(No Model.)

3 Sheets—Sheet 1.

E. MERRY.

HYDROCARBON ENGINE.

No. 579,068. Patented Mar. 16, 1897.

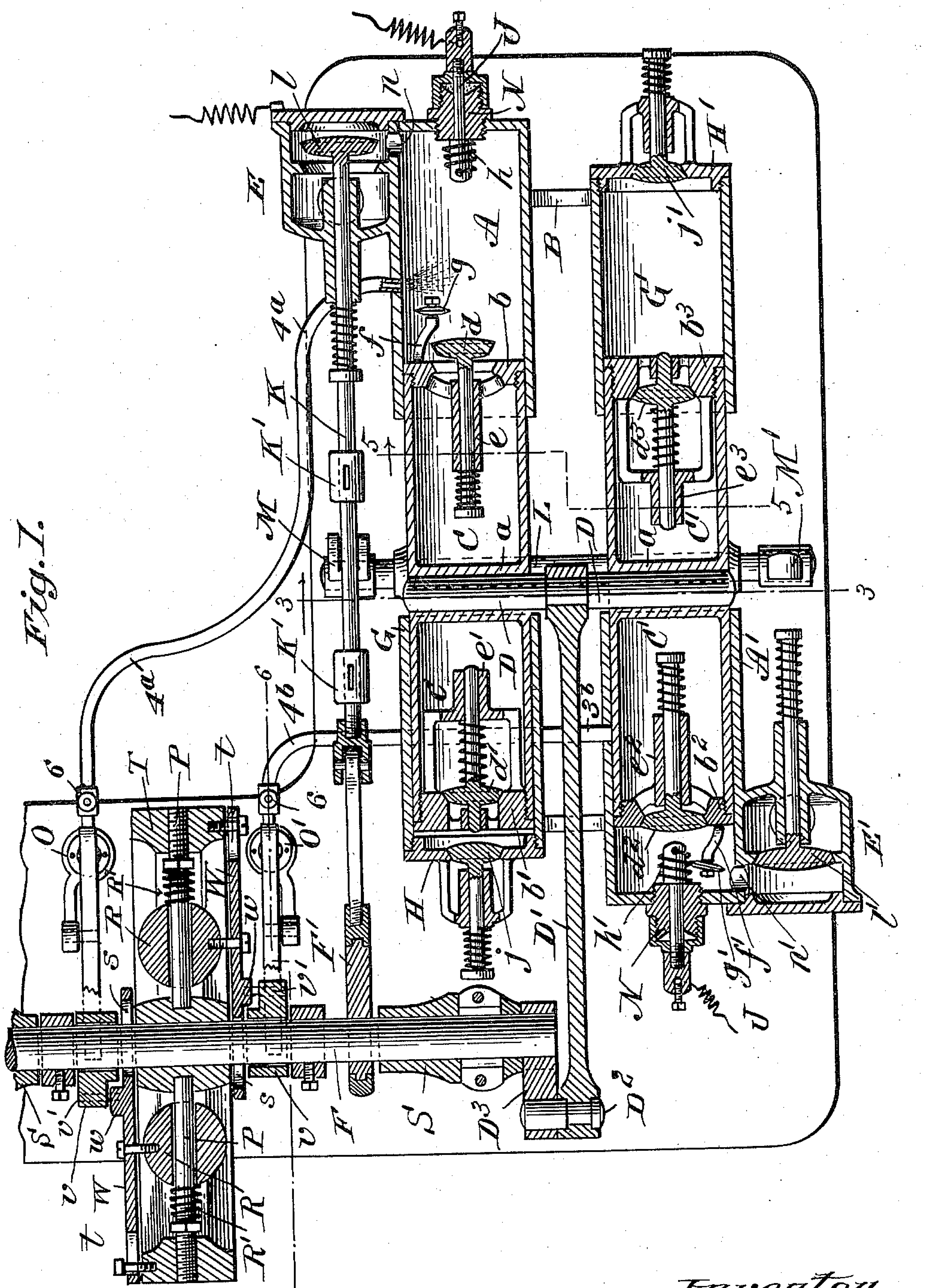

Fig. I.

