D. H. COLES.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 18, 1909.

1,011,032.

Patented Dec. 5, 1911.

2 SHEETS—SHEET 1.

Fig. 2.

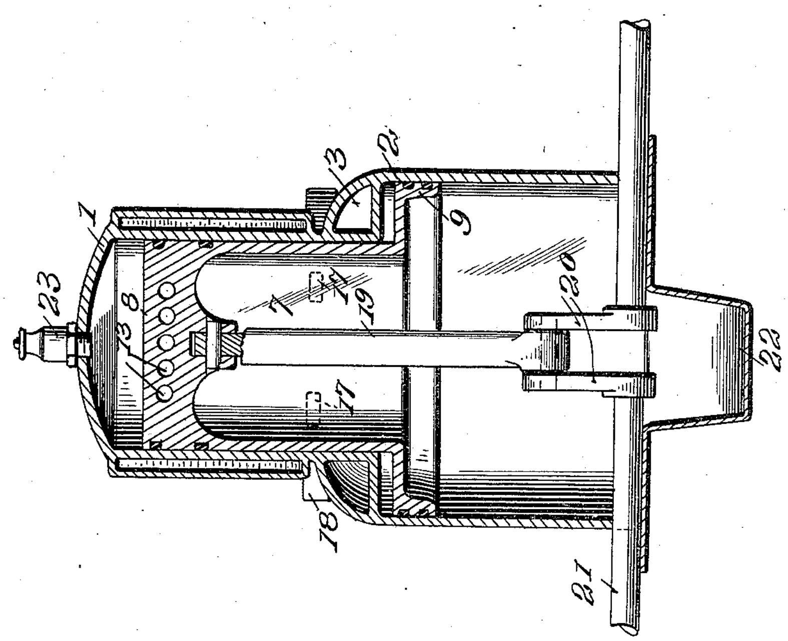
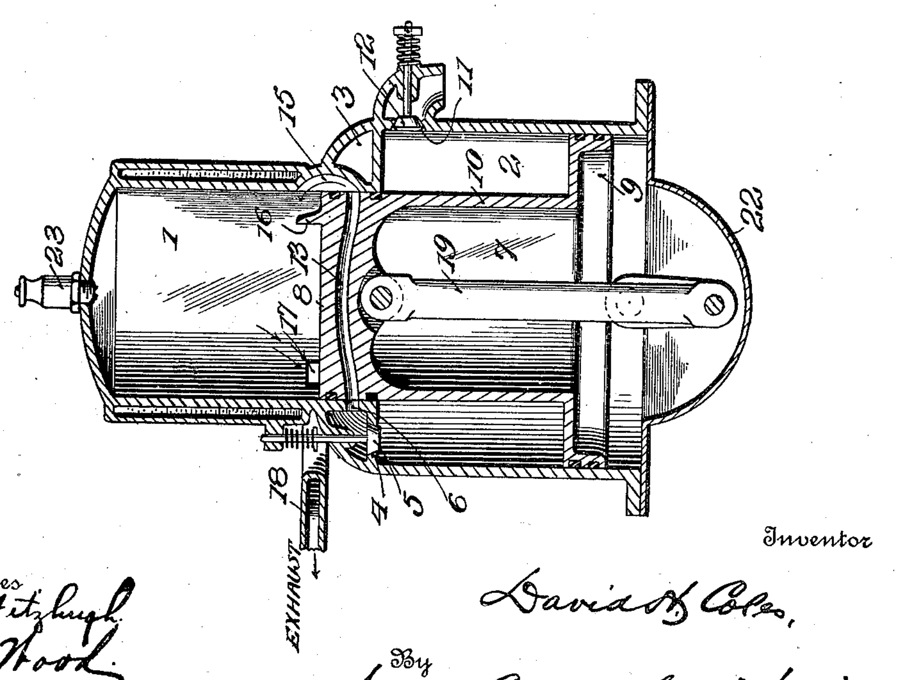


Fig. 1.



