A. HOLM.

ATMOSPHERIC ENGINE.

APPLICATION FILED JULY 28, 1910.

991,989.

Patented May 9, 1911.

2 SHEETS—SHEET 1.

Fig. 1.

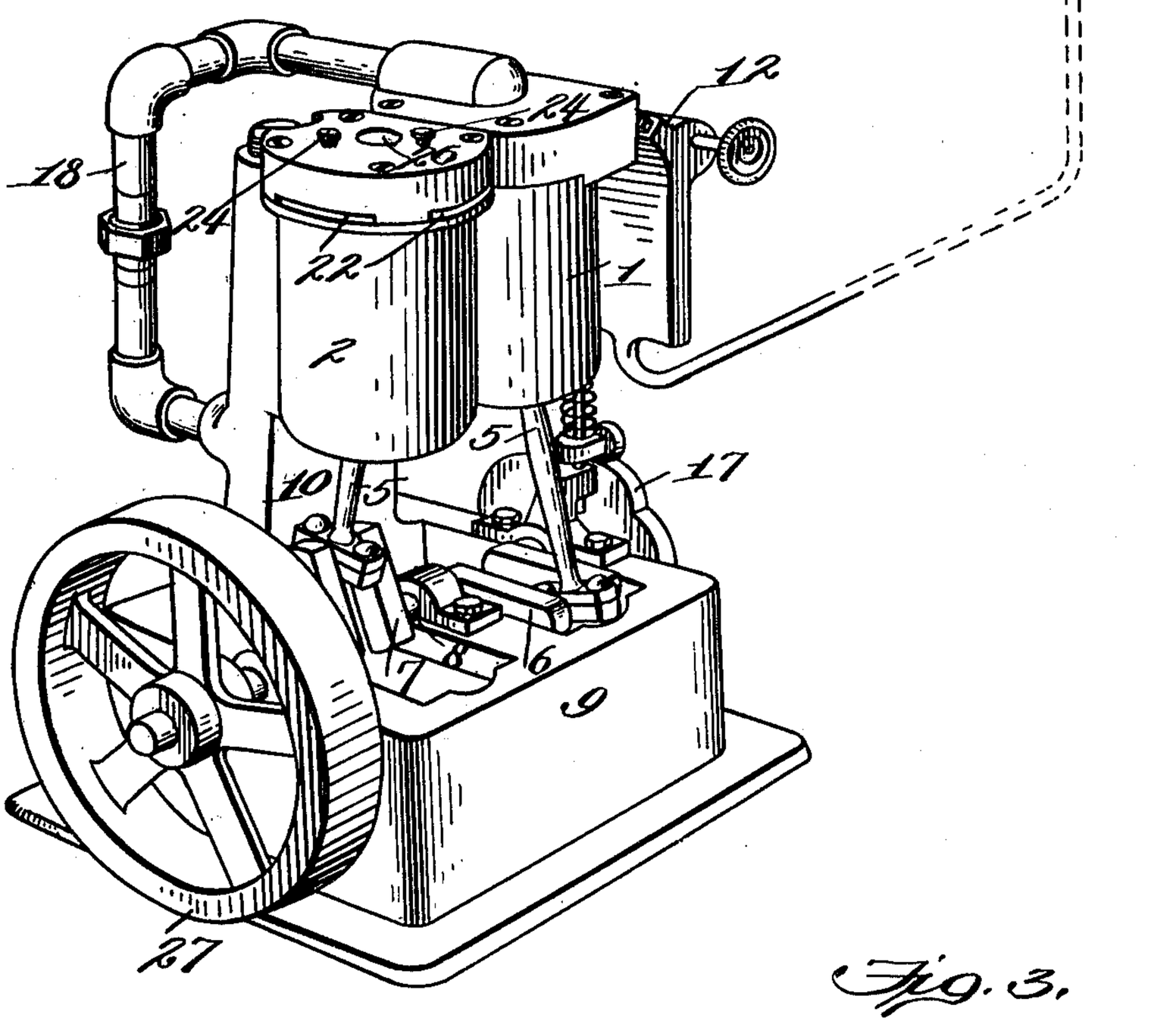
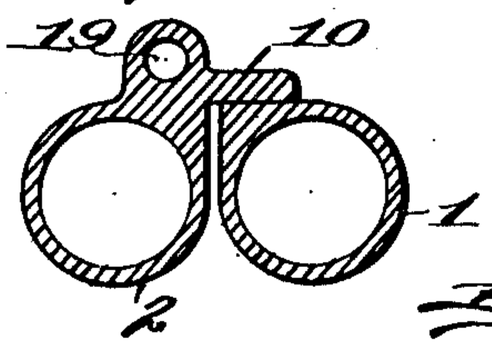


Fig. 3.

