A. RANDOLPH.

GAS ENGINE.

APPLICATION FILED AUG. 24, 1910.

1,046,491.

Patented Dec. 10, 1912.

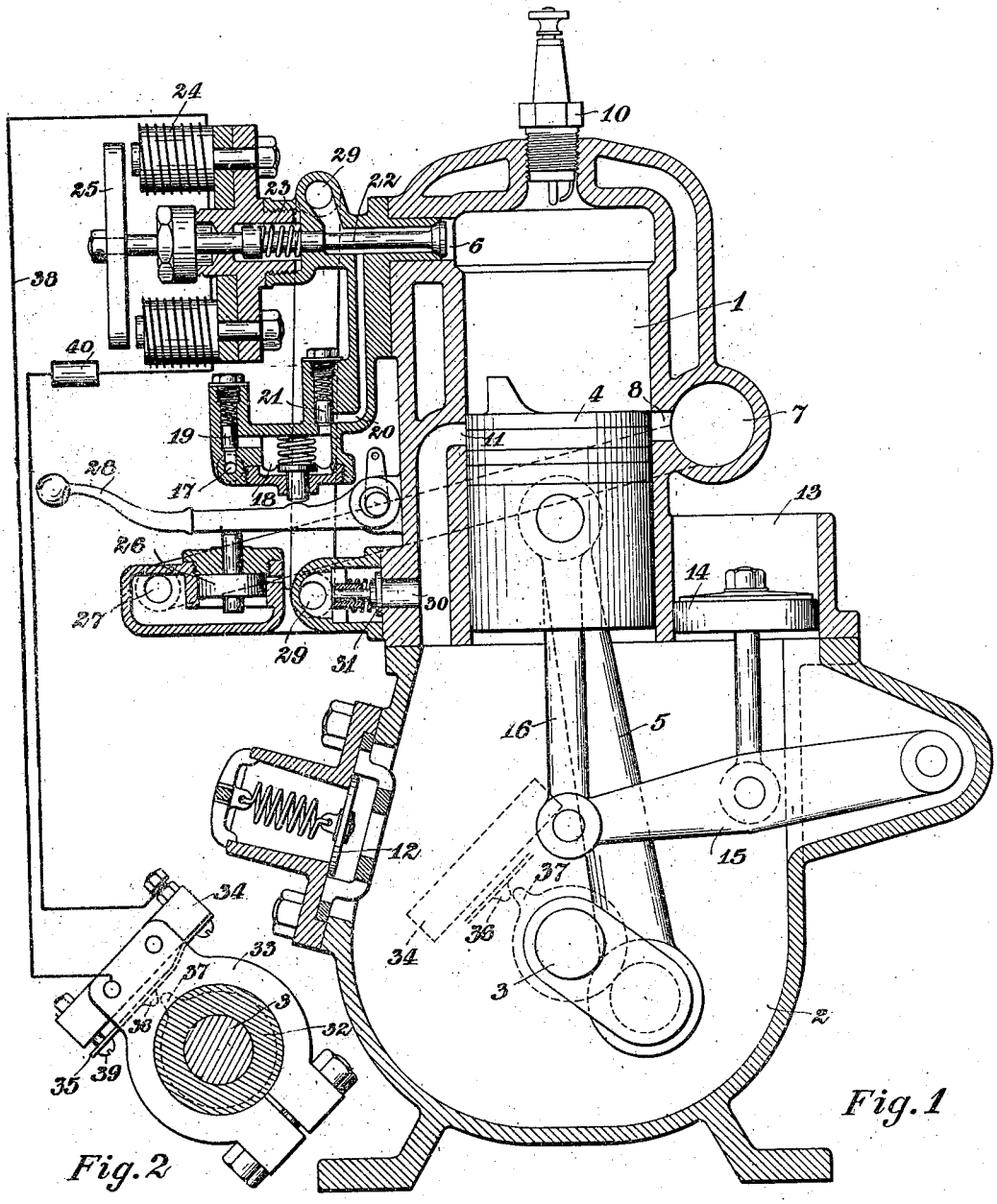

Fig. 1

Fig. 2

Witnesses

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UNITED STATES PATENT OFFICE.

