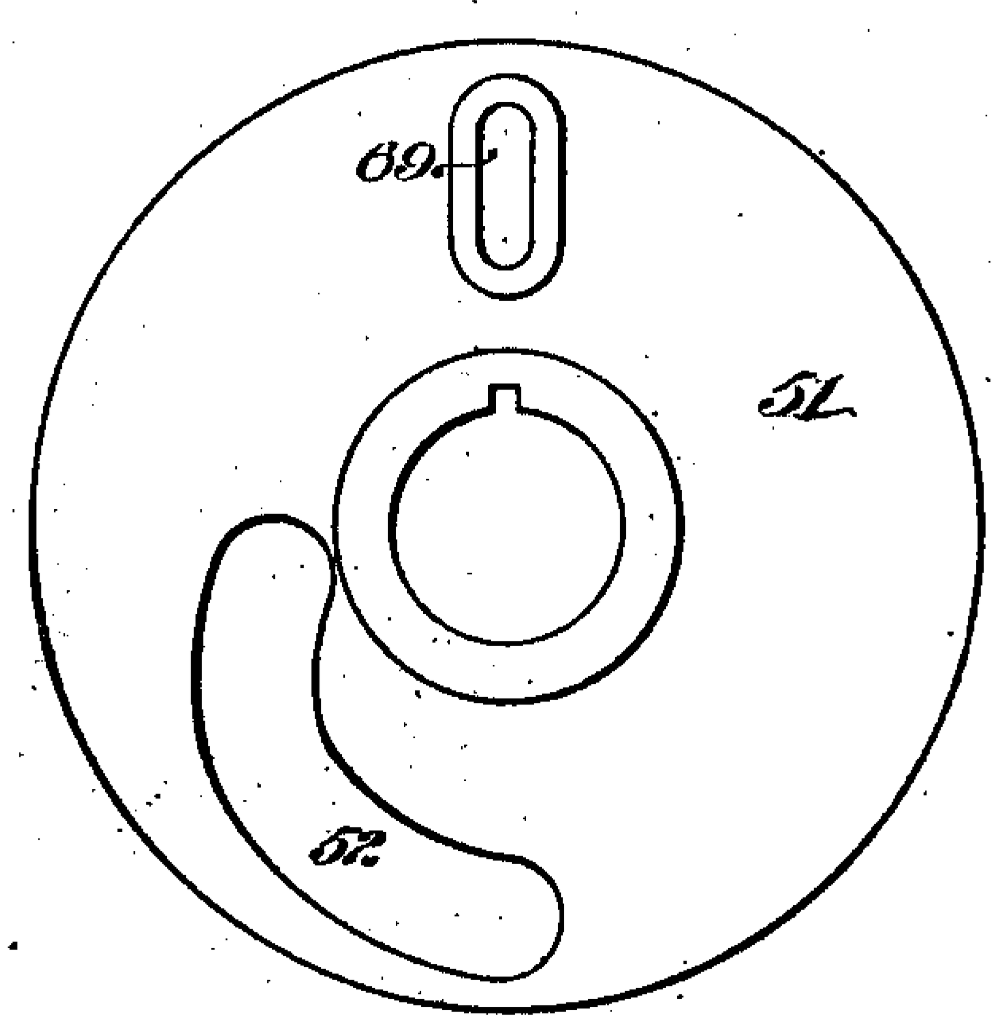

Fig. 11

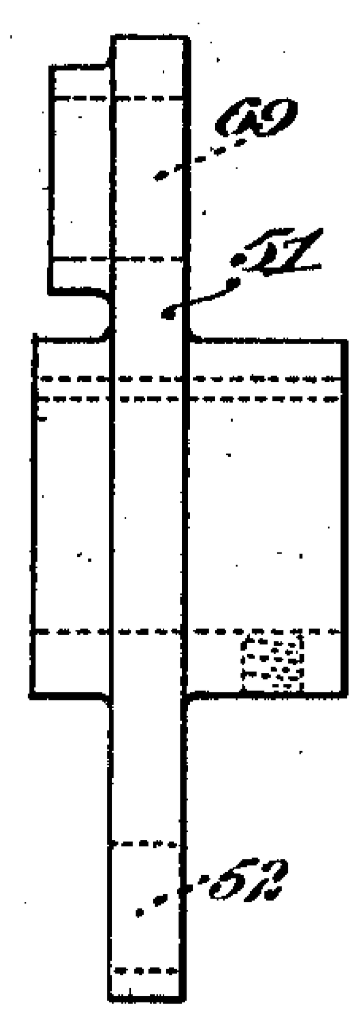

Fig. 12.