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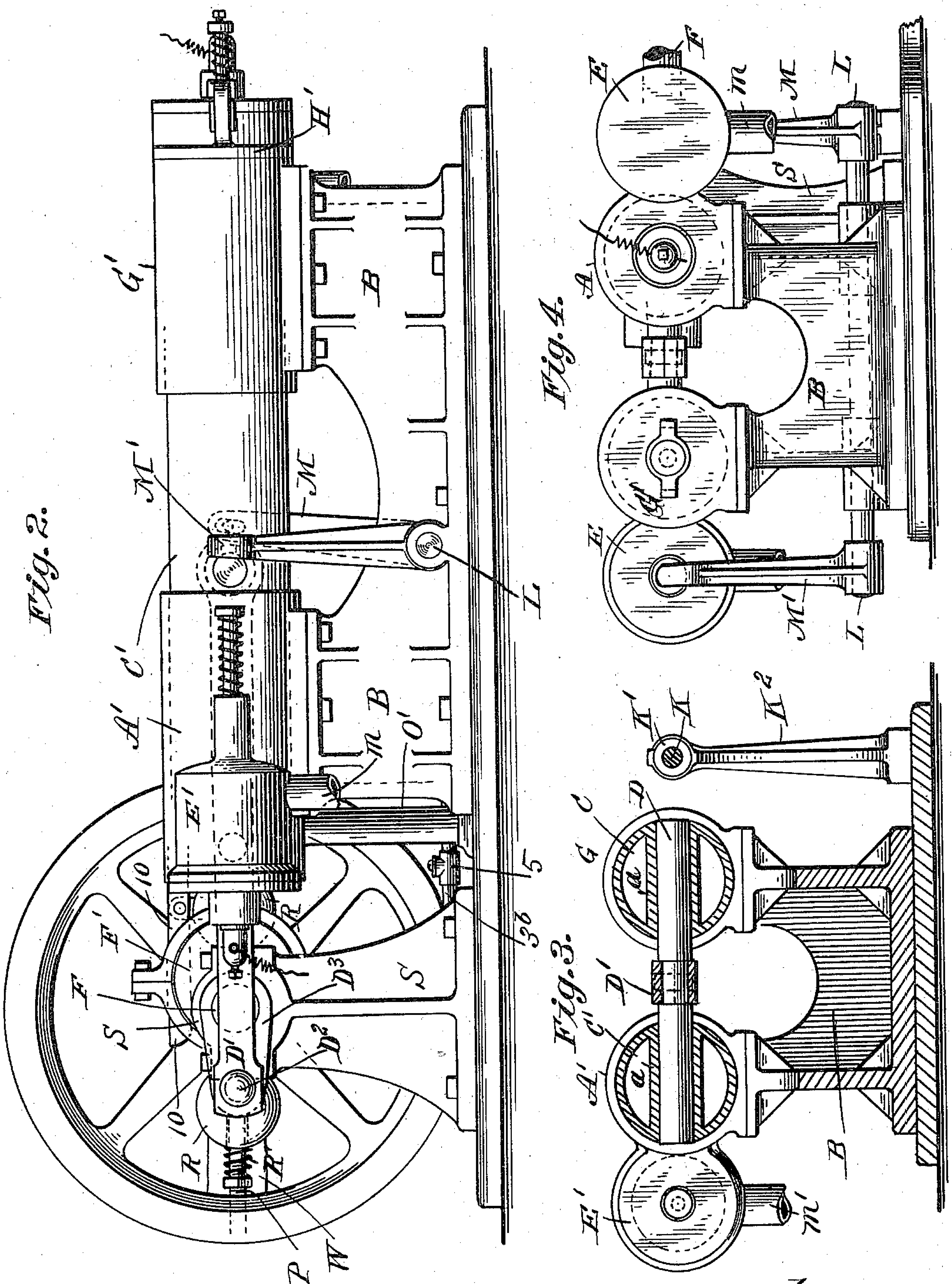

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Fig. 5.

