No. 645,044. Patented Mar. 6, 1900.

A. T. OTTO.

GAS ENGINE.

(Application filed Dec. 26, 1895. Renewed Nov. 29, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

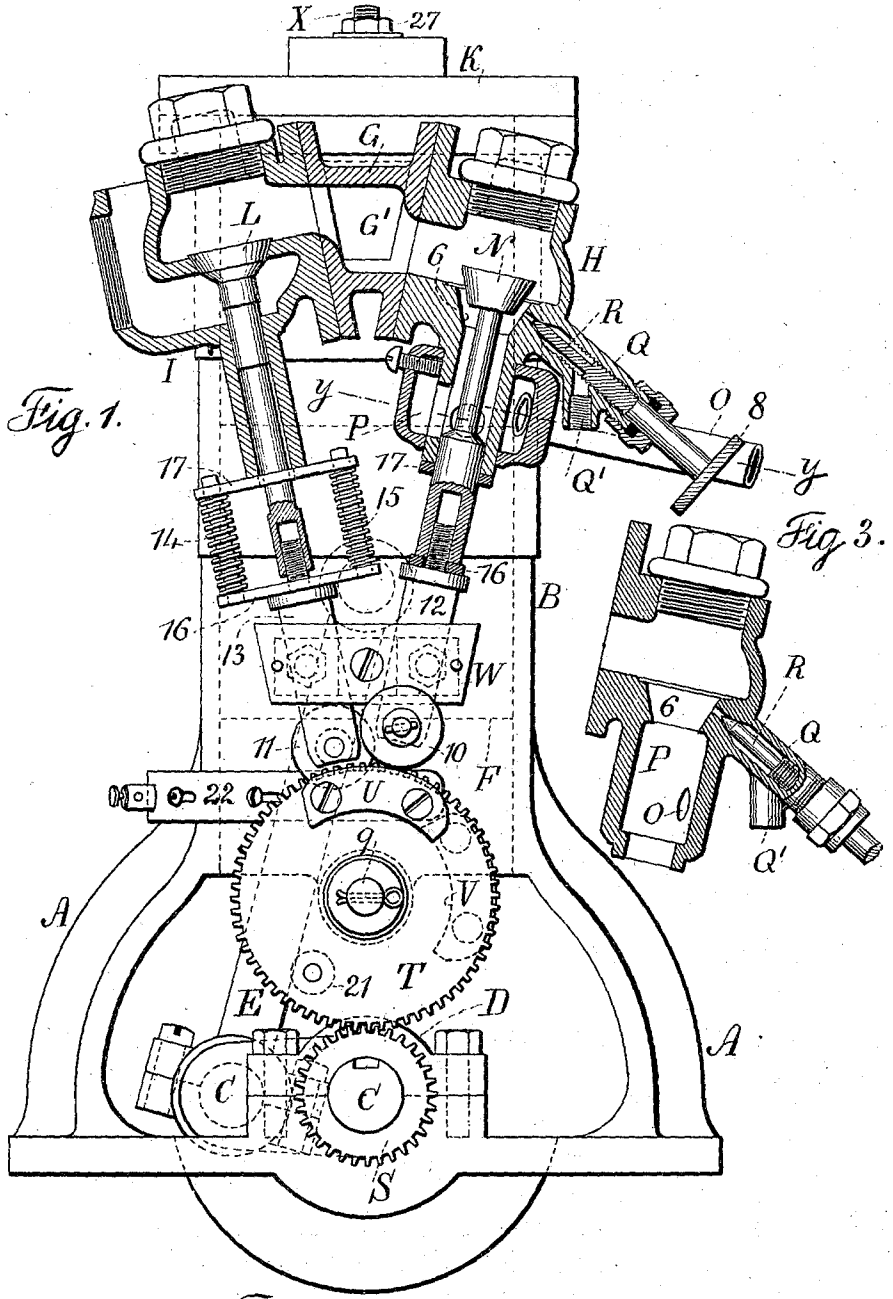
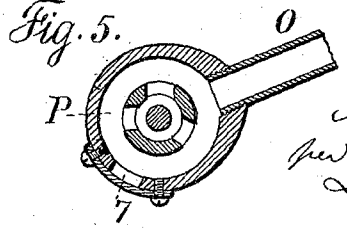


Fig. 3.

Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

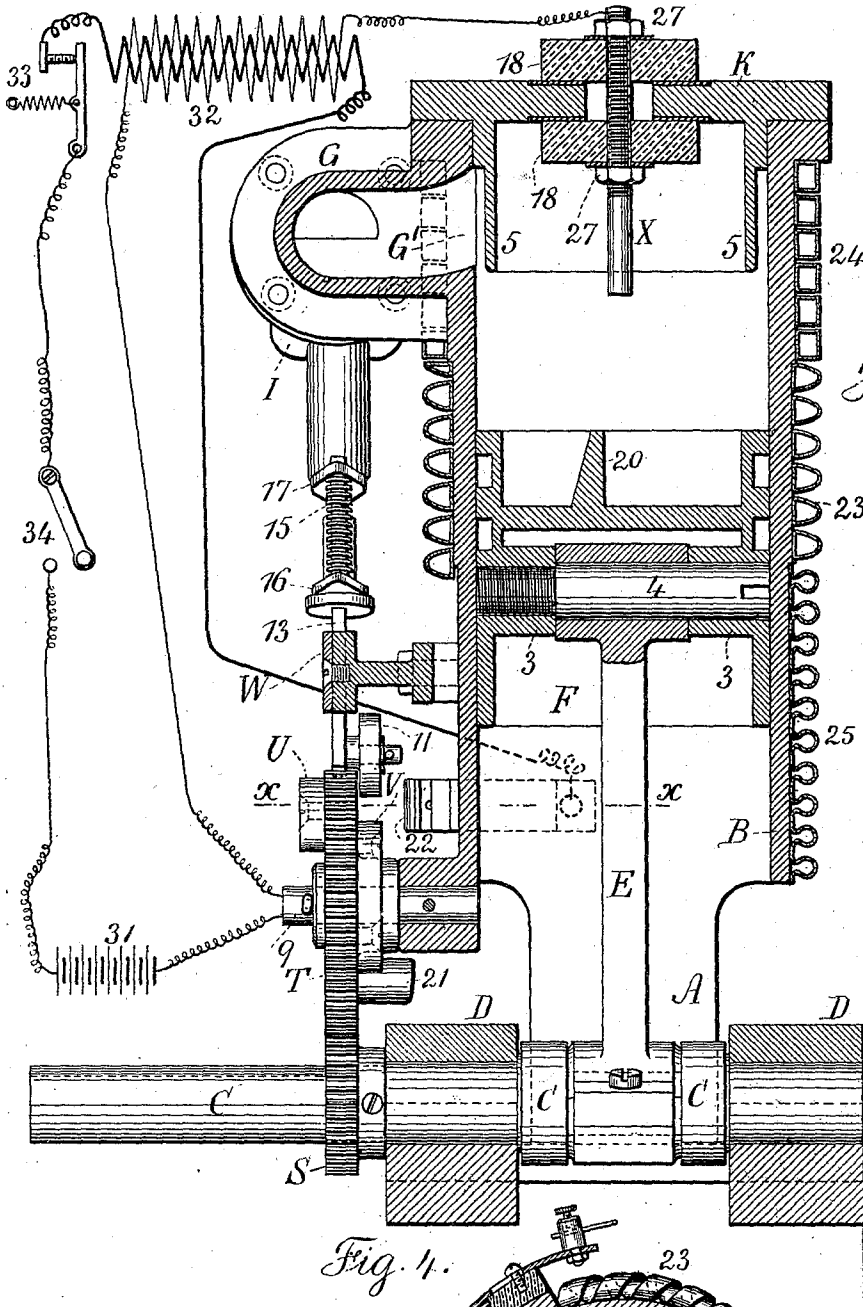

Fig. 2.

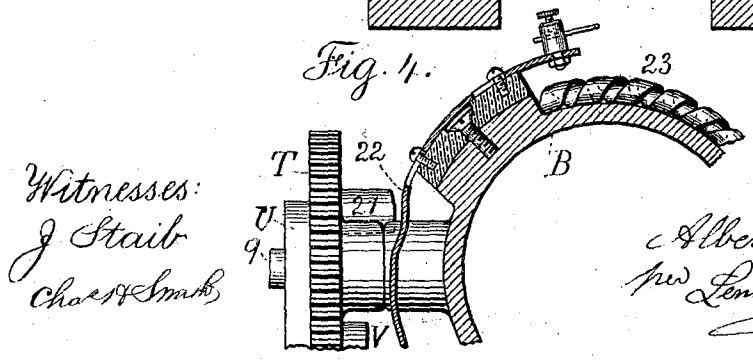

Fig. 1.

