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F. W. HAGAR.

EXPLOSIVE ENGINE.

APPLICATION FILED MAY 17, 1904.

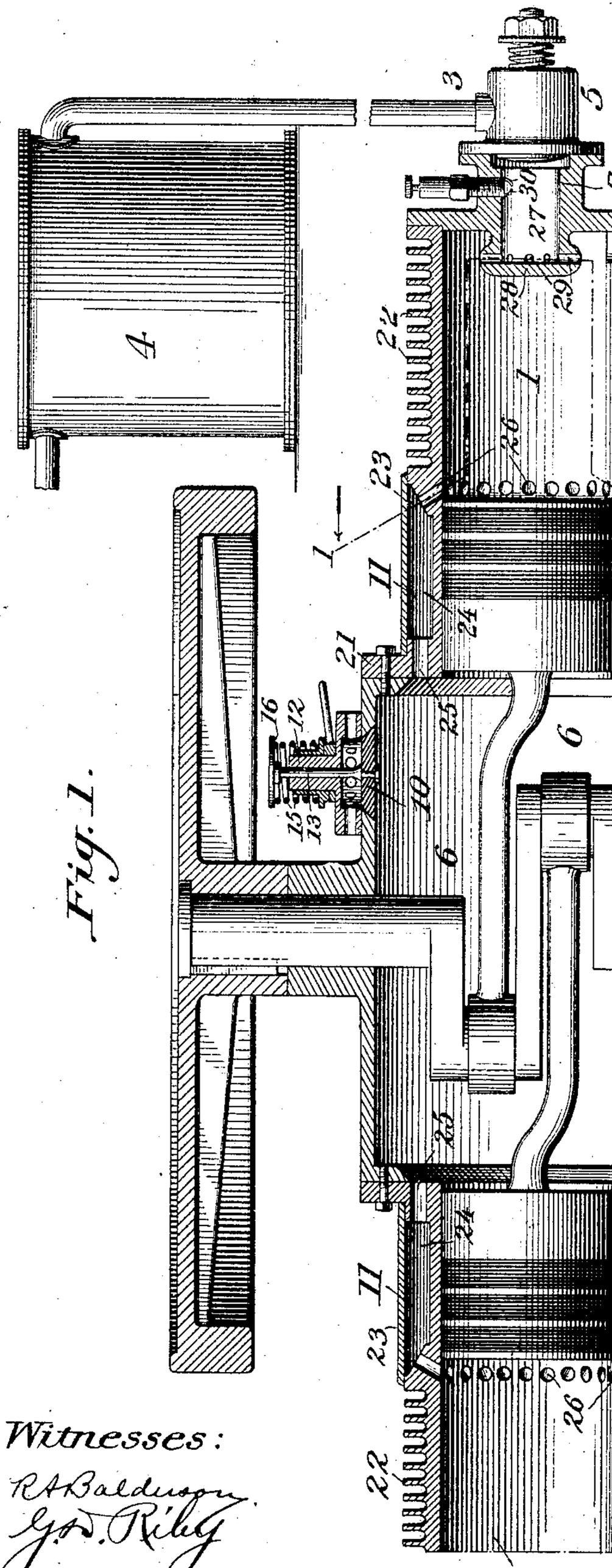

Fig. 1.

