N. B. WALES.

FOUR-CYCLE ENGINE.

APPLICATION FILED MAR. 2, 1907. RENEWED OCT. 24, 1911.

1,054,157. Patented Feb. 25, 1913.

Fig. 2.

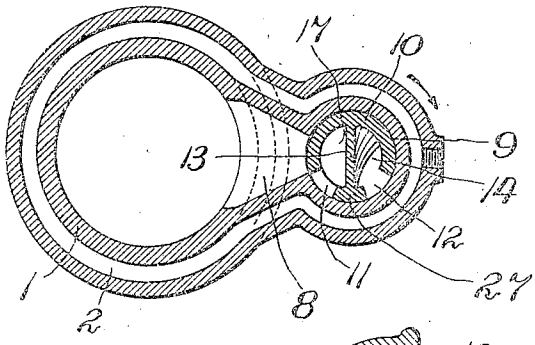


Fig. 4.

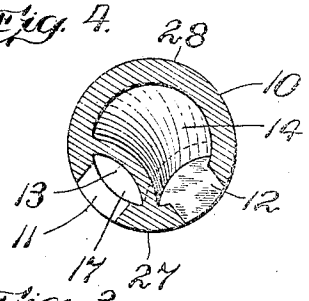
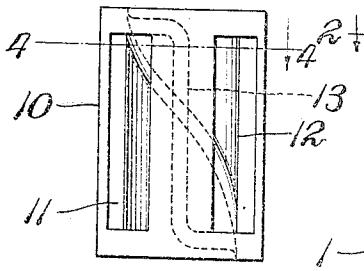


Fig. 3.



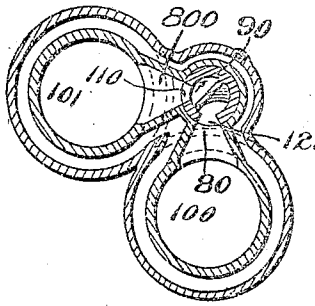


Fig. 5.

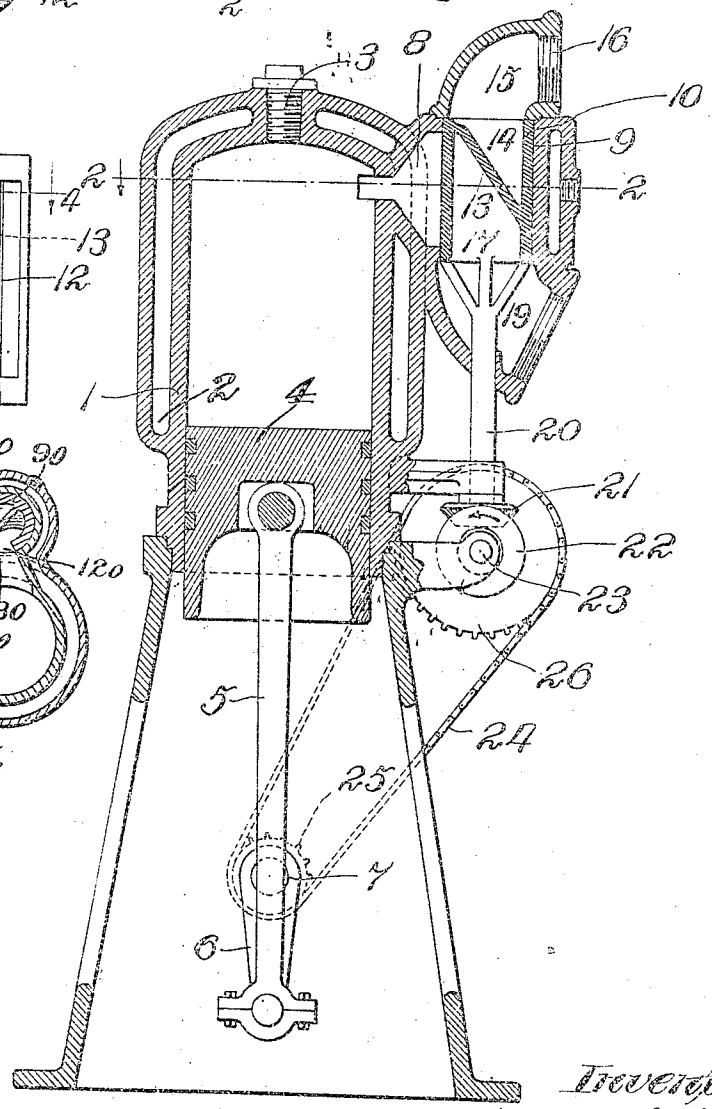


Fig. 1.