Witnesses

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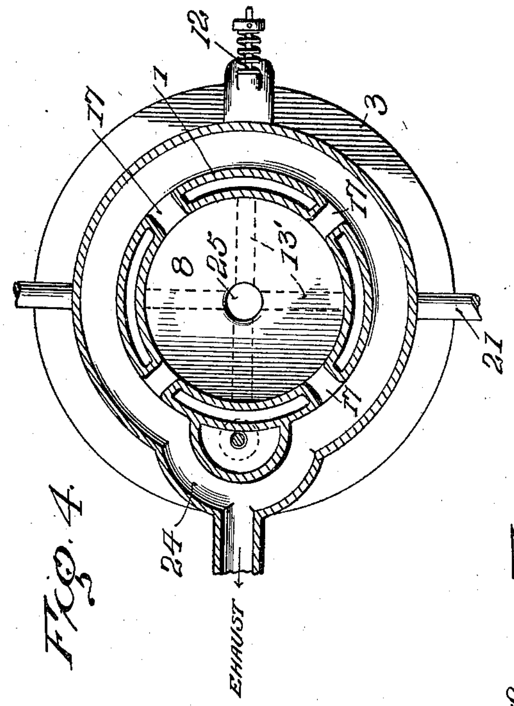

Fig. 4.

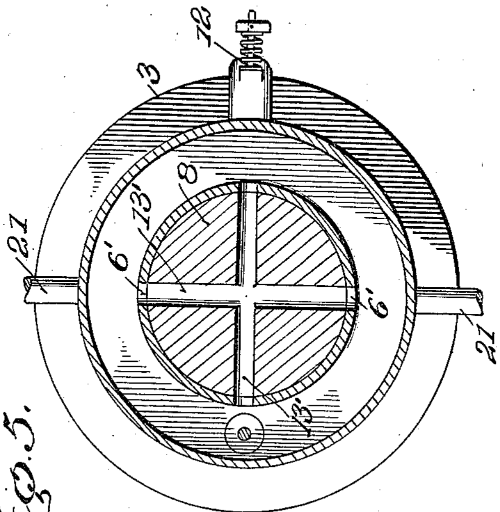

Fig. 5.

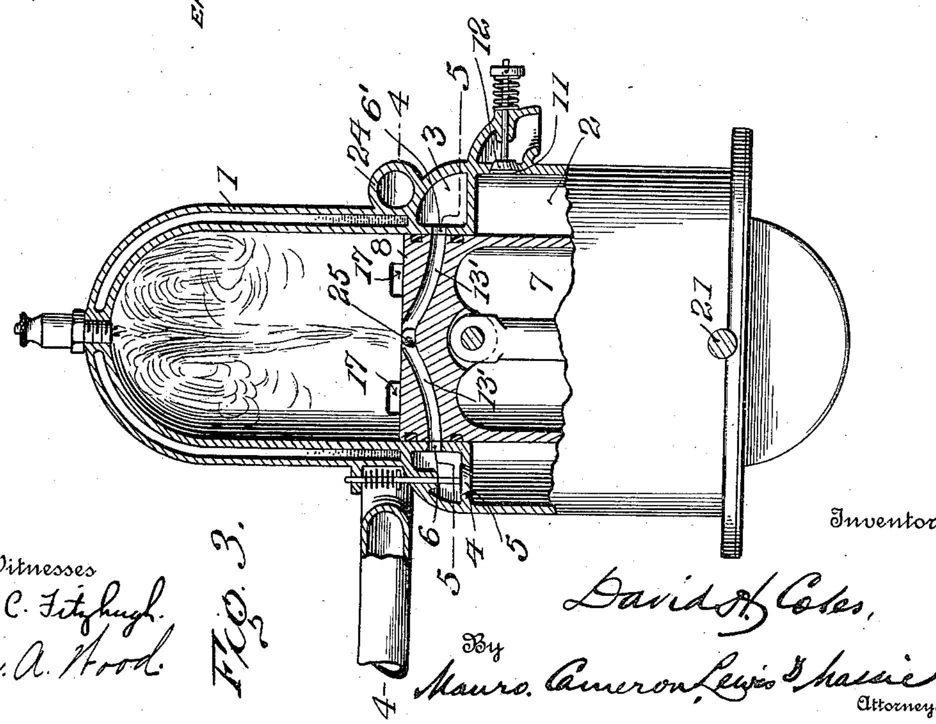

Fig. 3.