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UNITED STATES PATENT OFFICE.

ALBERT T. OTTO, OF CHICAGO, ILLINOIS, ASSIGNOR TO ROBERT L. STEVENS, OF HOBOKEN, NEW JERSEY.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 645,044, dated March 6, 1900.

Application filed December 26, 1895. Renewed November 29, 1898. Serial No. 697,801. (No model.)

To all whom it may concern:

Be it known that I, ALBERT T. OTTO, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented an Improvement in Gas-Engines, of which the following is a specification.

In explosive-gas engines difficulty has heretofore been experienced in consequence of the cylinder becoming excessively hot and also from the air and gas not being uniformly mixed, and hence there is an uncertainty in the uniformity of action in the explosion, and in addition to this the ignition of the gas is uncertain and the explosion will frequently be missed.

The object of the present invention is to overcome these difficulties.

I find that where one port is provided as a projection at one side of the cylinder the tendency to heat the cylinder is lessened, because the air and gas passing in a cold condition through this port are benefited by being heated, and the temperature of the cylinder and port are correspondingly lessened, and the hot products of combustion passing through the same port tend again to heat up such port, and in this way the average temperature of the cylinder is lessened. In addition to this I apply around within the cylinder and adjacent to the inlet and exhaust port an annular deflector, which performs the threefold duty of causing the air and gas to be intimately mixed, of taking up heat from the explosion, so as to lessen the heat of the cylinder, and of heating up the air and gas as they are brought into the cylinder and compressed therein previous to the next explosion. I also provide peculiar electric devices for exploding the charge in the cylinder, and I construct the valves and valve-gear in such a manner as to adapt the engine to use with liquid fuel, as well as with an admixture of air and gas.

In the drawings, Figure 1 is an elevation with the valve-chests in section. Fig. 2 is a section through the cylinder and parts at right angles to Fig. 1. Fig. 3 shows a modification of one of the valve-chests. Fig. 4 is a partial sectional plan at the line *x x*, Fig. 2; and Fig. 5 is a section of the supply pipe and chamber at the line *y y*, Fig. 1.

The frame A is of suitable size and shape, and to it is connected the cylinder B, and the crank-shaft C is supported in suitable bearings D upon the frame A, and the connecting-rod E extends to the piston F, where it is received between the lugs 3 and receives through it the connecting-pin 4. This piston F is to be of any desired character, except in the parts hereinafter named.

At one side of the cylinder B is a hollow projection G at the port or opening G′, leading into the cylinder, and the valve-chests H and I are connected to the flanges at the sides of the projection G, which flanges are inclined to each other, so that the axial lines of the valve-stems will be on radial lines extending to the actuating-wheel T, or nearly so, and the chest H is for the induction-valve and the chest I for the eduction.

The cylinder-head K is bolted onto the flanged end of the cylinder, and it is provided with an annular deflector 5 in the form of a comparatively-thin cylinder projecting from the head K into the cylinder and extending as far as the opening or port G′ in the projection G, and there is a space between this deflector and the interior surface of the cylinder, so that the air and gas or vapor passing into the cylinder through the port G′ strike against this deflector 5 and pass around the cylinder at the same time that they pass into the cylinder at the edge or end of the deflector.

The action of the parts thus far described is that as air and gas or vapor pass into the cylinder they strike against this deflector 5, and such deflector being in a highly-heated condition raises the temperature of the air and gas, so that it is in a better condition for perfect combustion, and when the explosion takes place the force of that explosion is largely concentrated upon the interior surface of such deflector, tending to increase the heat of the same and at the same time lessen the heat given to the cylinder itself, and as the heated products of combustion pass away from the cylinder they impinge upon this annular deflector, still further increasing the temperature of the same, and in the projection G′ a similar operation takes place—that is to say, the heated gases passing off through the port G′ impinge against the interior of the projection G and heat the same—and the air and gas or vapors when they pass in through such projection laterally from the induction-valve chest impinge against the sur-

face of such projection and become heated and lessen the heat of the cylinder and port. Thereby there is an interchange of the heat, tending, on the one hand, to fit the gaseous materials for perfect combustion or explosion, and, on the other hand, to reduce the temperature of the cylinder, and thereby lessen the risk of the lubricating material employed with the piston becoming carbonized.

