F. H. SUMMERIL.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 19, 1911.

1,145,820.

Patented July 6, 1915.

3 SHEETS—SHEET 1.

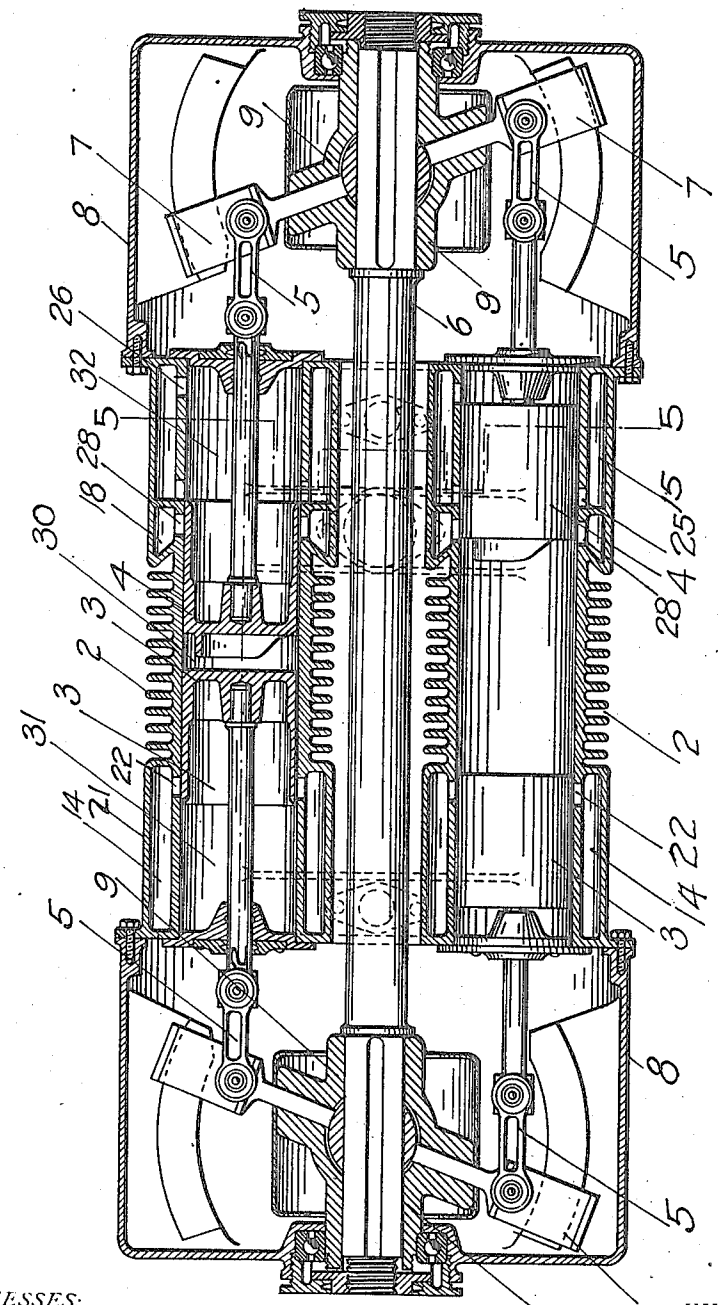

FIG. 1

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3 SHEETS—SHEET 2.

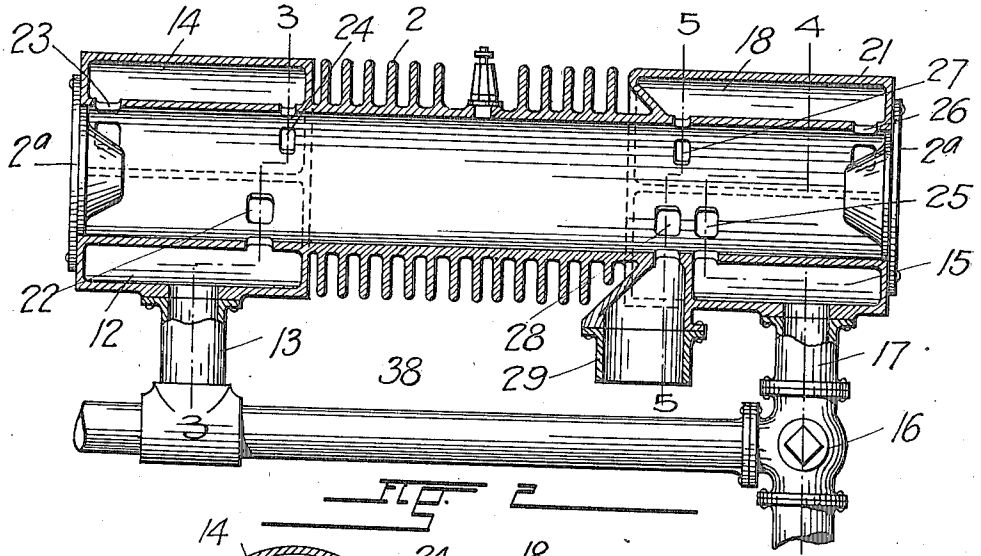

Fig. 2.

