No. 858,844. PATENTED JULY 2, 1907.

E. E. WINKLEY & F. V. HART.

HYDROCARBON MOTOR.

APPLICATION FILED MAY 25, 1903.

4 SHEETS—SHEET 1.

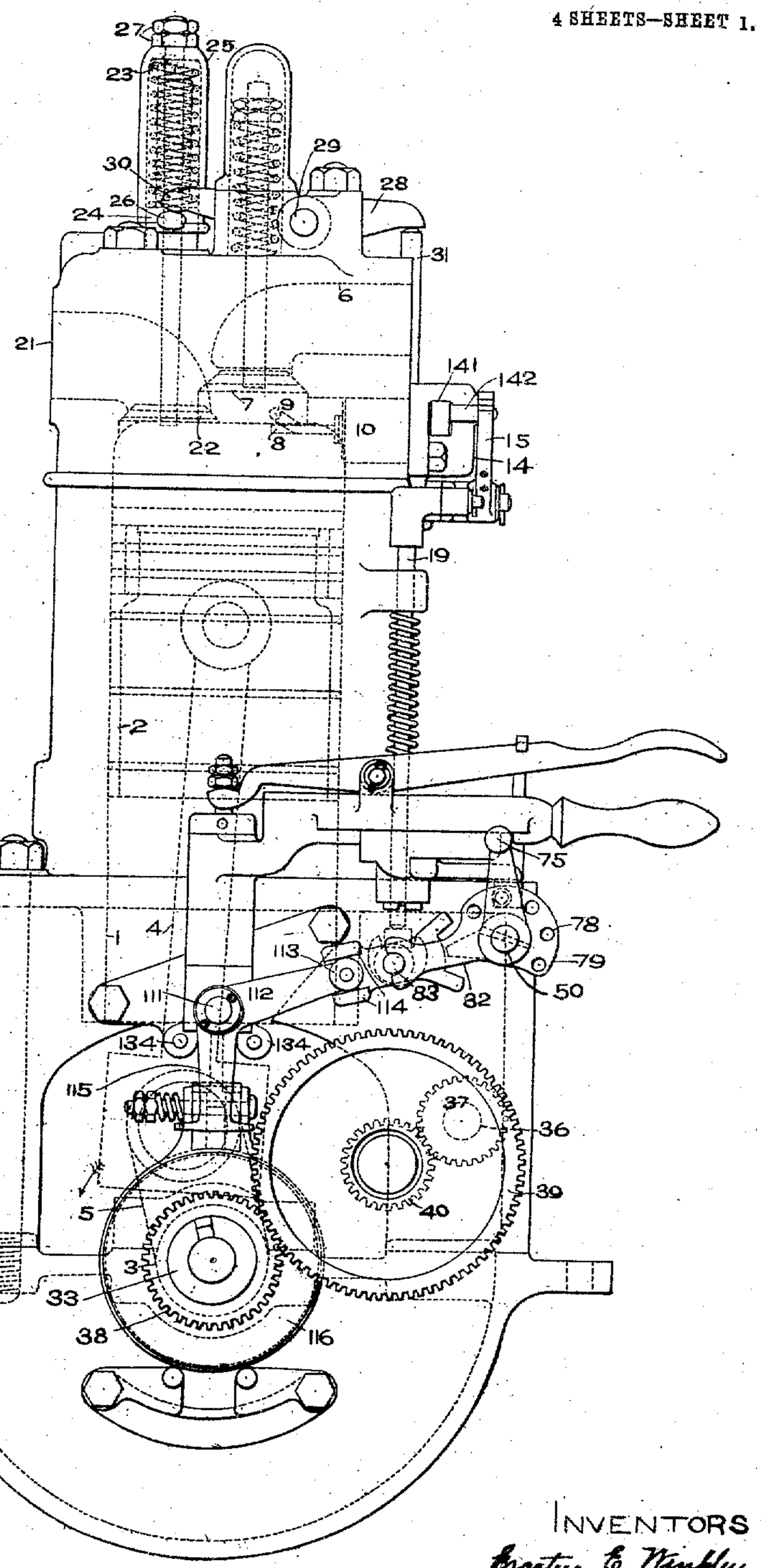

FIG. 1.

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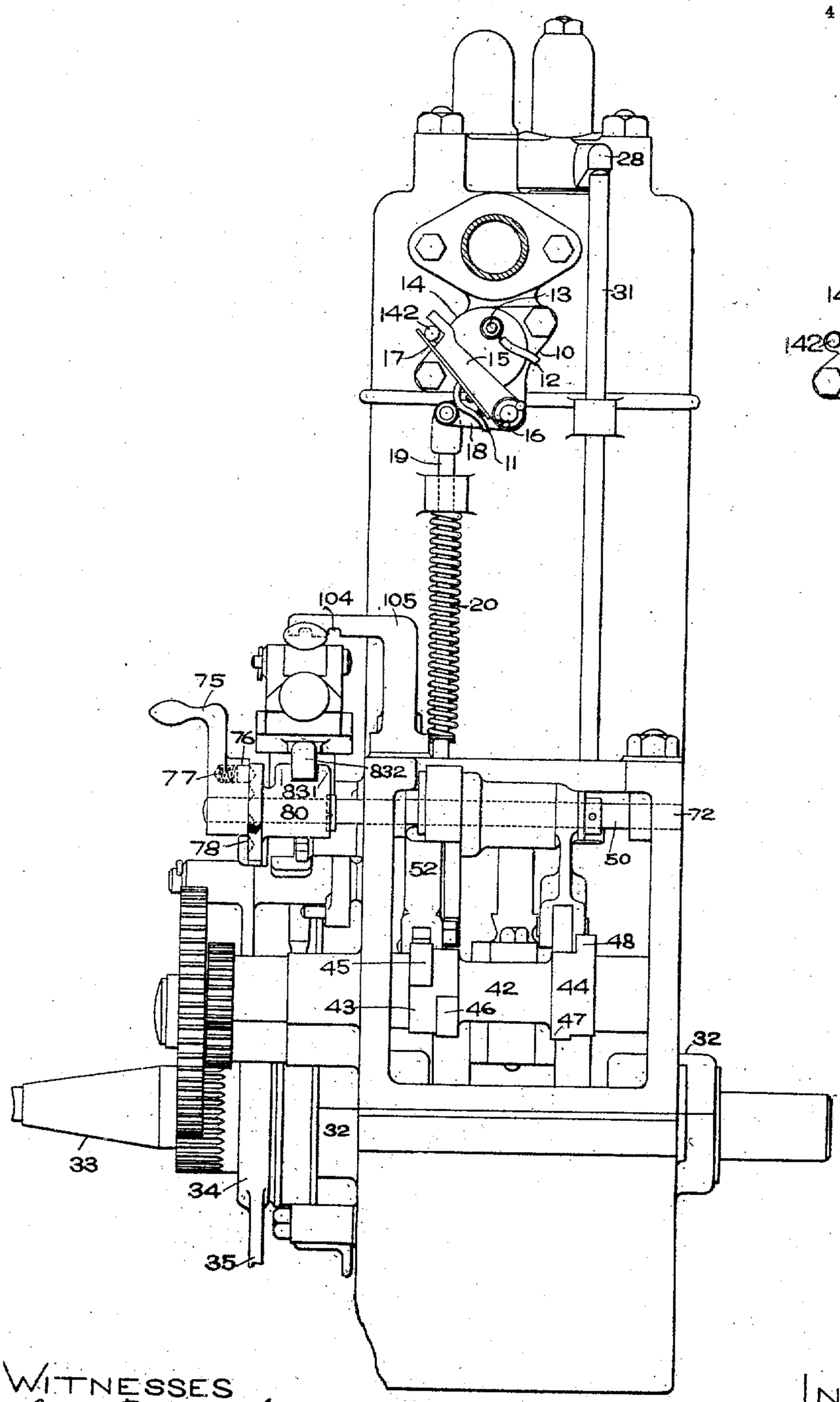
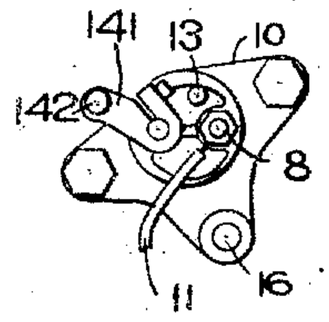