The exhaust-valve L opens inwardly, and there is an escape port or pipe for leading away the gases, and the induction-valve N also opens inwardly, and it rests upon the seat 6 when closed, and the stems of the valves L and N occupy radial or nearly-radial positions to the actuating-wheel. Where air and gas mixed together are employed, the same are advantageously supplied by a pipe O, which may be flexible, and the same opens into the mixing-chamber P, that surrounds the valve-stem. This mixing-chamber P may be separate, as indicated in Fig. 1; but I prefer to have the valve-chest and mixing-chamber in one, as seen in Fig. 3, and there is an opening at 7 through which air may be admitted; but when air and gas are supplied by the pipe O this opening 7 will usually be closed by a cap or plug.

This engine is adapted to liquid fuel, and with this object in view the pipe Q extends off from the valve-seat 6, such pipe terminating as a small hole through the valve-seat, so that the valve N will close the opening at the end of such pipe Q whenever the valve is seated; but when the valve is raised from its seat naphtha, gasolene, kerosene, or other material may be admitted through such hole in the form of a jet to strike against the valve and commingle with the air that is drawn into the cylinder every second stroke.

I place in the pipe Q a valve R, which is advantageously in the form of a pointed screw-stem, having a head 8 outside the end of the pipe Q, by which the valve can be adjusted, and the lateral branch Q′ to the pipe Q serves for the supply of naphtha, gasolene, or similar material, which should be under sufficient pressure to cause it to pass through the hole in the valve-seat in the form of a jet that is more or less atomized by the action of the air, so as to commingle therewith and be in the proper condition for explosion within the cylinder of the engine. The screw-stem and valve being directly in the line of the hole in the valve-seat also keep such hole free from any obstruction.

I remark that when ordinary illuminating-gas is mixed with air and supplied through the pipe O or when atmospheric air is caused to pass through a carbureter containing gasolene or similar material, so as to take up the vapors, the valve R may be left open to allow an additional volume of air to pass into the cylinder when the valve N is open.

In almost all instances it is necessary to draw in the explosive gases at one movement of the piston and compress the same by the movement of the piston in the other direction previous to igniting the gases, so that the explosion takes place every other stroke. I therefore make use of a gear S upon the crank-shaft driving the gear T upon a stud 9, and this gear T is twice the size of the gear S, so as to revolve once for each complete movement of the engine, and upon this gear T are cams U and V, preferably on opposite sides, the one for actuating the induction-valve and the other the eduction-valve, and these cams are properly shaped and timed to open these valves at the proper moment.

I prefer to provide rollers 10 and 11 upon slides 12 and 13 in the stationary guides W for the cams U and V to act upon the rollers and move the slides, and the slides are connected with the respective valve-stems, and the springs 14 and 15, intervening between the cross-pieces 16 at the ends of the slides and the cross-pieces 17 adjacent to the respective valve-chests, act to close the valves rapidly as the cams pass out of contact with the respective rollers.

In consequence of the valve-chests H and I having similar flanges that are bolted upon the inclined opposite sides of the hollow projection G, the positions of these valve-chests can be transposed to cause the engine to run in the reverse direction, and the valves and their stems being in the same perpendicular plane to the crank-shaft the parts are kept close to the cylinder, so that the fly-wheel is not at a distance from the bearings D.

This engine is especially adapted to driving the wheels in a horseless carriage or as a motor for light work or for driving the propeller in a comparatively-small boat, and such engine is made with reference to lightness and compactness, and in order to ignite a charge I find it advantageous to use an electric spark, and with this object in view I provide a central electrode X, passing through the cylinder-head and insulated therefrom by porcelain cylinders or non-conducting supports 18, through which the electrode passes, and which cylinders are firmly connected together by nuts 27 upon the central electrode, there being washers at the nuts and between the porcelain cylinders and the cylinder-head for making the parts gas-tight, and upon the piston there is a stud 20, that passes adjacent to the electrode; but this stud being eccentric to the piston is always in the proper position to the electrode for a spark to be drawn between the electrode and the stud, and by adjusting the central electrode lengthwise the time at which the explosion takes place can be varied, because the spark will pass from one electrode to the other sooner or later in the endwise movement of the piston near the end of the stroke and several sparks can pass between the electrodes to insure the ignition of the gases or vapors.