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INTERNAL-COMBUSTION ENGINE.

1,011,032. Specification of Letters Patent. Patented Dec. 5, 1911.

Application filed November 18, 1909. Serial No. 528,754.

To all whom it may concern:

Be it known that I, DAVID H. COLES, of Brooklyn, New York, have invented a new and useful Improvement in Internal-Combustion Engines, which invention is fully set forth in the following specification.

This invention relates to internal combustion engines, and has for its object to provide an engine of this class which is capable of developing great power while possessing extreme simplicity in construction, and in which thorough scavenging is effected and excessive heating is avoided.

In running internal combustion engines at considerable speed, it has been found that the charge of gas introduced into the power cylinder both in two and four cycle engines is often less than sufficient to fill the cylinder at atmospheric pressure. The greater the speed the smaller is the charge, and consequently a proportional reduction in power. The piston moves so rapidly that time is not sufficient for it to draw in a charge of fresh gas at atmospheric pressure without producing a partial vacuum in the power cylinder. While it has been sought to overcome this difficulty by compressing the charge in the crank-casing before introducing it into the power cylinder, the results have not been as satisfactory as desired, because of mechanical difficulties, such as making the crank-casing air-tight, great friction on the crank shaft journals, and inconvenience of getting at the parts within the casing to make repairs, and because such compression is not sufficient to secure the objects sought. Increased speed also increases the difficulties of scavenging the products of combustion, the presence of which contaminates the explosive charge and lessens power while increasing fouling. Increased speed also increases the heating effects, particularly of the piston when operating a two-cycle engine, in which heat of explosion occurs at every revolution of the crank shaft.

By means of my invention, I overcome the above objections, and secure the objects above described by providing an explosive engine with means whereby a charge of combustible gas, greater in normal volume than the contents of the power cylinder, is compressed to any desired amount, by action of the piston itself, and introduced into the power cylinder to get therein an initial pressure above atmospheric pressure, to be further compressed in the power cylinder preparatory to explosion on the face of the piston. I avail myself of this charge of combustible gas under pressure for scavenging the products of combustion from the cylinder, and may also use it for cooling the piston by bringing it into heat-interchanging relation therewith.

By way of illustrating my invention, I have described it in connection with a two-cycle type of explosive engine. I provide two coaxial cylinders having different cross-sectional areas and a piston for working therein having heads to correspond. The smaller cylinder constitutes the power cylinder and the larger one constitutes the gas compression cylinder which is provided with a gas inlet port normally closed by a check valve and a similarly controlled gas exit port. Intermediate the power cylinder and pump cylinder, I provide a compression chamber which may be integral with or separate from the engine cylinder. I preferably make it integral therewith. The power cylinder is provided with one or more wide exhaust ports, preferably a plurality, which are located well forward in the cylinder, and preferably communicating with each other exteriorly by means of a single passage or conduit which may or may not communicate with a muffler. The gas inlet port or ports in the power cylinder are located in advance of the exhaust port, and both the exhaust ports and inlet ports are preferably controlled by the piston head in the power cylinder to open and close simultaneously with each other, or one slightly in advance of the other, as may be desired. For the purpose of cooling the piston by the charge of incoming gas, I provide channels in the power cylinder piston head, which are adapted to communicate with the compression chamber and power cylinder when the piston is at or near the end of its working stroke. The blast of gas enters the power cylinder through the piston channels, and thereby reduces the temperature of the piston. These channels may have their exit on the periphery of the piston or in its face. In the latter position, I prefer to locate their discharge centrally of the face, thereby enabling the discharge to assume a jet form which will penetrate through the body of burning gases to the rear of the power cylinder, and there be deflected forward and outward from the axis of the cylinder, thereby displacing the products of combustion forward and out of the exhaust ports, while assisting in cooling the walls of the power cylinder. With a view of better directing the return movement of the gas jet, and securing more efficient displacement of the products of combustion, I prefer to make the end of the cylinder dome-shaped.

