J. J. McGUIRE.

TWO CYCLE ENGINE.

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1,014,078.

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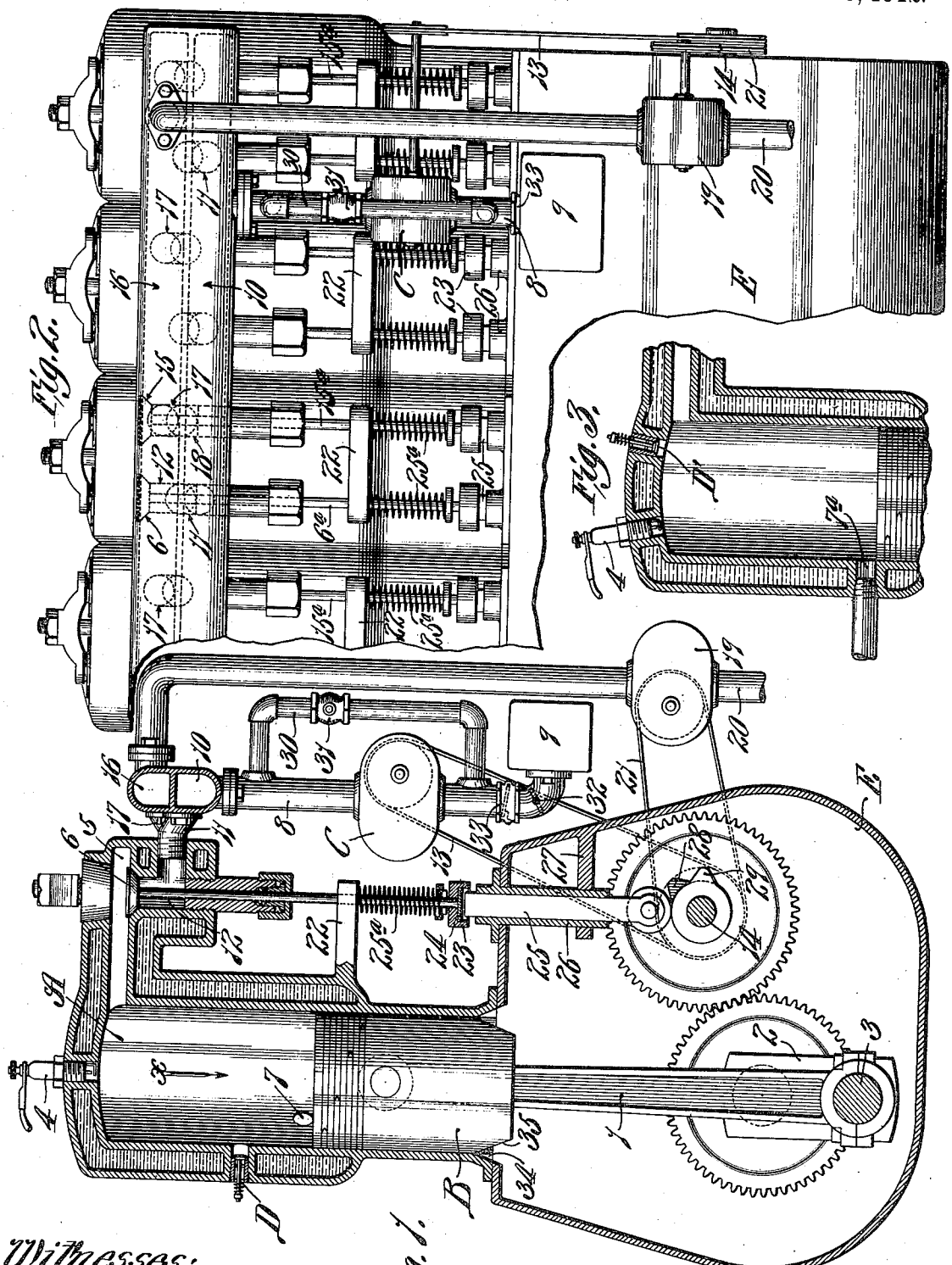

Fig. 1.

