J. WILLOUGHBY.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 9, 1911.

1,079,622.

Patented Nov. 25, 1913.

Fig. 1

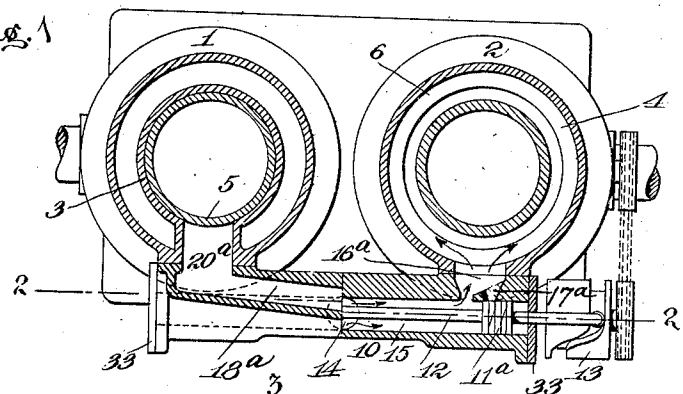


Fig. 2

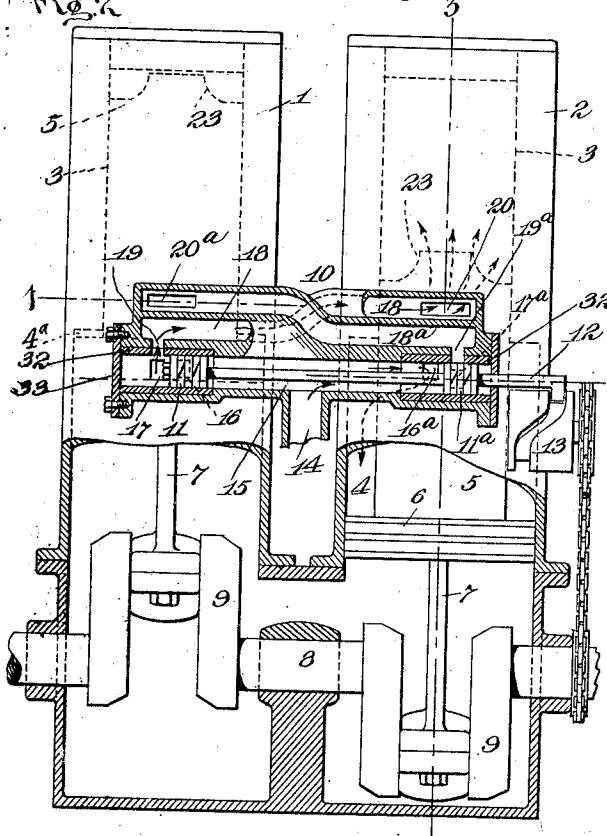


Fig. 3

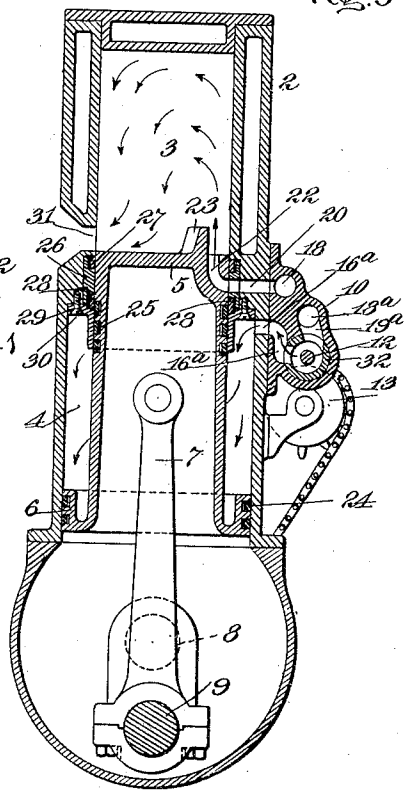


Fig. 4

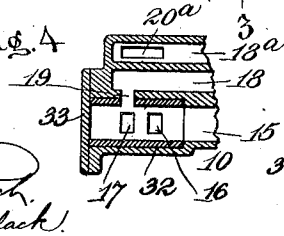
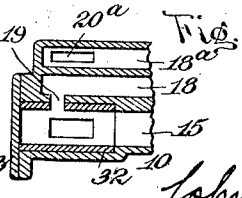


Fig. 5



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,079,622. Specification of Letters Patent. Patented Nov. 25, 1913.

Application filed June 9, 1911. Serial No. 632,153.

To all whom it may concern:

Be it known that I, JOHN WILLOUGHBY, a citizen of the United States, and a resident of the borough of Brooklyn, county of Kings, city and State of New York, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a specification.

The object I have in view is the production of an internal combustion engine of the two-cycle type, which will have superior efficiency than heretofore made, which will be simple, well balanced and easily accessible. These and further objects will appear from the following specification and accompanying drawings, considered together or separately.

Certain features of my invention are applicable to an engine having two cylinders or a multiple of two cylinders. Other features are applicable to an engine with a single cylinder, or an odd number of cylinders.

In the drawings, Figure 1 is a plan view of an apparatus embodying my invention, the plan being partly in section taken on the line 1—1 of Fig. 2. Fig. 2 is a side elevation of the same partly in section, the section being taken on the line 2—2 of Fig. 1. Fig. 3 is a section on the line 3—3 of Fig. 2; and Fig. 4 is a sectional view of a detail. Fig. 5 is a similar view of a modification.

In all of the views, like parts are designated by the same reference characters.

The particular embodiment chosen for illustration is a two cylinder engine. It will be understood that the principles disclosed in this apparatus may be applied in an engine of a different number of cylinders.

