Dec. 4, 1923. 1,476,255

T. KASHIWABARA

GAS ENGINE

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Fig. 2.

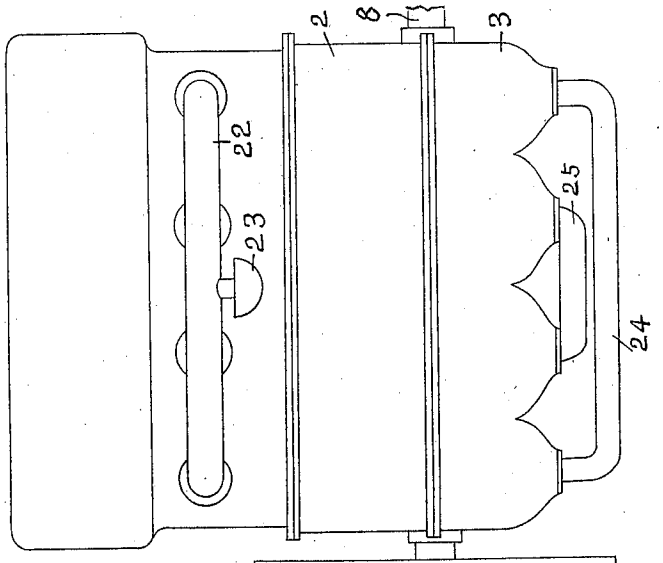
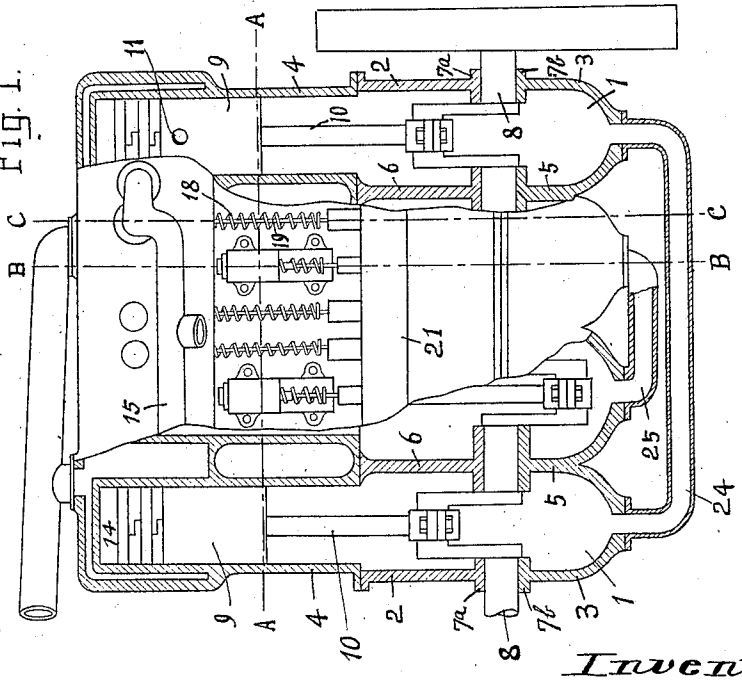


Fig. 1.



Inventor
T. Kashiwabara
By Marks & Clark
Attys.

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Fig. 5.