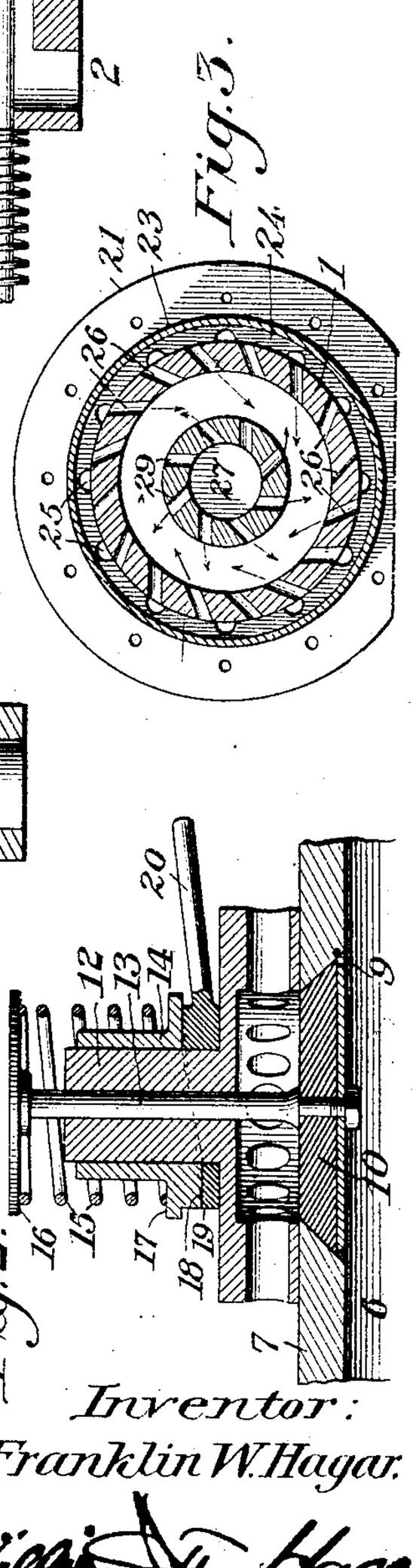

Fig. 3.

Fig. 2.

Witnesses:

R. A. Baldwin.

G. W. Riley.

Inventor:

Franklin W. Hagar.

By William A. Hagar

his Att'y.

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UNITED STATES PATENT OFFICE.

FRANKLIN WOOD HAGAR, OF NASHVILLE, TENNESSEE.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 779,778, dated January 10, 1905.

Application filed May 17, 1904. Serial No. 208,382.

To all whom it may concern:

Be it known that I, FRANKLIN WOOD HAGAR, a citizen of the United States, and a resident of Nashville, in the county of Davidson and State of Tennessee, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention relates to explosive-engines; and its object is to provide such an engine which is particularly simple in construction and highly efficient in operation.

To this end the invention includes the combination and arrangement of component parts and the details of construction to be hereinafter described, and particularly pointed out in the claims.

Although the invention is susceptible of various embodiments it has been deemed necessary for the purpose of fully disclosing the same to illustrate and describe but one exemplification thereof.

The selected exemplification is illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view. Fig. 2 is a detail view of one of the valves used on the engine; and Fig. 3 is a detail sectional view on the line 1 1, Fig. 1.

For the purpose of illustrating one exemplification of my invention I have shown the same embodied in an engine of the double four-cycle type in which one impulse is produced upon each revolution of the shaft occurring either alternately or simultaneously in each cylinder. In the particular description of the specific arrangement of the selected embodiment of my invention which is to follow only one cylinder and associated parts will be described.

The invention includes generally a cylinder, an unrestricted port leading thereto from a carbureter or a port having no throttling device associated with the same, an air-chamber, an inlet-opening therefor, a valve for controlling the same opening under the influence of the piston and held to its seat under variable tension, means for varying the action of the valve in reference to the force for opening the same created by a piston, an explosion-chamber, and a novel relative arrangement of ports leading therefrom into the cylinder and other ports leading from the air-chamber into the cylinder.

The cylinder is designated in the accompanying drawings by 1, is provided with a valve-controlled exhaust-port 2 and with an inlet-port 3, leading from a carbureter 4, which is substantially unrestricted or without a throttling device of any character, so that the amount of the explosive mixture which is drawn into the cylinder from the carbureter is dependent entirely upon the vacuum or suction created in the former. A check-valve 5 is located at the discharge end of the port 3 for the purpose of preventing back pressure in the latter during the compression of the charge and during the high pressure created by the explosion; but the tension of this spring is so light that it does not materially affect the unseating of the valve under the influence of the suction created in the cylinder.

