No. 871,508. PATENTED NOV. 19, 1907.

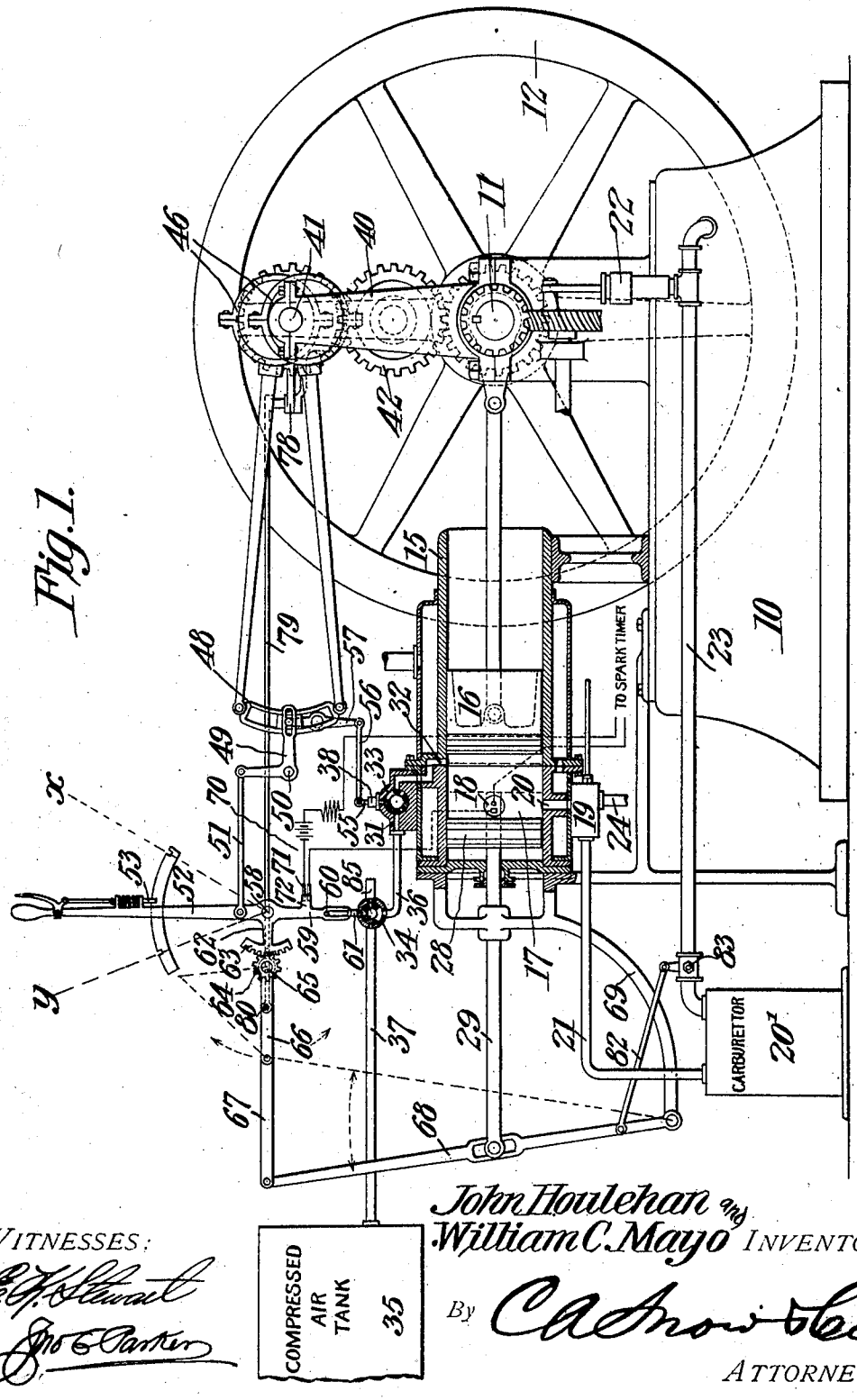
J. HOULEHAN & W. C. MAYO.

GAS ENGINE.