The inventive idea involved is capable of receiving a variety of mechanical expressions, some of which, for the purpose of illustration, are shown in the accompanying drawings, but such drawings are not for the purpose of indicating the limits of the invention, reference being had to the claims for this purpose.

Figure 1 is a vertical, central, sectional view, showing one embodiment of my invention; Fig. 2 is a similar view to that of Fig. 1, except the section is taken in a plane at right angles thereto, and shows the piston in a different position; Fig. 3 is in part a sectional and in part an elevational view, showing a somewhat different embodiment from that shown in Fig. 1; and Figs. 4 and 5 are transverse sectional views taken on lines 4—4 and 5—5 of Fig. 3.

Referring to Figs. 1 and 2, the engine casing comprises a fluid-cooled power cylinder 1 and a pump cylinder 2, in axial alinement therewith and of larger diameter than the power cylinder, whereby a charge of gas of larger volume, as measured at atmospheric pressure, than the contents of the power cylinder may be delivered to the latter. Intermediate the two cylinders is a gas compression chamber 3 having communication with the pump cylinder 2 through an inlet port 4 normally closed by a spring-pressed valve 5, and communicating with the power cylinder 1 through a wide delivery port 6. Working in said cylinders is a piston 7 having head portions 8 and 9 connected by a cylindrical member 10, which with the pump cylinder 2 forms an annular chamber for receiving the fresh charge of gas drawn in during the power stroke by head 9 through port 11 past check valve 12. The power piston head is provided preferably with a plurality of cooling passages 13 which are adapted to register on one side with a port 6 of the compression chamber 3 and on the opposite side with a by pass 15 when the piston is at or near the end of its power stroke. For the purpose of directing upward the stream of gases leaving by-pass 15, the piston is provided with a deflecting plate 16. The power cylinder is provided with wide exhaust ports 17, preferably two or more in number, located well forward in the cylinder and delivering into a single delivery passage 18, which may connect with a muffler or open into the atmosphere, as desired. 19 is a connecting rod and 20, 20, are cranks connecting the same with the power shaft 21. Beneath the engine I preferably locate a drip-pan 22. In my construction a crank casing is quite unnecessary, and is dispensed with. 23 is a spark plug.

The operation of the device as thus far described is as follows:—Assuming that the piston is at the end of its power stroke as shown in Fig. 1, the compression cylinder 2 is charged with fresh gas at atmospheric pressure drawn therein through the charging port 11 by piston head 9 during the previous power stroke. The exhaust ports 17 have been uncovered by the piston head 8 and the gas supply ports 6 register with the opening 14 to the cooling passages 13. While exhaust is taking place through ports 17, a charge of fresh gas under high pressure, which has previously been compressed in chamber 3 by the upstroke of the piston, is being discharged through the wide ports 6, piston opening 14, passages 13, and by-pass 15 into the power cylinder. This charge is high in pressure and materially lower in temperature than the piston, and is therefore peculiarly fitted to abstract heat therefrom, both by reason of cooling by expansion through the piston channels and by its initially lower temperature. As the charge of fresh gas leaves the by-pass 15, it is directed upward by the deflector 16, and assists in displacing the burned charge in the power cylinder through ports 17. By the time the port 6 is closed by the upward movement of the piston, a fresh charge of gas has been introduced into the power cylinder, the volume of which measured at atmospheric pressure is greater than that of the cylinder space. The power cylinder has been thus fully charged with pure combustible gases, under a pressure equal to or above atmospheric pressure, as a result of the initial compression of a charge of gas in the pump cylinder which is of larger capacity than the power cylinder, and of the rapid delivery of this charge to the power cylinder from the compression chamber which is of smaller capacity than either of the said cylinders. The upward stroke of the piston effects the further compression of the charge in power cylinder 1 to the highest state of compression that the gas mixture will bear without preignition, and at the same time compresses the fresh charge in the annular pump cylinder 2 previously taken from the carbureter not shown. The latter charge passes into the compression chamber 3 by way of port 4, and is retained therein until the piston again uncovers the exhaust ports 17 and exit ports 6. The compressed charge in the power cylinder is ignited by action of the sparking plug 23, and the piston descends on its working stroke at or near the end of which the above described cycle of operation is repeated.