The air-chamber is designated by 6, and in the present exemplification of my invention is formed within a casing 7, which incloses the crank-shaft and the sides of which provide bearings for the latter. The chamber 6 is in open communication with the inner end of each of the cylinders, is in communication with the outside atmosphere through a port 9, controlled by a valve 10, and is in communication with the interior of each cylinder above the piston when the latter is in its innermost position through unobstructed ports 11. The valve 10 is yieldingly held to its seat and suitable adjustable mechanism is provided for varying the tension of the yielding means. This mechanism and means in the illustrated embodiment of my invention includes a boss 12, having an axial opening providing a guide for the stem 13 of the valve 10, a sleeve 14 mounted on the boss and adjustable lengthwise of the latter, and a helical spring 16 interposed between the opposing surfaces 16 17 on the stem 13 and the sleeve 14, respectively. The sleeve 14 is intended to be shifted either automatically or manually for varying the tension of spring 15, and the illustrated construction for obtaining this object includes cam-surfaces 18 on the inner end of the sleeve

coacting with fixed surfaces 19, and means, as a handle 20, for rotating the sleeve on the boss.

In the illustrated exemplification of my invention each cylinder 1 includes a base-flange 21, bolted to one wall of the casing 7, and a cylindrical portion having an external annular recess formed therein, a plurality of external annular radiating surfaces 22 at its outer end portion, and a shell or band 23 embracing the external surfaces of the cylinder on opposite sides of the recess, completely covering the same and forming therewith an annular closed chamber 24. This chamber is in open communication at its innermost end with the chamber 6, through a plurality of ports 25, leading through the lower portion of the walls of the cylinder and through the base 21, and at its outermost end with the interior of the cylinder 1, through a plurality of ports 26, leading through the wall of the cylinder. The ports 25 26, together with the chamber 24, constitute the ports 11, hereinbefore referred to. The ports 26 preferably extend obliquely in a plane lengthwise of the cylinder in relation to the longitudinal axis of the same or are inclined inwardly toward the axis of the cylinder and outwardly toward the head thereof and are disposed in a plane transversely of the cylinder substantially tangentially in relation to the inner periphery of the same or at angles to imaginary radial lines intersecting the ends thereof, so that the streams of air issuing from said ports are directed toward the outer end of the cylinder, partake of a whirling movement, and hug the inner periphery of the wall of the cylinder. The discharge ends of these ports are preferably arranged in close juxtaposition, so that, in effect, the streams of air issuing therefrom intermingle and form a film having a whirling and a lengthwise movement in reference to the cylinder.

The explosion-chamber 27 is located in the head of the cylinder 1, is preferably disposed axially thereof, and is provided with a portion 28 extending a distance within the cylinder and provided with a plurality of laterally-directed discharge-ports 29, which extend substantially tangentially in reference to the axis of the cylinder and in opposite directions to the ports 26, so that the mixture issuing from the ports 29 will partake of a whirling movement in an opposite direction to the whirling movement of the air discharged through the ports 26. The port 3 communicates directly with the outer end of chamber 27, and between said point and the ports 29 suitable sparking electrodes 30 are located, which are connected up in the usual manner with a suitable source of supply and with make and break mechanism.