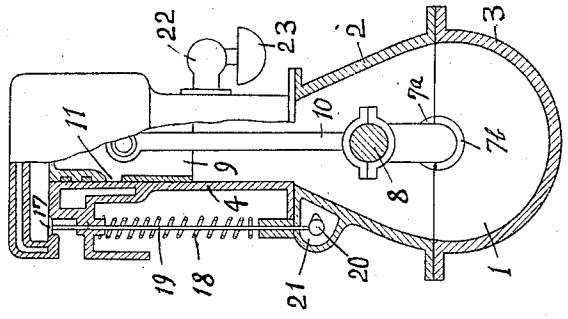


Fig. 4

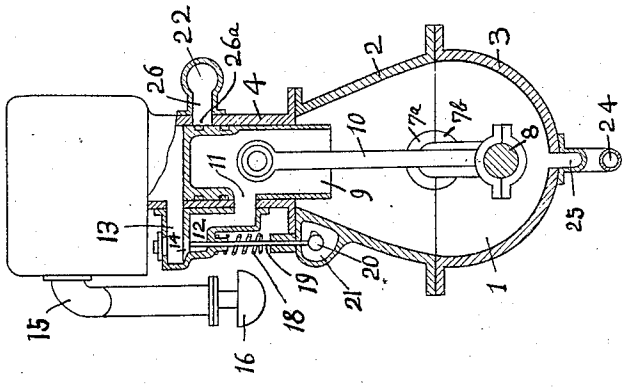
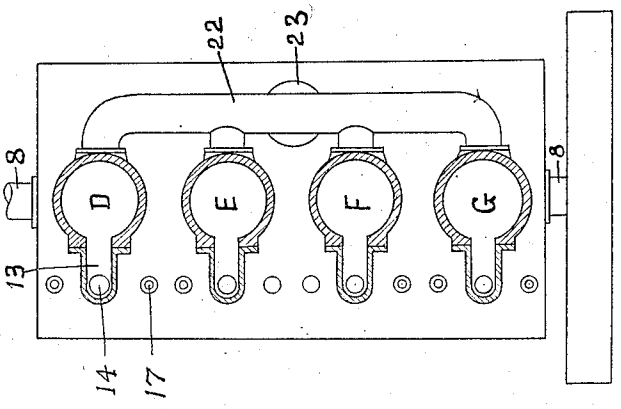


Fig. 3.



Inventor
T. Kashiwabara,
By Marks & Clerk
Attys.

Patented Dec. 4, 1923. 1,476,255

UNITED STATES PATENT OFFICE.

TSUNEJIRO KASHIWABARA, OF MII-GUN, FUKUOKA-KEN, JAPAN.

GAS ENGINE.

Application filed April 28, 1921. Serial No. 465,114.

To all whom it may concern:

Be it known that I, TSUNEJIRO KASHIWABARA, a subject of the Empire of Japan, residing at No. 288 Mii-Machi, Mii-Gun, Fukuoka-Ken, Japan, have invented certain new and useful Improvements in Gas Engines, of which the following is a specification.

My invention relates to gas engines with double charging system more particularly for the four cycle type of gas engine and the objects of my invention are:—

Firstly, to reduce the size of gas engines by increasing the volume of the charge of mixture, such object being attained by utilizing the suction and compression alternately caused in the cylinders and crank case compartments by the upward and downward strokes of the pistons, thereby increasing the charge to nearly three times that of a gas engine hitherto known. Thus the explosive force, and consequently, actual horse power of my engine will be very much greater than that of ordinary gas engines;

Secondly, to have all the crank case compartments always full with mixture, thereby cooling the pistons and making it possible to design powerful engines without increasing the number of cylinders but by enlarging the diameter of cylinders to a certain extent;

Thirdly, to provide gas engines which are simple in construction, easy to repair and less liable to disorders; and

Fourthly, to avoid collection of the products of combustion at the cylinder heads and valves by mixing gas and air thoroughly by upward and downward motions of the pistons in the crank case compartments before entering into the firing chamber and thus causing perfect combustion.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination, and arrangement of parts and portions as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon which form a part of this specification, in which:

Fig. 1 is a side elevational view of a four cylinder four cycle type gas engine, embodying my invention, parts being in section to facilitate the illustration;

Fig. 2 is the opposite side elevational view of the same;

Fig. 3 is a transverse sectional view through A—A of Fig. 1;

Fig. 4 is another sectional view through B—B of Fig. 1; and

Fig. 5 is a third sectional view through C—C of Fig. 1.

Similar characters of reference refer to similar parts and portions throughout the several views of the drawings.

The crank case compartments 1 are formed from an upper casing 2 and a lower casing 3, and to the upper casing 2 is suitably jointed a cylinder 4. To prevent mixture flowing from one to another, crank case compartments are separated with partitions 5 and 6. These partitions and the joint between the casings 2 and 3 are provided with gaskets for forming a tight joint between the separate crank case compartments and between these compartments and the outside.

Partitions 5 and 6 are provided with bearings 7^a and 7^b in which is journaled the crank shaft 8, and pistons 9 which act in cylinders 4 are connected to the crank shaft 8 by means of connecting rods 10.