FIG 2

FIG 3



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4 SHEETS—SHEET 3.

FIG 4

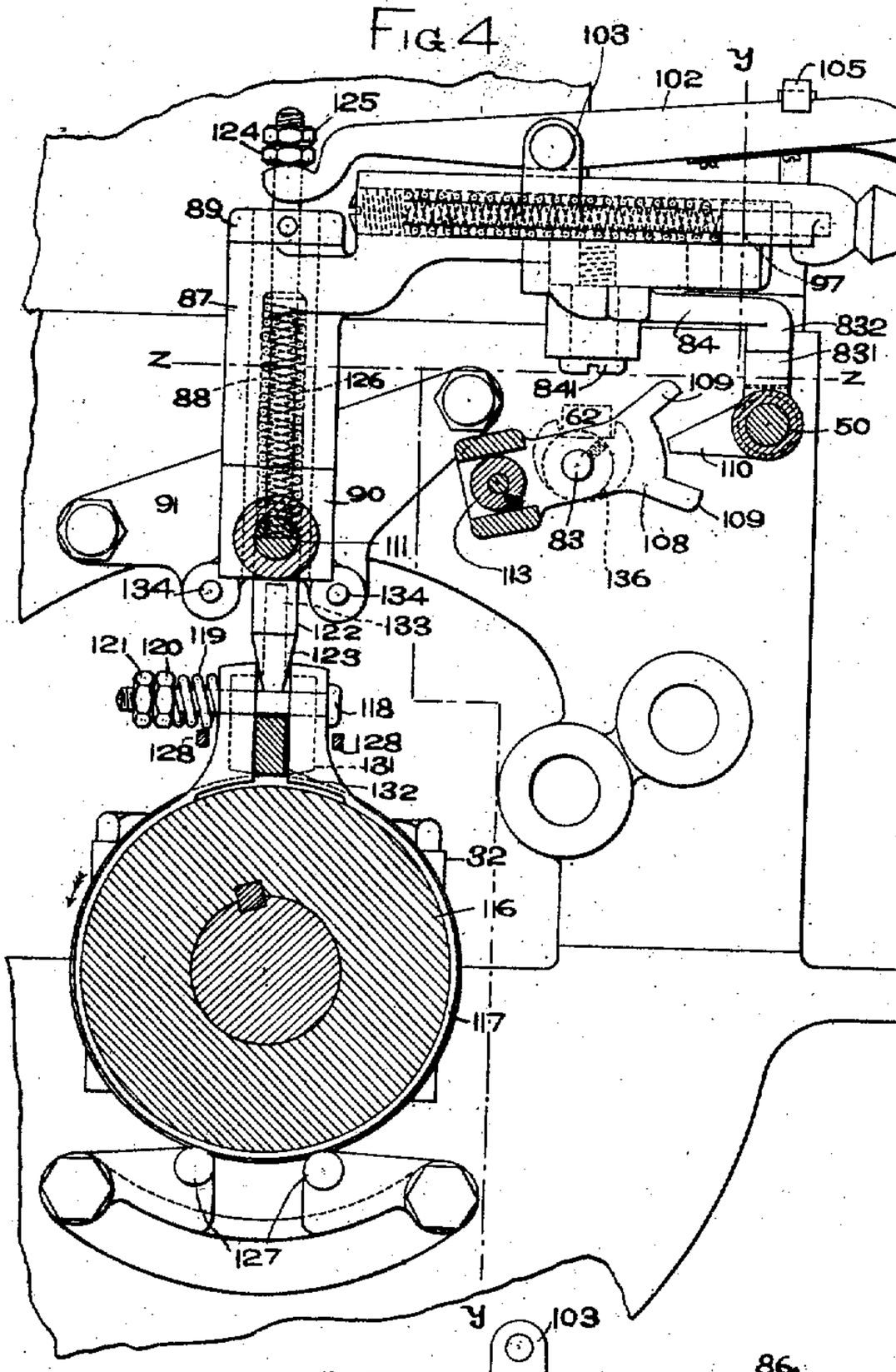

FIG. 7

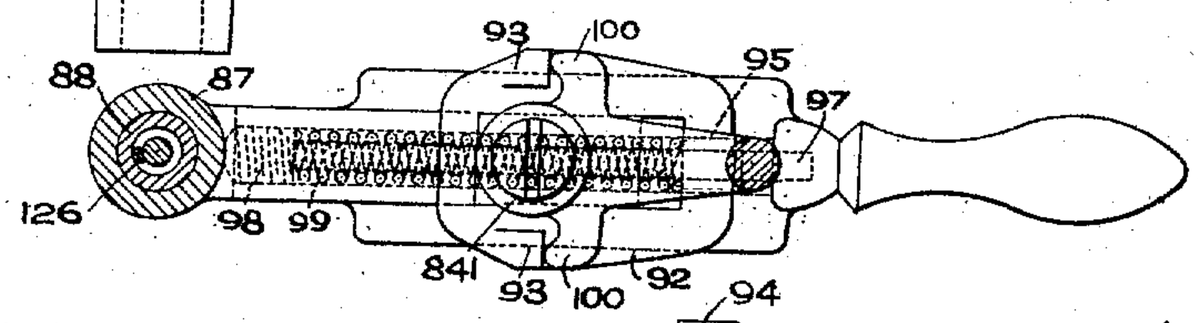

FIG. 6.