Fig. 2.



Witnesses.
C. Kesler
Robert Burnett

Inventor
Anton Holm
By James L. Norris, Jr.
Atty.

A. HOLM.

ATMOSPHERIC ENGINE.

APPLICATION FILED JULY 28, 1910.

991,989.

Patented May 9, 1911.

2 SHEETS—SHEET 2.

Fig. 4.

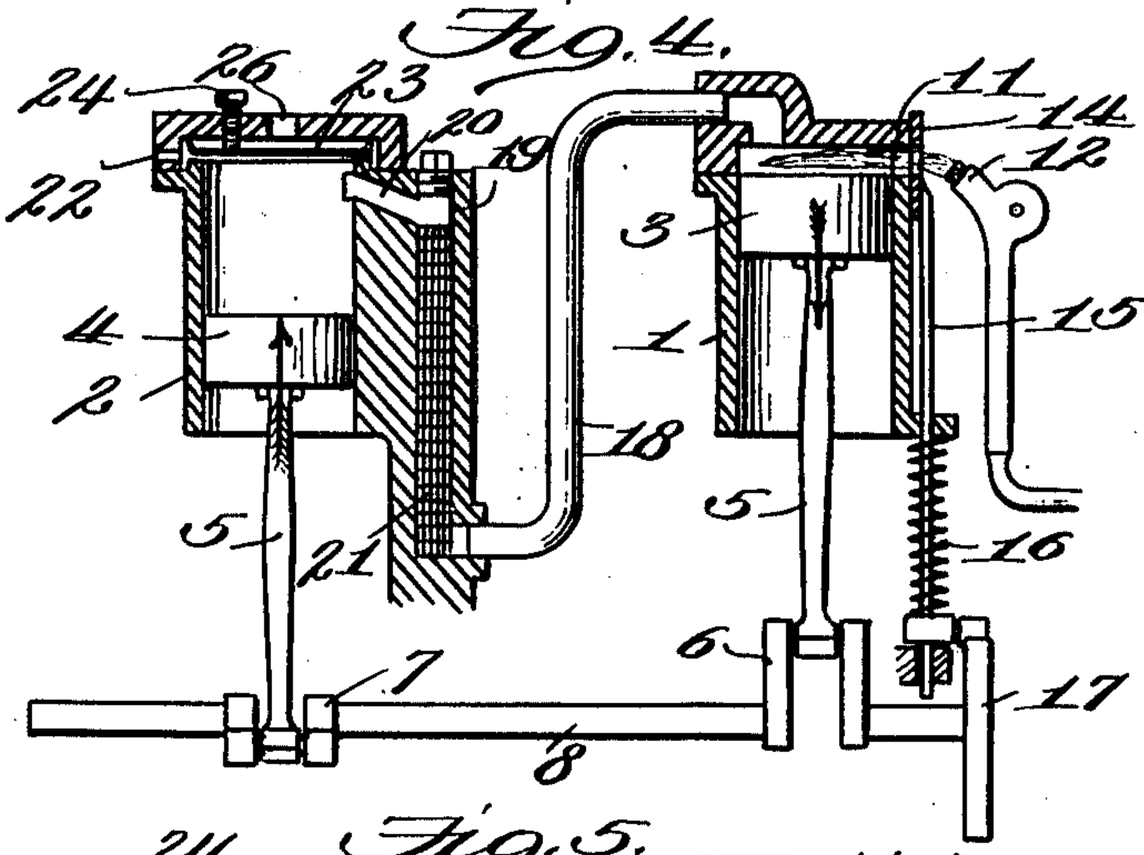


Fig. 4a

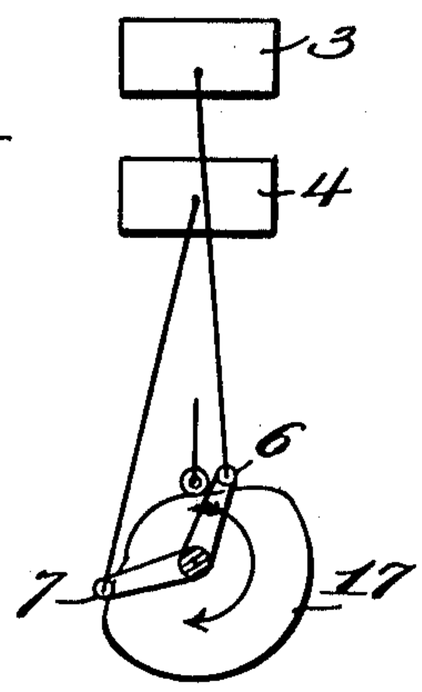


Fig. 5.