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UNITED STATES PATENT OFFICE.

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FOUR-CYCLE ENGINE.

1,054,157. Specification of Letters Patent. Patented Feb. 25, 1913.

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To all whom it may concern:

Be it known that I, NATHANIEL B. WALES, citizen of the United States, and resident of Braintree, Norfolk county, Massachusetts, have invented certain new and useful Improvements in Four-Cycle Engines, of which the following is a specification.

The invention relates to engines of that class known as four-cycle engines and its object is to provide means for controlling the supply of the motive fluid to the cylinder and the exhaust of the waste products therefrom which shall be simple and compact in construction, shall afford comparatively large port and passage areas for the ready and rapid supply and the exhaust of the gases, and shall operate with practically no waste of the motive fluid.

A further object is to provide a construction in which a single valve may be combined with the cylinders of a two-cylinder engine in such manner that the supply and exhaust for both cylinders is controlled by the same valve while the cranks are arranged at an angle of 180 degrees.

In practising the invention the supply and exhaust for the engine cylinder are controlled by a substantially cylindrical rotary valve mounted in a valve chamber which communicates with the upper end of the cylinder through a short port. The valve is provided with non-communicating exhaust and supply ports which are in communication with the exhaust chamber and supply chamber respectively and are brought successively into register with the cylinder port by the rotation of the valve. The periphery of the valve between the ports is properly proportioned to close the cylinder port during the compression and driving strokes of the piston and also for an instant between the exhaust and suction or supply strokes so that the exhaust port of the valve will pass out of register with the cylinder port before the supply port registers therewith. For the sake of simplicity and compactness I prefer to construct the valve in the form of a hollow sleeve open at both ends and provided with a partition which divides its interior into two chambers. The supply port extends longitudinally of the sleeve and opens through the peripheral wall of one of the chambers while the exhaust port is similarly arranged and opens through the peripheral wall of the other chamber. The supply and exhaust ports are thus in continuous communication with the supply and exhaust chambers at opposite ends of the valve. This construction provides for large port and passage areas with a comparatively small valve. By arranging the partition spirally the size of the valve may be reduced to a minimum and the partition may also be so arranged as to assist the flow of gases to and from the cylinder port.

The various features of the invention will be set forth in the claims and will be understood from the detailed description of the construction shown in the accompanying drawings.

In these drawings—Figure 1 is a vertical central section through the cylinder of a four-cycle engine embodying the features of the present invention. Fig. 2 is a horizontal section on line 2—2 Fig. 1. Fig. 3 is an enlarged elevation showing the ports in the cylindrical valve. Fig. 4 is a section on line 4—4 Fig. 3 looking in the direction of the arrow. Fig. 5 is a horizontal sectional view through the cylinder ports of a two-cylinder engine embodying the features of the present invention.

Referring to the construction shown in Figs. 1 to 4 the cylinder of the engine is indicated at 1 and may be provided with the usual water jacket 2 and with a spark plug indicated at 3. The piston 4 is mounted to reciprocate within the cylinder in the usual manner and is connected by a piston rod 5 with a crank 6 secured to the crank shaft 7. The motive fluid is supplied to the cylinder and the waste products discharged therefrom through a port 8 arranged between the upper end of the cylinder and a cylindrical valve chamber 9. The valve chamber 9 is preferably arranged parallel to the cylinder and in as close proximity thereto as is practicable. This arrangement is of advantage in securing a compact construction and a short direct port passage from the valve chamber to the cylinder. The supply and exhaust through the port 8 are controlled by a cylindrical valve 10 mounted within the valve casing 9 and provided with longitudinally extending exhaust and supply ports 11 and 12 which open through the peripheral wall of the valve. The valve is in the form of a hollow sleeve and the interior of the valve is divided into two chambers by a partition 13, the port 11 open-