FIG 5

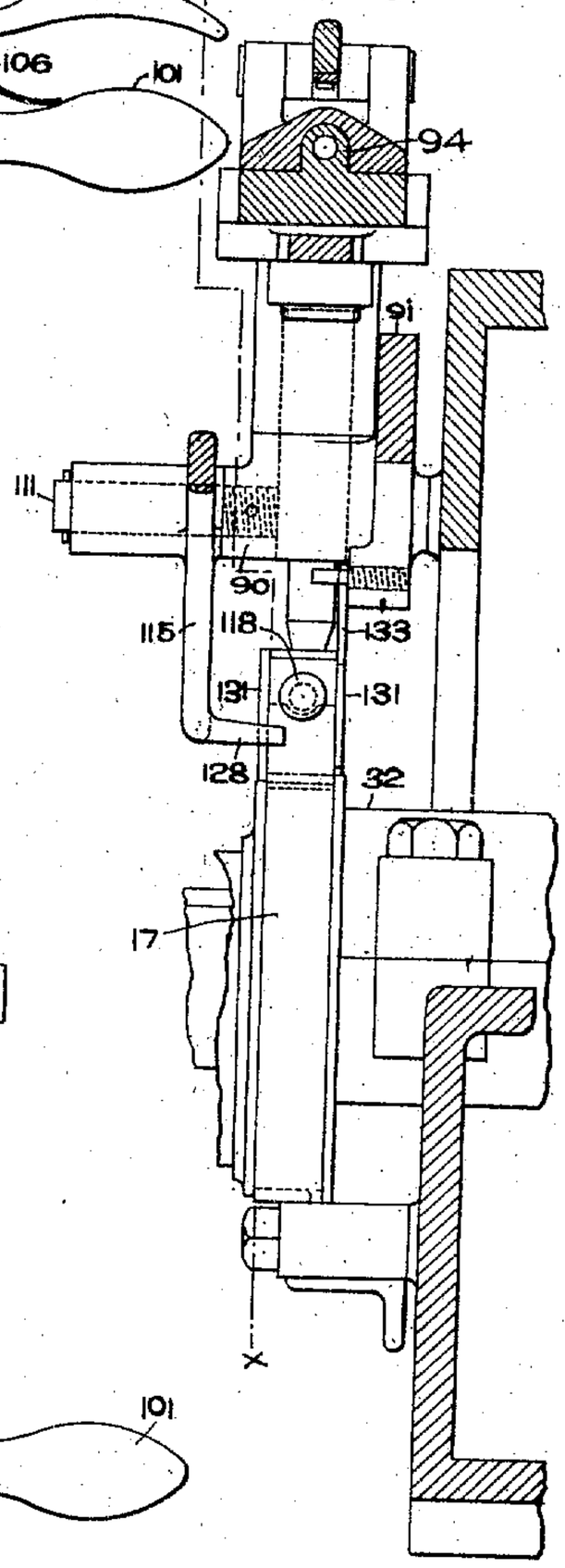

FIG. 8.

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HYDROCARBON MOTOR.

APPLICATION FILED MAY 25, 1903.