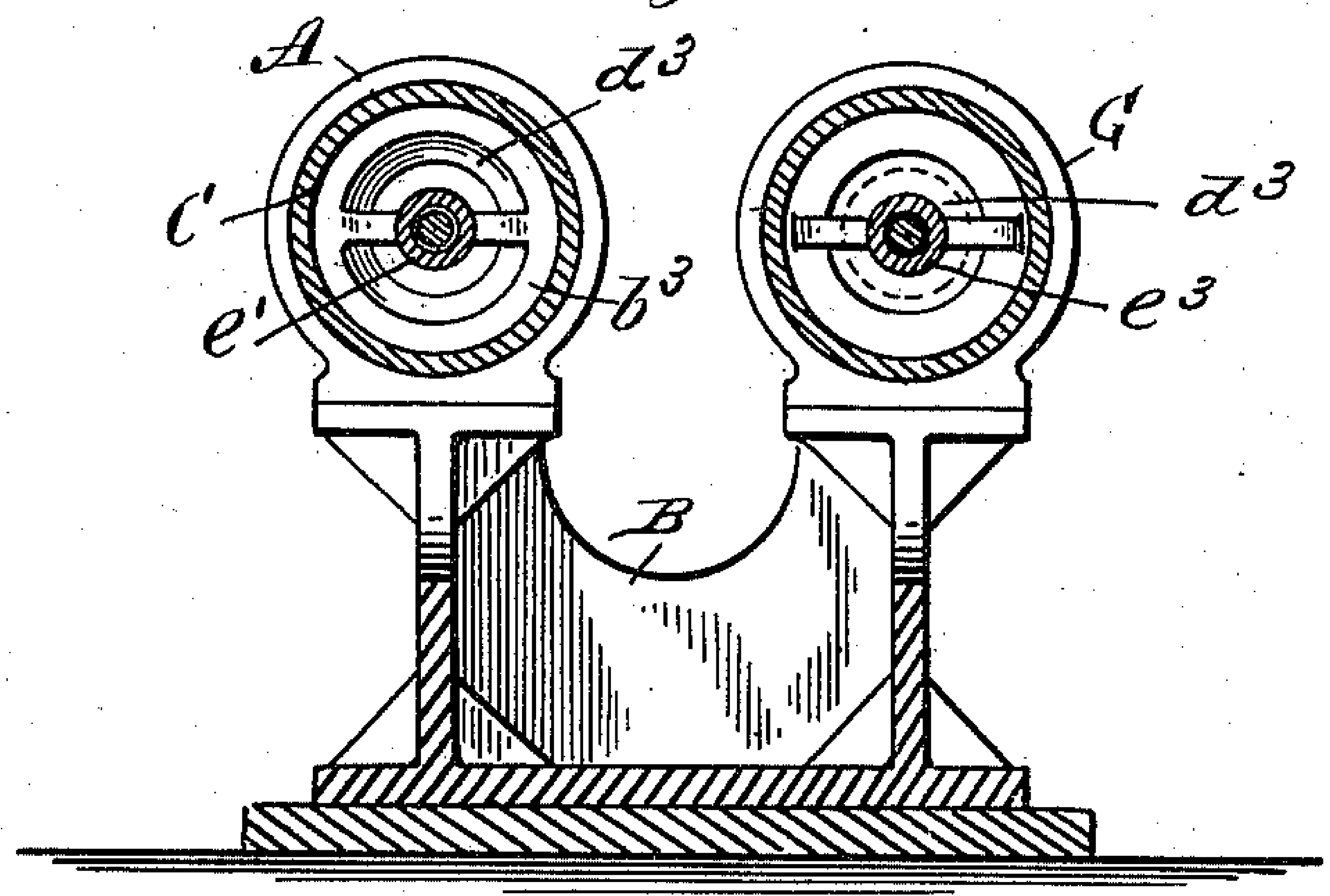


Fig. 6.