APPLICATION FILED SEPT. 10, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

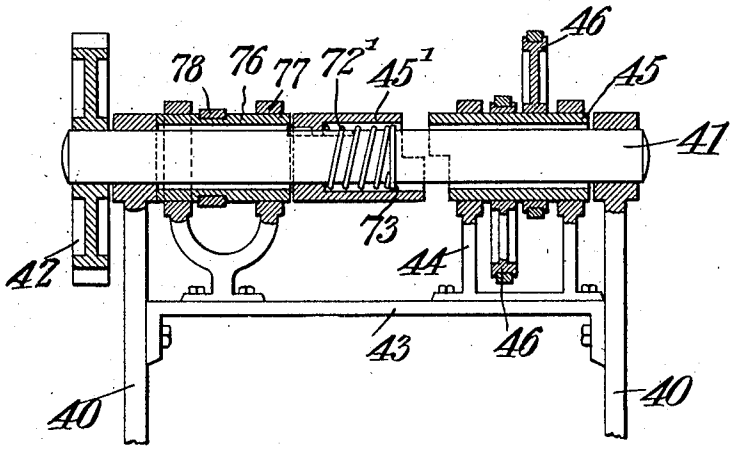


Fig. 3.

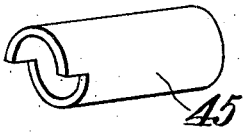


Fig. 4.

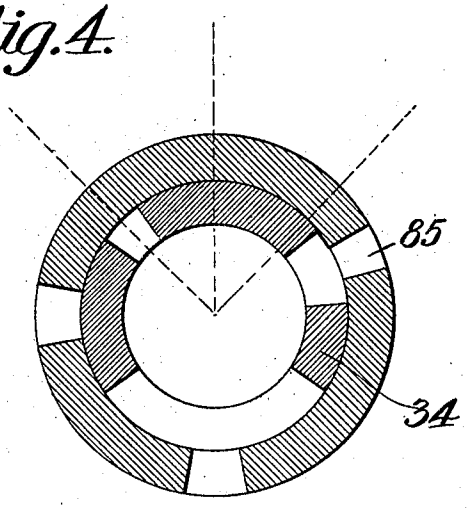
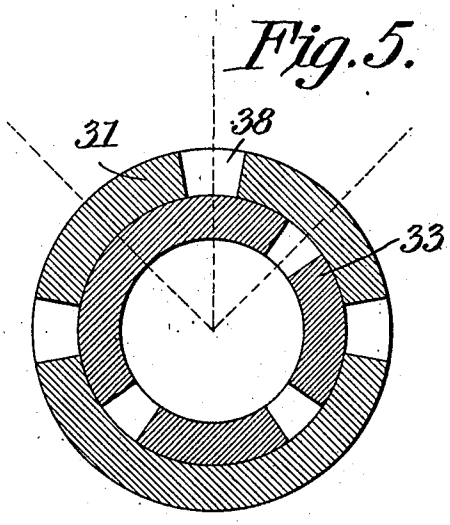


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN HOULEHAN AND WILLIAM C. MAYO, OF EL PASO, TEXAS.

GAS-ENGINE.

No. 871,508. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed September 10, 1906. Serial No. 334,002.

To all whom it may concern:

Be it known that we, JOHN HOULEHAN and WILLIAM C. MAYO, citizens of the United States, residing at El Paso, in the county of El Paso and State of Texas, have invented a new and useful Gas-Engine, of which the following is a specification.

This invention relates to starting devices for internal combustion engines, and has for its principal object to provide an engine especially adapted for use on automobiles and other vehicles, wherein the momentum of the vehicle may be utilized for the purpose of compressing air to be afterwards used in starting the engine, but the starting means are equally applicable to stationary engines where the momentum of the fly wheels is utilized to pump up the air supply for starting.

A further object of the invention is to provide an engine of such construction as to permit its instant conversion into an internal combustion engine, an air pump, or an air engine.

A still further object of the invention is to provide a device of this character in which the various attachments which are necessary to convert the engine into a pump or air engine are of such construction as not in any manner to interfere with the operation of the engine when running under the impulse of the exploded charges, and without any increase whatever either in friction or load.

A still further object of the invention is to provide a device of this character which may be utilized as a brake for retarding the movement of the engine or vehicle whenever necessary.

A still further object of the invention is to provide a novel combustion engine in which the rear wall of the explosion chamber is made adjustable and to permit the cutting off of communication between such explosion chamber and the usual inlet and exhaust ports and the igniter of the engine.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts, hereinafter fully described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings:—Figure 1 is a side elevation of an internal combustion engine constructed in accordance with the invention, parts being broken away in order to more clearly illustrate the construction. Fig. 2 is a transverse sectional view on an enlarged scale through the counter shaft which carries the eccentrics and other mechanism. Fig. 3 is a detail perspective view of one of the clutching sleeves; Fig. 4 is a transverse section of the compressed air tank valve; and Fig. 5 is a similar view of the main air valve.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The engine is provided with a suitable base 10 that has bearings for a main shaft 11, and on the latter is secured a balance wheel 12 of any ordinary construction.

