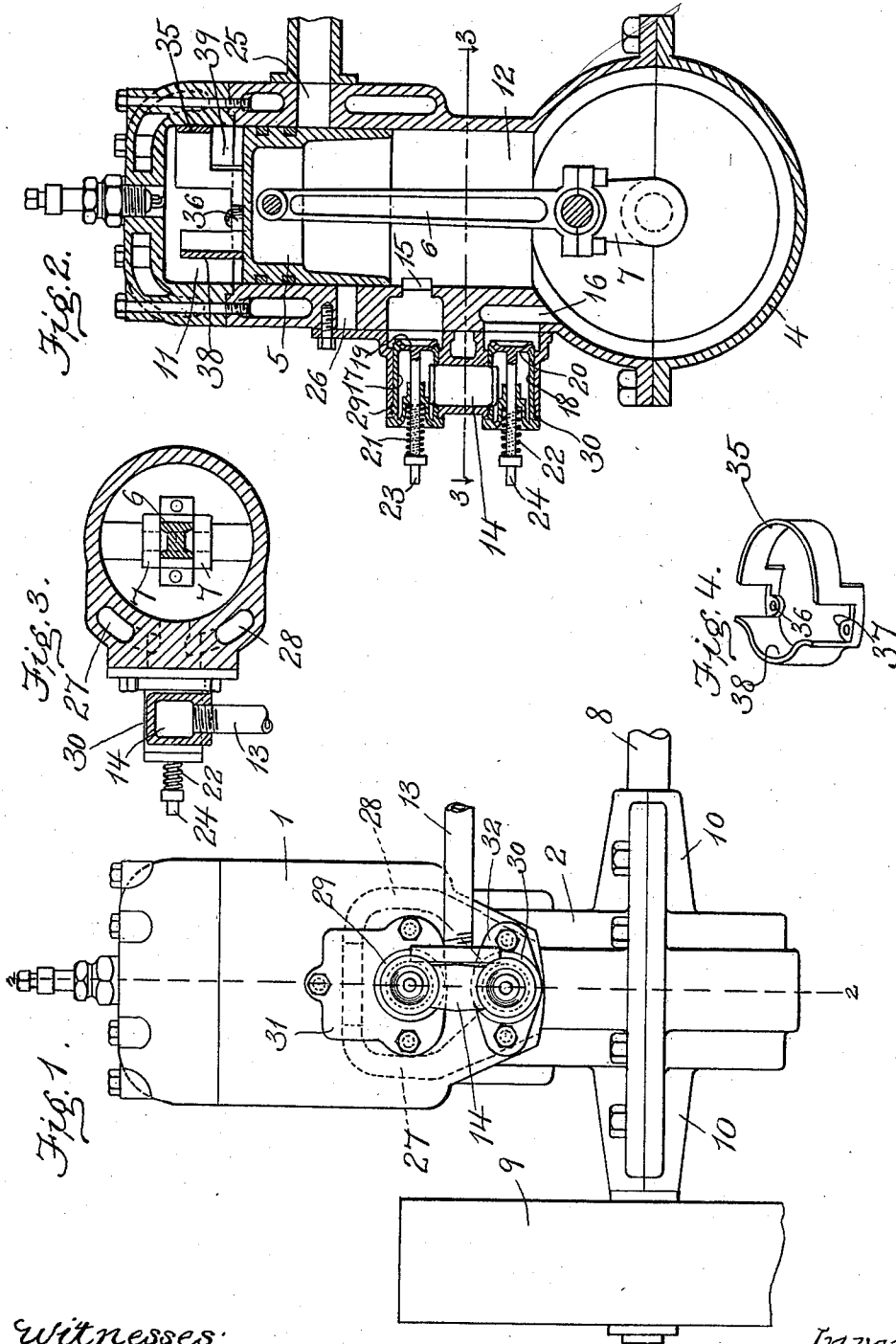


F. A. THURSTON.  
INTERNAL COMBUSTION ENGINE.  
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1,011,275.

Patented Dec. 12, 1911.



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# UNITED STATES PATENT OFFICE.

FREDRICK A. THURSTON, OF LYNN, MASSACHUSETTS.

INTERNAL-COMBUSTION ENGINE.

1,011,275.

Specification of Letters Patent.

Patented Dec. 12, 1911.