Witnesses:
Geo. P. Ladson
Wells L. Church.

Inventor,
James J. McGuire.
By Paul Bakewell Atty.

UNITED STATES PATENT OFFICE.

JAMES J. McGUIRE, OF ST. LOUIS, MISSOURI.

TWO-CYCLE ENGINE.

1,014,078. Specification of Letters Patent. Patented Jan. 9, 1912.

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To all whom it may concern:

Be it known that I, JAMES J. McGUIRE, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Two-Cycle Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to internal combustion engines, and particularly to two-cycle engines.

It is well-known that in the ordinary two-cycle engine the combustible gas or mixture is introduced into the crank case of the engine before it is admitted to the cylinder so that it will be partially compressed on the power stroke of the piston and forced out of the crank case into the cylinder. In view of the fact that the power stroke of the piston is utilized to force the gas from the crank case into the cylinder, it is necessary to have the inlet port of the cylinder open at the same time the exhaust port of the cylinder is open. Consequently, some of the combustible gas which is forced into the cylinder on the power stroke of the piston mingles with the burned gases and escapes through the exhaust port before the piston returns or starts on its compression stroke. This, of course, is a very objectionable feature as a great deal of fuel is wasted and some of the burned gases remain in the cylinder, and another objectionable feature of such engines is that the gas in the crank case becomes dirty and also escapes from the crank case if the bearings of the crank shaft are not perfectly tight.

One object of my invention is to provide a two-cycle engine which does not have the objectionable features above referred to, and to this end I have designed a two-cycle engine in which the combustible gas or mixture is forced directly into the cylinder under pressure instead of being first admitted to the crank case and then forced into the cylinder, thereby permitting the inlet port of the cylinder to be closed when the exhaust port is open and also preventing the gas from coming in contact with dirty lubricating oil or other foreign matter before it enters the cylinder.

Another object of my invention is to provide a two-cycle engine which is so designed that the cylinder will be thoroughly scavenged at each cycle of operations so as to drive out all of the burned gases, this being accomplished by means of an air valve which opens automatically and admits air into the cylinder.

Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a vertical sectional view of a four-cylinder two-cycle engine constructed in accordance with my invention; Fig. 2 is a front elevational view of the engine shown in Fig. 1; and Fig. 3 is a detail vertical sectional view illustrating a slightly modified form of my invention.

While I have herein shown my invention embodied in a four-cylinder engine, I wish it to be clearly understood that my invention is applicable to internal combustion engines provided with one cylinder or a plurality of cylinders.

Referring to the drawings which illustrate a four-cylinder engine, A designates the cylinders of the engine, and B designates the pistons in said cylinders which are connected by means of links 1 to crank arms 2 on the crank shaft 3. Each cylinder is provided with an ignition device 4 and an inlet port 5 in which an inlet valve 6 is seated, said valve being mechanically operated and so timed that it is opened when the exhaust port 7 of the cylinder is closed. The combustible gas or mixture is forced into the cylinder under pressure by means of a blower, pump or other suitable device C which is arranged in a supply pipe 8 that leads from the carbureter 9 to a gas manifold 10 with which the inlet ports 5 of the various cylinders communicate.

In the construction shown in Fig. 1 conduits 11 lead from the gas manifold to gas inlet chambers 12 in which the inlet valves 6 are seated, but I wish it to be clearly understood that it is immaterial, so far as my broad idea is concerned, how the gas is conducted from the source of supply to the cylinders or what particular means is used for partially compressing the gas and forcing it in the cylinders. Furthermore, while I have illustrated the pump or blower C as being driven by a belt 13 that passes around the pulley on the cam shaft 14, it will be obvious that various other means could be employed for driving the blower or device used for partially compressing the gas and forcing it into the cylinder.

