J. E. COCHRAN.

INTERNAL COMBUSTION ENGINE.

LICATION FILED MAY 18, 1911.

1,103,488.

Patented July 14, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

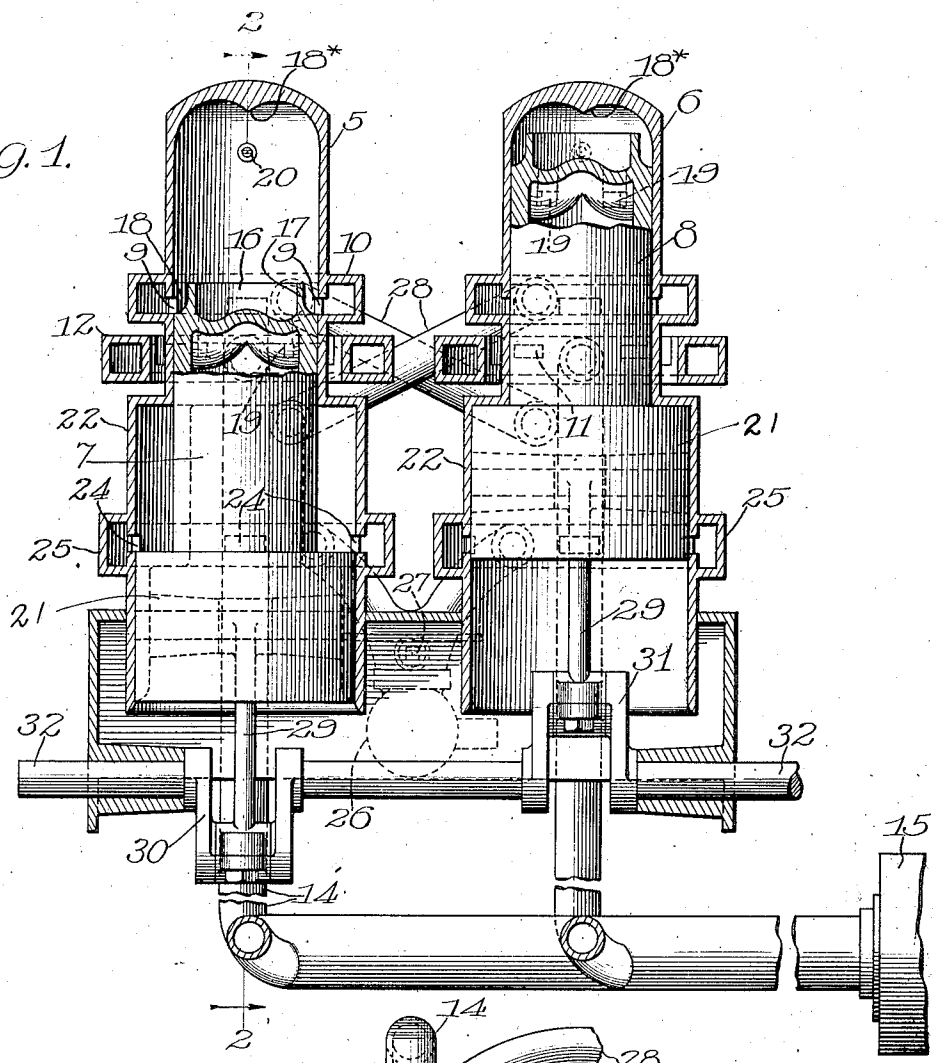
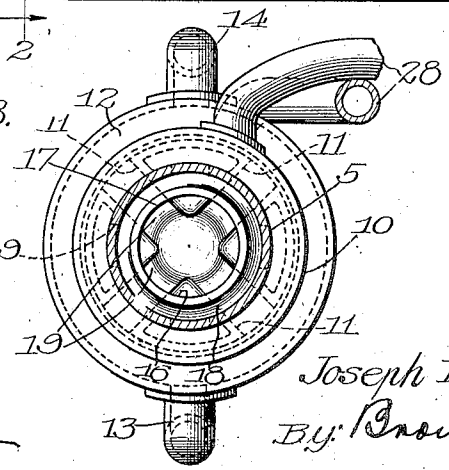


Fig. 3.