ing into one of the chambers and the port 12 opening into the other chamber. One edge of the partition extends longitudinally along the inner wall of the valve between the ports 11 and 12 and the other edge of the partition extends spirally along the inner periphery of the valve between the ports as indicated in Figs. 3 and 4. This arrangement of the partition divides the interior of the valve sleeve into two similarly shaped chambers which are of large cross sectional area at the open ends where ample space is required for the unimpeded flow of the supply or exhaust and which decrease in cross sectional area toward their closed ends where the least volume of gases passes. Thus the space within the sleeve is divided in a manner to secure the required passage area for the unretarded flow of the gases with the least diameter of valve and a resulting decrease in the frictional bearing surface of the valve. The partition is also so arranged that in the rotation of the valve the spiral partition tends to impel the supply gases toward the cylinder port and to impel the exhaust gases away from the cylinder port. The supply port 12 opens through the peripheral wall of the valve chamber 14, the upper end of which is in communication with a chamber 15 arranged above the valve and communicating through an opening 16 with the supply pipe for the motive fluid. The exhaust port 11 opens through the peripheral wall of the chamber 17, the lower end of which opens into a chamber 19 which is connected with the exhaust pipe for the engine. Thus the exhaust and supply ports are in continuous communication with the supply and exhaust chambers and are so arranged that they will be successively brought into register with the cylinder port by the rotation of the valve. The ports 11 and 12 are comparatively long and narrow and that part of the port 8 which opens into the chamber 9 is correspondingly shaped. In order that the port 8 may be as short and direct as is practicable and still have ample cross sectional area for the flow of the gases, the walls leading from the ends of the valve ports converge, while the walls leading from the sides of the valve port diverge. This provides a short direct port 8, the cylinder end of which is narrow axially and long circumferentially of the cylinder and the valve end of which is long axially and narrow circumferentially of the valve. This arrangement also enables the port and valve chamber to be readily inclosed with an extension of the water jacket 2 of the cylinder.

The valve is continuously rotated during the operation of the engine through a valve shaft 20 connected at its upper end to the valve and provided at its lower end with a gear 21 which meshes with a similar gear 22 secured to a shaft 23. The shaft 23 is driven from the crank shaft 7 through a chain 24 which passes over sprocket wheels 25 and 26 secured to the crank shaft and to the shaft 23 respectively. The sprocket wheel 25 is one half the diameter of the sprocket wheel 26 and the gears 21 and 22 are of the same diameter so that the valve is given a single revolution for each two revolutions of the crank shaft or two complete reciprocations of the piston.

The cylinder and valve ports are so proportioned and the valve ports so arranged that the exhaust port 11 is in communication with the cylinder port during the exhaust-stroke of the piston and the supply port 12 is in communication with the cylinder port during the supply stroke of the piston. For an instant between the exhaust and supply strokes of the piston the cylinder port is closed to both the supply and exhaust by the wall 27 of the valve which lies between the supply and exhaust ports and is of sufficient width to bridge over the cylinder port. During the compression and driving strokes of the piston the cylinder port is closed by the wall 28 of the valve which extends from the rear side of the supply port to the front side of the exhaust port.

With the construction and arrangement described the valve chamber may be arranged close to the cylinder chamber so that the gases will be supplied and exhausted through a short direct passage leading from the valve chamber to the cylinder; this port as well as the valve chamber may be conveniently surrounded by a water jacket so that the valve may operate under favorable temperature conditions; the motive fluid is supplied and the waste products discharged through separate uncommunicating valve ports so that there is no waste of motive fluid: and comparatively large port and passage areas are provided with a valve of small diameter thus economizing space.