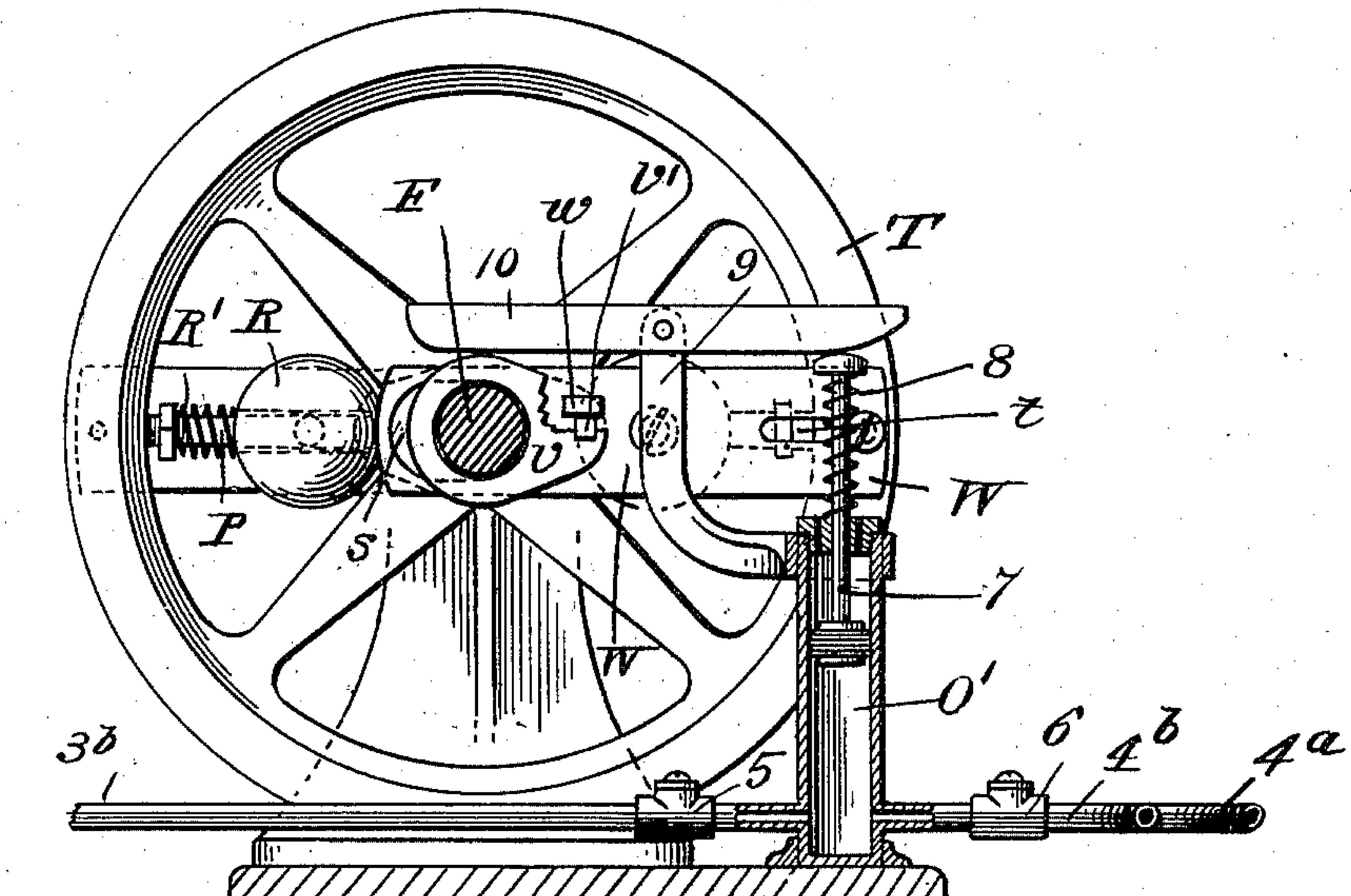
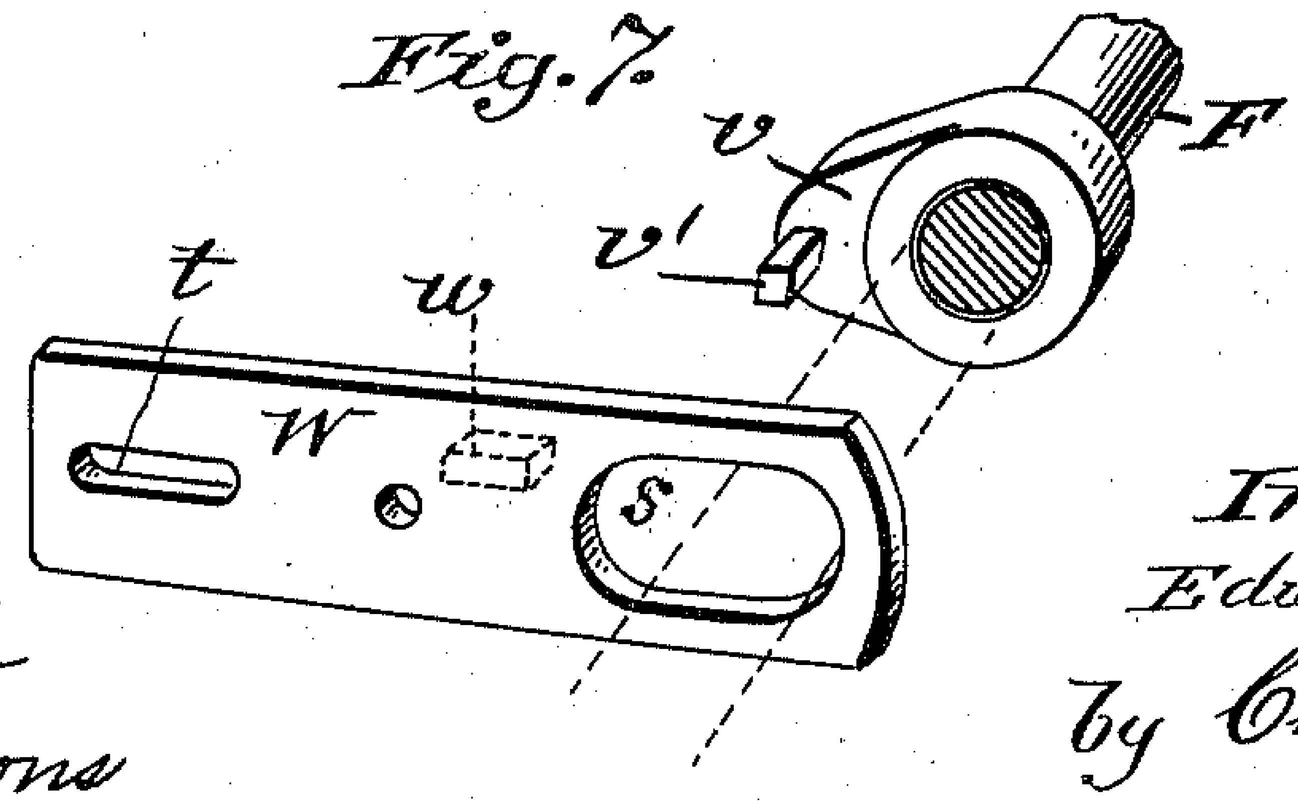