Any desired source of electric energy can be connected to the central insulated electrode X and also to the cylinder of the engine. I,

however, prefer to employ a battery 30 and an induction-coil or converter 31, the secondary of the inductorium being connected with the central electrode and the battery-circuit being closed and interrupted by the contact 21 upon the gear-wheel T coming into contact with an insulated plate 22 in the circuit to the battery, and the vibrator at 32 pulsates the battery-current and gives numerous sparks in the cylinder.

In addition to the foregoing devices by which the temperature of the cylinder is lessened I find it advantageous to employ radiators around such cylinder. These radiators are in the form of metal wires or strips projecting outwardly from the cylinder and setting closely at their inner portions against such cylinder, so as to convey away the heat by conduction from the cylinder and to disperse such heat by radiation from the projecting coils or open loops.

I find it advantageous to employ wire wound up into rectangular or nearly-rectangular helices 24 and drawn around the cylinder and held in position so that one flat portion of each helix sets closely against the surface of the cylinder and the other portion of such helix projects as a loop, and there are openings between these respective loops or projections, so that the air has an opportunity to circulate, and the heat that is conducted from the cylinder is dispersed both by radiation and by the convection of the air circulating through the openings in the radiators. These radiators are shown at 23 as flat on one side and arched on the other side and at 25 as in the form of loops with compound-curved sides.

It will be apparent from the diagrammatic illustration of the electric circuits appended to Fig. 2 that when the contact-stud 21 upon the gear T touches the insulated plate 22 the primary circuit of the inductorium 32 will be closed and the pulsator 33 therein will make and break the primary circuit; but the spark will not pass from between the central electrode X and the stud 20 until the latter approaches the stationary electrode and is sufficiently near for the spark to pass from one to the other, and by this arrangement the time of ignition is rendered very reliable, although the stud 21 may remain in contact with the plate 22 after the crank has turned the center and the piston moves in the other direction, and the numerous sparks passing between the electrodes as the armature of the inductorium vibrates will insure the explosion.

In consequence of the annular deflector 5 being in a position where it is liable to become highly heated by the explosion and the issuing products of combustion the same not only promotes a perfect combustion of the heated air and gases, but under some circumstances it appears to effect an ignition of such gases at the moment of the greatest compression of such gases upon the return stroke, even when the wires to the battery are disconnected; but by using the electric spark, as heretofore described, the possibility of a failure in the ignition is reduced to a minimum.

A battery or source of electric energy is illustrated at 31 and a switch at 34 for closing or breaking the primary circuit.

As I have filed, May 19, 1899, applications Serial Nos. 717,416, 717,417, and 717,418, I do not herein lay claim to the devices to which such applications relate.

I claim as my invention—

1. The cylinder of a gas-engine having a hollow projection and port at one side with inclined faces, in combination with valve-chests attached to the opposite inclined faces of the hollow projection and valves in such chests, substantially as set forth.

2. The cylinder of a gas-engine having a hollow projection and port at one side, in combination with valve-chests at opposite sides of the hollow projection, valves in such chests, a crank and crank-shaft, connecting-rod and piston, a wheel and cams at opposite sides for actuating the inlet and exhaust valves, substantially as set forth.

3. In a gas-engine, the cylinder having an integral hollow projection and one port for both the inlet and the exhaust to pass through, and a head at one end of the cylinder and a cylindrical deflector upon the head extending into the cylinder adjacent to the port and against which the gases impinge, substantially as set forth.

4. The combination in a gas-engine, of a cylinder having a lateral hollow projection and port with side faces inclined in opposite directions, induction and eduction valves and chests connected upon the inclined faces of the hollow projection and inclined to each other on radial lines or nearly so extending to the actuating-wheel, a gear on the crank-shaft and a second gear driven by the same and forming the actuating-wheel, cams upon such actuating-wheel, rollers and slides for opening the respective valves and springs for closing such valves, substantially as set forth.

5. The combination with the cylinder-piston and crank-shaft in a gas-engine having a lateral hollow projection and port, of valve-chests connected with the said lateral hollow projection and at opposite inclinations, valves and their rods in such chests and in a plane perpendicular to the crank-shaft, a wheel and cams for actuating the valves, a cylinder-head and an annular deflector within the cylinder and adjacent to the lateral port, substantially as set forth.

Signed by me this 20th day of December, 1895.

ALBERT T. OTTO.

Witnesses:
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S. T. HAVILAND.