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*To all whom it may concern:*

Be it known that I, FREDRICK A. THURSTON, of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines of the two-stroke cycle type, and more particularly of the type illustrated in the application for patent filed by me September 29th, 1908, Serial No. 455,354, although the particular improvement which affords the subject matter of this invention is not limited in its application to such engine, but may be applied to any internal combustion two-stroke cycle rear compression engine.

The object of the present invention is to enable more power to be developed by increasing the capacity for admission of the combustible mixture, and by lessening the resistance to that stroke of the engine during which the combustible mixture is drawn in. That is, it has been my object to devise a construction by which admission of the mixture to the admission side of the engine piston may commence immediately after the piston starts on its return stroke, and by which also a further admission of the combustible mixture is permitted, when the piston nears the completion of its return stroke. This object I accomplish by providing two inlets for the mixture, one of which inlets has a constantly open port in the engine casing, and the other of which inlets is a port that is opened just before the piston reaches the end of its compression stroke, which is likewise the filling stroke. The admission of the mixture to each of these ports or inlets is controlled by a check valve, the different valves opposing different degrees of resistance to the inflow of the working fluid.

The manner in which my invention is carried into practical effect can be best understood by a reference to the drawings forming a part of this application, it being understood that these drawings and the description thereof hereinafter following are presented as showing a typical embodiment of the invention to illustrate the same, without being intended as a limitation to the particular construction shown.

In these drawings, Figure 1 represents a front elevation of the engine. Fig. 2 repre-

sents an axial view on the line 2—2 of Fig. 1. Fig. 3 represents a cross section on line 3—3 of Fig. 2. Fig. 4 shows in perspective a device for preventing the escape of unburned combustible through the exhaust port.

The same reference characters indicate the same parts in all the figures.

In the drawings the cylinder of the engine is represented at 1 and the crank case thereof at 2. The interior of the crank case communicates with the interior of the cylinder 1 at the crank end thereof, and, as is usual with this type of engine, is hermetically closed in order to permit a certain degree of compression of the combustible mixture therein. For this purpose bolts are provided to secure the lower circular part 4 of the crank case to the upper part thereof, which, for structural reasons, is preferably made as a part of the cylinder casting.

5 represents the piston, 6 the connecting rod, 7 the crank, 8 the shaft and 9 the fly wheel of the engine, the shaft being contained in the bearings 10, projecting from each side of the crank case.

The piston divides the interior the engine casing into two chambers, one of which 11 is the compression and combustion chamber in which the mixture is compressed during the return or compression stroke of the engine, and in which also it is exploded. The other chamber represented at 12 is the receiving chamber into which the combustible mixture is drawn by the suction of the piston during the compression stroke, and from which it is forced into the combustion chamber at the termination of the working stroke.

The combustible mixture is drawn from a carbureter not shown through a pipe 13 to a coupling 14, which has two outlets opening respectively into the ports 15 and 16. The former of these is in the side of the cylinder and is covered by the piston at all times except when the latter is near the end of its outward stroke, while the latter port is in the wall of the crank case and is always open. The particular location of the port 16 is, however, not material, provided only it is in such a position as never to be covered by the piston and therefore to be always open. The ends of the coupling 14 have passages opening to the ports 15 and 16 and in these passages are secured the casings 17 and 18 of check valves 19 and 20 respec-

tively. These check valves seat against the inner ends of their casings and are normally drawn outward and held closed by springs 21, 22 respectively, surrounding the stems 23, 24 of the valves, and acting between abutments on the valve casings and on the stems respectively, in a manner which will be readily understood by an inspection of the drawings. These valves, therefore, can only be opened when the movement of the piston in its compression stroke produces a partial vacuum within the admission chamber 12 and reduces the pressure in the latter below the atmospheric pressure to an amount sufficient to overcome the tension of the springs 22 and 21.