Fig. 7.



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UNITED STATES PATENT OFFICE.

EDWARD MERRY, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO GEORGE D. LYTLE, OF SAME PLACE.

HYDROCARBON-ENGINE.

SPECIFICATION forming part of Letters Patent No. 579,068, dated March 16, 1897.

Application filed February 8, 1896. Serial No. 578,454. (No model.)

To all whom it may concern:

Be it known that I, EDWARD MERRY, a citizen of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Hydrocarbon-Engines, of which the following is a specification.

This invention relates to engines driven by sprayed or aerated gasolene or similar volatile combustible, the object being to produce a motor at once powerful, compact, and of light weight, and easily kept cool, for use in launches, motor vehicles, or for any purpose where the above qualities are required; and the invention consists in the peculiar construction and operation of the motor, all as will be fully described hereinafter and pointed out in the claims.

In the drawings forming part of this specification, Figure 1 is a plan view of the engine in section. Fig. 2 is a side elevation of the engine. Fig. 3 is a cross-section taken on line 3 3, Fig. 1, looking in the direction of the arrow on said line. Fig. 4 is an elevation of the end of the engine opposite the crank-shaft. Fig. 5 is a cross-section through the pistons, taken on line 5 5 of Fig. 1, looking in the direction of the arrow on said line. Fig. 6 is a section on line 6 6, Fig. 1, showing the balance-wheel and the engine-governor therein. Fig. 7 is a perspective view of a portion of the crank-shaft and a cam thereon and one of the elements of the governing devices.

This motor consists of two oppositely-located working cylinders A A′ and two oppositely-located air-pumping cylinders G G′, secured to the bed B, and two tubular pistons C C′, secured to a cross-head D, said cross-head being connected between the pistons thereon with the connecting-rod D′ of the engine, the opposite end of which is connected to the crank-pin D^2 of the crank D^3 in the usual manner. Exhaust-chambers E E′ are provided for each of said cylinders A A′, communicating with said cylinders by ports *n n′*, as shown in Fig. 1, and controlled by suitable valves operated from an eccentric F′ on the crank-shaft F of the engine.

The two air-cylinders G G′ are located in line centrally with the cylinders A A′, the tubular pistons C C′ being common to both the working cylinders and air-cylinders—viz., piston C working in cylinders A and G, and piston C′ in cylinders A′ and G′. These cylinders G and G′, pistons C C′, and their valves serve as air-pumps for supplying a quantity of fresh air, which is blown through the cylinders A A′ after each explosion of vapor or gas therein, whereby the said cylinders are freed from the products of combustion resulting from the said explosions of vaporized hydrocarbons or other gas and supplied with pure air after each explosion therein. The outer ends of the air-cylinders G G′ are closed by the heads H H′, either screwed into said cylinders or otherwise secured. The said heads have located therein the puppet-valves *j j′*, whose function will be fully described farther on. To receive the ends of said cross-head D, a tubular sleeve *a* is cast transversely across said pistons, as shown in Figs. 1 and 3. In each end of the pistons the heads *b b′* and b^2 b^3 are secured, in which are located the spring puppet-valves *d d′* and d^2 d^3, having their seats in the said heads, the purpose of which valves is to admit air to said tubular pistons from the air-cylinders and to discharge it into the working cylinders at proper periods. Suitable bearings for the stems of said valves are provided by casting on said piston-heads the sleeves *e e′* e^2 e^3, supported by yokes, as shown in Figs. 1 and 5. Spiral springs are applied to said valve-stems, whose function is to close said valves at the proper time during the operation of the engine, and said springs are so located as to be subjected to the least possible degree of heat.