Witnesses
Edward S. Day
Alfred H. Hildreth

Inventor
Alfred B. Fowler
by his attorneys
Phillips Van Everen & Fish

UNITED STATES PATENT OFFICE.

ALFRED B. FOWLER, OF BOSTON, MASSACHUSETTS.

HYDROCARBON-MOTOR.

989,241. Specification of Letters Patent. Patented Apr. 11, 1911.

Application filed August 4, 1902. Serial No. 118,408.

To all whom it may concern:

Be it known that I, ALFRED B. FOWLER, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, 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 construct a motor of the above class in which the quantity of explosive mixture compressed and ignited in the cylinder shall be accurately controlled by automatic mechanism to maintain the speed of the motor substantially constant under a varying load.

A further object of the present invention is to provide a hydro-carbon motor in which the quantity of oil or fuel supplied shall be automatically varied to maintain the explosive mixture at substantially the same degree of richness, irrespective of the size of the charges exploded in the cylinder.

Another object of the present invention is to provide a hydro-carbon motor with mechanism constructed and arranged to vary the point of ignition to conform to the new conditions resulting from a variation in speed of the motor and in size of the charges exploded therein.

In my pending application filed September 9, 1901, Serial No. 74,799, I have shown and described a hydro-carbon motor in which the quantity of gas admitted to the cylinder is automatically varied by means of a cut-off valve located in the supply pipe and actuated independently of the inlet valve. In the motor of the present application I have done away with this cut-off valve and vary the quantity of the charge exploded in the cylinder by means of the inlet valve, automatic mechanism being provided which may act to hold open said valve for a shorter or longer period of time at the beginning of the compression stroke of the piston according to the speed of the motor, to permit a portion of the full charge which is drawn into the cylinder at each suction stroke to be expelled therefrom so that only enough gas shall remain in the cylinder and be compressed and ignited to maintain the speed of the motor at the desired number of revolutions per minute. I have also provided in the motor, which is the subject of the present application, mechanism which automatically shifts the point of ignition when the speed changes and the size of the charge is varied, so that the point of ignition conforms to the quantity of gas exploded and to the speed of the motor. Moreover, I have provided a device for supplying fuel which automatically varies the amount delivered according to the size of the charges exploded in the cylinder, so that the quality of the explosive mixture remains substantially constant.

In the drawings which illustrate a preferred form of the present invention, Figure 1 is a vertical section of the inlet valve controlling mechanism and Fig. 2 is a side elevation of the same, a portion of the motor proper, which is preferably of the type shown in my pending application hereinbefore referred to, being shown to illustrate more clearly the construction and mode of operation of the governing device; Fig. 3 is a section on line 3—3, Fig. 5, looking toward the right, showing the ignition cam and the oil pump and its actuating cam; Fig. 4 is an elevation looking toward the right in Fig. 5, showing the inlet valve cam and oil pump cam; Fig. 5 is an elevation of the inlet valve, ignition and oil pump cams; Fig. 6 is an elevation of the sleeve for shifting the inlet valve and the ignition cams; Figs. 7 and 8 are detail views of the ignition cam; Figs. 9 and 10 are detail views of the member which carries the oil pump cam; and Figs. 11 and 12 are detail views of the member for varying the throw of the oil pump cam.

1 represents the cylinder of the motor in which two pistons are arranged to reciprocate, the arrangement of pistons, connecting rods, and cranks (not shown in the present drawings), being the same as in my pending application above referred to.

2 is the driving shaft of the motor and 3 a bearing for the same. 4 is a gear mounted upon said driving shaft and meshing with the gear 5 mounted upon the cam shaft 6.

7 is a lever pivoted at 8 and carrying the

cam roll 9 which engages the cam 10 keyed upon the shaft 6.

21 is the inlet valve and 22 the spindle therefor.