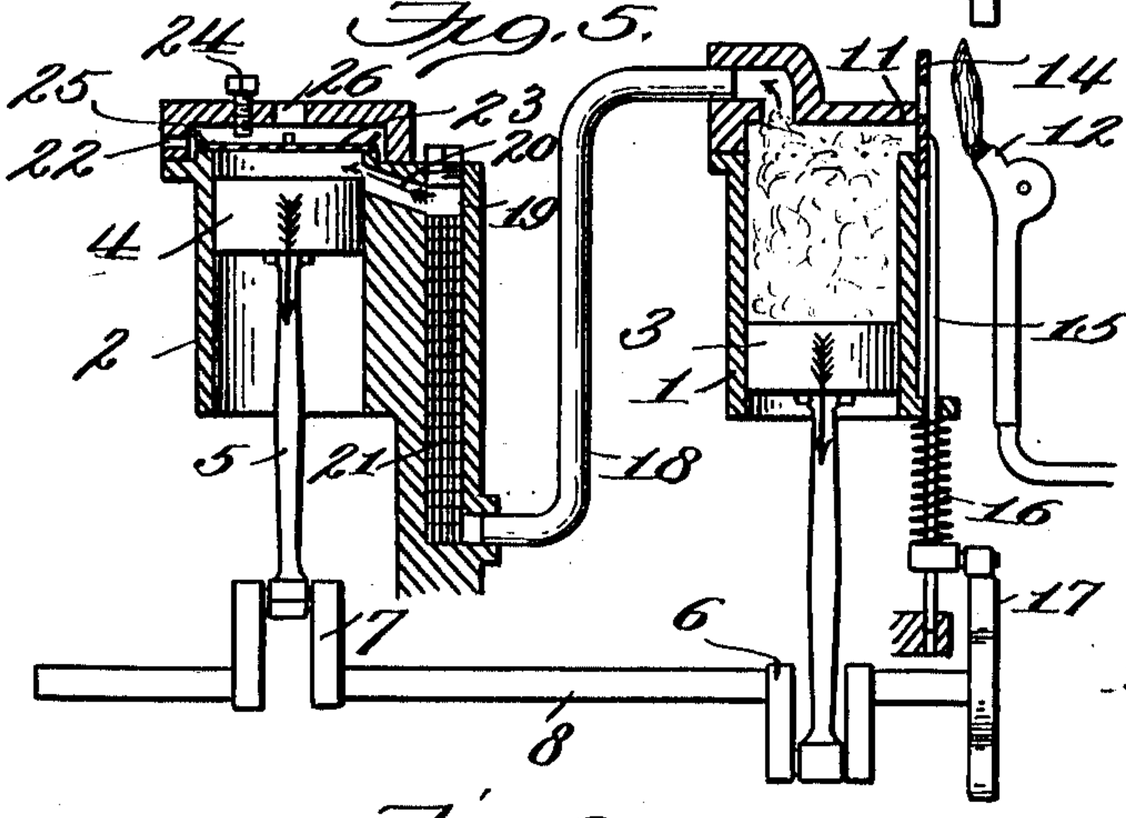


Fig. 5a

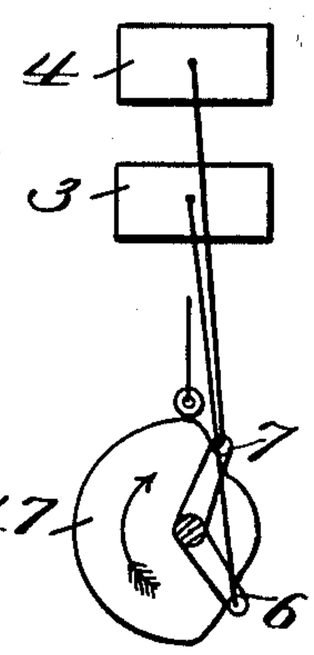


Fig. 6.

