F. W. OFELDT.

NAPHTHA ENGINE.

No. 279,270.

Patented June 12, 1883.
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Fig. 1.

Fig. 5.

Witnesses:

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NAPHTHA-ENGINE.

SPECIFICATION forming part of Letters Patent No. 279,270, dated June 12, 1883.

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To all whom it may concern:

Be it known that I, FRANK W. OFELDT, of Newark, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Naphtha-Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

My invention relates to the known processes for obtaining a motive power by working a liquefiable vapor expansively, then conveying it to a condenser for liquefaction, and then returning it automatically—in a cycle which is automatically completed without loss of the fluid—to a device for reconvert it into vapor in readiness for use again, its vaporization being effected by an application of heat derived from extraneous sources.

It consists in an improved method of completing the cycle without resort to external agency for supplying the heat by obtaining the liquefiable vapor from a combustible liquid through the application thereto of heat derived from the combustion of a portion of the vapor diverted to suitable burners in its passage to the working-chambers, and in the construction also of an improved apparatus, as hereinafter fully described, in which the vapor of naphtha or gasoline may be utilized as a motive power with all the practical advantages due, first, to its lubricating qualities in facilitating automatically the working of the engine, and, second, to its combustible quality, admitting of its use in heating the generator.

In the accompanying drawings, Fig. 1 is a central vertical section of my improved naphtha gas-engine in line $x x$ of Fig. 2. Fig. 2 is a central vertical section at right angles to the first, as indicated in line $w w$ of Fig. 1. Fig. 3 is a detached view, in elevation, of the pump, illustrating the adjustable connection of its rod with the rock-shaft by which it is operated. Fig. 4 is a transverse section in line $y y$, and Fig. 5 a transverse section in line $z z$, of Fig. 1. $A$ represents the combustion-chamber of my improved engine, constructed with a dome, $A'$, terminating in a smoke-stack, $A''$, adapted to carry off the products of combustion.

$B B'$ represent the retort or vapor-generator, constructed of two heavy metallic plates cast by preference in a circular form, and bolted together face to face, as shown in Figs. 1 and 2. The inner face of the lower plate, $B$, is grooved either spirally, as shown in Fig. 4, or in a series of concentric grooves which are made to communicate by transverse channels, so as to form practically a continuous groove or channel leading from the circumference to the center of the plate, and covering in its length the utmost available surface thereof. This groove or channel $e e$ may be either square or semi-circular in cross-section, and it is covered by the plate $B'$, to form, in effect, a continuous conduit, which, fully inclosed within the thick, heavy body of the plates, extends from the outer edge to the center thereof. The retort thus constructed is mounted upon and secured to an open tube, $C$, extending through a central aperture in the plates, to project a short distance above the same, and whose lower end is fitted centrally in the top of a valve-chest, $D$, fitted and secured upon the bottom of the combustion-chamber. The upper end of the tube $C$ terminates in an encircling vapor or pressure-chamber, $E$, formed by means of a box or case fitted upon the top of the retort, over the tube, and which projects up into the dome $A'$ of the combustion-chamber.

A burner, $F$, consisting of an annular perforated pipe, placed under the retort to encircle the vapor-tube $C$, is connected by a supply-pipe, $F'$, with an injector, $G$, outside of the combustion-chamber. (See Fig. 1.) The pressure-port of the injector is connected by a gas-supply pipe, $F''$, with the valve-chest, and its draft-port is connected by an air-supply pipe, $F''$, with a hot-air chamber, $G'$, formed on top of the combustion-chamber, around the base of the dome. Inlet-ports $b b$ are pierced in the side of the air-chamber $G'$, opposite to the air-pipe $F''$, leading therefrom, so that the air supplied to the injector through said pipe must pass through the chamber to become heated therein. The burner may be fitted with a series of tubular perforated arms radiating therefrom, to adapt it more fully to the form of the retort.

The retort, $B B'$, inclosed within the combustion-chamber $A$, is heated by the flame from the burner $F$, the weight of the metal in the plates of the retort serving to equalize and
diffuse as well as to retain the heat in every part thereof.