4 SHEETS—SHEET 4.

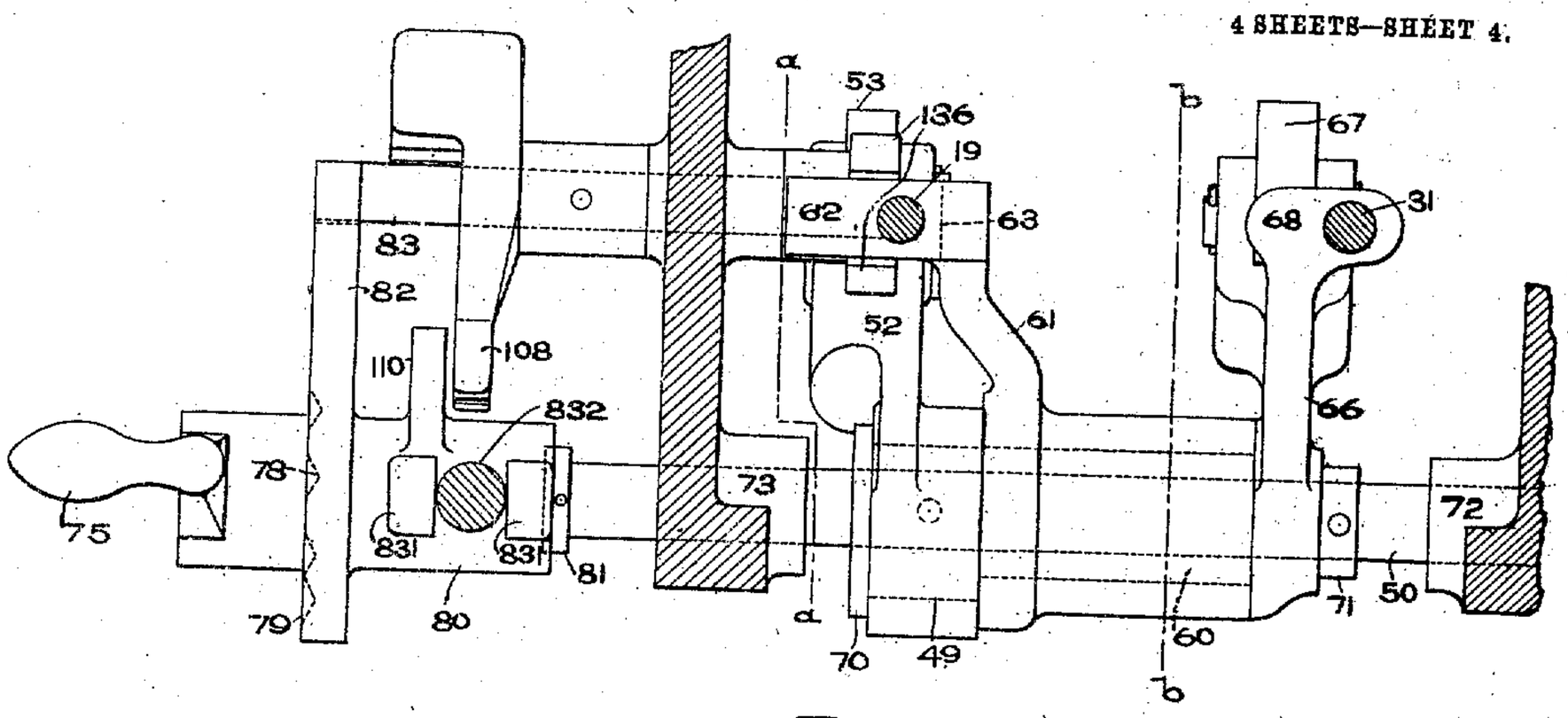

FIG 9

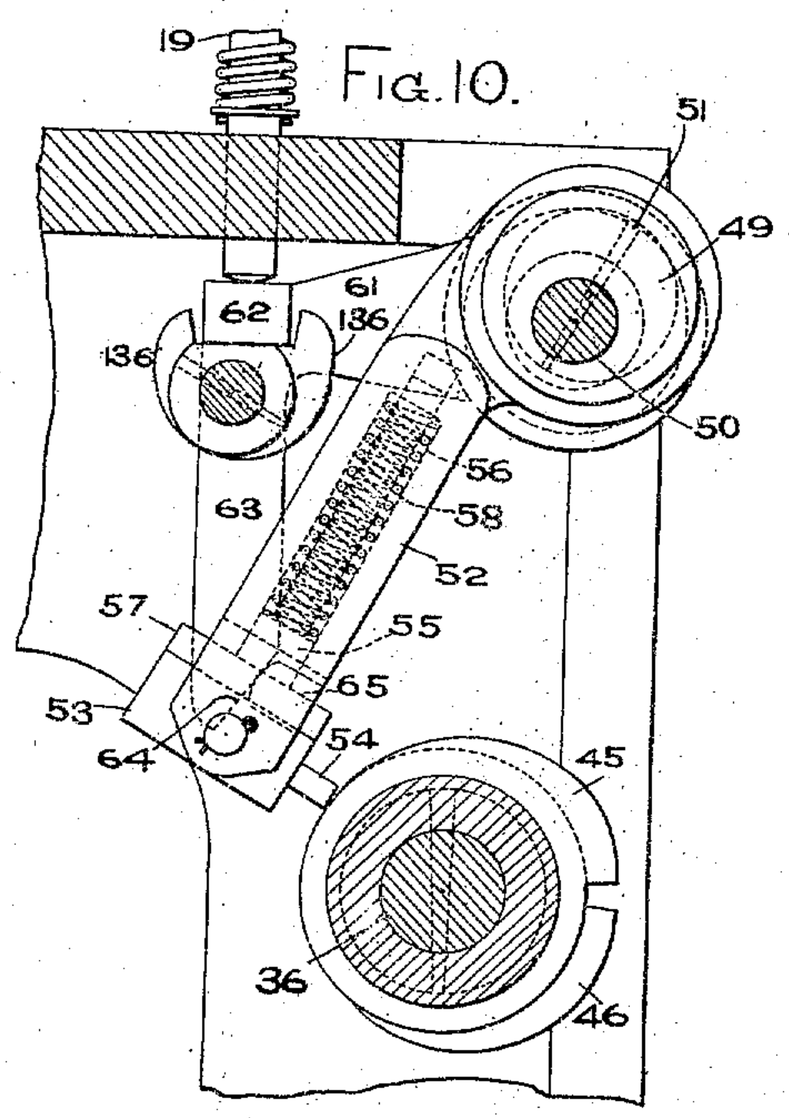

FIG. 10.

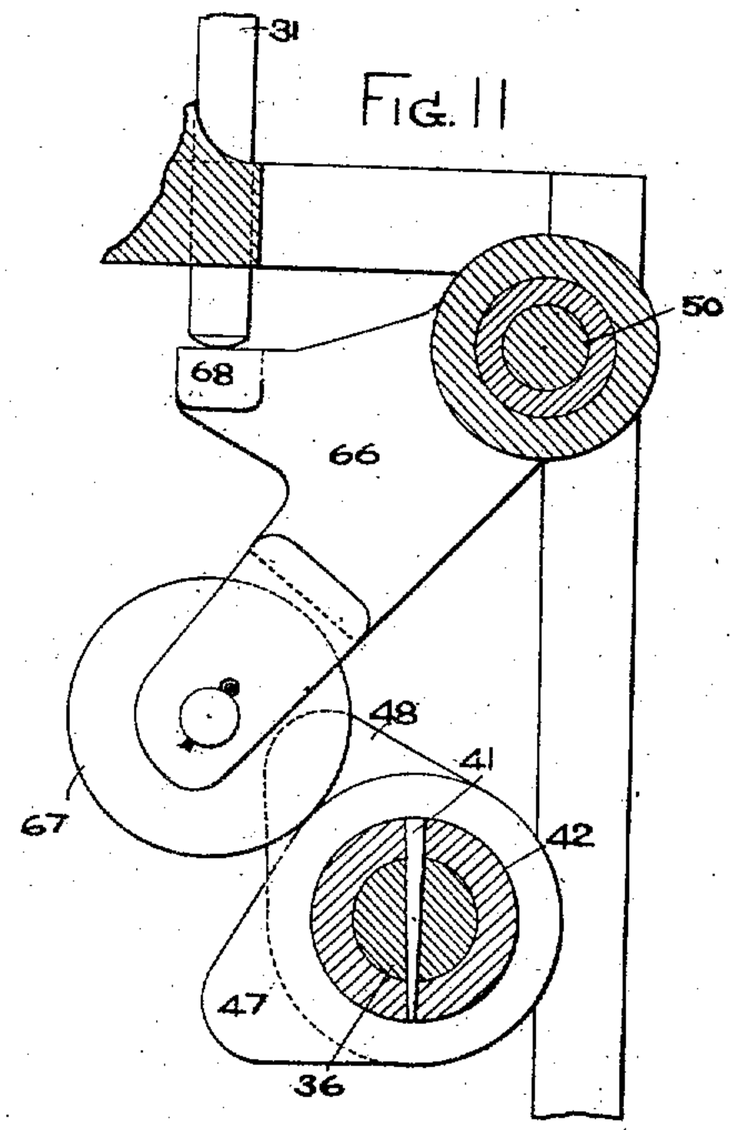

FIG. 11

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UNITED STATES PATENT OFFICE.

