No. 824,528. PATENTED JUNE 26, 1906.

H. D. DIBBLE.

EXPLOSION ENGINE.

APPLICATION FILED FEB. 2, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

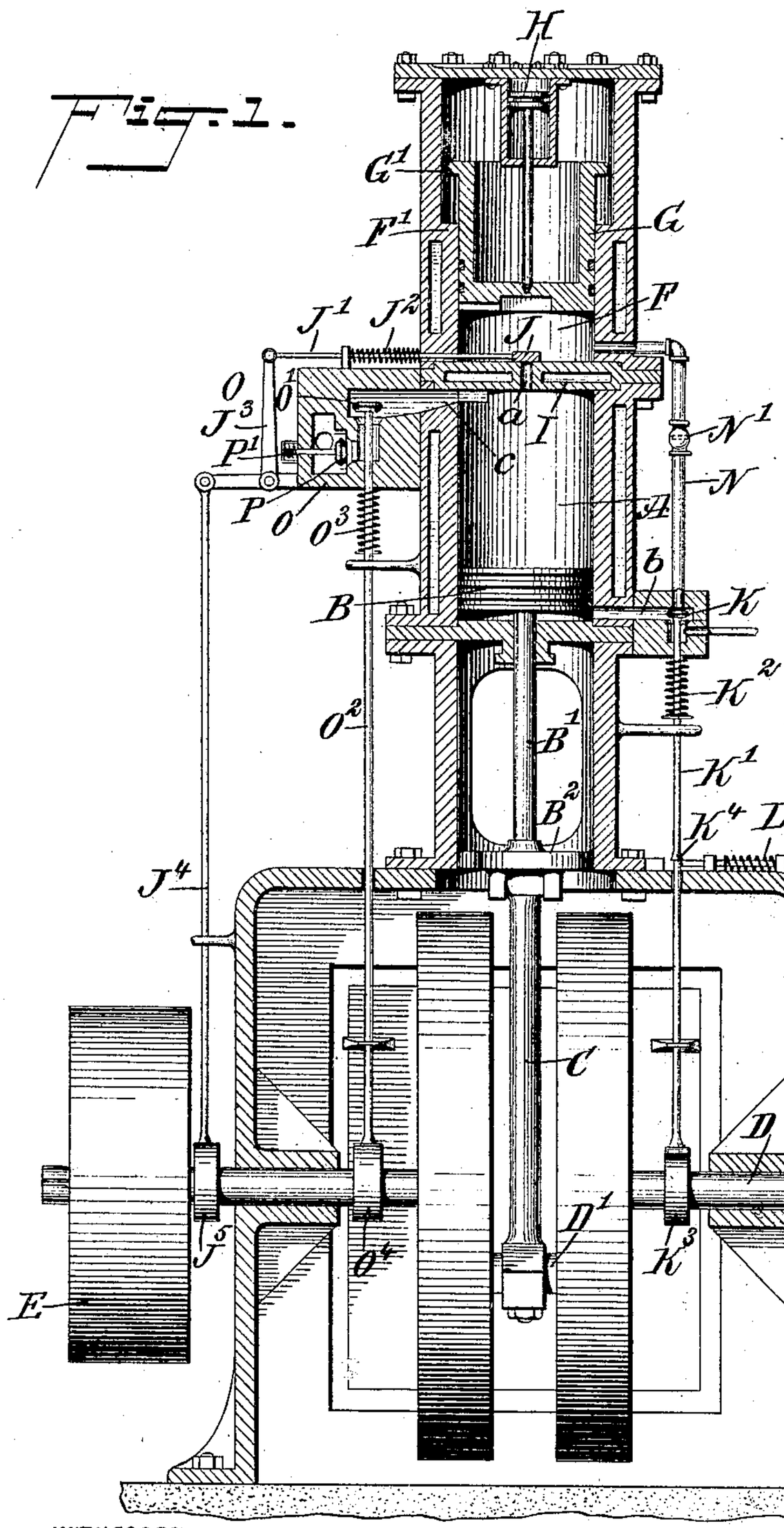
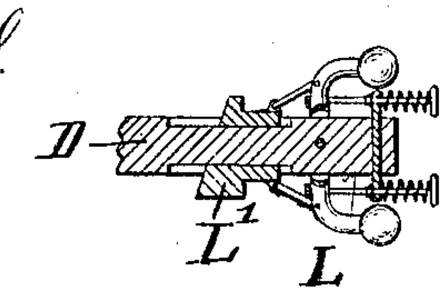



Fig. 3.