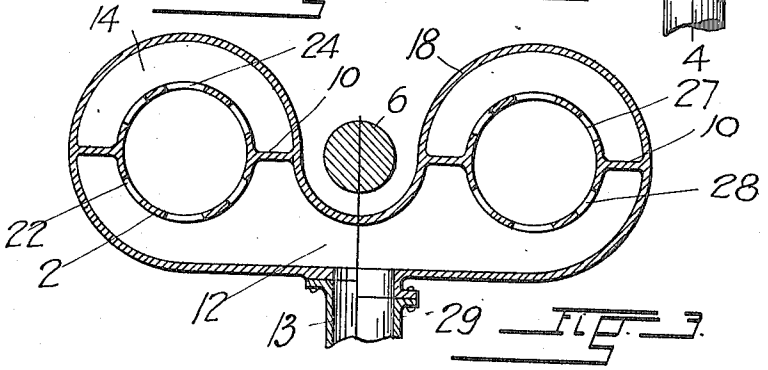

Fig. 3.

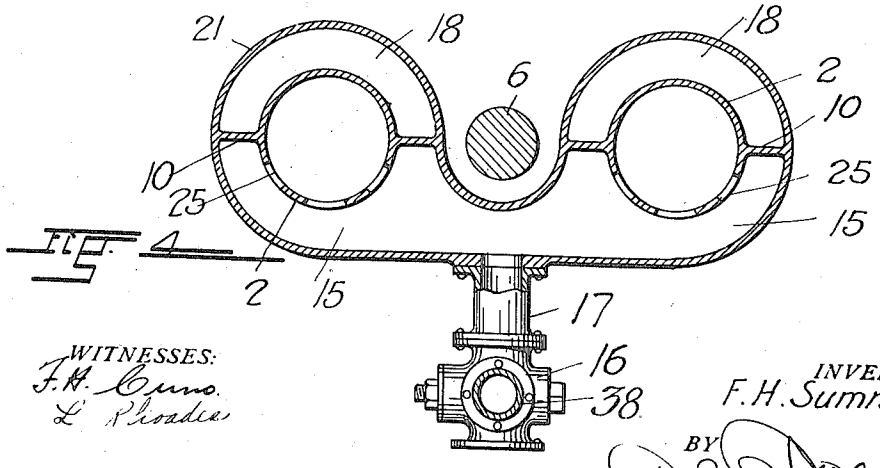

Fig. 4.

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3 SHEETS—SHEET 3.

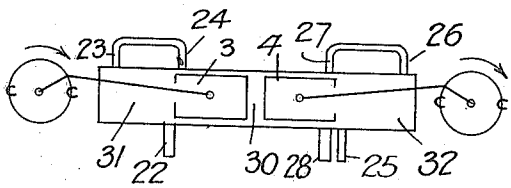

Fig. 5.

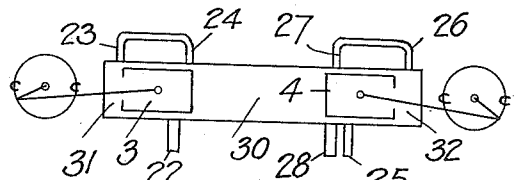

Fig. 9.

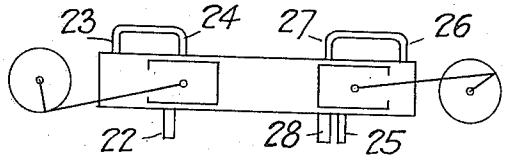

Fig. 6.

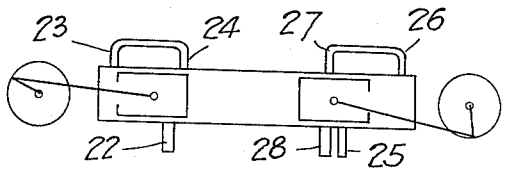

Fig. 10.