The engine may be provided with any of the usual connections for imparting motion to the vehicle, but as these form no part of the present invention, they have been omitted from the drawings for the sake of clearness and the engine is shown as of the ordinary stationary type instead of the marine type ordinarily employed on motor vehicles.

Mounted on the engine frame is a cylinder 15 that is open at one end and receives a piston 16 of the familiar trunk type usually employed in gas engines, the piston being connected to the crank shaft 11 in the usual manner. In the explosion chamber 17 of the cylinder is a spark plug 18, and at one side is shown a valve casing 19 and a port 20, which, in the present instance may be considered as representing both the inlet and the exhaust port for the explosive charges, the charge being supplied from a carbureter 20′ through a pipe 21, and gasolene or other hydrocarbon being forced into the carbureter by an engine operated pump 22 that is connected to the carbureter or mixing chamber by means of a pipe 23. The products of combustion are delivered through an escape pipe 24 and any suitable valve mechanism is arranged within the valve chamber 19, the construction of this valve mechanism forming no part of the present invention.

The rear wall of the explosion chamber is formed of a movable piston 28 that is carried

by a rod 29 preferably passing through a stuffing box at the rear end of the explosion chamber casting, and this piston may be moved from the full line position shown in Fig. 1 to the dotted line position shown in the same figure, and when in the latter position the explosion chamber will be cut off from communication with the inlet and exhaust port, and the spark plug will also be cut off from the chamber. While the parts are in the full line position, the device is adapted to operate in the manner commonly practiced in internal combustion engines either of the two cycle or four cycle type, and when the piston 28 is moved to the dotted line position the engine is converted into either an air compression pump or an air driven engine, as the case may be.

At a point above the explosion chamber is a valve casing 31 which communicates with the cylinder of the engine through a port 32, the latter being opened at all times to the cylinder without regard to the position to which the piston 28 is adjusted. In this valve casing is arranged a valve 33 of a construction more fully described hereinafter, this valve serving in connection with a valve 34 to establish communication between the cylinder of the engine and the compressed air reservoir 35 through the medium of pipes 36 and 37. Leading from the valve casing is an exhaust port 38, through which the exhaust air is discharged when the device is operating as an air driven engine, this port serving also for the admission of air to the cylinder when the engine is operating as an air compressing pump.

It may be here noted that when the piston 28 is adjusted to the dotted line position shown in Fig. 1 and certain other adjustments are made, as hereinafter described, the device may operate as an air pump, and air will be forced from the cylinder into the tank 35, the air being stored up and subsequently utilized in the cylinder for the purpose of starting the engine into motion, so that cranking will not be necessary.

Extending upward from the bearings of the shaft 11 are standards 40 at the upper ends of which are arranged bearings for the reception of a counter shaft 41 that is driven by a train of gears 42 from the main shaft 11. Extending between the two standards 40 is a cross bar 43 that carries bearings 44 for a sleeve 45 that loosely encircles the shaft 41, but is not in frictional engagement therewith, and when the sleeve or hollow shaft 45 is not coupled to the shaft 41, the latter will rotate freely, and without undue friction. The sleeve or hollow shaft 45 carries a pair of eccentrics 46 having straps which are connected to the opposite ends of a link 48 forming part of a link motion of ordinary construction. The link is supported by a bell crank lever 49 mounted on a tumbling shaft 50 said bell crank lever being connected by a rod 51 to an operating lever 52 and the latter carries a latch bolt 53 of the usual construction, said latch bolt being adjustable to the central position shown in full lines in Fig. 1 where the device is to be used as a gas engine. The lever may be adjusted to the dotted line position x when the device is to be used as an air pump, and to the dotted line position y when the device is to be used as an air driven engine.

Extending from the valve 33 is a stem to which is connected a rocker arm 55, said arm being connected by a rod 56 to a lever 57 which latter is connected in the usual manner to the link block. When the link is in the mid-position, as shown by full lines in Fig. 1, no motion will be imparted to the valve 33, and said valve will, therefore, not interfere in any manner with the operation of the device as an internal combustion engine. When adjusted to either the full up or the full down positions, the valve 33 will be operated and will control the passage of air to and from the main cylinder.