The naphtha, forced by means of a supply-pipe, S, into the outer end of the continuous channel a, extending in a series of close convolutions to the center of the retort, is vaporized and superheated in its passage through the same, and escapes at a high tension into the vapor-chamber E, from which it finds free passage through the central pressure-tube, C, to the valve-chest D. A supply of the vapor under pressure is carried through the pipe F" to the injector, and operates therein to draw in through the air-pipe F a suitable supply of air from the chamber G'. This air, admixed with the vapor in proper proportions, produces a highly-combustible gas, which is carried to the burner through the pipe F', the supply being regulated as required by means of the injector-valve.

By enclosing the vapor-chamber E, tube C, and valve-chest D within the combustion-chamber in which the retort is heated, the high temperature and tension of the vapor necessary for its greatest efficiency is maintained with great economy of fuel from the time the vapor is generated until it passes into the working-chamber. The economy thus attained is furthermore increased by utilizing the heat above the retort in heating the air which is supplied to the injector.

The combustion-chamber A is mounted upon a large air-tight chamber, H, constructed upon a substantial bed-plate, H', constituting the base of the engine.

Piston-cylinders I I, open at their lower ends, are secured to the under side of the valve-chest D, a narrow interval being left between them to receive a rock-shaft, J, and arm J', for actuating a slide-valve, K, in the valve-chest. This slide-valve K covers and uncovers alternately, in the customary manner, induction-ports opening from the valve-chest into the piston cylinders. The arm J extends from the rock-shaft upwardly to engage the center of the valve through a slot in the bottom of the valve-chest, this slot being constantly covered by the valve. Single-acting pistons M M are constructed and fitted to work in the cylinders I I in the customary manner, the cylinders being adapted to exhaust freely at the end of the stroke into the chamber H. Each piston is connected by a pitman working through the lower open end of the cylinder with an appropriate crank, N', on the inner end of a shaft, N, which is so supported in suitable bearings in the exhaust-chamber H as to permit of the free revolution of the cranks within said chamber beneath the cylinders. The shaft N projects outwardly through a suitable packing-box in the side of the exhaust-chamber to carry the driving-pulley of the engine. The outer end of the rock-shaft J also projects outwardly from the exhaust-chamber through a suitable packing-box, (see Fig. 2,) and is fitted with an arm, J', (see Fig. 2, and dotted lines, Fig. 1,) to which is pivoted a connecting-link, L, extending thence to a parallel arm, L', projecting from one end of a second rock-shaft, L", supported parallel with the shaft J in bearings upon the outside of the exhaust-chamber, over the shaft N, and at a right angle thereto. The arm L' is slotted longitudinally to admit of the play and adjustment therein of a sleeve or washer serving to form a pivotal connection of the link L to the arm. By the movement of the sleeve in the slot the end of the link may be brought nearer to or farther from the axis, thereby shortening or lengthening its stroke. This adjustment, by controlling the movement of the rock-shaft J and of the slide-valve K, will operate to regulate the movement of the engine. The arm J' of the rock-shaft J is extended beyond the connection thereto of the link L to form a handle, (see Fig. 2,) by means of which the valve K may be started and actuated by hand. The opposite end of the outer rock-shaft, L", is also fitted with an arm, L"', (see Fig. 5,) projecting therefrom, to actuate by its oscillation the piston-rod of a plunger-pump, P, secured upon the bed-plate H' of the engine, by the side of the exhaust-chamber. This arm L"' is slotted longitudinally, (see Fig. 5,) to permit an adjustment of the connection of the pump-rod therewith to a point nearer to or farther from the axis of the rock-shaft, so as to regulate thereby at pleasure the stroke of the pump. The connection of the rod and arm 100 may be made by a pivot pin or bolt through a sleeve working in a slot, and which, when adjusted, is made fast to the arm by means of a set-screw. The rock-shaft L", which actuates the slide-valve and the pump-rod, is itself actuated by means of a central arm, L', (see Fig. 5,) extending therefrom over the shaft N, and whose outer end is coupled by a connecting rod and strap, O, with an eccentric, O', on the shaft N, (see Fig. 1,) which thus serves in its rotation to operate medially the slide-valve and feed-pump of the engine.

The feed-pump P is connected for its supply with a condenser, R, (see Fig. 5,) which is connected with the exhaust-chamber H by a pipe entering the latter at a point above the level of the shaft N. (See Fig. 1.) A receptacle is thus formed beneath the shaft to contain a supply of lubricating-oil derived from the naphtha by its condensation, which will serve to lubricate constantly the cranks and bearings of the shaft.