Referring to the drawings, the cylinders 1, 2 are shown as being vertical, although their position is not essential, and each contains a piston which is connected to the usual crank shaft. The cylinders have the usual heads and water jackets, as shown. The cylinders are alike and each comprises a combustion chamber 3, and a compression chamber 4, the compression chamber 4 being of larger diameter than the combustion chamber. In the combustion chamber is located a working piston 5, and in the compression chamber is a compressing piston 6, the two being preferably combined in one structure, as shown. The usual connecting rod 7, shaft 8 and cranks 9 are provided, the cranks being 180° apart. It is apparent that while the pistons in one cylinder go up, those in the other go down, and when those in one reach the extreme of their upper stroke those in the other reach the extreme of their bottom stroke.

The valve gear and port arrangement are as follows (those parts in connection with the right-hand engine being designated by the exponent "a").

On the sides of the cylinders is the valve casing 10, preferably a casting, which is preferably made of aluminum. In this valve casing are piston valves 11, 11^a connected together by a valve rod 12, one end of which is actuated by a cam appropriately rotated by suitable mechanism so as to turn in time with the shaft 9. This cam 13 moves the valve rod from right to left, and with it the two piston valves 11, 11^a in sequence. The portions of the valve casing which come in contact with the valve may be provided with cast iron liners 32, as shown, and the ends of the casings may be inclosed with covers 33, as shown.

Intermediate the two valves 11 and 11^a is a passage 14 from the carbureter (not shown). This passage communicates with the valve chest 15, which in turn communicates at each end through the ports 16, 16^a to the compression chambers 4 and 4^a. Ports 17, 17^a serve as a means of communication from the compression chambers to the valve chest. Cross passages 18, 18^a communicate with the valve chest by means of ports 19, 19^a. Ports 20, 20^a connect the cross passages to the combustion chambers. At the upper corner of each of the working pistons is a port 22, which is adapted to register with the port 20 or 20^a when the piston is at the bottom of its stroke. The usual deflector 23 is provided adjacent to the port 22. 31 is the exhaust port.

The operation is as follows. During the down stroke of the right-hand pair of pistons, as shown, carbureted air will be drawn through the port 14 into the valve chest 15, thence through the port 16^a into the compression chamber 4^a, the valve 11 being in such a position that the port 16^a is uncovered. On the upstroke of the left-hand pair of pistons port 16 is covered and ports 17 and 19 are uncovered. The explosive mixture will be compressed in the chamber 4, passed through the ports 17 and 19 and

through the cross-passage 18 into the port 20 and will be compressed in these places. As soon as the working piston 5 in the right-hand cylinder is at the end of its stroke, the port 22 on the piston will register with the valve casing port 20 and the charge which has been previously compressed in the compression cylinder on the opposite side will expand through port 20 into the combustion chamber, scavenging the latter, and driving out the products of combustion from the previous explosion through the exhaust port. It will be seen that as the compressing piston 6 of, say, the right-hand cylinder, is ascending, the working piston 5 of the left-hand cylinder will be descending; consequently, when the working piston has reached the bottom of its stroke and has registered the port 22 with the port 20, the compressing piston of the right-hand cylinder will be at the uppermost part of its stroke, having compressed the explosive mixture, and this mixture, under pressure, will immediately pass into the combustion chamber, and the same results will, of course, occur on the down-stroke the mixture passing to the other side of the engine.

As it is apparent that when the working piston on one side of the engine is descending, subjected to a pressure on its upper face, the compression piston on that side is acting as a suction piston, drawing the mixture into the compressing cylinder. The great difference in pressure between the two sides of the working piston within a particular cylinder would ordinarily result in leakage. This I prevent by means of the packing rings 27 and 28. As these rings must be compression rings, in order to be effective, it is necessary in order to get them in place, to utilize the bull ring 26 and lower plate 29. This bull ring, having annular grooves for the reception of the packing rings 27 and 28, is introduced into place, and the lower plate 29, which is annular in shape, is then introduced in place and holds the lower ring 28 and also the bull ring in place. This lower plate is held in position by means of screws 30. The lower plate extends downward a sufficient distance to contact with the rings 25 on the working piston, when the latter is at the lowest part of its stroke, and therefore hold them in place, and the compressing piston is in the form of an annular skirt which extends upward around this lower plate when the piston is at the uppermost position, so that the compressing space is made as small as possible and the necessary compression secured. By this device, the joint which separates the combustion chamber and the compression chamber is effectively packed by means of the ordinary form of expansion piston rings.

While I have shown separate ports 17 and 16, it is apparent that a single long port, as shown in Fig. 5, may be employed, the ends being alternately covered and uncovered by the piston valve.

The improved packing device can be employed in situations where the cross-over feature is not employed, as for instance, in engines where each cylinder is an entirety and the air or charge is compressed and fired in the combustion and compressing chambers located in the same cylinder.

The improved packing device, herein disclosed is not claimed in this application for patent, but forms the subject-matter of an application filed by me on January 4, 1912, Serial No. 669,306.

In accordance with the provisions of the patent statutes, I have described the principle of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is merely illustrative and that the invention can be carried out in other ways.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:—

An internal combustion engine of the two-cycle type, having cylinders arranged in pairs, each embracing a compressing chamber and a combustion chamber, with pistons in each cylinder working in synchronism, a valve casing connected to the two cylinders of each pair, each compressing chamber having a port communicating through a cross-over passage with the combustion chamber of the opposite cylinder, said ports being controlled by piston valves sliding within the valve casing, two piston valves sliding within the valve casing, a rigid connection between the valves, and means for sliding the valves as a unit.

This specification signed and witnessed this seventh day of June, 1911.

JOHN WILLOUGHBY.

Witnesses:
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