By means of my invention as above described, I am enabled to fill the power cylinder with a charge of gas mixture at or above atmospheric pressure, cool the piston, compress the mixture to as high a pressure as it will bear without pre-ignition, explode the charge on the face of the piston, and scavenge the products of a previous combustion, all in one revolution of the crank. Three valves only are required, two of which are check valves, the third being the piston itself, thereby dispensing with valve-operating devices. I also dispense with back compression, and avoid the use of a crank case.

Instead of arranging the piston-passages to deliver at the side of the piston as shown in Fig. 1, I may provide for the delivery of the charge from these passages at the center of the piston-head as shown in Figs. 3, 4, and 5. In this construction the piston-passages 13′ are radial. The peripheral openings are adapted to register with corresponding openings 6′ in the wall of the chamber 3. The exhaust ports 17, four in number as shown, are preferably equally distributed in the water-cooled walls of the power-cylinder and open into a collecting conduit or passage 24 which delivers through a pipe 18 to a muffler or into the atmosphere. The inner ends of the piston passages 13′ preferably unite into a single opening 25 in the axis of the piston below the dome-shaped end of the power cylinder. Central delivery of the charge into the power cylinder through the piston against the concave end of the cylinder is advantageous in connection with the use of a charge of gas held under reservoir pressure in chamber 3, for the reason that the piston delivers a strong stream of gas through the burned charge. This stream is reflected back and drives before it the products of combustion through the exhaust ports with much force, and leaves a fresh charge in its place at superatmospheric pressure. The exhaust ports 17 are preferably distributed around the cylinder as shown in Fig. 4, and open through the fluid-cooled power cylinder walls into a passage or conduit 24 in heat-interchanging relation with the cooling jacket, thereby assisting in reduction of the temperature and pressure of the escaping exhaust at the discharge, and facilitating escape of the products of combustion.

Obvious changes in the specific details herein described, which come within the spirit of my invention, and not involving a departure therefrom, will no doubt suggest themselves to the skilled mechanic, and such changes are designed to be within the scope of my claims.

What I claim is:—

1. In an explosive engine, two coaxial cylinders of unequal diameters comprising a power cylinder and a pump cylinder, a piston having heads of unequal diameters working in said cylinders, the piston head of small diameter being provided with a cooling passage for delivering gas to said power cylinder, a compression chamber having a port adapted to register with said piston cooling passage at or near the end of the power stroke and having a valve controlled port normally closed to said pump cylinder, whereby a charge of gas compressed into said chamber by the pump piston during the compresison stroke is delivered under superatmospheric pressure through said piston passage into the power cylinder at or near the end of the next power stroke, cooling said piston and filling the power cylinder with a fresh charge of gas.

2. In an explosion engine, two coaxial cylinders of unequal diameters comprising a power cylinder and a pump cylinder, a piston having heads of unequal diameters working in said cylinders, the piston head of smaller diameter being provided with passages which open on the periphery and on the face of said piston, a compression chamber having a plurality of ports adapted to register with said peripheral piston openings at or near the end of the power stroke, and having a valve controlled port into the pump cylinder whereby a charge of gas compressed into said chamber by the pump piston during the compression stroke is delivered under super-atmospheric pressure through said piston passages into the power cylinder at or near the end of the next power stroke, cooling said piston and filling the power cylinder with a fresh charge of gas.

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

DAVID H. COLES.

Witnesses:
C. A. L. MASSIE,
RALPH L. SCOTT.