The operating lever 52 is pivoted on a stud or shaft 58 and is provided with a downwardly extended arm 59 having a slot for the reception of a pin 60 that projects from a rocker arm 61 on the stem of the valve 34 for the purpose of controlling the position of said valve. The lever also carries an arm 62 carrying a sector 63 which engages with a gear 64 mounted on a short shaft or pin 65. Secured to this shaft or pin is an arm 66 that is connected by a link 67 to the upper end of a lever 68, the latter being fulcrumed on a stationary bracket 69. When the operating lever is moved from the central position to either the position x or the position y, the gear 64 will be turned, and movement will be transmitted to the piston to effect its adjustment to the dotted line position shown in Fig. 1. When moved to the two positions mentioned, the apparatus will operate either as an air pump or an air driven engine, and as the sparker is no longer necessary, provision is made for cutting it out of circuit, indicated at 70, by placing therein a pair of contacts 71 that are engaged by a projection 72 on the lower arm of the operating lever when the latter is in the central position. When the operating lever is in the central position, the sparker circuit is intact. When moved to either of the other positions, the sparker circuit is broken.

Returning now to the counter shaft 41, it will be seen that one end of the hollow shaft 45 is cut away to form a clutch, and that this clutch engages the clutch end of a sleeve 45′ that is feathered on the shaft 41, and is normally held in inoperative position by a coiled spring 72′ that is arranged within the sleeve and bears at one end against a flange 73 on

shaft 41. The clutching sleeve is under the control of an endwise movable operating sleeve 76 that is mounted in suitable bearings 77 independent of the shaft 41. This sleeve 76 is provided with an annular groove for the reception of a bell crank lever 78, and the second arm of the bell crank lever is connected by a rod 79 to a pin 80 on the arm 66. So long as the operating lever remains in the central position, the clutch is inoperative, but if moved to either the position x or the position y, the sleeve 76 will be moved against the sleeve 45′, moving the latter into clutching engagement with the sleeve 45, so that movement will be transmitted directly from the shaft 41, and the link motion will be started into operation, transmitting the movement to the valve 33. In this connection it is to be noted that the shape of the clutch faces is such that they cannot be improperly engaged. When it is desired to disengage the clutch faces the lever 52 is moved to the central position and the spring 72′ will then cause the sleeve 45′ to move away from the sleeve 45 and thus disengage the clutch.

When the parts are in the position illustrated in full lines in Fig. 1, the engine may operate in the usual manner, taking in charges which are exploded, and subsequently exhausting them. When it is desired to stop the engine, or when on a vehicle to stop the latter or to check its speed, as on descending grades, the operating lever is moved backward to the dotted line position y. This movement is transmitted through sector 63 and gear 64 to the shaft 65, arm 66 being moved downward and pulling the lever 68 over in such manner as to force the piston 28 inward to the dotted line position shown in Fig. 1. The piston 28 thereupon cuts off or closes the gas inlet and exhaust port of the engine, and also the recess in which the spark plug is arranged. At the same time the projection 72 moves from engagement with the contacts 71 of the sparker circuit, and the latter is broken. The movement is transmitted from the arm 66 to the rod 79, and the clutch is thrown over to engage the hollow shaft or sleeve 45 of the counter shaft 41, whereupon the eccentrics are locked to the shaft and the link motion is set into operation. At the same time the link is lowered and movement is immediately transmitted to the valve 33, the latter being so adjusted as to control communication between the main cylinder, the air inlet port 38, and the pipe 36 which leads to the valve 34. This valve 34 is adjusted through the arm 59 of the operating lever into position to establish communication between the pipes 36 and 37, and therefore with the tank 35. At the same time the link 82 that is connected to a valve 83 on the gasolene supply pipe 23 is moved to close the valve, thus preventing the flooding of the carbureter or mixer. The momentum of the vehicle or of the fly wheel of the engine then causes the engine to operate as an air pump, air being drawn in through the port 38 and port 32 to the cylinder during the movement of the piston in the direction of the crank shaft, and this air being compressed as the piston returns, and being forced out to the tank 35, where it is held under pressure, a safety valve being employed on the tank if necessary.

After the engine has stopped or slowed down, and it is desired to start the same into operation, the operating lever is moved over to the position y. During this adjustment, the sector 63 engages the gear 64 and the arm 66 is turned up again, moving the piston 28 inward to the dotted line position shown in Fig. 1. The valve 83 is closed, the valve 34 is turned to again establish communication between the pipes 36 and 37, the clutch is operated to engage the sleeve 45 of the shaft 41, the link is raised, and the position of the valve 33 is thereby so adjusted as to convert the engine into an ordinary fluid pressure engine. The compressed air from the reservoir 35 is now directed through the pipe 37, valve 34, pipe 36, valve 33, port 32 to the main cylinder, forcing the piston outward and then as the piston returns, the air is driven out through the exhaust port 38. The operation may be successfully carried on with a single cylinder engine, but with a multiple cylinder engine, the operation is, of course, more certain, owing to the fact that all of the cranks cannot stop on dead center at the same time.