WITNESSES:

John K. Brachvogel

Rud. J. Hoster

INVENTOR

Harvey D. Dibble

BY

ATTORNEYS

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2 SHEETS—SHEET 2.

Fig. 2.

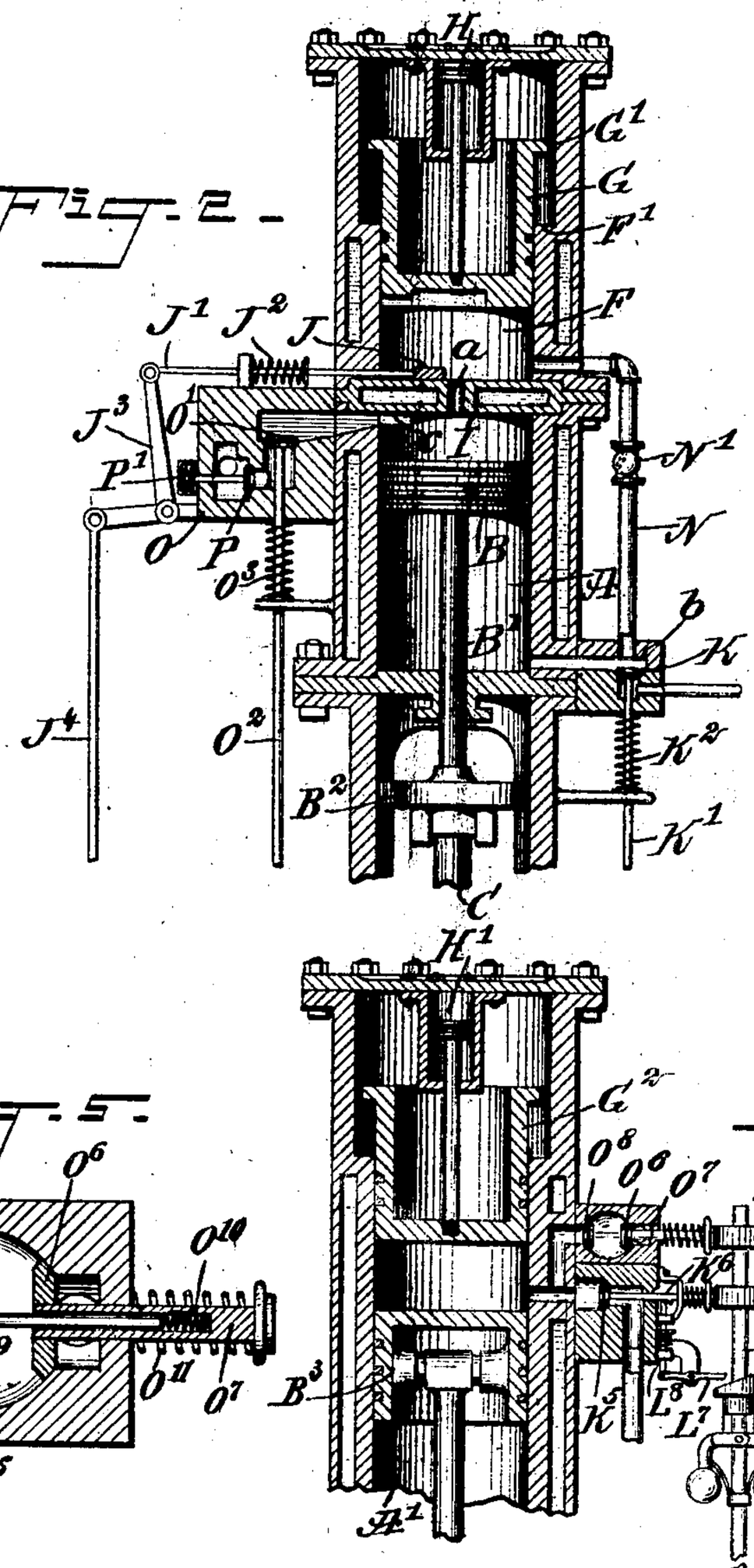


Fig. 5.

Fig. 4.

WITNESSES:

John K Buchanan

Rudy. Hoskins

INVENTOR

Harvey D. Dibble

BY

ATTORNEYS

# UNITED STATES PATENT OFFICE.

HARVEY DOUGLASS DIBBLE, OF MYSTIC, SOUTH DAKOTA.

## EXPLOSION-ENGINE.

No. 824,528. Specification of Letters Patent. Patented June 26, 1906.