ERASTUS E. WINKLEY AND FRED V. HART, OF LYNN, MASSACHUSETTS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WINKLEY ENGINEERING COMPANY, OF KITTERY, MAINE, A CORPORATION OF MAINE.

HYDROCARBON-MOTOR.

No. 858,844. Specification of Letters Patent. Patented July 2, 1907.

Application filed May 25, 1903. Serial No. 158,591.

To all whom it may concern:

Be it known that we, ERASTUS E. WINKLEY and FRED V. HART, citizens of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Hydrocarbon-Motors; and we 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 hydro-carbon motors and more particularly to that class of motors which are adapted to be reversed in their direction of rotation while in continuous operation.

In our pending application Ser. No. 112,242, filed July 18, 1902, we have described and claimed a hydro-carbon motor in which the direction of rotation is automatically reversed by the compression, that is, by the expansion of an unexploded charge after the motor has momentarily come to rest during a compression stroke. The impulse given to the piston by the expanding compressed charge is augmented by exploding the charge during this expansion stroke of the piston, thus establishing the cycle of operation of the motor in the reverse direction, the times of operation of the ignition device and of the valves being properly shifted therefor.

In the present invention the same method of reversing the motor is employed as in our pending application, and one of the objects of the present invention is to simplify the construction of the controlling devices, so that the operator by a single movement of one hand may reverse the motor at will.

A further object is to simplify the construction and improve the operation of other portions of the mechanism so that the possibility of derangement of the parts and failure of the motor to reverse shall be reduced to a minimum.

With these and other objects in view apparent to those skilled in the art, our present invention consists of the devices and combinations of devices hereinafter described and claimed.

In the accompanying drawings which illustrate a preferred form of our invention, Figure 1 is a front elevation of our improved hydro-carbon motor with fly wheel removed; Fig. 2 is a side elevation of the same; Fig. 3 shows the ignition device separate from the motor and with parts removed; Fig. 4 is an enlarged view on line *x*—*x* Fig. 5 looking toward the right showing a portion of the reversing mechanism; Fig. 5 is a corresponding view on line *y*—*y* Fig. 4 looking toward the left; Fig. 6 is a bottom plan view of the reversing lever and parts carried thereby on line *z*—*z* Fig. 4; Fig. 7 is a front elevation of the lever; Fig. 8 is a front elevation of the sliding member carried by said lever; Fig. 9 is a top plan view of the actuating mechanism for the ignition device and the exhaust valve with the cams and cam shaft removed; Fig. 10 is an enlarged view on line *a*—*a*, Fig. 9, looking toward the right, showing the actuating mechanism for the ignition device; and Fig. 11 is an enlarged view on line *b*—*b*, Fig. 9, looking toward the right, showing the actuating mechanism for the exhaust valve.

The cylinder, the piston arranged to reciprocate therein, the shaft, the suction-operated inlet valve, the ignition device, and the exhaust valve in our improved hydro-carbon motor are all of the usual or ordinary type. The actuating mechanism for the ignition device and exhaust valve, however, differs from that ordinarily employed on these motors, and comprises briefly two sets of cams for actuating the ignition device and exhaust valve, one set timed for forward rotation and the other set for reverse rotation of the motor, a spring-actuated shipping device for throwing one set out of and the other into operation, a detent for preventing the shipping device from operating, means for rendering the ignition device inoperative, and mechanism operating upon a reversal in the direction of rotation of the motor to actuate the detent and to actuate and render operative the ignition device.

As shown in Fig. 1 our motor comprises the cylinder 1 in which reciprocates the piston 2 which imparts motion to the shaft 3 through the connecting rod 4 and crank 5. The explosive mixture enters the cylinder from a suitable carbureter or other device (not shown) through the inlet port 6 having the suction-operated inlet valve 7, and after compression is ignited by an electric spark, the ignition device being of the ordinary make-and-break type having the fixed electrode 8 and movable electrode 9 mounted in the base or support 10 secured to the wall of the cylinder. The fixed electrode is electrically insulated from the support 10 and is connected with one pole of a battery (not shown) or other suitable source of electricity by means of the wire 11. The other wire 12 of the circuit is connected to the threaded pin 13 which is secured in the support 10 and projects through the cover plate 14. The movable electrode is actuated by means of an arm 141 rigidly connected therewith and from which projects the pin 142. One arm 15 of a bell crank lever mounted upon the stud 16 projecting from the support 10 engages one side of the pin 142 to actuate the arm 141 to swing the movable electrode 9 out of contact with the fixed electrode 8 to cause a spark within the cylinder, a spring 17 secured upon an arm 15 engaging the other side of the pin to swing the movable electrode into contact with the fixed electrode, the spring yielding after the elec-

trodes are in contact to permit further movement of the arm 15 without injury to any of the parts. The other arm 18 of the bell crank lever is actuated by the vertically reciprocating rod 19 normally held depressed by the spring 20 and raised against the tension of the spring by mechanism hereinafter to be described.

The burned gases are expelled through the outlet port 21 provided with the exhaust valve 22 normally held closed by the spring 23 engaging at one end a boss or abutment 24 in the head of the cylinder and at the other the top of the cap 25 provided with the projections 26 extending from opposite sides near the bottom. The nuts 27 permit the position of the projections 26 to be properly adjusted. The valve stem is depressed and the valve opened by means of the lever 28 pivoted at 29 and having the bifurcated or forked end 30 which straddles the cap and engages the projections 26 thereon. The opposite end of the lever 28 is raised by means of the rod 31 which is actuated by mechanism hereinafter to be described.

As shown in Fig. 2 the main shaft 3 of the motor is mounted in suitable bearings 32 and, as is the practice with hydro-carbon motors, is provided with a fly wheel (not shown) which is securely keyed upon the tapered portion 33 of the shaft. The cylinder is water-jacketed and circulation is maintained by means of a pump (not shown) operated by an eccentric (not shown) and eccentric strap 34 and rod 35.