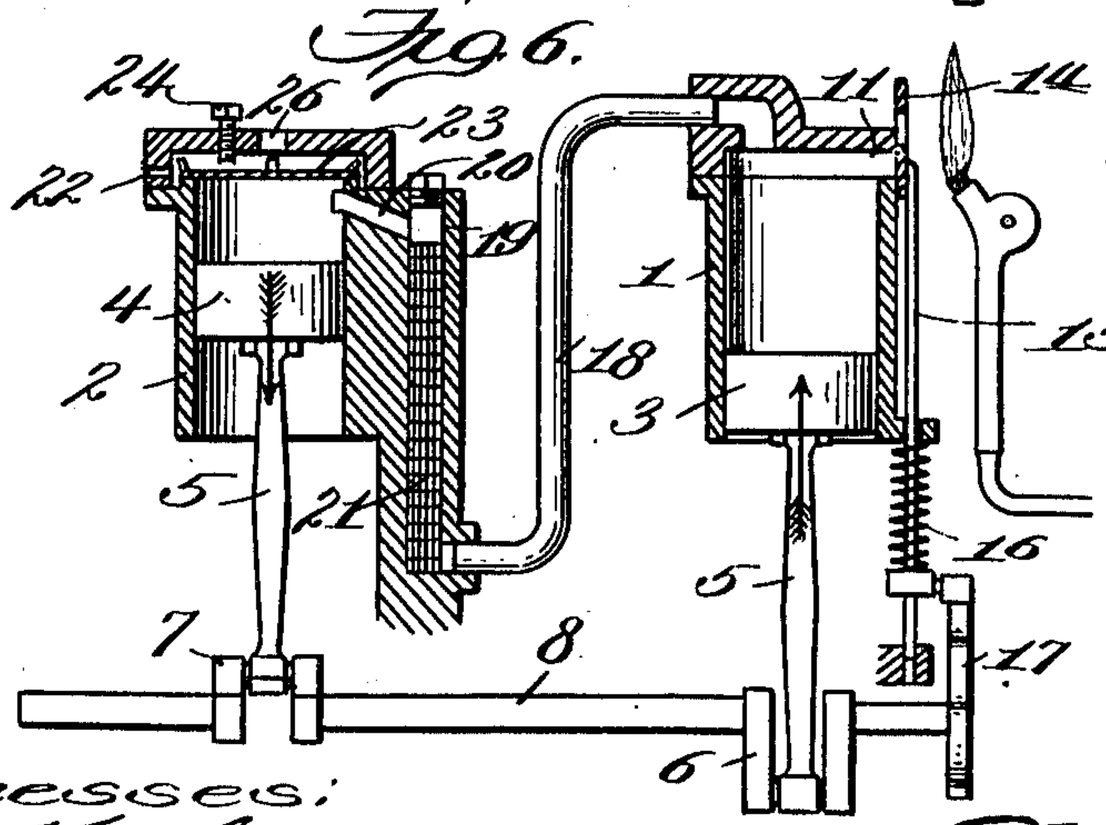
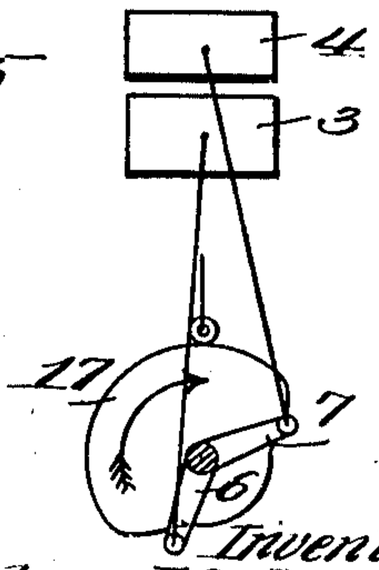


Fig. 6a



Witnesses:
E. E. Kesler
Robert Ennett.