In order to render the adjustment of the operating lever 52 as easy as possible, the valve 34 is provided with an exhaust or vent 85 through which gases or air in the main cylinder may escape during the adjustment of the piston 28, inasmuch as it would be at times extremely difficult to move the piston where the main piston 16 is traveling rapidly.

As the engine need make but a few turns before its momentum will enable it to receive and compress an explosive charge, a comparatively small compressed air tank will be sufficient.

In any case the engine may be disconnected from the car or other vehicle and allowed to run idly as usual.

We claim:—

1. In an internal combustion engine having a power cylinder provided with an explosion chamber and means for introducing the explosive mixture and exhausting the burned gases, a compressed air reservoir, means for establishing and cutting off communication between the said reservoir and the explosion chamber of the engine, a movable member forming the rear wall of the explosion chamber, and means for adjusting said movable member to cut off communication between

the explosion chamber and the intake and exhaust means.

2. In an internal combustion engine having a cylinder provided with an explosion chamber and with intake and exhaust means, a movable piston forming the rear wall of the explosion chamber and adjustable to a position to cut off communication between the cylinder and the intake and exhaust means, a compressed air reservoir, means connecting said reservoir with the cylinder, a valve in said connection, a normally idle operating means for the valve, and mechanism for simultaneously moving the piston and setting the valve-operating means in motion.

3. In an internal combustion engine having a cylinder and an adjustable explosion chamber head therein, a compressed air reservoir, connecting means between said cylinder and the reservoir provided with a valved passage controlling communication between the cylinder and said reservoir, a normally idle mechanism for operating the valve in the valved passage, and a single operating lever for adjusting the head and at the same time connecting the valve-operating mechanism to a movable part of the engine.

4. The combination with an internal combustion engine having an adjustable explosion chamber head movable to cut off communication between the cylinder of the engine and the intake and exhaust means, of an auxiliary air port in the cylinder, a valve for controlling said port, a valve-operating mechanism normally disconnected from the engine for operating said valve, a compressed air reservoir with which said valved air port communicates, a lever and mechanisms under the control of said lever for adjusting the explosion chamber head, adjusting the valve mechanism, and connecting said valve mechanism to the engine.

5. An internal combustion engine including an explosive-agent supply pipe, a valve therein, an electric igniter, an electric circuit connected therewith and having spaced terminals, a lever, a contact carried thereby and arranged to engage said terminals when the lever is in one position and movable to break the igniter circuit and to close the valve, an auxiliary air port in the cylinder, an air reservoir, communicating means between the air reservoir and the auxiliary port, a valve in said communicating means, a normally idle valve-operating mechanism for said valve, and means under the control of said lever for connecting the valve-operating mechanism to a movable part of the engine.

6. An internal combustion engine including a movable piston which forms the head of the explosion chamber, a rod carrying said piston, a lever for moving said rod, an explosive-agent supply pipe, a valve arranged therein and connected to said lever, a compressed air reservoir, a port in the cylinder, means connecting said port to the air reservoir, a valve for controlling said port, a normally idle operating mechanism for the valve, a clutch for connecting said valve-operating mechanism to a movable part of the engine, an electric igniter, an electric circuit in which the igniter is included, said circuit having spaced terminals, a second lever, means for connecting the same to the piston-adjusting lever, means for connecting said second lever to the clutch mechanism, and means under the control of said lever for making and breaking the igniter-circuit.

7. An internal combustion engine having an explosion chamber, intake means for the explosion mixture and exhaust means for the burned gases, a movable piston forming the rear head of the explosion chamber, an air reservoir, connections between the air reservoir and the explosion chamber, a valve interposed in said connections, means for operating said valve, a valved vent in said connections, and means for adjusting the movable piston to cut off the intake and exhaust means from the explosion chamber.

In testimony that we claim the foregoing as our own, we have hereto affixed our signatures in the presence of two witnesses.

JOHN HOULEHAN.
WILLIAM C. MAYO.

Witnesses:
SAM B. GILLETT,
D. W. BUNKHALTER.