Application filed Februa y 2, 1905. Serial No. 243,828.

*To all whom it may concern:*

Be it known that I, HARVEY DOUGLAS DIBBLE, a citizen of the United States, and a resident of Mystic, in the county of Pennington and State of South Dakota, have invented a new and Improved Explosion-Engine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved gas or explosion engine which is simple and durable in construction, very effective in operation, and arranged to utilize the motive agent to the fullest advantage and to use a small portion of the hot residue from a previous explosion to compress the same to the igniting-point with a view to ignite the incoming new charge.

The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional side elevation of the improvement arranged as a two-cycle engine. Fig. 2 is a like view of the same, showing the parts in different positions. Fig. 3 is a sectional side elevation of the governor on the main shaft for controlling the admission-valve. Fig. 4 is a sectional side elevation of the improvement arranged as a four-cycle engine, and Fig. 5 is an enlarged sectional side elevation of a modified form of the exhaust-valve.

In the working cylinder A of the engine reciprocates a piston B, connected by its piston-rod B′ with a cross-head $B^2$, connected by a pitman C with the crank-arm D′ of the main shaft D, provided with the usual pulley E or other means for transmitting the rotary motion of the main shaft to other machinery. An auxiliary cylinder F is superimposed on the cylinder A and in it operates an air-cushioned piston G, provided with a buffer or dash-pot H, of any approved construction, to prevent shock and jar when the piston G seats itself—that is, when its annular flange G′ moves in engagement with a seat F′, formed in the cylinder F, as plainly indicated in Fig. 1. The adjacent ends of the cylinders A and F are separated from each other by a water-jacketed partition I, having a port *a* controlled by a slide-valve J, the valve-stem J′ of which is pressed on by a spring $J^2$, and the stem is connected with a bell-crank lever $J^3$, connected with a rod $J^4$, adapted to be engaged by a cam $J^5$, secured on the main shaft D of the engine, so that when the engine is running the cam $J^5$ imparts periodical movement to the rod $J^4$, so that the bell-crank lever $J^3$ acts on the stem J′ to shift the valve J into an open or closed position relative to the port *a*.

The lower or compression end of the cylinder A is provided with a port *b*, connected with an admission-valve K for admitting an explosive mixture into the lower end of the cylinder A at the time the piston B is on the upstroke and the admission-valve K is open. (See Fig. 1.) The admission-valve K has its valve-stem K′ pressed on by a spring $K^2$, and the said stem is engaged by a cam $K^3$, secured on the main shaft D of the engine, so that when the latter is running the valve K is periodically opened and closed by the action of the cam $K^3$ and the spring $K^2$.

In order to hold the admission-valve K in an open position for a length of time corresponding to the speed of the main shaft D, the following device is provided: On the main shaft D is arranged a governor L of any approved construction and having its weighted arms connected with a cam L′ mounted to slide on and to turn with the main shaft D, the said cam being adapted to engage and actuate a lever $L^2$, connected with a locking-bolt $L^3$, mounted to slide and pressed on by a spring $L^4$, the free end of the locking-bolt being adapted to engage a shoulder $K^4$ on the stem K′, so that when the cam $K^3$ raises the stem K′ the said bolt $L^3$ snaps under the shoulder $K^4$ to hold the stem K′ raised against the tension of the spring $K^2$, at the same time holding the admission-valve K in an open position. The bolt $L^3$ is withdrawn from the shoulder $K^4$ by the action of the cam L′ rotating with the shaft D and controlled by the governor L, so that the admission-valve K is free to close by the action of its spring $K^2$ whenever the said bolt $L^3$ is withdrawn.

The lower or compression end of the cylinder A is also connected with the lower end of the auxiliary cylinder F, and for this purpose a pipe N, provided with a check-valve N′

leads from the port *b* into the lower end of the cylinder F to allow the charge previously drawn into the lower end of the cylinder A and compressed by the downward-moving piston B to pass by way of the pipe N into the lower end of the cylinder F, and when the valve J is open then this charge can pass by way of the port *a* into the working end of the cylinder A to be ignited therein to force the piston B on its downstroke. The ignition of the charge entering by way of the port *a* takes place by the charge coming in contact with a small portion of the hot residue from a previous explosion, the said small portion of gases being compressed by the piston B to the ignition-point—say about four hundred pounds pressure—so that the incoming charge is ignited. The main portion of the products of combustion from a previous explosion are discharged by way of an exhaust-port *c*, leading from the upper or working end of the cylinder A to the valve-casing O of an exhaust-valve O′, having its valve-stem $O^2$ pressed on by a spring $O^3$ to normally hold the exhaust-valve O′ to its seat. The valve-stem $O^2$ is engaged by a cam $O^4$ on the main shaft D to periodically open the exhaust-valve O′ for the discharge of the main portion of the gases of a previous explosion at the time the piston B is on the upstroke and draws in a new charge into the compression end of the cylinder, as previously explained.