The condenser R may be constructed as a surface-condenser to produce a rapid condensation of the vapor discharged therein from the exhaust-chamber H; but any approved form of condensing apparatus may be employed.

A supply-tank, Q, may also be connected with the pump to supply from time to time the loss of naphtha occasioned by the consumption of vapor supplied to the burner.

The delivery-port of the pump is directly connected by the pipe S with the outer end of the open vaporizing-channel a in the retort B.
so that the piston of the pump will operate at each stroke to force a charge of naphtha into the retort, the quantity so delivered being determined by the length of the stroke, which is regulated at will, as above described, by an adjustment of the connection of the piston-rod with the oscillating arm \( L' \). The pressure of the vapor in the engine is determined by the quantity of naphtha delivered to the retort, which must be so heated as to produce its complete and instant vaporization, the degree of heat being regulated by an adjustment of the injector \( G \), supplying gas to the burner. The working-pressure is confined within the space which extends in a continuous, uninterrupted channel from the pump through the pipe \( S \), the conduit \( a \) in the retort, and the vapor-chamber \( E \) and tube \( C \); to the valve-chest \( D \). An excess of pressure in the apparatus is prevented by means of a safety-valve, \( S' \), connected with the supply-pipe \( S \), leading from the pump to the retort, and which is arranged to open into the exhaust-chamber \( H \).

A free vent-opening, \( S'' \), is formed between the pump-cylinder, above its piston or plunger, and the exhaust-chamber, so that any possible leak of naphtha about the piston will be discharged into said exhaust-chamber.

It will be noted that there are no packed joints or glands in the channels or chambers of the pump subjected to pressure, and that all joints likely to leak find their vent into the exhaust-chamber.

A supply of air is admitted to the pump, when required, through an air cock and valve, \( T \), in the lower end of the pump-chamber.

The entire apparatus is simple, compact, and self-contained.

The operation of my improved engine, briefly described, is as follows: The condenser, the retort, and the lower portion of the exhaust-chamber having been duly charged with naphtha or gasoline, the air-valve \( T \) in the pump is opened, and the pump worked by hand until a pressure is produced in the engine. The air thus introduced into the engine will become sufficiently charged with the vapor of naphtha to be combustible, and, passing to the burner through the pipes \( F' \), \( F'' \), will, when ignited at the burner, produce a flame which will heat the retort \( B \). The air-valve of the pump may now be closed and the automatic action of the engine will begin. The naphtha in the retort, vaporized by the heat, and passing under pressure to the valve-chest, will, by the movement of the slide-valve, be admitted to the working-chambers to actuate the pistons therein. The movement of the pistons, producing a rotation of the shaft \( X \), will thereby automatically actuate both the slide-valve and the pump, so that the latter will draw from the condenser and force to the retort a sufficient supply of naphtha, and the former will admit the vapor, under pressure, alternately to the working-chambers. The vapor, after expanding in the piston-cylinders, exhausts into the exhaust-chamber, and is drawn thence, together with any excess of the condensed liquid, into the condenser, to be thence forced back by the pump to the retort. When the proper supply of naphtha carried through this cycle of expansion and condensation is unduly diminished by the combustion of the portion of vapor drawn off to supply the burner, a fresh charge may be introduced from the tank \( Q \).

The heat of the retort is maintained by the admission of the vapor from the valve-chest to the burner, and this vapor, passing under pressure through the injector, will operate to draw in with it a supply of fresh heated air from the chamber \( G \). The air, admixing with the naphtha vapor, produces a highly-combustible gas, which, being ignited at the burner, will properly heat the retort as required.

I do not claim as new working the vapor of a liquefiable gas expansively, thence conveying it to a condenser, and thence returning it automatically to a device for reconvert it into vapor to be used over again.

I contemplate making the construction of the retort as herein described the subject matter of separate application for Letters Patent.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The method of automatically operating a motor which consists in generating vapor from a combustible liquid within a retort heated by the combustion of a portion of the vapor so generated, and then working the remainder of the vapor expansively in the piston-chamber of the engine, condensing it after its exhaust, and returning it so condensed without appreciable loss to the retort, all substantially in the manner herein set forth,