In Fig. 5 a two-cylinder engine is shown in which the supply and exhaust for both cylinders are controlled by a single rotary valve. In this construction the valve 90 has the same construction and the same arrangement of ports and chambers as is shown in Figs. 1 to 4 and has already been described. In this construction the exhaust port 110 and the supply port 120 are by the rotation of the valve brought successively into register with the ports 80 and 800 of the two cylinders 100 and 101 of the engine. The cranks to which the pistons of the cylinders are connected are arranged at an angle of 180 degrees to each other as is usual in two-cylinder engines. The cylinder ports 80 and 800 are so arranged with relation to each other that the exhaust port 110 is in communication with the port 800 of the cylinder

101 during the time that the supply port 120 is in communication with the port 80 of the cylinder 100. The piston in the cylinder 101 will therefore be making its upward exhaust stroke while the piston in the cylinder 100 is making its downward suction or supply stroke. After the piston of cylinder 101 has made its exhaust stroke the supply port 120 comes into register with the port 800 and continues in register therewith during the downward suction stroke of the piston. During this stroke of the piston in cylinder 101 the wall of the valve 90 closes the port 80 of the cylinder 100 and the piston therein makes its upward compression stroke. The wall of the valve continues to close the port 80 during the driving stroke of the piston in the cylinder 100 and at the end of this stroke the exhaust port 110 comes into communication with the cylinder port 80 and remains in register therewith during the exhaust stroke of the piston in this cylinder. After the supply stroke of the piston in the cylinder 101 has been completed the supply port 120 of the valve passes out of register with the cylinder port 800 and the wall of the valve closes this port during the compression and driving stroke of the piston and until the exhaust port 110 again comes into register with the cylinder port. Thus by the continuous rotation of the valve 90 the supply of motive fluid to the two cylinders and the exhaust of the waste products therefrom are controlled while the cranks to which the piston is connected are arranged on an angle of 180 degrees. By arranging the cylinders with the port of one cylinder 90 degrees in advance of the port of the other cylinder, a compact arrangement is provided in which the cranks may be arranged at an angle of 180 degrees and in which short direct ports lead from the valve chamber to the cylinder and in which the ports and valve chamber may be surrounded by the same water jacket which surrounds the cylinders.

Without attempting to point out in detail the various constructions and arrangements in which the features of the invention may be embodied, what I desire to claim is:—

1. A four-cycle engine comprising two parallel cylinders, a valve chamber arranged parallel to the cylinders, ports leading from the valve chamber to the cylinders arranged one 90 degrees in advance of the other, a valve sleeve within the valve chamber having ports the ends of which are closed by the wall of the sleeve arranged to successively register with the ports for the two cylinders and so that the advance port will register with one cylinder port while the other valve port is registering with the other cylinder port, and a partition dividing the interior of the sleeve into two non-communicating chambers opening out of the opposite ends of the sleeve, substantially as described.

2. A four-cycle engine comprising a cylinder, a piston therein, a valve chamber, a port in the wall of the chamber communicating with the cylinder, a hollow valve sleeve having open ends and fitting within the valve chamber, two similar parallel ports opening through the wall of the valve sleeve and arranged to register successively with the port in the valve chamber, and a partition within the sleeve, one edge of which extends longitudinally along the inner wall of the sleeve between the ports, and the other edge of which extends spirally along the inner wall of the sleeve between the ports and divides the interior of the valve into two similar non-communicating chambers, the open ends of which are the open ends of the sleeve, substantially as described.

3. A four-cycle engine comprising a cylinder, a piston therein, a valve chamber, a port in the wall of the chamber communicating with the cylinder, a hollow valve sleeve having circular open ends and continuous bearing surfaces fitting the valve chamber at the ends of the port, and a partition dividing the interior of the sleeve into two non-communicating chambers and two parallel ports of the same size in the walls of the respective chambers arranged to register successively with the port in the valve chamber, substantially as described.

In witness whereof, I have hereunto set my hand, this 28th day of February 1907.

NATHANIEL B. WALES.

In the presence of—
IRA L. FISH,
K. A. DUGAN.