In order to prevent atmospheric air from being drawn in by way of the exhaust-valve casing and the port *c* into the cylinder A, an auxiliary valve P is provided, pressed on by a spring P′ and opening outwardly by slight pressure of the exhaust-gases after leaving the open valve O′. This auxiliary valve for the exhaust-valve may be arranged as illustrated in Fig. 5—that is, the exhaust-valve $O^6$ has a portion of its stem $O^7$ formed into a guideway for the stem $O^9$ of an auxiliary valve $O^8$, controlling the port *c*′, leading to the interior of the cylinder, the stem $O^9$ being pressed on by a spring $O^{10}$ to hold the valve $O^8$ to its seat, but to allow the valve $O^8$ to open as soon as the pressure from the inside of the cylinder is sufficiently strong to overcome the tension of the spring $O^{10}$. The valve $O^6$ is periodically opened from the main shaft, as previously described, and is normally held to its seat by a spring $O^{11}$.

The operation is as follows: When the engine is running and the several parts are in the position illustrated in Fig. 1, then the piston B is on the upstroke and the valves K, O′, and P are opened, while the valve J is closed, so that the upward movement of the piston B expels the products of combustion from a previous explosion by way of the port *c* and the valves O′ and P. At the same time the upward movement of the piston B draws in a fresh charge of the explosive mixture by way of the open admission-valve K and the port *b*. When the piston B is near the end of its upstroke, then the valve O′ closes and the remaining portion of the hot residue from a previous explosion is compressed to the igniting-point, and when the piston B has reached the end of its upward stroke the valve J opens so that the previously-compressed charge in the cylinder F passes by way of the port *a* into the working end of the cylinder A to be ignited therein and to exert its pressure against the piston B and send the same on the downstroke. During the time the piston B moves downward the charge previously drawn into the compression end of the cylinder A is compressed, and as the valve K is now closed (see Fig. 2) the compressed charge is forced by way of the port *b* and pipe N into the cylinder F at the time the valve J is again in a closed position and the piston B nearly reaches the end of its downward stroke.

It is understood that the cylinder or chamber F is filled with compressed air, and this pressure can be anything desired, but should be about four hundred pounds per square inch. The chamber F should be large enough, or preferably should be connected with an air-receiver large enough, so that the rise and fall of the piston G would not perceptibly increase or decrease the pressure therein. The piston G being free to rise against such pressure whenever the pressure of compression or ignition is greater than the pressure in the chamber F and whenever the working piston in the cylinder A starts on its working stroke, the piston G follows the same and communicates to said working piston the energy that had been stored in the compressed air in the chamber F until the piston G is seated, when the expansion is adiabatic to the end of the stroke.

In the four-cycle engine shown in Fig. 4 the cylinder A′ contains both the working piston $B^3$ and the auxiliary piston $G^2$, having the buffer H′, and in this case the admission-valve $K^5$, as well as the exhaust-valve $O^6$, are actuated by cams Q′ and $Q^2$ on a shaft Q, connected, by bevel gear-wheels $Q^3$ and $Q^4$, with the main shaft D. The governor $L^5$ controls the cam $L^6$, the same as previously described relative to Fig. 3, and this cam $L^6$ acts on a lever $L^7$, connected with a spring-pressed locking-bolt $L^8$ for locking the stem $K^6$ and valve $K^5$ in an open position until the cam $L^6$ causes a withdrawal of the locking-bolt $L^8$, the same as previously described in reference to Figs. 1 and 3. The gearing $Q^3$ and $Q^4$ is so arranged that the shaft Q makes one revolution to two revolutions of the main shaft D to actuate the valves $K^5$ and $O^6$ correspondingly, as is well known in the four-cycle type of engines, and consequently further description of the same is not deemed necessary.