13, 13 are springs which act normally to raise the cross bar 14 which is guided by the vertical rods 15. A collar 16 pinned upon the valve spindle 22 is engaged by said cross-bar 14 and pressed upward, normally holding the inlet valve closed. The outlet valve 11 provided with the valve spindle 12 is normally held closed in the same manner as inlet valve 21 by means of the springs, guide rods, cross bar and collar. The spindle 12 is depressed and the outlet valve opened against the tension of the springs by means of a horizontal lever (not shown but corresponding to lever 24) pivoted upon the bracket 18 which is projected from the cover 19 of the valve chest, a vertical lever 20 pivotally connected at its upper end to the horizontal lever and engaged at its lower end by the cam lever 7 imparting the vertical oscillations of said cam lever 7 to the horizontal lever. Cam 10 being keyed upon shaft 6 which is rotated at just half the speed of shaft 2, the motor being of the Otto or four-cycle type, the outlet valve is opened and closed in unchanging time relation in the cycle of operation of the motor. The construction above described of the outlet valve and its actuating mechanism is substantially identical with that shown in my prior application.

The inlet valve 21 is arranged to be opened by the suction of the piston and, when the engine is developing its maximum power, that is, using a full charge, this valve is closed by the springs 13 assisted by the compression. When, however, the engine is developing less than its full power, that is, when it is using only a portion of a full charge, the closing of the inlet valve at the end of the intake or suction stroke is prevented, such closing taking place later and at some point in the compression stroke so that a portion of the full charge which has been drawn into the cylinder is forced back through the inlet valve. This delay in the closing of the inlet valve to reduce the charge and thus control the speed of the motor is accomplished in the following manner.

Pivotally mounted near its middle upon the bracket 23 is the horizontal lever 24, one end of which is arranged to engage the end of the spindle 22, while with the other end of the lever is connected by a pin and slot connection the vertically movable cam lever 25 carrying at its lower end the cam roller 26 which engages the cam 27. This cam 27, the shape of which is shown in Fig. 4, normally rotates with the shaft 6 but is arranged to be automatically rotated with relation to said shaft in order that said cam may engage the cam roll 26 later in the cycle of operation of the motor and thus delay the closing of the inlet valve until a portion of the charge originally drawn into the cylinder has been forced back through the valve, so that the charge left to be compressed and ignited shall be no more than sufficient to maintain the speed of the motor at the predetermined number of revolutions per minute.

The cam is rotated as follows:—Rotatably mounted upon the shaft 6 is the sleeve 28 provided with the segmental gears 29 and carrying the cam 27 keyed thereon. Rigidly secured upon the end of the cam shaft 6 by some suitable means, such as the set screw 31, is the head 30. Mounted in bearings in the opposite ends of said head are the short shafts 32 carrying on their inner ends the arms 33 provided with the segmental gears 34 which mesh with the segmental gears 29 on the sleeve 28. Pinned upon the outer ends of the shafts 32 are the weighted arms 35, normally held close together by means of the tension spring 36. When the motor is in operation the sleeve 28 and cam secured thereon will be held to rotate with the shaft 6 by the intermeshing gears 29 and 34, and only when the speed of the motor changes will the weighted arms 35 act to rock the shafts 32 in their bearings and oscillate the segmental gears 34, which in turn rotate the sleeve 28 upon the shaft 6 and with it the cam 27, thus bringing said cam into a different relative position and varying the time of closing of the inlet valve. If the speed decreases due to an increase in the load, the cam will be rotated forward upon the shaft 6 so that the inlet valve may close earlier in the compression stroke or even at the end of the suction stroke, when the whole charge drawn into the cylinder will be compressed and exploded. If, however, the load is diminished and the speed increases, the cam will be rotated backward and the inlet valve will be held from closing for a longer or shorter period during the compression stroke of the pistons.

The gas or explosive mixture for the motor is produced by means of a carbureter into which is delivered the requisite quantity of gasolene or other liquid fuel. In order that the quality of the gaseous mixture supplied to the cylinder shall remain substantially constant, I have provided means whereby a variable quantity of fuel may be delivered to the carbureter, said quantity varying directly as the quantity of fresh air drawn through the carbureter to replace the charge last used is varied; in other words, the quantity of fuel supplied will be greater or less, according as the time of closing of the inlet valve is earlier or later in the compression stroke of the pistons. This result is accomplished in the illustrated embodiment of my invention by mechanism which acts to vary the length of the stroke of an oil pump as the speed of the motor varies, the governing device for the inlet valve mechanism controlling also the oil pump stroke varying mechanism.