It will be understood that the admission from the carbureter to the coupling 14 is always open and that when the piston travels from the crank end toward the head end of the cylinder, it diminishes the pneumatic pressure in the chamber 12, assuming that at the commencement of such stroke this pressure is practically that of the atmosphere. Accordingly the unbalanced atmospheric pressure causes the valve 20 to be first opened and the combustible mixture of gas or vaporized liquid fuel and air to be admitted. At the commencement of the compression stroke the piston, of course, covers the port 15, but when it nears the end of this stroke it uncovers this port and allows the mixture to flow through the same after first opening and passing the check valve 19. When the piston is at the head end of its stroke, the admission chamber 12 is filled with the fuel vapor or gas and air at practically atmospheric pressure. When the mixture compressed in the chamber 11 is exploded, the piston travels toward the shaft until it uncovers the exhaust port 25, the burned gases thus escape, and shortly after this escape occurs, the piston uncovers the port 26, which is preferably formed in the opposite side of the cylinder wall from the exhaust port. This port 26 communicates with the port 16 previously described through passages 27 and 28 in the wall of the cylinder casting, such passages being formed preferably as shown in Figs. 1 and 3, spreading apart to surround the inlet port 15 and merging together in the ports 26 and 16. Then the mixture which was drawn into the chamber 12 on the preceding stroke of the engine is forced through the passages 27 and 28 into the port 26 and thence into the combustion chamber. The spring 22 of the valve 20 is made sufficiently strong to hold the valve firmly closed against its seat when the vapor in the chamber 12 is no longer under greatly less than atmospheric pressure, as this is necessary in order to prevent the valve from chattering or perhaps opening under its own weight and permitting the vapor compressed in the cham-

ber 12 to flow back into the carbureter. The spring 21 on the valve 19, however, need not be of so great stiffness, but may be relatively very weak, since it is not subjected to any material pressure when the piston compresses the mixture in the chamber 12, because the port 15 is covered by the piston before the contents of the chamber 12 are appreciably increased in pressure. Thereby a very slight degree of vacuum in the chamber 12 is sufficient to cause the combustible mixture to be admitted past the valve 19 at the end of the compression stroke of the piston when the port 15 is uncovered, and thus it is possible to have the mixture in the admission chamber of almost atmospheric pressure before it is compressed and forced into the combustion chamber 11.

I have found from actual experimentation and tests that an engine equipped with the device above described is capable of developing as high as 25 per cent. more power over an engine unequipped with the device. This increase in power is due to the fact that after the check valve in the first admission port is closed, a further charge is admitted into the crank end of the cylinder when the piston nears the end of its compression stroke. In engines of the two-stroke cycle type hitherto made, which are provided with a port for admitting combustible charge as soon as the piston commences its compression and filling stroke, the admission of the fresh charge into the crank case is interrupted at a comparatively early point on account of the fact that the spring of the check valve which is set in the admission passage and is necessarily stiff to prevent leakage and injury to the valve, closes and prevents the admission of sufficient of the mixture to equalize the pressure in the crank case with that of the atmosphere. Secondly the final part of the compression stroke produces a partial vacuum in the crank case and is subject to a drag equal to the tension of the check valve closing spring, increased by the ratio of the piston area to the check valve area. By my invention, in which a further charge of the combustible mixture is admitted when the piston uncovers the port 15, the vacuum in the crank case is destroyed and an additional amount of combustible mixture is drawn in. Thereby, not only is the drag due to the partial vacuum eliminated, but also a greater amount of fuel is admitted preparatory to being forced into the combustion chamber at the end of the working stroke.

The coupling member 14 containing the valve casing and check valves is conveniently made as a separate piece capable of being applied to any engine and detached therefrom. As shown in the drawings accompanying this application, the coupling

is a tubular or box-like member, provided at its ends with cylindrical casings 29 and 30, into which are threaded the valve holders 17 and 18. At the ends of the coupling member 14 are flanges or lugs 31 and 32 respectively, which are detachably secured by bolts or otherwise to the exterior of the cylinder casting.

The threaded connection between the valve holders 17, 18 and the cylindrical casings 29, 30, respectively permit the valve holders to be readily removed from the box or coupling 14 which forms the valve chest. This forms a ready and simple mode of assembling the valves and is of particular value in that it enables the valve-holders with the valves to be readily removed for the purpose of grinding the valves upon their seats. As the valve seats are respectively on the inner ends of the valve-holders, it is thus possible to grind them as often as may be necessary to secure tight closing of the valves without taking the whole apparatus to pieces.