Witnesses:
G. W. Tomarus Jr.
Nina J. Halsne

Inventor:
Joseph E. Cochran
By: Brown & Hofstens
Attys.

J. E. COCHRAN.

INTERNAL COMBUSTION ENGINE.

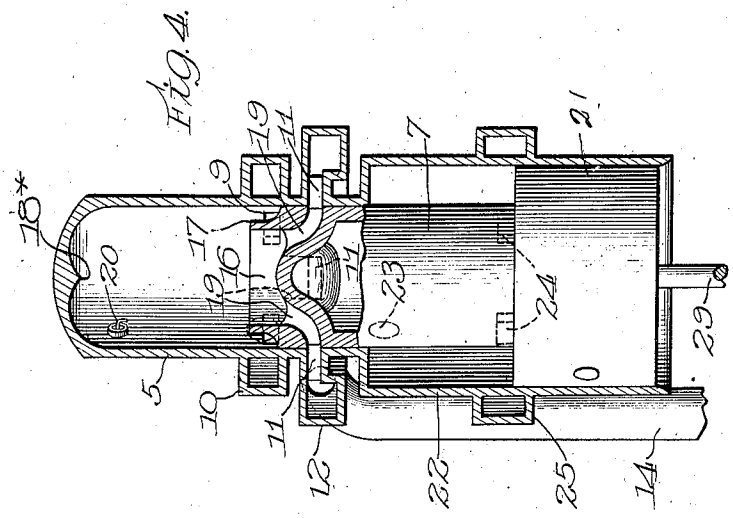
APPLICATION FILED MAY 18, 1911

1,103,488

Patented July 14, 1914.

2 SHEETS—SHEET 2.

Fig. 4.



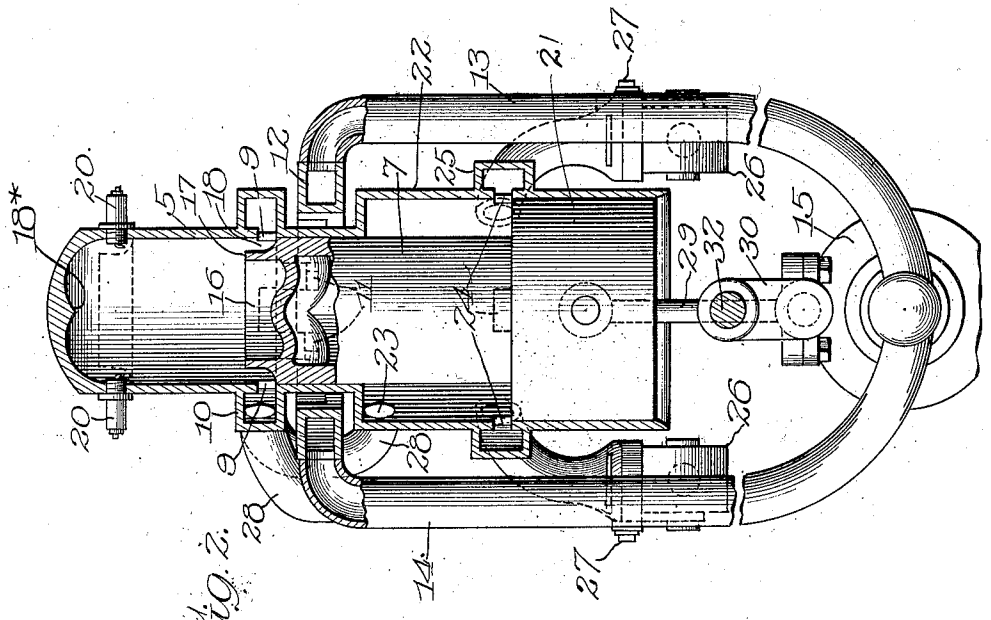


Fig. 2.