40 is the oil pump provided with the rod 41 which carries at its end the cam roll 42 mounted upon the cross head 43. In each end of the cross head 43 are secured the rods 44 which are arranged to slide in bearings in a fixed cross head 45 secured to the head of the pump cylinder. Springs 46, surrounding the rods 44 and engaging at one end the movable cross head 43 and at the other the fixed cross head 45, act to move the cam roll and the piston rod outwardly from the pump, the limit of such movement being variable by adjustment of the nuts 47 on the ends of the rods 44. The cam roll 42 engages a cam which acts to force the piston and piston rod inwardly to make the power stroke of the pump, the idle or suction stroke being made by the springs which have been compressed during this operation.

The cam which actuates the oil pump is so constructed that its radial depth shall be varied by the governing device, thus increasing or diminishing the length of stroke of the oil pump. This variable throw cam is constructed as follows:—Secured to the cam shaft 6 by means of the set screw 50 is the circular disk 51 provided with the cam slot 52 (see Fig. 11). Pivotally mounted at 54 on the member 55, rigidly secured to the sleeve 28 by the screw key 58 is the cam member 56, carrying the roll 57 which engages the cam slot 52 in the circular disk 51. Since the circular disk is held to rotate with the shaft 6 while the sleeve 28 and the member 55 are arranged to be rotated thereon, it will be seen that when such rotation on shaft 6 occurs the roll 57 will move along the slot 52 diminishing or increasing the extent to which the cam member 56 projects beyond the surface of the circular disk 51 according to the direction of such relative movement. If the speed of the motor rises above the predetermined number of revolutions per minute, the inlet valve cam 27 will be rotated backward upon the shaft 6 (the direction of rotation of this shaft is indicated by the arrows, Figs. 2 and 3), thereby delaying the closing of the inlet valve during the compression stroke until a portion of the charge originally drawn into the cylinder has been forced back through the inlet valve. This backward movement of the inlet valve cam 27 and the member 55 causes the cam member 56 to be drawn in by the movement of the roll 57 along the groove 52 and the length of the stroke of the oil pump will thus be diminished and the quantity of oil supplied to the carbureter reduced to correspond to the diminished quantity of fresh air which will be drawn therethrough at the next suction stroke of the piston. If the speed of the motor falls below the predetermined speed, the cam 27 will be rotated forwardly and the cam member moved out to project a greater distance beyond the disk 51, thus increasing the stroke of the oil pump.

Although the cam for holding open the inlet valve is shown as extending through about 45°, being arranged to engage the cam roll 26 to actuate the lever 24 not earlier than the middle of the suction stroke of the pistons, it is evident that a cam extending through nearly 90° could be employed if it were so set that the cam roll 26 was engaged and the lever 24 actuated just after the beginning of the suction stroke of the pistons. It is also evident that by employing a fixed cam in connection with the movable cam 27, the inlet valve might be positively opened at the beginning of the suction stroke of the piston, the time of closing being varied according to the position of the movable cam. In this connection it is to be understood that the pipe for supplying air to the carbureter is of such a length and size that air which has once been drawn into the carbureter and there mixed with the naphtha or gasolene will not be forced back and out of the air supply pipe when a portion of the charge drawn into the cylinder is forced back through the inlet valve during the first part of the compression stroke of the piston. On the next intake stroke the gases forced back through the carbureter will again be drawn therethrough, together with a quantity of fresh air equal to the quantity of gas compressed and exploded in the cylinder, and into this fresh air will be sprayed the measured amount of gasolene.

It will be noted that the cam slot 52 in the disk 51 is so shaped that the throw of the cam 56 will be progressively and gradually diminished as the speed of the motor increases until the cam roll 57 reaches the angle in the slot, when a further slight increase in the speed will quickly reduce the throw to zero and the oil pump will miss one or more strokes until the speed falls, the cam 27 at such a time being rotated to its extreme position so the inlet valve will not close until the middle of the compression stroke or later. After one or two revolutions of the motor shaft, the speed will quickly drop as only fresh air will be drawn into the cylinder. These conditions, however, can exist only when the motor is running wild, for when it is working under any appreciable load, a charge will be exploded every other revolution, giving only a slight variation in speed.