The mechanism for actuating the ignition device and the exhaust valve comprises briefly a cam shaft driven from the main shaft of the motor and provided with two sets of cams, one for forward rotation and the other for reverse rotation, and cam levers actuated by one or the other of the cams and in turn actuating the vertically reciprocating rods 19 and 31 to actuate the ignition device and exhaust valve, the cam levers being movable laterally to be brought into position to be engaged by one or the other of the cams according to the direction of rotation of the motor.

As shown on the drawings the cam shaft 36 is driven by gear 37 from gear 38 upon the main shaft and the intermediate gears 39 and 40, gear 39 being twice the diameter of gear 38 so that the cam shaft 36 rotates at half the speed of the main shaft as is the practice with four-cycle motors. Secured upon the cam shaft by the pin 41 is a cam member 42 carrying the cam disks 43 and 44. Upon the cam disk 43 are the cams 45 and 46 for actuating the ignition device during forward and reverse rotation respectively, what we call forward rotation of the motor being that indicated by the arrow in Fig. 1. Upon the cam disk 44 are formed the cams 47 and 48 for actuating the exhaust valve during forward and reverse rotation respectively.

Pivotally mounted upon the eccentric 49 secured upon the shaft 50 by means of the taper pin 51 is the cam lever 52 having a bifurcated end in which the block 53 is pivoted. A finger 54 depending from the block engages the periphery of the cam disk 43 and is actuated by one or the other of cams 45 and 46. The block is normally held from turning upon its pivotal support and in the position shown in Fig. 10 by means of the bolt 55 guided in the cylindrical recess 56 in the cam lever 52, the head 57 of which bolt is pressed against the block by means of the coiled spring 58. If by any chance the cam disk should be so rotated that the abrupt face of either cam is brought against the finger 54, the block will turn upon its pivot, forcing the bolt farther into the recess against the tension of spring 58 and saving the parts from injury.

The eccentric 49 is formed with a cylindrical portion 60 upon which is pivoted the lever 61 provided with the horizontal part 62 and the vertical portion 63 depending therefrom and having the beveled end 64 arranged to be engaged by the abutment or projection 65 upon the cam lever 52. The top of the horizontal portion 62 engages the bottom of the rod 19 for actuating the ignition device and raises the same as cam 45 or 46 passes beneath the finger 54.

Pivotally mounted upon the shaft 50 is the cam lever 66 having a forked or bifurcated end in which is pivoted the cam roll 67 arranged to be engaged by one or the other of cams 47 and 48. A projection 68 on this lever engages the bottom of rod 31 and raises the same to open the exhaust valve at the proper time in the cycle of operation of the motor. All three levers 52, 61 and 66 are confined between the flange 70 on the eccentric 49 and the collar 71 pinned upon the shaft 50 so that longitudinal movement of the shaft in its bearings 72 and 73 will ship all three levers, shifting the cam levers from one set of cams to the other, so that the times of operation of the ignition device and of the exhaust valve shall be shifted for rotation in the opposite direction, the rod engaging portions 62 and 68 being sufficiently long to permit this movement without their being carried out of engagement with the ends of their respective rods.

The object of mounting the cam lever 52 upon the eccentric 49 instead of concentrically with the shaft 50 as is cam lever 66 is to permit the time of ignition to be varied so that either early or late ignition may be obtained at the will of the operator. This is accomplished by means of the adjusting handle 75 pinned upon the end of shaft 50 by means of which the shaft may be turned and the eccentric adjusted to move lever 52 longitudinally, causing finger 54 to drop off the abrupt face of the cam at an earlier or later point in the rotation of the cam shaft. The beveled face 64 on the depending arm 63 of lever 61 is of sufficient length to permit this longitudinal adjustment of lever 52 without throwing said beveled face out of engagement with the projection 65 on lever 52. Locking devices are provided so that the lever 75 may be securely held in the desired position and these devices comprise a pin 76 longitudinally movable in a recess in the lever and pressed outwardly by the spring 77. The end of the pin is conical and is arranged to enter correspondingly-shaped recesses 78 in the plate 79 formed integral with the shipping member 80 hereinafter to be described. The plate and member are loose upon the shaft 50, being confined between the lever 75 and a collar 81 secured upon the shaft, and they are held from rotation by the arm 82 projecting from the plate and having a forked end which loosely engages the shaft 83.

The shipping member 80 is provided with two abutments or projections 831 between which is located the depending arm 832 of the shipping lever 84 pivoted upon the stud 841 secured in the depending block 85 upon the reversing lever 86. The reversing lever is provided with a hub 87 pivoted upon the hollow stud 88 and confined between the collar 89 pinned upon

the stud and the support 90 in which the stud is mounted, which support is provided with a base 91 secured to the crank casing of the motor. Longitudinally movable upon the bottom of the lever 86 is the slide block 92 having an aperture into which the projection 85 fits, the aperture being somewhat longer than the projection. The block 92 is provided with the downwardly extending projections or abutments 93 and with the upwardly turned end 94 arranged to enter the recess 95 in the reversing lever 86. The end 94 of the block 92 is provided with an aperture 96 through which extends the rod 97 having the screw-threaded head 98 and surrounded by the spring 99 both rod and spring being located within the reversing lever. The spring engages at one end the screw-threaded head 98 and at the other the upwardly turned head 94 of the block 92 and acts normally to force said sliding block outwardly, that is, to the right in Figs. 4 and 6. The shipping lever 84 is provided with arms 100 arranged to be engaged by the abutments 93 on block 92 which tend normally to hold the shipping lever 84 and the reversing lever 86 in line as shown in Fig. 6. The depending end 832 on lever 84, however, may be thrown out of line with the reversing lever by relative movement of the ends of these levers, by which movement the sliding block 92 will be moved inwardly compressing the spring 99 which at the first opportunity will expand, move the block to the right and swing the levers into alinement again.

By means of a handle 101 the reversing lever 86 may be swung upon its pivotal support and may be secured in the desired position by means of a pinch lever 102 pivoted between the ears 103 rising from the reversing lever and arranged to latch in one or the other of two notches 104 in the piece 105. A spring 106 normally holds the lever 102 raised, a hand-grip 107 being provided in close proximity to the handle 101 of the shipping lever so that with one hand the operator may depress the pinch lever and then actuate the reversing lever.

In order to prevent the shaft 50 from being shipped immediately upon the actuation of the reversing lever 86, a detent has been provided which is released at the proper instant by automatic mechanism. This detent comprises the lever 108 secured upon the shaft 83 and is provided with two projections 109, one or the other of which may be swung into a position to engage the arm 110 projecting from the shipping member 80 to prevent movement of the latter when the reversing lever 86 is actuated.