The means for scavenging the cylinder so as to drive out the burned gases consists pri-

marily of an inwardly opening air valve that operates automatically and permits a charge of fresh air to be drawn into the cylinder. In some types of engines, namely, high-speed engines which comprise a large number of cylinders, it is preferable to employ a vacuum pump or other suitable suction device for creating a partial vacuum in the cylinder so as to cause said air inlet valve to open and thus cause the charge of fresh air to rush through the cylinder, but in other types of engines, namely, engines which run at a comparatively slow speed and which have only a few cylinders that exhaust into the open atmosphere or into a muffler of large enough dimensions to overcome any tendency of back pressure, this vacuum pump or suction device can be omitted and the partial vacuum that is produced in the cylinder on the power stroke of the piston can be relied upon to cause the automatic air inlet valve to open.

In Figs. 1 and 2 I have illustrated an engine that is provided with a vacuum pump or device for creating a partial vacuum in the cylinders, and in Fig. 3 I have illustrated an engine in which the partial vacuum produced in the cylinder by the power stroke of the piston is relied upon to cause the automatic air inlet valve to open. In the form of my invention shown in Fig. 1 an inwardly opening automatic air valve D is arranged in the side wall of the cylinder at a point between the exhaust port 7 and the upper end of the cylinder, and an auxiliary exhaust valve 15, shown in dotted lines in Fig. 2, is arranged adjacent the upper end of the cylinder in an auxiliary exhaust port which communicates with an auxiliary exhaust manifold 16, said manifold being connected by conduits 17 with auxiliary exhaust chambers 18 of substantially the same construction as the air inlet chambers 12, previously described. Each cylinder of the engine is provided with an air inlet chamber 12 and an auxiliary exhaust chamber 18 which is located at one side of the inlet chamber 12, said chambers being separated from each other by means of a partition. A partial vacuum is created in this auxiliary exhaust manifold 16 by means of a vacuum pump or other suitable device 19 that communicates with a pipe 20 which leads to said manifold, said pump being driven by means of a belt 21 which passes over a pulley on the cam shaft 14 of the engine.

The inlet valve 6 and the auxiliary exhaust valve 15 of each cylinder are of substantially the same construction, and said valves are provided with stems 6^a and 15^a that pass downwardly through stuffing boxes 6^b, 15^b and stationary guide lugs 22. Said valve stems are provided at their lower ends with inverted cup-shaped steel caps 23 for holding the usual pads or bumpers 24 against which the upper ends of the valve-lifters 25 bear and said valve-lifters are slidingly mounted in cages 26 that are supported by the top wall of the crank case E of the engine and integral lugs 27 on the front wall of said crank case, as shown in Fig. 1. The cam shaft 14 is provided with a set of cams 28 which actuate the valve-lifters 25 with which the auxiliary exhaust valves 15 coöperate, and also a separate and distinct set of cams 29 which actuate the valve-lifters 25 with which the gas inlet valves 6 coöperate, the set of cams 28 being so arranged that the auxiliary exhaust valves open in advance of the gas inlet valves. Coiled expansion springs 25^a are mounted on the stems of the inlet valves and auxiliary exhaust valves between the guide lugs 22 and the steel caps 23 on the lower ends of said valve stems so as to close said valves and hold them seated. A by-pass 30 is preferably arranged around the blower C, and a relief valve 31 is arranged in said by-pass so as to permit the gas which has been compressed to travel back through the by-pass in case the pressure in the gas manifold 10 exceeds a certain degree, said relief valve 31 being so designed that it will open automatically when the gas in the manifold 10 or in the upper part of the by-pass reaches a certain pressure. A throttle valve 32 is arranged between the carbureter 9 and the blower C so as to control the supply of combustible gas to the engine, and a check valve 33 is arranged between said throttle valve and the carbureter so as to prevent the gas which circulates through the by-pass from returning to the carbureter.