The operation of the herein-described engine is substantially as follows: Assuming that a charge has been compressed in the upper portion of the cylinder 1 and ignition has just taken place, the piston will be forced inwardly or toward the crank-shaft, and will thereby act to compress the air in the chamber 6, which was drawn into the same during the outstroke of the piston. Before the end of the instroke of the piston is reached the exhaust-valve opens, which permits of the escape of the exploded charge or dead gases, a part of which immediately begins to pass out through the port 2. In the continued movement of the piston and just before the limit of its stroke is reached the ends of the ports 26 are uncovered, whereupon the air from the chamber 6 immediately rushes into the cylinder 1 under the burned gases therein and expels the larger quantity of the same through the port 2. In the first part of the outstroke of the piston the residue of said gases will be forced out, and in the continued outward movement only the fresh air will be present in the cylinder, and this will serve to take off heat from both the cylinder and the piston. As will be appreciated, when the ports 26 are uncovered by the piston the exploded charge in the upper portion of the cylinder is already under motion on its way out through the exhaust-port 2, and the incoming charge of fresh air only sets in motion that part of the exploded charge or dead gases in the lower part of the cylinder and immediately contiguous to the cylinder-head. The exhaust-valve is timed so that it will close at a point in the outstroke of the piston which will insure a predetermined quantity of air remaining in the cylinder in relation to the amount which passes thereinto through port 26. Upon the succeeding inward stroke of the piston a vacuum or suction is created in the cylinder, the strength of which varies in accordance with the quantity of fresh air remaining therein, and under the influence of this suction a quantity of the explosive mixture is drawn into the cylinder from the carbureter through port 3, chamber 27, and ports 29. At the same time the quantity of air which has been drawn into the chamber 6 in the preceding outward stroke of the piston is now compressed, and as soon as the outer edge of the piston passes the ends of ports 26 this air passes out into the cylinder and acts only to crowd the admitted charge toward the upper end of the cylinder and will be maintained itself in the lower part thereof and about the head of the piston, so that as the explosive charge is compressed and fired substantially at the completion of the outstroke the flame or highly-heated residuum of dead gases does not come into contact with the piston-head or lower part of the cylinder-wall, as the same is thoroughly protected by the film of fresh air. Upon substantially the completion of the compression-stroke of the piston the initial part of the explosion occurs in the chamber 27, and the positiveness and the completeness of

this explosion are assured by reason of the richness of the mixture in said chamber, and the flames escaping through the ports 29 instantaneously ignite the major portion of the compressed charge in the cylinder. The tendency of the flame issuing through the ports 29 to contact with the cylinder-wall is arrested in a large measure by the body of air traveling in a reverse direction to the medium issuing through ports 29, which air has been introduced through the ports 26, as hereinbefore described.

By reason of the fact that the tension of spring 13 can be regulated it is possible to regulate the amount of air which will be drawn into chamber 6 on the outward stroke of the piston and therethrough the amount of air which will be forced into cylinder 1, and as the suction or vacuum which is created in the latter by the inward stroke of the piston depends on the quantity of said air and as the mixture drawn from the carbureter into the cylinder depends upon the strength of said vacuum or suction the speed of the engine can be regulated by varying said tension.

By the described construction it will be appreciated that the cylinder is not only thoroughly scavengered and cooled, but the speed of the engine is controlled by varying the quantity of air utilized for performing the other functions.

The construction and operation of my invention will be readily understood upon reference to the foregoing description and the accompanying drawings, and it will be appreciated that the parts and combinations recited may be varied within a wide range without departing from the spirit and scope thereof.

Having thus described my invention, what is claimed as new, and desired to be secured by Letters Patent, is—

1. In an explosive-engine, and in combination, a cylinder, a piston movable therein, means for feeding an explosive mixture to the cylinder controlled by the strength of the vacuum or suction in the latter, means for feeding a quantity of air to the cylinder for scavenging and cooling the latter, and means for varying the quantity of said air and therethrough the strength of the vacuum or suction created in the cylinder, substantially as described.

2. In an explosive-engine and in combination, a cylinder, a piston, an air-chamber having an inlet-port, a valve controlling the same and movable under the influence of the piston, means for varying the action of said valve, ports leading from the air-chamber to the chamber in the cylinder, a carbureter, and a substantially unrestricted or unthrottled port leading therefrom to the cylinder.

3. In an explosive-engine and in combination, a cylinder, a piston movable therein, means for feeding an explosive mixture to the cylinder controlled by the strength of the vacuum or suction created in the latter by the movement of the piston, an air-chamber, unrestricted ports leading therefrom to the cylinder, an air-inlet port leading to the air-chamber, a valve for controlling the same, yielding means for holding said valve upon its seat, and means for varying the tension of said yielding means, substantially as described.