Secured on the piston-heads *b* and b^2 and projecting within the cylinders A and C′ are two short posts *f f′*, having secured loosely on their ends the disks *g g′* in such position that the periphery of said disks will contact lightly with the convolutions of the coiled springs *h h′* on the insulated posts J when the ends of the pistons approach the closed ends of the cylinders A and C′, the said posts *f f′* and the springs *h h′* being the terminals of the two poles of an electric battery or other source of electricity. The sparking necessary to ignite the charge of explosive is produced by breaking the contact of said disks

g g' with the springs h h', and said disks being loosely mounted on their supports and the coils of wire of the springs lying angularly across the paths of said disks the latter are by their passage across the coils of the spring revolved more or less about their supports, and thus present a new portion of the disk to be brought into contact with the spring, whereby the burning or oxidation of the said disks at any one point is obviated and the certainty of the ignition of the charge of explosive is insured.

The post J, on which the springs h and h' are supported, is embedded in a plug N, of some suitable insulating material, which is secured in any convenient manner in the end of the cylinders A and A', the end of the post projecting through said plug for the attachment thereto of one of the two wires of a battery or other electric source, the other wire being attached to the engine at any convenient point, the electric circuit being completed by the contact of the disks g g' and springs h h' at every stroke of the piston.

Within the two exhaust-chambers E E' are the two valves l l', supported, as are the valves in the pistons, by their valve-stems passing through sleeves provided therefor, the ends of the said stems projecting beyond the sleeves being provided with springs, whereby the valves are closed at the proper time. Seats for said valves are provided within said chambers, and exhaust-pipes m m' are connected to said chambers, the valves l l' being interposed between the said pipes m m' and the ports n n' in said cylinders A and A'.

The exhaust-valves are operated from the crank-shaft by means of an eccentric F' thereon, whereby intermittent movements are imparted to the horizontally-sliding rod K in bearings K' on suitable standards K^2. (See Fig. 3.) The said rod K is in line horizontally with the stem of the valve l in exhaust-chamber E and at the proper time operates said valve to permit the discharge from said cylinder A of the products resulting from the combustion of the propulsive charge contained in said cylinder. The exhaust-valve l' in the chamber E' is in its turn operated by the rod K as follows: A rock-shaft L, having the two upstanding arms M M' on each end thereof, is located in suitable bearings on the bed-plate of the engine at right angles to the line of movement of the pistons. The upper end of the arm M is pivotally connected to the sliding rod K between the bearings K', the arm M' being adjusted to engage at the proper time with the stem of the valve l' in exhaust-chamber E' to open the same.

Supported in suitable standards S S is the crank-shaft F, carrying the balance-wheel T, secured thereon. The governing devices for the engine are carried in this wheel and are constructed as follows: Two rods P P' are screwed into the hub and the rim of the wheel or otherwise secured therein, each carrying a governor-ball R thereon, and on which said ball has a free sliding movement. Said governor-balls are normally held at or near the hub of the balance-wheel by the tension of the springs R' R', which tension may be regulated by the nut on the rod P, between which and the ball R the spring is confined. Secured to each of the governor-balls by a screw, as shown in Figs. 1 and 6, are the plates W W. One of the ends of said plates W is provided with an elongated slot s, the smallest dimension of said slot being the diameter of shaft F, which passes therethrough. The opposite end of said plate is provided with a slot t, through which passes a screw into the rim of the wheel, permitting to said plate, however, a sliding movement on said crank-shaft and screw within the limits of the said slots s t. On the crank-shaft are two cams v v, one on each side of the balance-wheel, not fixed on said shaft F, but given a rotary movement by the engagement of the square-faced studs v' v' on their inner faces, with projections w w on the sliding plate W W, carried by the balance-wheel.