On the power stroke of the engine, namely, when the pistons move in the direction indicated by the arrow *x* in Fig. 1, the gas inlet valves 6 and auxiliary exhaust valves 15 will remain closed and when the pistons uncover the main exhaust ports 7 most of the burned gases in the cylinders will escape through said main exhaust ports. On the return stroke or compression stroke the auxiliary exhaust valves 15 open after the pistons have closed the main exhaust port 7, thereby establishing communication between the cylinders and the auxiliary exhaust manifold 16. The suction which is created in the upper ends of the cylinders when the auxiliary exhaust valves open causes the air inlet valves D to open automatically and thus permit blasts of air to rush through the cylinders and scavenge same or force the burned gases into the auxiliary exhaust manifold 16 from which said burned gases escape through the conduit 20. As soon as the auxiliary exhaust valves close the gas inlet valves 6 open and thus permit the partially compressed gas in the gas manifold 10 to flow into the cylinders, the charge that is admitted to each cylinder being further com-

pressed by the compression strokes of the pistons. The explosion of the charges in the cylinders causes the pistons to move in the opposite direction, and when the pistons uncover the main exhaust ports 7 most of the burned gases will escape from the cylinders. While it is desirable to use a vacuum pump or other suction device for creating a partial vacuum in the cylinders of engines which have a large number of cylinders and travel at a high speed, still with other types of engines, namely, those which have only a few cylinders and travel at a slow speed, a suction device or exhauster is not absolutely necessary to the successful operation of the engine.

In Fig. 3 I have illustrated a portion of an engine of the type last referred to, said engine being provided with means of substantially the same construction shown in Fig. 1 for partially compressing the gas and forcing it into the cylinder, and also provided with an inwardly opening automatic air valve D′ which is arranged at the upper end of the cylinder preferably in the head of the cylinder. In such a structure the burned gases escape freely from the exhaust port 7^a when the piston completes its power stroke, and as said gases cool rapidly a partial vacuum will be created in the cylinder which causes the air inlet valve D′ to open automatically and thus permit a charge of fresh air to rush through the cylinder and scavenge same or force out any burned gases which remain therein, said air inlet valve returning automatically to its closed position as soon as the piston covers the exhaust port 7^a on its compression stroke.

In addition to the desirable features above set forth, my engine also comprises other features which make it a decided improvement on the two-cycle engines heretofore in use. One of these desirable features consists of pistons and cylinders which are so designed that comparatively long crank arms 2 can be used on the crank shaft and thus obtain a long stroke, the cylinders being provided at their lower ends with grooves 34 and the pistons being provided at their lower ends with slots 35 which provide a clearance for the piston-operating links 1 when the crank arms are midway their dead center positions.

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

1. A two-cycle internal combustion engine provided with a plurality of cylinders, gas inlet valves for said cylinders, means for opening said valves at each cycle of operations when the exhaust ports of the cylinders are closed, a gas manifold that communicates with the inlet ports of said cylinders, means for partially compressing combustible gas and supplying it to said manifold, means for maintaining a certain pressure in said manifold when the engine is in operation, an auxiliary exhaust manifold, auxiliary exhaust valves which open and close at each cycle of operations, and means for creating a partial vacuum in said exhaust manifold.

2. In a two-cycle internal combustion engine, a gas manifold, a compressor arranged between said manifold and the source of supply for partially compressing the gas that is introduced into said manifold, a by-pass arranged around said compressor, and a valve in said by-pass.

3. In a two-cycle internal combustion engine, a gas manifold, a compressor arranged between said manifold and the source of supply for partially compressing the gas that is introduced into said manifold, a by-pass arranged around said compressor, a relief valve in said by-pass that opens automatically when the pressure in the manifold exceeds a certain degree, and a check valve arranged between said by-pass and the source of supply.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this sixth day of June, 1910.

JAMES J. McGUIRE.

Witnesses:
WELLS L. CHURCH,
GEORGE BAKEWELL.