It is desirable in all two-cycle engines to provide means whereby the escape of a fresh charge through the exhaust port may be prevented, and this is an end especially desirable in an engine such as above-described, in which provisions exist for admitting a more than ordinarily copious charge into the combustion chamber at each cycle. If the exhaust port is open when the fresh mixture is admitted to the combustion chamber, there is great liability of some of this mixture escaping before the exhaust port is closed. In carrying this object into effect, I have devised a shield which is adapted to close the exhaust port after the burned gases have been released, and while the fresh charge is flowing into the cylinder. This shield is then adapted to uncover the exhaust port upon the commencement of the compression stroke and permit whatever burned gases may remain in the cylinder to be forced out. The shield is made in such a form that it may be applied to any engine and be removed therefrom when occasion warrants. This shield consists of a curved member 35, which is fastened to the piston 5 at two or more points, as by means of screws passing through lugs 36 and 37. The member 35 is shaped so as to fit closely within the inner walls of the cylinder, as shown in Fig. 2, and has a linear extent somewhat greater than that of the exhaust port 26. It has a width at least equal to the width of the port and its lower edge is separated from the edge of the piston by a space of approximately equal width. Thus, as soon as the end of the piston passes the exhaust port, the latter is opened and the gases can escape, but at the end of the piston stroke, when the admission port 26 is opened, the shield 35 covers the exhaust port and pre-

vents the fresh charge from escaping. The part of the shield at the side thereof next to the admission port 26, is set in somewhat from the cylinder wall and forms a baffle plate 38, which lies between the admission port and the center of the cylinder when the latter port is opened, and deflects the inflowing charge toward the head of the cylinder. The flow of the charge then tends to clear the exhaust gases from the head of the cylinder and force them toward the piston, whereby they are finally cleared from the cylinder when the piston rises on its compression stroke sufficiently far to enable the shield 35 to uncover the exhaust port. The open space in that portion of the shield adjacent to the exhaust port 25 constitutes a port 39 supplemental to the exhaust port which uncovers the latter momentarily on each stroke of the piston. As a measure of practical construction I find it advisable to make the shield 35 and baffle plate in one piece, as shown in Fig. 4.

I claim,

1. A two-cycle internal combustion engine comprising a cylinder, a closed crank case, a piston reciprocating in the cylinder, an inlet port in one side of the cylinder, an exhaust port at the opposite side of the cylinder, a transfer passage contained in the wall of the cylinder opening at its lower end in the crank case, being carried around the inlet port and opening at its upper end into the cylinder, and a conductor for explosive mixture having a connection with a carbureter, being secured to one wall of the cylinder and having one outlet at the lower end of the transfer passage and another outlet at the inlet port.

2. A two-cycle internal combustion engine comprising a cylinder, a crank case and a piston, said cylinder having inlet and outlet ports in opposite sides and at different heights, adapted to be opened and closed by movement of the piston, the outlet port being opened by the head end of the piston and the inlet port by the crank end thereof, so as to communicate with the interior of the cylinder only when the piston is near the head end of its stroke, and a transfer port formed in the side wall of the cylinder having its lower end opening into the crank case and its upper end opening into the cylinder above the inlet port, the intermediate part of said transfer port being offset and carried around the inlet port, a box detachably secured to the outside of the cylinder having one opening communicating with the inlet port and another opening communicating with the transfer passage, and a conduit for leading the explosive mixture to said openings.

3. In combination with a two-cycle internal combustion engine having an inlet port in the side of its cylinder and a transfer passage formed wholly in the side of the

cylinder, passing around the inlet port and opening into the cylinder and crank case respectively above and below the inlet, a distributor for the combustible mixture comprising a case detachably secured upon the wall of the cylinder having an outlet communicating with such inlet port and another outlet communicating with the transfer passage, and means for conducting the explosive mixture to such distributor.

4. In combination with a two-cycle internal combustion engine having an inlet port in the side of its cylinder and a transfer passage formed wholly in the side of the cylinder, passing around the inlet port and opening into the cylinder and crank case respectively above and below the inlet, a

distributor for the combustible mixture comprising a case detachably secured upon the wall of the cylinder having an outlet communicating with such inlet port and another outlet communicating with the transfer passage, an inwardly opening spring-closed check valve in that opening of the distributor which communicates with the transfer passage, and means for conducting the explosive mixture to such distributor.

In testimony whereof I have affixed my signature, in presence of two witnesses.

FREDRICK A. THURSTON.

Witnesses:

GEORGE F. EMERY,  
ALICE F. TRUSSELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."