Witnesses:
G. W. Dunnavus Jr.
Nina J. Halsne

Inventor:
Joseph E. Cochran
By: Brown & Hofbauer
Attys.

UNITED STATES PATENT OFFICE.

JOSEPH E. COCHRAN, OF ELKHART, INDIANA, ASSIGNOR TO STUART W. COCHRAN AND JOSEPH T. COCHRAN, BOTH OF ELKHART, INDIANA.

INTERNAL-COMBUSTION ENGINE.

1,103,488. Specification of Letters Patent. Patented July 14, 1914.

Application filed May 18, 1911. Serial No. 627,968.

To all whom it may concern:

Be it known that I, JOSEPH E. COCHRAN, a citizen of the United States, residing at Elkhart, in the county of Elkhart and State of Indiana, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a full, clear, and exact specification.

This invention relates more particularly to the two-cycle type of internal combustion engines. In my pending application No. 565,176, filed June 6, 1910, I have shown, described and claimed a two-cycle type of engine embodying certain improvements in the means for facilitating the introduction of the charge of gas, and the outlet of the burnt gases of exhaust, one of the features of which is an apertured piston having one or more lateral ports adapted to register with one or more exhaust ports formed at different points around the circumference of the cylinder, so that while the new charge of gas is entering the cylinder, the old charge or burnt gases may escape in a different path through the piston. Substantially the same feature of improvement is shown in the present application, though not claimed, excepting in combination with the improvements of the present invention, which relate more particularly to the means for compressing the charge and introducing the same into the explosion space of the cylinder.

The primary object of my present invention is to provide an improved valveless form of internal combustion engine in which the charge is introduced under more or less compression produced by a shouldered or compressor piston moving in unison with the working piston in a special cylinder or chamber provided therefor.

Another object of this invention is to provide an improved valveless form of two-cycle internal combustion engines of the plural cylinder type, in which the charge for one engine or cylinder is introduced by the compressor piston of the other cylinder, thus reducing liability of premature explosion.

Other objects of the invention will appear from the subjoined description and the accompanying drawings forming part of this specification.

The invention consists in the features of improvement and combinations set forth in the claims.

In the said drawings—Figure 1 is a diagrammatic vertical section of an engine consisting of two cylinders and their complement of appropriate parts. Fig. 2 is a vertical transverse section taken through one of the cylinders in Fig. 1 on the line 2—2. Fig. 3 is a plan section of one of the cylinders; and Fig. 4 is a vertical section of the parts shown in Fig. 3.

5 and 6 are the working cylinders, and 7 and 8 are the working pistons in the cylinders respectively. Each cylinder is provided with means for admitting a charge of explosive mixture, preferably consisting of a plurality of intake ports 9, arranged at intervals around the circumference of the cylinder and opening directly into a surrounding manifold chamber or passage 10. Each working cylinder is also provided with means for exhausting the burnt gases, preferably consisting of a plurality of exhaust ports 11, which are arranged in a different plane extending transversely to the axis of the cylinder from the plane in which the intake ports 9 are situated, but the exhaust ports 11 are arranged in lines extending parallel with the axis of the cylinder between the intake ports 9 and in line with the space between said intake ports. The exhaust ports 11 are also connected with a surrounding manifold chamber or passage 12, and this is preferably provided with a plurality of outlets, which may be located on opposite sides of the engine, as shown in Fig. 2, and connected by pipes or passages 13—14 with a single silencer 15, thus giving the exhaust freedom of outlet from manifold chamber 12, and avoiding the possibility of back pressure.