The pistons 9 are cupshaped, with a port 11 on one side. On the outside of each cylinder 4 is provided a passage 12 which opens into the cylinder 4 at a place where it corresponds with the port 11 of the piston 9 as it is at the lower dead point, and the other end of the said passage 12 communicates with a passage 13 which leads to the firing chamber of that cylinder, provided with the second intake valve 14 between the said two passages. On the top part of the cylinders 4 is provided the first intake manifold 15 which is connected with the first carburetor 16, and the said manifold 15 communicates with each cylinder 4, provided with the first intake valve 17 between the said manifold 15 and the cylinder. Intake valves 14 and 17 are closed by means of springs 18 fixed to valve stem 19, and are opened by means of a cam on a cam shaft 20 mounted in a casing 21 provided on the outside of the crank case compartments 1.

Along a side of the cylinders 4 is provided the second intake manifold 22 which is connected with the second carburetor 23. The said manifold 22 communicates with each cylinder 4 by an extending portion 26 at such a position that the port 26^a will be opened when the piston 9 is at its upper dead point, and closed as it comes downward for being

intercepted by the piston itself. Thus when the piston 9 reaches upper dead point a pair of the crank case compartments at a time will suck in the mixture by the vacuum formed by two pistons from the second carburetor 23 through the second intake manifold 22 and when it comes downward, it will close the port 26ª and then force the mixture of the crank case compartments by the pressure of the pistons 9 into one of the combustion chambers as will be described later.

According to my invention, a pair of the pistons operate in unison, and the crank case compartments of each pair are connected by a passage. As shown in the drawings, one pair is connected with the passage 24 and the other pair by the passage 25. In the accompanying drawings a four cylinder engine is shown, the first (D) and fourth (G), and the second (E) and third cylinder (F) making pairs. If the number of cylinders is six, then the first and sixth, the second and fifth, and the third and fourth should be connected with the passages.

To explain how the engine of my invention works, take a pair of cylinders, say the first (D) and fourth (G). When pistons rise and reach their upper dead points, the extending portion 26 will be opened and mixture will be sucked into both crank case compartments. Suppose, ignition takes place in one of the firing chambers. The extending portion 26 will be closed by the pistons coming downward, and the intake valves 17 and 14 of the respective cylinder will be opened. The cam shaft 20 being so arranged that the intake valves 17 and 14 of each cylinder open only in charging stroke in certain limited time, first the valve 17 opens and it closes as soon as the piston port 11 aligns with the opening of the passage 12, and then the valve 14 opens. When the valve 17 of the cylinder opens, mixture will be sucked into the firing chamber of the cylinder from the first carburetor 16 through the first intake manifold 15. On the pistons further descending the valve 17 will be closed; and on the pistons arriving at their lower dead points at same stroke, the valve 14 will be opened, the port 11 of the pistons will align with the openings of the passages 12, and the mixture will be forced from both crank case compartments being compressed by the pistons through the passages 12 and 13 into the firing chamber which is already filled with some mixture drawn from the first carburetor 16 through the first intake manifold 15. The charge is therefore nearly three times that of an ordinary four cycle engine, and it would explode with a greater force corresponding to the amount.

The working of other pairs of cylinders is exactly the same as that of the pair just described.

Though I have shown and described a particular construction, combination and arrangement of parts and portions, I do not wish to be limited to this particular construction, combination and arrangement but desire to include in the purview of my invention the construction, combination and arrangement substantially as set forth in the appended claims.

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

1. A multiple cylinder gas engine of the type referred to having in combination, a plurality of cylinders, a crank shaft, pistons arranged in the cylinders and so connected to the crank shaft that certain of said pistons move in unison, a crank case with a separate compartment for each cylinder, a conduit connection between the crank case compartments of cylinders in which the pistons operate in unison, and a dual system of independent fuel intake manifolds extending lengthwise of the engine and communicating respectively with each cylinder head and each crank case compartment.

2. A multiple cylinder engine as claimed in claim 1 in which the communication of the crank case intake manifold with the separate crank case compartments is governed by the engine pistons.

3. A multiple cylinder engine as claimed in claim 1 in which each cylinder is provided with ports communicating with the cylinder head intake manifold and the corresponding crank case compartment respectively, said ports being valve controlled in such manner that combustible fuel is admitted to the cylinders only during the charging stroke of their respective pistons.

4. A multiple cylinder engine as claimed in claim 1 in which the crank case fuel intake manifold is provided with ports open to the crank chambers only when their respective pistons reach the upper dead point.

In testimony whereof I affix my signature in presence of two witnesses.

TSUNEJIRO KASHIWABARA.

Witnesses:
KEIICHI KOJIMA,
TATEKI MATSUMOTO.