4. In an explosive-engine and in combination, a cylinder, a piston movable therein, means for feeding an explosive mixture to the cylinder controlled by the strength of the vacuum or suction created in the latter by the movement of the piston, an air-chamber, unrestricted ports leading therefrom to the cylinder, an air-inlet port leading to the air-chamber, a valve for controlling the same having a stem, a boss providing a guide for said stem, a sleeve mounted upon said boss, a spring for holding the valve to its seat interposed between opposing surfaces of the valve-stem and boss, respectively, and means for shifting the sleeve lengthwise of the boss, substantially as described.

5. In an explosive-engine and in combination, a cylinder, a piston movable therein, means for feeding an explosive mixture to the cylinder controlled by the strength of the vacuum or suction created in the latter by the movement of the piston, an air-chamber, unrestricted ports leading therefrom to the cylinder, an air-inlet port leading to the air-chamber, a valve for controlling the same having a stem, a boss providing a guide for said stem, a sleeve mounted upon said boss, a spring for holding the valve to its seat interposed between opposing surfaces of the valve-stem and boss, respectively, and means for shifting the sleeve lengthwise of the boss, said means comprising cam-surfaces on the sleeve and fixed surfaces coacting therewith, substantially as described.

6. In an explosive-engine and in combination, a cylinder, a piston movable therein, means for feeding an explosive mixture to the cylinder controlled by the strength of the vacuum or suction created in the latter by the movement of the piston, an air-chamber, unrestricted ports leading therefrom to the cylinder, an air-inlet port leading to the air-chamber, a valve for controlling the same having a stem, a boss providing a guide for said stem, a sleeve mounted upon said boss, a spring for holding the valve to its seat interposed between opposing surfaces of the valve-stem and boss, respectively, and means for shifting the sleeve lengthwise of the boss, said means including cam-surfaces on the sleeve, fixed projections coacting therewith and means for rotating the sleeve on the boss, substantially as described.

7. The combination with a cylinder, a piston, an explosion-chamber formed in the cylinder-head and having a portion extending

within the cylinder, ports leading laterally through the projecting portion of the wall of said chamber and disposed substantially tangentially of the axis of the cylinder, an inlet in the opposite end of the chamber, and sparking mechanism located between said inlet and the discharge-ports, substantially as described.

8. The combination with a cylinder, a piston, an explosion-chamber formed in the cylinder-head and having a portion extending within the cylinder, ports leading laterally through the projecting portion of the wall of said chamber and disposed substantially tangentially of the axis of the cylinder, air-admission ports leading through the wall of the cylinder having their end portions disposed obliquely in relation to the longitudinal axis of the cylinder and at angles to imaginary radial lines intersecting said ports and arranged to discharge the mixture issuing therefrom in an opposite direction to the medium issuing from the ports in the combustion-chamber, an inlet-port in communication with the combustion-chamber, and sparking mechanism arranged in the latter, substantially as described.

9. In an explosive-engine, the combination with a cylinder, a piston movable therein and an outlet-port, of ports leading to the cylinder-chamber, for the admission of air under pressure, so disposed as to give said air a whirling motion and distribute the same in the cylinder-chamber in the form of a belt or film, and means for feeding the explosive mixture toward said belt or film, substantially as described.

10. In an explosive-engine, the combination with a cylinder, a piston movable therein and an outlet-port, of ports leading to the cylinder-chamber, for the admission of air under pressure, so disposed as to give said air a whirling motion and distribute the same in the cylinder-chamber in the form of a belt or film, and means for feeding the explosive mixture toward said belt or film from substantially the axis of the same, substantially as described.

11. In an explosive-engine, the combination with a cylinder, a piston movable therein and an outlet-port, of ports leading to the cylinder-chamber, for the admission of air under pressure, so disposed as to give said air a whirling motion and distribute the same in the cylinder-chamber in the form of a belt or film, and means for feeding the explosive mixture into said belt or film, substantially as described.