On the bed-plate of the engine and secured thereto, one on each side of the balance-wheel, are two pumps O and O'. (See Figs. 1, 2, and 6.) These pumps are for the purpose of supplying the gasolene or other substance to the cylinders A A', in which it is to be exploded, and for this purpose these pumps are provided with suitable pipes 3^b and 3^b, running to the gasolene-supply tank, and discharge-pipes 4^a and 4^b, connecting the pumps to the cylinders A and A', respectively. The said pipes are provided with suitable oppositely-operating check-valves 5 and 6 for the suction and discharge pipes of the pumps.

The pump herein shown is of the ordinary type, the stem of the plunger 7 being provided with a head thereon, between which and the top of the pump-body is the spiral spring 8. Secured to the upper end of the pump-body is the curved arm 9, to which is pivoted the lever 10, one end of which bears on the top of the cam v of the crank-shaft, and the other end of which rests on the head of the pump-plunger 7, the spring 8 thereon always keeping said lever in contact with the top of the cam. The cams v operate at the proper time to force a supply of gasolene or other explosive into one of the cylinders A or A', the pumps O and O' acting alternately to supply said cylinders.

Any suitable mechanism other than that described may be used for forcing the supply of explosive to the cylinders, provided such means can be applied so as to be operated by connections from the cams v v.

The method whereby the supply of explosive furnished by the said pumps is regulated is as follows: As described, the plates W, secured to the governor-balls R, have a sliding movement radially to and from the center of said crank-shaft F on said shaft and on the screw in the slot t in the outer extremity of said plate, and the projection w on said plate engages with the stud v' on cam v. As long as the engine runs at normal speed the above relation of the parts w and v' remains unchanged, but should the speed of the engine become accelerated the balls R by centrifugal force are thrown out toward the rim of the balance-wheel, sliding on the rods P, compressing the springs R′, and carrying the plates W with them, thereby disengaging the projections w from the studs v' on the cams v and stopping the action of the pumps completely, the cams v, as above described, not being secured to said crank-shaft. As soon as the engine slows down to normal speed again the springs R′ on the rods P force back the governor-balls, carrying plates W toward the center of the balance-wheel, and the projections w of said plates again become engaged with the studs on the cams v, and the first downstroke of the pumps gives a fresh charge of explosive to the cylinders.

In the drawings the two supply-pipes 4^a and 4^b are here shown leading into the cylinders A A′ about midway between the ends thereof, but, if desired, they may be entered through the head of the cylinders opposite the end of the pistons or at any other convenient point. Neither is there shown or described herein any special means for atomizing or spraying the gasolene, as any of the well-known devices for that purpose may be employed.

Referring now to Fig. 1 and assuming that the charge of explosive in the cylinder A has just pushed the piston C into the air-cylinder G, the operation of the motor is as follows: Said piston C in moving forward into the cylinder G compresses the air therein contained until the resistance of the spiral spring on the stem of valve d' has been overcome, when through said open valve the air passes from said cylinder G into the tubular piston C, and the cubic contents of said piston being less than the contents of the air-cylinder the movement of the piston into the said cylinder compresses the air in the tubular piston to a certain degree. Any desired amount of air and any desired pressure may be obtained by varying the relative sizes of the air-cylinders and tubular pistons.

It will be understood that while the air is being compressed in the hollow piston as it moves forward the valve d is kept firmly to its seat by the far greater pressure it receives from the expanding gases in cylinder A. As soon, however, as the piston has reached the end of its stroke the eccentric F′ has, through the rod K, opened the valve l in the exhaust-chamber E, and immediately the pressure in the cylinder A is relieved. At the moment the pressure in cylinder A reaches a point lower than the pressure of the air contained in the tubular piston the valve d in the head b of said piston flies open and allows the charge of compressed air therein to escape with considerable force into the cylinder A, through it, and out of the exhaust-port, completely cleansing it from the gases resulting from the combustion of the explosive, which had just moved the piston in the opposite direction. Immediately following the opening of the valve d the pump O is timed to force the charge of explosive into cylinder A and before all the air contained in the piston C has issued therefrom, whereby the sprayed gasolene is met by a cross-current of pure air, and thereby becomes thorougly mixed therewith. The exhaust-valve l in chamber E is timed to close simultaneously with the first movement of the pump O to supply the cylinder A with a fresh charge of explosive, as above described. By the time the head b of the piston has reached the opening in the wall of the cylinder through which the gasolene is received therein by the pipe 4^a the stroke of the pump has been completed, the valve d in said piston-head has been closed by its spring, and the charge of explosive and air in cylinder A is compressed by the return movement of the piston C, which is imparted to it by the piston C′ in cylinder A′, receiving at this time the impulse from the explosion of its charge. The piston C as it begins to move out of the air-cylinder G from the position shown in Fig. 1 acts as a pump-piston, drawing a supply of air through the valve j in the head H of said cylinder, which valve closes by the action of its spiral spring as soon as the piston has reached the end of its stroke, confining said air within cylinder G, from which it is in turn taken up by the tubular piston C, and the operation above described is again repeated by the breaking contact of the disk g and the spring h, whereby the explosive is ignited and a return movement given to the piston.