The inner end of the working piston in each of the working cylinders is provided with a recess 16, and this is surrounded by an annular flange 17, forming an annular space 18 with the wall of the cylinder. When the piston is at the outer end of its stroke, or at a point where it is when it is time to admit the new charge, this annular flange, whose outer face is rounded, comes directly opposite the intake ports 9 and forms a deflector for driving the incoming charge upwardly in streams or a tubular current surrounding the flange 17, and re-

maining more or less adjacent to the walls of the cylinder until the upper end of this tubular current strikes the dome of the cylinder, which latter is curved, as shown in Fig. 4, and if desired may be provided with a central protuberance 18* adapted to direct the edges of the tubular current in a downward direction at the center of the cylinder, thereby forming a downward current surrounded by the walls of this upward tubular current, and which downward current serves to drive the burnt gases into the recess or cavity 16 of the piston, whence they discharge through one or more exhaust ports 19 extending laterally through the sides of the piston in register with the exhaust ports 11 in the cylinder. The exhaust ports 19, however, are so proportioned and arranged that they pass between the intake ports 9 and do not overlap the latter, and as a consequence the exhaust is prevented from taking place until the ports 11—19 come into register. The ports may be so proportioned and arranged that the cylinder will be sufficiently relieved of the hot gases before the intake ports 9 are uncovered by the piston, to avoid the possibility of backfiring in the manifold chamber 10; but if desired the ports 9 may be guarded inside the manifold chamber by means of perforated guards or shields composed of wire netting, according to a method well known in the art.

20 are the igniters or spark plugs, one or more of which may be employed according to whether the single or dual system of ignition be used. In either event, however, it is desirable to locate the igniter at the side of the cylinder in position to be overlapped by the annular flange 17 when the latter rises during the upward stroke of the piston, because by this arrangement it will be seen the igniter points or electrodes of the spark plug will be enveloped by the fresh gases contained in the annular space 18, and the possibility of "missing" on account of dead gases being contiguous to the igniter at the time when the ignition should occur will be avoided, even though all of the dead gases might not have been driven out of the cavity 16.

Secured to each of the working pistons 7—8, in coaxial relation thereto, is a compressor piston 21, which is considerably larger in diameter than the working piston, so as to form a shoulder for drawing in and compressing the charge in a compressor chamber 22, which is of cylindrical form and arranged in coaxial relation to the working cylinder, one of these compressor chambers being of course provided for each of the working cylinders. Each compressor chamber 22 is provided with a discharge port 23 and a means for admitting the explosive mixture or charge, preferably consisting of a plurality of inlet ports 24, opening into a manifold chamber 25, surrounding the compressor chamber and connected to a carbureter 26. One of these carbureters may be—and preferably is—located at each side of the manifold chamber 25, and they are of equal capacity, each capable of supplying the engine with the requisite amount of explosive mixture, but provided with means (such as valve or cutoff 27) whereby either may be shut off when the other is working, thus providing against loss of time in the event of accident to either carbureter. The discharge port 23 of one compressor chamber is connected to the intake ports of the working cylinder belonging to the other compressor chamber by a passage 28, one for each cylinder, which are illustrated on the drawings diagrammatically for the sake of simplicity, so that while the working piston 7, for example, is making its compression stroke or moving inwardly, the compressor piston 21 belonging to that working piston will be forcing a charge out of the compressor chamber in which it works into the passage 28 and the manifold passage 10 of the adjacent cylinder, thus storing the explosive mixture under compression in these passages, ready to expand into the working cylinder 8 the instant the piston in that cylinder uncovers the intake ports 9 thereof, whereupon the charge ascends along the walls of cylinder 8 in the form of a hollow or tubular current, as before explained. When the compressor piston which is associated with the working piston 7 again descends or moves outwardly in its compressor chamber 22, the intake ports 9 of cylinder 6 will be covered by the piston 8, and consequently a partial vacuum will be created in compressor chamber 22 under the cylinder 5. As the compressor piston 21 uncovers the inlet ports 24, however, this partial vacuum will be supplied by the explosive mixture drawn in from one or the other of the carbureters and the manifold 25, thus filling compressor chamber 22 with air and combustible vapor, which is forced therefrom by the next upward or inward stroke of the compressor piston through the discharge port 23, as before explained.