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GAS-ENGINE.

1,046,491. Specification of Letters Patent. Patented Dec. 10, 1912.

Application filed August 24, 1910. Serial No. 578,740.

To all whom it may concern:

Be it known that I, ALFRED RANDOLPH, a citizen of the United States, residing at Salem, Columbiana county, Ohio, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention, pertaining to gas engines of two-cycle type, will be readily understood from the following description taken in connection with the accompanying drawing, in which:—

Figure 1 is a vertically longitudinal section of a gas engine exemplifying my invention; and Fig. 2 is a side elevation of the timing device; diagrammatic lines connecting Figs. 1 and 2 to illustrate suitable circuit connections between the timing device and the electromagnet for operating the fuel-valve.

In the drawing:—1, indicates the cylinder: 2, the closed crank-case connected therewith: 3, the crank-shaft: 4, the piston: 5, the connecting rod: 6, the inlet-port for admitting fuel into the upper end of the cylinder: 7, the exhaust-passage: 8, the exhaust-port leading from the cylinder to the exhaust-passage and opened and closed by the piston in its reciprocations: 10, an igniter, of usual type, to ignite the charge in the cylinder: 11, a port placing the crank-case in communication with the cylinder, this port being opened and closed by the piston in its reciprocations: 12, an inwardly opening check-valve to admit air to the crank-case: 13, a supplementary cylinder open to the crank-case: 14, a piston in the supplementary cylinder: 15, a rocker pivoted within the crank-case and connected with the supplementary piston: 16, a link connecting the piston with the rocker to cause the supplementary piston to move in unison with the main piston: 17, the fuel-inlet: 18, a diaphragm pump, the diaphragm being spring loaded: 19, a valve disposed between fuel-inlet 17 and the pump-chamber, this valve being the inlet-valve of the pump: 20, a fuel-passage leading from the pump to inlet-port 6: 21, the discharge-valve of the pump, disposed between the pump-chamber and passage 20: 22, the fuel-valve arranged to open and close fuel-port 6, this valve opening toward the cylinder: 23, a spring on the stem of the fuel-valve, serving to close it: 24, an electromagnet: 25, the armature of the electromagnet, the same being on the stem of the fuel-valve so that when the electromagnet is energized the armature will be attracted and the fuel-valve opened: 26, a piston working in a cylinder: 27, a passage leading from the exhaust-passage to the cylinder of piston 26: 28, a lever engaging under the stem of the diaphragm of the diaphragm-pump and over the stem of piston 26, this lever being provided also with a handle: 29, an air-passage leading to fuel-port 6 at a point behind fuel-valve 22: 30, a port placing this air-passage in communication with the crank-case: 31, a check-valve disposed between port 30 and passage 29 and opening away from the crank-case: 32, one of the fixed bearings of the crank-shaft: 33, an angularly adjustable collar clamped upon this bearing: 34, a block of insulating material secured to the collar: 35, a metallic spring secured to the block between it and the bearing: 36, a contact-point carried by the spring: 37, a contact-point projecting from the crank-shaft, or a collar fixed to it, adapted, at each turn of the crank-shaft, to make momentary contact with point 36: 38, a conductor leading from the electromagnet to collar 33, and, therefore, to contact-point 37: 39, a screw mounted in the insulating block and serving as a means for adjusting contact-spring 35 so as to bring its contact-point more or less in the range of contact-point 37: and 40, a generator of current arranged in a conductor between the electromagnet and contact-spring 35, which generator may be a battery or dynamo.