2. In an engine for utilizing as a motive power naphtha or other liquid convertible into a combustible vapor at a comparatively low temperature, the combination of a retort, a vapor-chamber, a combustion-chamber encircling the retort and vapor-chamber, one or more burners for heating the retort, a pipe connecting the vapor-chamber with said burners, working-chambers communicating with the valve-chamber and opening into an exhaust-chamber, a slide-valve controlling the ports between the working and valve chambers, and actuated automatically by the rotation of the driving-shaft, an exhaust-chamber enclosing the working-chambers, a driving-shaft fitted with cranks revolving in the exhaust-chamber and actuated by pistons in the working-chamber, a condenser connected with the exhaust-chamber, and a pump actuated automatically by the driving-shaft and adapted to force the liquid from the condenser into the retort, all constructed and arranged to operate automatically, substantially in the manner herein set forth,

3. In an engine for utilizing as a motive power the vapor of naphtha or other equivalent liquid adapted to serve as a lubricant, the combination, with pistons moving in piston-
cylinders in which the vapor is worked expansively, and with an exhaust-chamber inclosing said cylinders and serving as a receiver for the vapor discharged therefrom, of a driving-shaft projecting out from the lower end of said exhaust-chamber, and fitted with cranks driven by said pistons to revolve within said exhaust-chamber and be automatically lubricated by the condensed vapor therein, substantially in the manner and for the purpose herein set forth.

4. In an engine for utilizing as a motive power the vapor of naphtha or other equivalent lubricating liquid, the combination, with the valve-chest connected with the vapor-generator, the slide-valve controlling the ports leading from the valve-chest into the cylinders, and an exhaust-chamber inclosing said cylinders, of a rock-shaft within the exhaust-chamber, actuated mediatly by an eccentric upon the crank-shaft, and fitted with an arm made to extend through an opening formed between the valve-chest and exhaust-chamber to engage and actuate the slide-valve covering said opening, substantially in the manner and for the purpose herein set forth.

5. In a naphtha or gasoline engine, the combination, with the feed-pump, the vapor-generator, and the valve-chest communicating with the working-chambers of the engine, of a continuous, uninterrupted open passage extending from the pump through the retort to the slide-valve in the valve-chest, substantially in the manner and for the purpose herein set forth.

6. The combination, in a naphtha or gasoline engine, of the plunger-rod of the feed-pump, controlling the supply of naphtha to the vapor-generating retort, a rock-shaft actuated by the engine, and an arm projecting radially from said rock-shaft, formed with a longitudinal slot therein, adapted to engage a pin on the outer end of the pump-rod, and admit of its adjustment to and from the axis of the shaft, to regulate thereby the stroke of the pump, and consequently the speed of the engine, substantially in the manner herein set forth.

7. In an engine for utilizing as a motive power the vapor of naphtha or its equivalent, the combination, with the feed-pump of the engine, of a vent communicating freely from the pump-cylinder above its piston into the exhaust-chamber or condenser of the engine, substantially in the manner and for the purpose herein set forth.

8. In a naphtha or gasoline engine, the combination, with the feed-pipe extending from the pump to the vapor-generating retort, of a safety-valve interposed between said pipe and the exhaust-chamber or condenser of the engine, substantially in the manner and for the purpose herein set forth.

9. In a naphtha or gasoline engine, the combination, with a vapor-generating retort communicating with the valve-chest and working cylinders of the engine, a combustion-chamber inclosing the retort and the pipe connecting it with the valve-chest, burners within said chamber, adapted to heat the retort and connecting-pipe, a supply-pipe leading to said burners, an injector opening into said supply-pipe, and tubes or passages connecting the retort or vapor-generator with the injector, of an air-heating chamber formed in or upon the combustion-chamber, above the retort therein, and an air-supply pipe connecting the heating-chamber with the injector, substantially in the manner and for the purpose herein set forth.

10. In a naphtha or gasoline engine, the combination, with a vapor-generating retort communicating with the valve-chest and working cylinders of the engine, and with a condenser communicating with the chamber receiving the exhaust from said cylinders, of a pump, actuated by the movement of the engine, and adapted to automatically force and feed the fluid from the condenser back into the retort, substantially in the manner and for the purpose herein set forth.

11. The combination of the adjustable link L, pivoted to the arm of the rock shaft J, actuating the slide-valve K, with a slotted arm, L', of the rock-shaft L', actuated by an eccentric, O', on the main shaft of the engine, to permit of an adjustment of the link and movement of the slide-valve, substantially in the manner and for the purpose herein set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANK W. OFELDT.

Witnesses:
J. F. ACKER, JR.,
JOHN A. ELLIS.