12. In an explosive-engine, the combination with a cylinder, a piston movable therein and an outlet-port, of ports leading to the cylinder-chamber, for the admission of air under pressure, so disposed as to give said air a whirling motion and distribute the same in the cylinder-chamber in the form of a belt or film, and means for feeding the explosive mixture into said belt or film from substantially the axis of the same, substantially as described.

13. In an explosive-engine, the combination with a cylinder and a piston movable therein, of means at one end of the cylinder for supplying a body of air under compression to the cylinder-chamber in the form of a whirling film or belt, an outlet-port and an inlet-port, one of the latter ports communicating with the zone inclosed by said film or belt and the other of said ports communicating with the belt, substantially as described.

14. In an explosive-engine, the combination with the cylinder and a piston movable therein, of a port in communication with the axis of the cylinder-chamber, a second port also in communication with the cylinder-chamber, and inlet-openings at the opposite end of the cylinder to said ports for supplying a body of air to the cylinder-chamber in the form of a whirling belt or film having a spiral and an advancing movement toward said ports, substantially as described.

15. In an explosive-engine and in combination, a cylinder; an inlet for the explosive mixture and a discharge-port located at one end of the cylinder, and means for discharging a body of air into the cylinder adjacent to the opposite end of the same in the form of a whirling film contiguous to the inner wall of said cylinder, substantially as described.

16. In an explosive-engine and in combination, a cylinder; an inlet for the explosive mixture and an exhaust-port located at the rear end of the cylinder, an air-compression chamber, and means for conducting air from the latter and discharging the same into the forward end of the cylinder tangentially of the inner wall of the latter, substantially as described.

17. In an explosive-engine and in combination, a cylinder; an inlet for the explosive mixture and an exhaust-port located at the rear end of the cylinder, an air-compression chamber, and means for conducting air from the latter and discharging the same into the forward end of the cylinder tangentially in relation to the inner wall of the same and toward the rear end of the latter, substantially as described.

18. In an explosive-engine and in combination, a cylinder having an inlet-port for the explosive mixture and an exhaust-port at one end of the same, an air-compression chamber and ports leading from the latter to the cylinder, the discharge ends of said ports being disposed substantially tangentially in relation to the inner wall of the cylinder and arranged obliquely in relation to the longitudinal axis of the latter, substantially as described.

19. In an explosive-engine and in combination, a cylinder having an inlet-port for the explosive mixture and an exhaust-port at one end of the same, an air-compression chamber and ports leading from the latter and discharging into the cylinder tangentially of the same in a plane adjacent to the head of the piston when the latter is at the limit of its outstroke, substantially as described.

20. In an explosive-engine and in combination, a cylinder, an air-compression chamber, a plurality of ports providing means of communication between the cylinder and chamber, said ports having their discharge end portions disposed at an angle to an imaginary line radiating from the axis of the cylinder and intersecting the extreme ends of said ports, said ends forming substantially a continuous line around the inner wall of the cylinder, substantially as described.

21. In an explosive-engine and in combination, a cylinder, an air-compression chamber and a plurality of ports equidistantly spaced around the cylinder, each having an end portion arranged obliquely in relation to the longitudinal axis of the cylinder and disposed in a horizontal plane substantially tangentially of the inner wall thereof, substantially as described.

22. In combination with an explosive-engine, an air-compression chamber, a cylinder opening into the upper end of the latter at its lower end, a piston working in said cylinder constituting a diaphragm for separating the cylinder-space from the air-compression space, a valve-controlled inlet for said air-compression chamber, and a plurality of ports vertically arranged in the wall of the engine-cylinder opening at their lower ends into the air-compression chamber, and at their upper ends into the cylinder in a horizontal plane above that occupied by the head of the piston when at the extremity of its downstroke, the end portions of said ports being inclined inwardly and arranged substantially tangentially of the inner wall of said cylinder, substantially as described.

In testimony whereof I have hereunto signed my name, in the presence of two attesting witnesses, at Nashville, in the county of Davidson and State of Tennessee, this 7th day of May, 1904.

FRANKLIN WOOD HAGAR.

Witnesses:
B. T. LANNOM,
MARY C. MCCARTHY.