Inventor
Anton Holm
By James L. Norris, Atty.

UNITED STATES PATENT OFFICE.

ANTON HOLM, OF PASSAIC, NEW JERSEY, ASSIGNOR TO HENRY RICHARDSON, OF NEW YORK, N. Y.

ATMOSPHERIC ENGINE.

991,989. Specification of Letters Patent. Patented May 9, 1911.

Application filed July 28, 1910. Serial No. 574,385.

To all whom it may concern:

Be it known that I, ANTON HOLM, a subject of the King of Norway, residing at Passaic, in the county of Passaic and State of New Jersey, have invented new and useful Improvements in Atmospheric Engines, of which the following is a specification.

This invention relates to improvements in atmospheric engines and it is intended more particularly as an improvement on the atmospheric engine which forms the subject of U. S. Patent No. 923,086, granted May 25, 1909, to William H. Spiers and myself.

The object of the present invention is to provide an engine of the type stated in which the practical efficiency approaches the theoretical efficiency as nearly as possible; that is to say to develop as much power as possible in proportion to its weight and with as small a fuel consumption as possible. The engine is especially adapted to environments where high power and lightness of weight are requisite, *e. g.* in connection with aeroplanes. In such use, owing to the lightness of the construction and its capability for developing high power, a battery of engines may be employed to provide a factor of safety and such a battery will be materially lighter than the gas engines now employed which of course are of multi-cylinder construction for the purposes of providing a factor of safety and of eliminating destructive vibration.

An embodiment of the invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a perspective view of an engine in accordance with the present invention; Fig. 2 is a horizontal sectional view through the cylinders, showing the manner of their assemblage; Fig. 3 is a detail view of the exhaust valve; Figs. 4 and 4ª are diagrams, in section and side elevation, showing one stage of operation; Figs. 5 and 5ª are similar views showing a second stage of operation; and Figs. 6 and 6ª are similar views showing a third stage of operation.

Similar characters of reference designate corresponding parts throughout the several views.

It will be understood that all words of location hereinafter employed are used in a relative and not in an absolute sense.

The engine involves primary and secondary cylinders 1 and 2, and corresponding pistons 3 and 4. These are joined by links 5 to the respective crank arms 6 and 7 of a shaft 8. The latter is journaled in bearings in a bed 9 from which the cylinders 1 and 2 are supported. The support for the cylinders comprises a standard 10 which is secured to the bed and which is preferably cast integral with the cylinder 2, and the cylinder 1 is securely fastened to said standard by suitable devices. In the embodiment shown the cylinders 1 and 2 are disposed in parallel relation and are open at their lower ends so that their pistons 3 and 4 are exposed to the atmosphere.

At one side of the cylinder 1 an inhaust port 11 is provided and adjacent thereto is a burner 12, which, in the example shown, includes a wick supplied from a tank or reservoir 13. The flame from the burner 12 is, in the operation of the engine, intermittently drawn into the cylinder 1 through the port 11 and the admission of the flame to said cylinder is controlled by a slide valve which includes a valve plate 14 and a stem 15 carrying the plate. The stem is mounted for axial movement in suitable guide lugs and is forced downwardly by a spring 16. The movements of the valve are controlled by a cam 17 provided at one end of the shaft 8. The cam 17 acts directly on the valve stem 15, the latter having its cam engaging end provided with a roller to reduce friction.