On the upstroke of the main piston a partial vacuum is created in the crank-case, which vacuum is satisfied by the inflow of air through valve 12. On the downstroke of the piston this air, confined in the crank-case, is compressed. The supplementary piston 14 serves in increasing the displacement on the downstroke of the main piston. When the pressure of the air in the crank-case exceeds the resistance of the spring on valve 31, then that valve opens and permits the compressed air to flow through passage 29 and go to the back of the fuel-valve. When the descending main piston opens port 11 compressed air from the crank-case blows through the cylinder and out at exhaust port 8, cleansing the cylinder of the unburned gases. When the rising piston closes

exhaust-port 8 it leaves the cylinder charged with clear air under some pressure, and at this instant the electric circuit is closed by contact-point 37, thus energizing the electromagnet, whereupon the fuel-valve is quickly opened and the compressed air from passage 29 permitted to blow through port 6 into the cylinder, this blast of air spraying into the cylinder the fuel fed through passage 20, the consequence being that the cylinder becomes charged with a mixture of air and fuel, which, at the proper time, is ignited by the igniter in the usual way, the expansion due to the burning of the fuel in the cylinder producing the power stroke of the piston.

In starting the engine the diaphragm-pump may be worked by hand through lever 28, the upstroke of the diaphragm being produced by the lever and the downstroke by the spring load over the diaphragm, thus delivering fuel behind the fuel-valve. After the engine is started then the diaphragm-pump will be operated by piston 26 under the influence of the pulsations of pressure derived from the exhaust, or other source of pulsating pressure. The chamber in which piston 26 works may be filled with lubricating oil, preferably of the same kind as is used in the crank-case, thus preventing the piston 26 from being subjected to direct contact with the exhaust gases. The pivot of lever 28, as shown, is an eccentric one, and the angular adjustment of this eccentric, which may be effected by hand or put under governor control, varies the degree of delivery by the pump through passage 20 and thus keeps behind the fuel-valve the proper supply of fuel to be carried into the cylinder by the air at each opening of the fuel valve.

Conductor 38 is illustrated as being connected with collar 33, but it is sufficient if it be connected with any metallic part of the engine in constant electrical connection with contact-point 37. The angular adjustment of collar 33 permits of adjusting the time at which the circuit is closed, and also the direction of crank-motion, and screw 39 provides for the adjustment of the duration of time during which the circuit shall be closed.

As seen in the drawing, the main piston is surmounted by the deflector usually provided to prevent direct flow of mixture across the piston in usual constructions where the mixture is compressed in the crank-case, the object of the deflector being to prevent the mixture from going directly across the piston and wasting out of the exhaust, and to compel it to move upwardly so as to displace the products of combustion and clean the cylinder. In my system the deflector serves to prevent the air from port 11 from passing directly to the exhaust-port and impels it upwardly so as to cause the burnt gases to become exhausted ahead of the incoming compressed air and before the fuel is admitted to the cylinder, thus avoiding waste of mixture.

Passage 29 is not for the conveyance of vapor but is for the conveyance of air to blow into the upper end of the cylinder the liquid fuel delivered in measured quantities behind inlet-valve 6 by the action of the pump. The liquid fuel sprayed into the cylinder is delivered ready for spraying close to the valve and the valve is in turn close to the cylinder. The quantity of liquid fuel thus sprayed into the cylinder is not dependent on the quantity or pressure of the air moving through passage 29, understanding that that quantity of air will always be sufficient to spray the fuel into the cylinder, nor is the quantity of fuel thus sprayed into the cylinder dependent on the pressure acting on piston 26, which operates the pump, understanding that the pump operates full stroke at each impulse of the engine. The stroke of the pump is small, but little of the liquid fuel being required for each impulse, and the quantity sprayed into the cylinder at each impulse will remain unchanged so long as the eccentric pivot of the pump lever is not shifted in order to effect adjustment of the quantity of fuel per impulse. Desired richness of mixture and high efficiency are thus obtained.

The class of gas-engines to which the present invention relates may be defined as a two-cycle engine having a closed crank-case, and having a passage leading from the crank-case to the cylinder at a point where it will be closed by the piston at the beginning of its compression stroke, and having an exhaust port leading from the cylinder at a point where it will be closed by the piston at the beginning of its compression stroke, and having a check-valve to admit air to the crank-case, and having a fuel-inlet into the closed end of the cylinder, and having a valve in said fuel-inlet close to the cylinder, and having a passage leading from the crank-case to a point behind said fuel-inlet valve, and having a loaded check-valve in said last-mentioned passage opening away from the crank-case, and having an igniter to explode the charge within the cylinder. The expression "gas engine of the class described" as employed in the claims is to be taken as above defined.