The mechanism for automatically shifting the point of ignition to conform to the speed of the motor and the size of the charge exploded in the cylinder comprises a fixed contact, a rotating contact cam, and connections between the contact cam and the inlet valve cam constructed and arranged so that the shifting of the inlet valve cam to cause a reduction in the charge will also shift the contact cam to retard the time of ignition. In the drawings the fixed contact is shown at 59, being preferably formed of some spring metal of good electrical conductivity such as copper, and is rigidly secured upon an arm or bracket 60, being electrically insulated therefrom by means of fiber or vulcanite 61. A binding post 62 in electrical connection with the contact member 59 and insulated from the bracket 60 is provided for one terminal of the electric circuit, the other terminal being any convenient point on the motor, the electrical connection with the contact cam being made through the various shafts and bearings. In this connection I desire to state that although I have shown my invention as embodied in a jump-spark system (the spark points, however, not being shown as they may be of any suitable form or type), it will be obvious to those skilled in the art that my invention is equally applicable to the make-and-break system of electrical ignition by substituting a cam roll and a lever operatively connected to the movable electrode, and by slightly altering the shape of the contact cam.

The contact cam is shown at 63 as projected from a sleeve 64 rotatably mounted upon the sleeve 28 which shifts the inlet valve cam. Pivotally connected to the lug 65 on the sleeve 64 is the lever or link 66 carrying at its end the elongated pin or stud 67 which passes through a cam slot 68 in the member 55 and also through a vertical slot 69 in the circular disk 51. Inasmuch as disk 51 is rigidly secured to shaft 6 while member 55 is rotated on the shaft with the inlet valve cam 27, the stud 67 acting in the relatively movable cam slots 68 and 69 will, through the link 66 and lug 65, rotate the sleeve 64 and contact cam 63 upon the sleeve 28. The position and form of the cam slots 68 and 69 are such that as the inlet valve cam 27 is automatically shifted to reduce the charge, the point of ignition will also be automatically shifted in conformity with the new conditions of speed and quantity of the charge.

It will be noted that the bracket 60 (see Fig. 1) is mounted upon the cam shaft 6, being secured to the bearing for the shaft by means of a set screw 70 passing through the slot 71 in the bracket 60. By first slightly loosening this set screw, the bracket may be adjusted so that the ignition cam 63 will make contact with the contact member 59 at the proper time in the cycle of operation of the machine.

My invention, therefore, in its broader aspects is not limited to the exact construction shown and described, as it is evident that many changes and modifications may be made without departing from the spirit of my invention.

Having thus described my invention, 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, a pump, a piston for the pump provided with a cam roll, a cam member, a pivotal support for one end of the member, a cam surface for supporting the other end of the member, and means for relatively moving said pivotal support and said cam surface to vary the throw of the cam, substantially as described.

2. A hydro-carbon motor, having, in combination, a piston arranged to reciprocate therein, an oil pump, a shaft, a support and a disk capable of relative rotation carried by the shaft and normally held to rotate therewith, a cam member pivotally mounted on the support and carrying a cam roll, a cam groove in the disk engaged by the cam roll, means controlled by the speed of the motor for relatively rotating the support and the disk to vary the throw of the cam, and means actuated by the cam member for operating the pump, substantially as described.

3. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet valve, an ignition device, a rotating shaft, an inlet valve cam and an ignition cam mounted on said shaft, a member fixed upon said shaft, a member rigidly connected with the inlet valve cam, coöperating cam grooves in said members, a stud engaging said grooves, and connections between the stud and the ignition cam constructed and arranged to shift the ignition cam on the shaft when the inlet cam is shifted, substantially as described.

4. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, fuel controlling means and connected mechanism operating automatically to diminish the quantity of fuel supplied, the size of the charge, and to delay the time of ignition, substantially as described.

5. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet valve, fuel controlling means, an ignition device, and means controlled by the speed of the motor for varying the quantity of fuel supplied, and for delaying the closing the inlet valve, and the time of ignition, substantially as described.

6. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, an inlet valve, fuel controlling means, and connected mechanism

for varying the time of closing the inlet valve and the quantity of fuel supplied, substantially as described.

7. A hydro-carbon motor, having, in combination, a cylinder, a piston arranged to reciprocate therein, a rotating shaft, an ignition cam mounted thereon, a member fixedly secured upon the shaft and provided with a cam slot, a second member mounted upon the shaft and provided with a cam slot, a cam roll passing through said slots, connections between the cam roll and the ignition cam, and means for shifting the second member upon the shaft, substantially as described.

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

ALFRED B. FOWLER.

Witnesses:
ALFRED H. HILDRETH,
HORACE VAN EVEREN.