The cylinder 1 is in communication with the cylinder 2 and the connections include a pipe 18 which leads from the upper head of the cylinder 1 to the lower end of a vertical bore or chamber 19 provided in the standard 10. The upper portion of the bore or chamber 19 communicates with the upper end of the cylinder 2 through a passage 20. Within the chamber 19 a coil of wire mesh or other suitable material 21 may be provided, the functions of which are to prevent the flame admitted into the cylinder 1 from passing into the cylinder 2 and also to trap vaporous particles and thus prevent their condensation in the cylinder 2. The upper head of the latter has its under face formed at the edge thereof with suitably spaced recesses which afford exhaust ports 22. These are controlled by a valve 23 shown in detail in Fig. 3. The valve 23 comprises a plate which in one position seats against the upper end of the cylinder 2 and in another position is held away from the upper end of the cyl-

inder 2 and against screw 24, threaded through the upper head of said cylinder and limiting the upward movement of the valve. The latter is centered and guided in its movements by means of a plurality of outwardly inclined edge fingers 25. In order to prevent a cushion above the valve 23, the upper head of the cylinder 2 is provided with an opening 26. When the valve 23 occupies the position shown in Figs. 5 and 6, wherein it is seated against the upper end of the cylinder 2, the communication of the interior of said cylinder with the exhaust ports 22 is interrupted, but when said valve occupies the position shown in Fig. 4, wherein it is held against the screws 24, the communication of the interior of the cylinder 2 and the exhaust ports 22 is established.

The shaft 8 is provided with the usual fly wheel 27.

The cranks 6 and 7 are set at an angle of approximately 120° in order to provide for the sequence of operations to be set forth.

The operation is as follows, it being understood that the parts are set for a clockwise rotation of the crank shaft: Just as the piston 3 reaches its uppermost position and while the crank 6 is moving through a dead interval and past its upper center, the valve 14 uncovers the port 11. This port remains uncovered throughout the greater period of the downward movement of the piston 3, during which period the flame is drawn into the cylinder 1. The valve 14 closes during the last stage of movement of the piston 3, that is to say, just before the crank 6 moves through a dead interval in passing over its lower center, and the flame thus admitted into the cylinder 1 is thus cut off from the atmosphere. The piston 4 completes its upward movement slightly before the piston 3 completes its downward movement and during the last stage of the downward movement of the piston 3, at which time, as has been explained, the port 11 is closed, the piston 4 commences the first stage of its downward movement, and for a brief period during which the port 11 is closed, the downward movements of the pistons are synchronous. This relation is shown in Fig. 5. During the admission period, very little air passes into the cylinder 1 with the flame. The action of the latter is to exclude air and the flame practically occupies the entire volume of the cylinder 1. During that period when the downward movements of the pistons are synchronous, an almost instantaneous mechanical vacuum is produced which quickens condensation and when condensation has taken place, there is no force in the cylinder 1 which offers any practical degree of resistance to the outside air. Therefore when the crank 6 passes over its lower center, the air forces the piston 3 upwardly with great rapidity. Throughout the upward movement of the piston 3 the port 11 remains closed and is not uncovered until the upward movement of said piston is completed and the crank 6 reaches its upper dead interval. During the greater portion of the upward movement of the piston 3, the piston 4 is moving downwardly as shown in Fig. 6, and the dead gases are forced from the cylinder 1 to the cylinder 2 through the connections described. The lower dead interval of the crank 7 is practically coincident with the last stage of the upward movement of the piston 3 and the first stage of the upward movement of the piston 4 is practically coincident with the upper dead interval of the crank 6 as shown in Fig. 4. Thereafter the piston 4 moves upwardly as the piston 3 moves downwardly and the presence of the flame in the cylinder 1 prevents any back passage of the dead gases from the cylinder 2 to the cylinder 1 as an incident of the upward movement of the piston 4. These gases exhaust through the ports 22, the valve 23 opening under their pressure as shown in Fig. 4. The operation is started by "cranking" in the manner customary with gas engines.

An important consideration in the operation of the present engine is that a hot flame practically occupies the entire volume of the cylinder 1, and that the amount of heated air passing into the cylinder during the admission period is practically negligible. Consequently, when the flame is extinguished, only a very small amount of carbon dioxid remains in the cylinder, and this offers the least resistance to the action of the air on the piston 3. Since a flame occupies the cylinder 1 during the admission period, it is possible to have the cylinder 2 exhausting at the same time, and it is unnecessary to provide any complicated valve arrangements between these cylinders to prevent back-passage of the dead gases. Moreover, it is unnecessary to effect condensation by means of mechanical adjuncts, such as cooling chambers or rarefying pumps. Condensation takes place naturally when the flame is separated from the outside air and is quickened by the mechanical vacuum which occurs when the pistons 3 and 4 move downwardly for a brief interval at the same time, in the relation shown in Fig. 4, this interval being practically coincident with the instant of the closing of the valve 14. It will be apparent also that the air acts with primary motive effect on the piston 3 and with secondary motive effect on the piston 4, causing the latter to assist the downward movement of the piston 3. The movement of the slide valve 14 is practically without friction. This is due not only to the use of an operating cam related to the valve stem as described, but also to the fact that the movements of the valve are timed to occur when the pressure