The means for operating the detent lever 108 to release the shipping member consist of a bell crank lever pivoted upon a stud 111 projecting from the support 90 which carries the hollow stud upon which the reversing lever is pivoted. One arm 112 of this bell crank lever is provided with a head 113 located between projections 114 upon the end of the detent lever 108, so that said lever may be actuated in either direction by the bell crank lever. The other arm 115 of said lever is actuated by the following mechanism:—Secured upon the main shaft of the motor is the friction disk 116 the periphery of which is arranged to be engaged by the friction ring or band 117. The stud 118 passing through the ends of the band, the spring 119, the adjusting nut 120 and check nut 121 act to pinch the ends of the band together to make it grip the disk. In order to spread the ends apart so that the band may be loose upon the disk, a pin or rod 122 is provided, the conical end 123 of which is arranged to enter between the ends of the band and to wedge them apart. This pin passes through the hollow stud 88 and the end of the pinch lever 102 and is raised by the latter by means of the adjusting nut 124 and check nut 125. A spring 126 within the hollow stud forces the pin or rod 122 downwardly with sufficient force to separate the ends of the band to loosen the same upon the disk. Two pins 127 support the bottom of the band when the ends are forced apart so that when the parts are in this position which is their normal position during the operation of the motor the band is out of engagement with the periphery of the disk.

When the pinch lever 102 is actuated and the conical end 123 on rod 122 removed from between the ends of the band, the latter immediately tightens and tends to turn with the disk. The lower end of the arm 115 of the bell crank lever is provided with branches at right-angles thereto from which project the fingers 128 one upon each side of the ends of the band, so that when this turning occurs the arm 115 is actuated and one of the projections 109 is swung into position to be engaged by the arm 110 on the shipping member as soon as the reversing lever is actuated.

Any considerable extent of movement of the friction band is prevented by a stop device which consists of the substantially square heads 131 one on each side of the two ends of the band 117 and connected by the portion 132 located between the ends of the band and rectangular in cross section. A tail or projection 133 from the rear head 131 is arranged to engage one or the other of the stop pins 134 according to the direction in which the shaft is rotating, not only arresting the movement of the band but also releasing to a great extent the pressure of the band upon the disk, as the portion 132 will be turned slightly by the pressure brought upon the projection 133 forcing the ends of the band apart.

The mechanism for rendering the ignition device inoperative consists of two stops or cams 136 secured upon shaft 84 and arranged to be swung one or the other beneath the bottom of the horizontal portion 62 of lever 61 when the latter has been raised by cam lever 52 preventing the former and rod 19 from being depressed by spring 20 when the finger 54 drops off the abrupt face of cam 45 and thus holding the electrodes in contact and rendering the ignition device inoperative. Inasmuch as the cams or stops 136 can be swung under the horizontal portion 62 of lever 61 only when the latter has been raised, the detent lever 108 can be turned to bring one or the other of projections 109 into position to engage arm 110 on the shipping member only at this time and the bell crank lever and friction band 117 will be correspondingly limited as to their time of operation.

The operation of our improved motor is as follows:—Assuming the motor to be in operation in the forward direction with the parts in the positions shown in the drawings, the operator when he wishes to reverse the motor first grasps the handles 101 and 107 in one hand, and depresses the pinch lever to unlatch it, which movement raises rod 122 and causes the band 117 to engage the friction disk. The band immediately tends to turn with the disk but will be prevented from doing so

until lever 61 is raised by cam 45 when the band turns a slight distance, actuating the bell crank lever and detent lever 108 which renders the ignition device inoperative and carries the lower projection 109 into position to engage the arm 110 on shipping member 80. Since something less than two complete revolutions of the motor shaft is the most that can ever be required before the lever 61 will be raised so that the detent may be swung into operative position, a delay of a few seconds after depressing the pinch lever will be sufficient and the reversing lever 86 may then be moved to the right as shown in Fig. 2 and the pinch lever released to secure it in the reverse position. The ignition device being inoperative, the explosions cease and the speed of the motor drops quickly and it soon stops on a compression stroke. No sooner does it come to rest, however, than it begins to rotate in the reverse direction under the expansion of the compressed charge of unexploded gas in the cylinder. The friction band immediately starts back with the disk 116, as the band will grip the disk the instant the pressure of the projection 133 upon stop pin 134 is relieved and the band will turn with the disk until the end 123 of rod 122 drops into the space between the ends, stopping the band and loosening it upon the disk. The reverse movement of the band oscillates the bell crank lever to actuate the detent lever 108, withdrawing the projection 109 from behind the arm 110 and the cam or stop 136 from beneath the horizontal portion 62 of lever 61. The shaft 50 is instantly shipped and the ignition device actuated to ignite the expanding charge. In the motor of the drawings the actuation of the ignition device will generally be caused by the finger 54 dropping off the side of the cam 45 when shaft 50 is shipped rather than by the withdrawing of cam 136 from beneath the horizontal portion 62 of lever 61, for the motor will usually stop on the latter part of the compression stroke when the high part of cam 45 is beneath the finger 54 as this cam is of considerable length, and lever 61 will be held raised by the cam after stop 136 has been withdrawn. Both the shipping of shaft 50 and the withdrawal of cam 136 occur so nearly simultaneously, however, that it is immaterial so far as the operation of the motor is concerned which causes the actuation of the ignition device to produce the first explosion. The motor after this first explosion takes up its regular cycle of operation in the reverse direction, the ignition device being actuated by cam 46 and the exhaust valve by cam 48. The motor may be reversed again to run in forward direction by depressing the pinch lever 102 and then swinging the reversing lever to the left in Fig. 2 when the friction band will be turned to the right in Fig. 1 and the left hand cam or stop 136 will hold the ignition device inoperative while the upper projection 109 will be swung in front of the arm 110 to prevent shipping of the cams until a reversal in the direction of rotation of the motor.

Having thus described our invention and its mode of operation we claim as new and desire to secure by Letters Patent.

1. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a spring for actuating said means, a detent, and means for actuating the detent upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

2. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a spring for actuating said means, a detent, and means including a slip clutch for actuating the detent upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

3. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a rotating disk, a friction band normally loose upon the disk and arranged to grip the disk, and connections between the band and said means, substantially as described.

4. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a rotating disk, a friction band normally tending to grip the disk, a wedge for spreading the ends of the band apart to loosen the band upon the disk, and connections between the band and said means, substantially as described.

5. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a rotating disk, a friction band, means for supporting the band out of engagement with the disk, and connections between the band and said first-mentioned means, substantially as described.

6. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a rotating disk, a movable friction band arranged to grip the disk, means for limiting the movement of the band and for loosening the band upon the disk, and connections between the band and said first-mentioned means, substantially as described.

7. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for rendering said device inoperative, a clutch one member of which is secured upon the shaft, and means automatically actuated by the other member of the clutch for rendering the ignition device operative upon a reversal in the direction of rotation of the shaft, substantially as described.

8. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a clutch one member of which is secured upon the shaft, means actuated by the other member of the clutch for rendering the ignition device inoperative and for thereafter automatically rendering it operative upon a reversal in the direction of rotation of the shaft, and mechanism under the control of the operator for controlling the operation of said latter member, substantially as described.

9. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a lever for actuating the ignition device, a stop arranged to engage the lever to render the ignition device inoperative, means for withdrawing the stop, and mechanism for actuating said last-mentioned means upon a reversal in the direction of rotation of the shaft, substantially as described.

10. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a lever for actuating said device, means for shifting the time of operation of said lever for reverse rotation of the motor, a spring for actuating said means, an auxiliary shaft, a detent mounted thereon, a stop upon said shaft for holding the lever in its raised position to render the ignition device inoperative, and means for actuating the auxiliary shaft, substantially as described.

11. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a spring for actuating said means, a detent, mechanism for rendering the ignition device inoperative and devices connected with and actuating said mechanism and detent to render the ignition device inoperative

and the detent operative and thereafter upon a reversal in the direction of rotation of the shaft actuating said mechanism and detent to render the ignition device operative and the detent inoperative, substantially as described.

12. A hydro-carbon motor, having, in combination, a piston, a shaft, an ignition device, two cams, a pivoted lever, a member pivoted upon the lever and provided with a cam engaging portion, a spring pressed bolt carried by the lever and engaging the pivoted member and normally preventing turning of the same, and means for rendering one or the other of the cams operative, substantially as described.

13. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a reversing lever, a pinch lever adjacent thereto, and mechanism rendered operative by said levers and operating automatically upon a reversal in the direction of rotation of the shaft to shift the time of operation of the ignition device for reverse rotation of the motor, substantially as described.

14. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for a reverse rotation of the motor, a spring for actuating said means, a detent, a lever for compressing the spring, a second lever for rendering the detent operative, and mechanism operating automatically upon a reversal in the direction of rotation of the shaft to actuate the detent to render the spring operative, substantially as described.

15. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a lever, an arm pivoted thereon, and a spring to actuate the arm to shift the time of operation of the ignition device for reverse rotation of the motor, substantially as described.

16. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a lever, an arm pivoted thereon, a spring-pressed member mounted to slide upon the lever and arranged to actuate the arm to shift the time of operation of the ignition device for reverse rotation of the motor, substantially as described.

17. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a spring for actuating said means, a detent, and means for actuating the detent upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

18. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a spring for actuating said means, a detent, and means including a slip clutch for actuating the detent upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

19. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a rotating disk, a friction band normally loose upon the disk and arranged to grip the disk, and connections between the band and said means, substantially as described.

20. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a rotating disk, a friction band normally tending to grip the disk, a wedge for spreading the ends of the band apart to loosen the band upon the disk, and connections between the band and said means, substantially as described.

21. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a rotating disk, a friction band, and means for supporting the band out of engagement with the disk, and connections between the band and said first-mentioned means, substantially as described.

22. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a rotating disk, a movable friction band arranged to grip the disk, means for limiting the movement of the band and for loosening the band upon the disk, and connections between the band and said first-mentioned means, substantially as described.

23. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, a reversing lever, a pinch lever adjacent thereto, and mechanism rendered operative by said levers and operating automatically upon a reversal in the direction of rotation of the shaft to shift the time of operation of the valve for reverse rotation of the motor, substantially as described.

24. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a spring for actuating said means, a detent, a lever for compressing the spring, a second lever for rendering the detent operative, and mechanism operating automatically upon a reversal in the direction of rotation of the shaft to actuate the detent to render the spring operative, substantially as described.

25. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, a lever, an arm pivoted thereon, a spring to actuate the arm to shift the time of operation of the valve for reverse rotation of the motor, substantially as described.

26. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, a lever, an arm pivoted thereon, a spring-pressed member mounted to slide upon the lever and arranged to actuate the arm to shift the time of operation of the valve for reverse rotation of the motor, substantially as described.

27. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a valve, means for shifting the times of operation of the ignition device and of the valve for reverse rotation of the motor, a spring for actuating said means, a detent, and means for actuating the detent upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

28. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a valve, means for rendering the ignition device inoperative, a clutch one member of which is secured upon the shaft, and mechanism automatically actuated by the other member of the clutch for rendering the ignition device operative and for shifting the times of operation of the ignition device and of the valve for reverse rotation of the motor, upon a reversal in the direction of rotation of the shaft, substantially as described.

29. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a valve, two sets of cams for actuating the ignition device and the valve, a cam lever for the ignition device, a cam lever for the valve, a support for said levers, and mechanism operating upon a reversal in the direction of rotation of the motor to shift the levers from one set of cams to the other, substantially as described.

30. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, a valve, two sets of cams for actuating the ignition device and the valve, a longitudinally movable shaft provided with an eccentric, a cam lever for the ignition device mounted upon the eccentric, a cam lever for the valve mounted upon the shaft, means for turning the shaft to vary the time of actuation of the ignition device, and mechanism for moving the shaft longitudinally to shift the cam levers from one set of cams to the other, substantially as described.

31. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, an ignition device, means for shifting the time of operation of the ignition device for reverse rotation of the motor, a spring for actuating said means, and mechanism operating upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

32. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, a valve, means for shifting the time of operation of the valve for reverse rotation of the motor, a spring for actuating said means, and mechanism

operating upon a reversal in the direction of rotation of the shaft to render the spring operative, substantially as described.

33. A hydro-carbon motor, having, in combination, a cylinder, a piston, a shaft, and ignition device, and means including a shipping member and a locking member therefor for shifting the time of operation of the ignition device for reverse rotation of the motor and connections between the locking member and the ignition device to render said device inoperative, substantially as described.

In testimony whereof we affix our signatures, in presence of two witnesses.

ERASTUS E. WINKLEY.
FRED V. HART.

Witnesses:
ALFRED H. HILDRETH,
GEORGE H. GIFFORD.