The pistons belonging to one side of the engine are of course operatively connected with those belonging to the other side in the usual or some suitable way, the usual way being to connect them by connecting rods 29 to cranks 30—31, of crank shaft 32 illustrated diagrammatically, and the engine being a two cycle engine these cranks are set opposite one another or arranged substantially 180 degrees apart, as the ignition occurs in each cylinder every time its piston reaches the end of its inward or upward stroke, or is about to do so, the point of ignition being controlled, as usual, by

any of the well known devices employed for that purpose.

With an engine thus constructed it will be seen that the port area, with respect to both the intake and exhaust, is very liberal and considerably greater than is usual, and this increased area is made possible by the use of the manifold chambers and the particular arrangement of the intake ports with relation to the exhaust ports in association with the piston having an outlet therethrough for the exhaust. It will also be seen that by the employment of outlet through the piston for the exhaust and the surrounding deflector for the incoming charge, two defined passages are established for the fresh charge and the burnt gases, thus giving a further advantage, in addition to the liberal exhaust port area, in that it relieves the cylinder quickly of the heat and burnt gases, and reduces the liability of premature explosion to the minimum. It will also be seen that by the employment of the surrounding or annular deflector flange 17, the very serious objection to two cycle engines of blowing the lubricating oil out through the exhaust when the edge of the piston passes the exhaust ports, is entirely overcome, as the annular space or cavity 18 serves to retain the lubricating oil which runs down the walls of the cylinder, and prevents the same from reaching the exhaust ports.

What I claim is:

1. In a two-cycle internal combustion engine, the combination of a pair of working cylinders, each having fuel intake and exhaust ports and independent manifold chambers common to said intake and exhaust ports, a compressor chamber associated with each of said working cylinders, having fuel inlet and discharge ports arranged in different planes, said discharge port in each compressor chamber being connected with the intake manifold of the working cylinder associated with the other compressor chamber, a manifold common to the inlet ports of each compressor chamber, a carbureter common to the manifolds of the compressor chamber inlet ports, a working piston in each working cylinder, and a compressor piston connected therewith in each compressor chamber for covering and uncovering the fuel inlet ports thereof, and drawing a charge of fuel thereinto through such inlet ports, and expelling the charge through the discharge port of such chamber, two connected cranks, one connected with one working piston and its associated compressor piston, and the other with the other working piston and its associated compressor piston, whereby the piston connected with one crank will maintain a definite relation to those connected with the other, the compressor piston of one crank being so disposed with relation to the working piston of the other crank that it will intercept communication between the inlet and discharge ports of its chamber when the inlet port of the other compressor chamber is uncovered by its compressor piston.

2. In a two-cycle internal combustion engine, the combination of a working cylinder, having a plurality of intake ports situated at intervals around its periphery, and a plurality of exhaust ports situated at intervals around its periphery in a plane removed from the plane in which said intake ports are situated, and arranged respectively in lines parallel with the axis of the cylinder and extending between said intake ports, a working piston in said cylinder having a recessed end and reduced in external diameter, a plurality of lateral ports connected with such recess and adapted to register with said exhaust ports and to be covered by the spaces between said intake ports during a portion of the stroke of the piston.

3. In an internal combustion engine, the combination of a working cylinder, having a plurality of intake ports, a manifold forming a common chamber connected with said ports, a plurality of carbureters of equal capacity having communication with said manifold chamber, a working piston in said cylinder, and means for exhausting the burned gases from said cylinder.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 6th day of May A. D. 1911.

JOSEPH E. COCHRAN.

Witnesses:

MARIE SCOTT,

M. W. ROSENHAUER.