on both faces thereof is practically the same and hence a binding of the valve during its action is prevented. In fine the engine is one of such nature that the pressure of the atmosphere has a very high degree of working efficiency in proportion to the bulk and weight of the construction and the consumption of fuel.

Having fully described my invention, I claim:

1. An engine of the type set forth, including a pair of cylinders, each having a closed and an open end, pistons working in the cylinders, a crank shaft connected to the pistons, a source of flame, one cylinder having a port through which the flame is drawn, a connection between the cylinders whereby the dead gases are passed from the first cylinder to the second cylinder, the latter having exhaust ports and a valve controlling the same, and a valve arranged to alternately cover and uncover the first-named port.

2. An engine of the type set forth, including a pair of parallel primary and secondary cylinders, each having a closed and an open end, a crank shaft having its crank arms at an angle of approximately 120° and connected to the respective pistons, a source of flame, the primary cylinder having an inhaust port adjacent its closed end through which the flame is drawn, a valveless connection between the cylinders, a valve arranged to alternately cover and uncover the inhaust port, and an exhaust valve in the secondary cylinder.

3. An engine of the type set forth, including a pair of parallel primary and secondary cylinders, each having a closed and an open end, a crank shaft having its crank arms at an angle of approximately 120° and connected to the respective pistons, a source of flame, the primary cylinder having an inhaust port adjacent its closed end through which the flame is drawn, a valveless connection between the cylinders, inhaust valve mechanism including a plate slidable across the inhaust port and operative to alternately cover and uncover the same, a spring loaded stem carrying the plate, and a cam arranged on the crank shaft and controlling the movements of the stem, and an exhaust valve in the secondary cylinder.

4. An engine of the type set forth, including a pair of parallel primary and secondary cylinders, each having a closed and an open end, a crank shaft having its crank arms at an angle of approximately 120° and connected to the respective pistons, a source of flame, the primary cylinder having an inhaust port adjacent its closed end through which the flame is drawn, a valveless connection between the cylinders, a valve arranged to alternately cover and uncover the inhaust port, the secondary cylinder having one or more exhaust ports near the upper end thereof, and a plate valve arranged to seat against an interior shoulder of the secondary cylinder and to interrupt the communication of the latter with the exhaust port or ports, the plate valve being movable under pressure away from said shoulder to establish the communication of said secondary cylinder and said port or ports.

5. An engine of the type set forth, including a pair of parallel primary and secondary cylinders, each having a closed and an open end, a crank shaft having its crank arms at an angle of approximately 120° and connected to the respective pistons, a source of flame, the primary cylinder having an inhaust port adjacent its closed end through which the flame is drawn, a valveless connection between the cylinders, a foraminous filling in said connection, a valve arranged to alternately cover and uncover the inhaust port, and an exhaust valve in the secondary cylinder.

6. An engine of the type set forth comprising a cylinder having an inhaust port, a source of flame, the flame passing through said port, a piston movable through the cylinder, a valve which uncovers the port during the greater portion of the outward movement of the piston and which closes just before the completion of the outward movement of the piston, a shaft driven by the piston, means operated by the shaft for producing an instantaneous mechanical vacuum in the cylinder coincidently with the instant of closing movement of the valve, and exhaust valve means for the dead gases.

7. An engine of the type set forth which comprises two communicating cylinders and pistons working therein, a source of flame, one of the cylinders having valve controlled flame inhaust means and the other cylinder having dead gas exhaust means, the piston of the latter cylinder being so set as to cooperate with the piston of the former cylinder to produce a mechanical vacuum immediately following the confinement of the flame in the first cylinder.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ANTON HOLM. [L. S.]

Witnesses:
STANLEY G. MURRAY,
IRA J. BOGERT.