I claim:—

1. In a gas engine, the combination of a crank case, a cylinder, a crank shaft, a piston adapted to compress air in the crank case, a connecting rod, a valve for admitting air to the crank case, a piston controlled exhaust port in the cylinder, a piston controlled inlet port in the cylinder, a passage leading from the crank case to said inlet port, a fuel port in the cylinder head, a valve seat secured to the cylinder within

said port, a valve sleeve leading out from said seat, a fuel valve for said seat arranged to open inwardly, a valve stem extending outward through said sleeve, a spring for closing the valve, and valve operating mechanism, the valve sleeve providing a fuel space about said stem, a fuel pump, means for actuating said pump, a fuel conduit leading from said pump to the fuel chamber adjacent to said valve, an air conduit communicating with said fuel chamber and supplied from the crank case, and a check valve in said conduit to prevent return of air to the crank case.

2. In a gas engine, the combination of a crank case, a cylinder, a crank shaft, a piston adapted to compress air in the crank case, a connecting rod, a valve for admitting air to the crank case, a piston controlled exhaust port in the cylinder, a piston controlled inlet port in the cylinder, a passage leading from the crank case to said inlet port, a fuel port in the cylinder head, a fuel valve for said port arranged to open inwardly, valve-operating means, a fuel chamber adjacent to the valve, a fuel pump, means by which the action of the engine operates said pump, a fuel conduit from said pump to said fuel chamber, an air conduit communicating with said chamber, and connected with the crank case, and a puppet valve in said conduit to prevent return of air from said fuel chamber.

3. In a gas engine, the combination of a crank case, a cylinder, a crank shaft, a piston adapted to compress air in the crank case, a connecting rod, a valve for admitting air to the crank case, a piston controlled exhaust port in the cylinder, a piston controlled inlet port in the cylinder, a passage leading from the crank case to said inlet port, a fuel port in the cylinder head, a fuel valve for said port arranged to open inwardly, valve-operating means, a fuel chamber adjacent to the valve, a fuel pump, means by which the action of the engine operates said pump, a fuel conduit from said pump to said fuel chamber, an air conduit communicating with said chamber and connected with the crank case, a puppet valve in said conduit to prevent return of air from said fuel chamber, and means for adjusting the pumping capacity of the fuel pump.

4. In a gas engine, the combination of a crank case, a cylinder, a crank shaft, a piston adapted to compress air in the crank case, a connecting rod, a valve for admitting air to the crank case, a piston controlled exhaust port in the cylinder, a piston controlled inlet port in the cylinder, a passage leading from the crank case to said inlet port, a fuel port in the cylinder head, a fuel valve sleeve for said port, a puppet valve seated against the end of said sleeve and arranged to open inwardly, a valve stem, the sleeve being enlarged about said stem to provide a fuel space, means for operating said valve, a fuel conduit leading to said fuel space, a fuel pump, motor-actuated means for actuating the pump, means by which the pump action may be adjusted, an air conduit leading from the crank case to the rear end of said fuel space, and a check valve in said conduit to prevent return of air.

5. In a gas engine, the combination of a crank case, a cylinder, a crank shaft, a piston adapted to compress air in the crank case, a connecting rod, a valve for admitting air to the crank case, a piston controlled exhaust port in the cylinder, a piston controlled inlet port in the cylinder, a passage leading from the crank case to said inlet port, a fuel port in the cylinder head, a fuel valve sleeve for said port, a puppet valve seated against the end of said sleeve and arranged to open inwardly, a valve stem, the sleeve being enlarged about said stem to provide a fuel space, an electro-magnet fixed near said valve stem, an armature on the stem to be pulled by the magnet to open the valve, a spring to close the valve, a current source, an electric circuit including said magnet and said current source, a fixed contact and a moving contact carried by the crank shaft, a fuel conduit leading to said fuel space, a fuel pump, motor-actuated means for actuating the pump, means by which the pump action may be adjusted, an air conduit leading from the crank case to the rear end of said fuel space, and a check valve in said conduit to prevent return of air.

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Witnesses:
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