It is understood that as the cam L′ ($L^6$) is

actuated by the governor L ($L^5$) the admission-valve K ($K^5$) is closed sooner or later, according to the speed of the main shaft D, and consequently the speed of the engine is positively regulated by the ratio of expansion. If this expansion is very great when the engine is running under a light load, then the exhaust pressure might fall below that of the atmosphere, so that the engine would be working against a partial vacuum, and if the exhaust-valve O′ ($O^3$) opened at the end of the stroke the atmosphere would be liable to rush in, and the work done in forming the vacuum would be lost. To save this loss of power, the auxiliary valve P ($O^8$) is provided, which closes on pressure from without, but opens on the slightest pressure from within.

In both types of the engine shown the ignition is by compression, although in both types it will probably be advantageous to use a spark-plug or some other form of igniter in starting the engine until the engine warms up.

In the four-cycle type of engine it will be noticed that if the charge is ignited a little too soon no shock occurs whatever, as the auxiliary piston $G^2$ is free to slide upward against the compressed air in the upper end of the cylinder A′ and this compressed air is again used for sending the piston $G^2$ downward at the time the piston $B^3$ is on the down stroke.

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

1. An explosion-engine comprising a main shaft, a working cylinder, a piston therein connected with the main shaft, an auxiliary cylinder, a piston in the said auxiliary cylinder and air-cushioned, a partition separating the said cylinders and having a connecting-port, a valve controlling the said port and periodically actuated from the said main shaft, an admission-valve for the compression end of the said working cylinder, and a connection between the compression end of the working cylinder and the said auxiliary cylinder.

2. An explosion-engine comprising a main shaft, a working cylinder, a piston therein connected with the main shaft, an auxiliary cylinder, a piston in the said auxiliary cylinder and air-cushioned, a partition separating the said cylinders and having a connecting-port, a valve controlling the said port and periodically actuated from the said main shaft, an admission-valve for the compression end of the said working cylinder, a connection between the compression end of the working cylinder and the said auxiliary cylinder, and means for periodically actuating the said admission-valve from the said main shaft.

3. An explosion-engine comprising a main shaft, a working cylinder, a piston therein connected with the main shaft, an auxiliary cylinder, a piston in the said auxiliary cylinder and air-cushioned, a partition separating the said cylinders and having a connecting-port, a valve controlling the said port and periodically actuated from the said main shaft, an admission-valve for the compression end of the said working cylinder, a connection between the compression end of the working cylinder and the said auxiliary cylinder, means for periodically actuating the said admission-valve from the said main shaft, the said means including a governor on the main shaft and a locking device controlled from the governor, for holding the admission-valve open a length of time corresponding to the speed of the main shaft.

4. An explosion-engine comprising a main shaft, a working cylinder, a piston therein connected with the main shaft, an auxiliary cylinder, a piston in the said auxiliary cylinder and air-cushioned, a partition separating the said cylinders and having a connecting-port, a valve controlling the said port and periodically actuated from the said main shaft, an admission-valve for the compression end of the said working cylinder, a connection between the compression end of the working cylinder and the said auxiliary cylinder, and an exhaust-valve controlled from the said main shaft and having an auxiliary check-valve.

5. An explosion-engine comprising a main shaft, a working cylinder, a piston therein connected with the main shaft, an auxiliary cylinder, a piston in the said auxiliary cylinder and air-cushioned, a partition separating the said cylinders and having a connecting-port, a valve controlling the said port and periodically actuated from the said main shaft, an admission-valve for the compression end of the said working cylinder, a connection between the compression end of the working cylinder and the said auxiliary cylinder, means for periodically actuating the said admission-valve from the said main shaft, the said means including a governor on the main shaft and a locking device controlled from the governor, for holding the admission-valve open a length of time corresponding to the speed of the main shaft, and an exhaust-valve controlled from the said main shaft and provided with a check-valve arranged between the exhaust-valve proper and the outlet to the atmosphere.

6. An explosion-engine provided with a main cylinder having a working piston, an auxiliary cylinder having a cushioned piston, a valve controlling a connection between the cylinders, and a valved connection between the compression end of the main cylinder and the said auxiliary cylinder.

7. In an explosion-engine and in combination, a working cylinder, a piston therein, an expansible compression-cylinder, means whereby the power-stroke of the piston may compress a charge of explosive mixture and

force it into the compression-cylinder, means whereby the return stroke of the piston may expel a portion of the spent charge and compress the remainder to the ignition-point, and means whereby to admit the compressed charge of explosive mixture to the compressed portion of the spent charge when at its highest point of compression.

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

HARVEY DOUGLASS DIBBLE.

Witnesses:
G. P. BILLUPS,
J. W. LAPP.