The working cylinders and the air-cylinders A A′ and G G′ operate alternately in precisely the same manner, and the above description of the operation of cylinders A and G therefore renders unnecessary any description of the operation of the other cylinders A′ and G′. The two pairs of cylinders A G′, C C′ being placed in a line with each other, act as guides for the reciprocating pistons C C′ and take the lateral strain or power from them. These pistons being hollow, they act as receivers for the fresh charges of air, which they hold until the discharge has taken place in cylinders A G′, when the charges of air are alternately discharged, so as to drive out the products of combustion from the cylinders with considerable force. Each cylinder having an impulse to each revolution and acting alternately, the driving-wheel receives two impulses to each revolution, and this wheel being driven by a single crank-shaft I obtain a high rate of speed at the same time that I reduce the number of operating parts.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a hydrocarbon or analogous engine, a working cylinder, an air-compressing cyl-

inder, provided with an inlet-valve for the gases, and a tubular piston, provided with a valve at each end, combined with a connecting-rod, operated by said piston, and the crank-shaft, substantially as shown.

2. In hydrocarbon or other gas engines, the combination with the cylinder and piston thereof, of a crank-shaft and connections between said piston and crank-shaft, a balance-wheel on said crank-shaft having governor-balls sliding on radial arms therein, a pump-actuating cam free on said crank-shaft, and a pump located near said crank-shaft, and means of connection between one of said balls and said cam whereby, by the variable speed of the engine, movement is imparted to said governor-balls, causing the stopping and starting of said pump-actuating cam and pump, and pipe connections between said pump and the cylinder of the engine, substantially as set forth.

3. In hydrocarbon or other gas engines, the combination with the cylinder and piston thereof, of a crank-shaft and connections between the same and said piston, a balance-wheel on said crank-shaft having governor-balls sliding on radial arms therein, the plates W, fixed to said balls and having a sliding engagement with said crank-shaft and said balance-wheel, pump-actuating cams v, free on said crank-shaft and projection w, on the plates W, having an engagement with studs v', of said cams, whereby variations of the speed of the engine cause the engagement and disengagement of the said plates W, and the pump-actuating cam, substantially as set forth.

4. In a hydrocarbon-engine, an air-compressing cylinder, provided with an inlet-valve, a working cylinder placed in line with the said cylinder and provided with an outlet for the gases, and a tubular piston common to both cylinders and provided with a spring-actuated valve at each end, combined with a connecting-rod operated by the piston, the crank-shaft, a means for injecting vapor into the working cylinder, and a sparking mechanism, substantially as specified.

5. In a hydrocarbon-engine, an air-compressing and a working cylinder placed in alinement with each other, combined with a tubular piston provided with a spring-actuated valve in each end, and which piston acts as a receiver for a charge of compressed air which is discharged forcibly into the working cylinder to eject the gases after each discharge, substantially as described.

6. In a hydrocarbon-engine, the two air-cylinders, each provided with an air-inlet valve, two working cylinders provided with outlets for the gases, and two tubular pistons connected together, and provided with a valve in each end, combined with a single connecting-rod, and a shaft having but a single crank, whereby the two pistons unite in driving the crank-shaft by a single rod, substantially as set forth.

7. In a hydrocarbon-engine, an air-compressing cylinder, provided with an inlet-valve, and a working cylinder, provided with an outlet for the gases, combined with a tubular piston, provided with a removable cap and a spring-actuated valve at each end, a connecting-rod, crank-shaft, a mechanism for injecting vapor into the working cylinder, and a sparking device, substantially as shown.

8. In a hydrocarbon-engine, an air-receiving cylinder, provided with an inlet-valve, a working cylinder, provided with an outlet-chamber connected with the working cylinder, a valve in the outlet-chamber, and a mechanism for operating the valve, combined with a tubular piston, common to both cylinders, and provided with a valve at each end, a connecting-rod connected at one end to the piston, the crank-shaft, a means for injecting vapor into the working cylinder, and a sparking device, substantially as described.

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