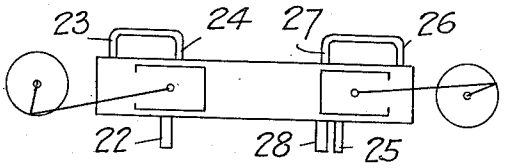

Fig. 7.

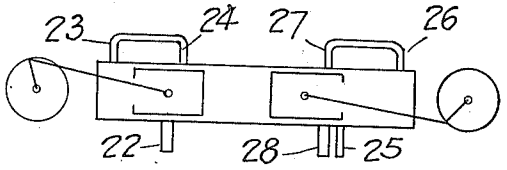

Fig. 11.

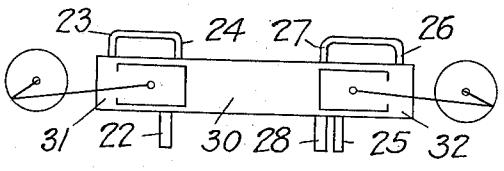

Fig. 8.

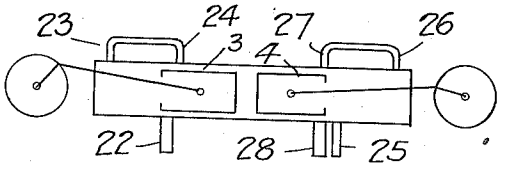

Fig. 12.

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UNITED STATES PATENT OFFICE.

FRANK H. SUMMERIL, OF DENVER, COLORADO.

INTERNAL-COMBUSTION ENGINE.

1,145,820. Specification of Letters Patent. Patented July 6, 1915.

Application filed April 19, 1911. Serial No. 622,014.

To all whom it may concern:

Be it known that I, FRANK H. SUMMERIL, a citizen of the United States of America, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines of the type in which a pair of coactive pistons are disposed in one cylinder to be impelled in opposite directions by the explosion of an interposed charge of combustible gas.

The principal object of my invention is to provide an engine of simple construction in which the opposed pistons in each cylinder have a relatively unbalanced movement for the purpose of timing the opening and closing periods of the admission and exhaust ports so as to prevent waste of explosive mixture and to promote the thorough scavenging of the cylinder after each explosion.

The unbalanced movements of the pistons are attained by displacement of their crank-connections around the shaft, at an angle of less than one hundred and eighty degrees, whereby, when the two pistons have reached the end of their strokes, the said connections will extend approximately at equal angles at opposite sides of the dead centers in the crank-motion. By reason of their unbalanced movements, the pistons will be at all times, in a position to effectively carry the crank shaft past its dead centers and the speed of the engine will thus be materially increased.

Further objects of my invention reside in the provision of a "surge chamber" in which the mixture obtained from the carbureter or other source of supply, is stored before being admitted into the part of the cylinder between the two pistons, for the purposes of relieving the carbureter of the detrimental jerks to which it is ordinarily subjected, of promoting the intimate intermixture of the explosive gas and oxygen and of heating the mixture by contact with the outer wall of the cylinder before being admitted into the part thereof in which the explosion takes place.

Another object of the invention is to provide means whereby the charge admitted into the cylinder at one time may be increased to approximately twice its volume, by adjustment of a valve applied between the carbureter and the cylinder, whenever an increase in the load on the engine, demands a proportionately greater impellent force.

The above and other minor objects all of which will fully appear in the following description, are attained by the mechanism illustrated in the accompanying drawings in the various views of which like parts are similarly designated, and in which,

Figure 1 represents a longitudinal sectional view of the engine, Fig. 2, a longitudinal section taken through one of the cylinders along the line 2—2, Fig. 1, the pistons having been omitted to more clearly show the positions of the various ports. Fig. 3, a composite view showing transverse sections taken respectively along the lines 3—3 and 5—5, Fig. 2, Fig. 4, a transverse section along the line 4—4, Fig. 2, Figs. 5 to 12 inclusive, diagrammatic views showing the positions of the opposed pistons and their respective cranks, with relation to the exhaust and admission ports at the distinctive points in the cycle of operations.

The engine, as shown in the drawings, operating on the well known two-cycle principle, is composed of two cylinders 2, each provided with two opposed pistons 3 and 4, the stems of which are, by means of link-connections 5 operatively associated with double cranks on a shaft 6 which is rotatably mounted between the two cylinders, in parallel relation to their axes. The cranks are preferably constructed in the form of disks 7 which have an oscillatory movement in crank-cases 8, between two collars 9 which are keyed to the shaft 6. I wish it understood, however, that the crank connection between the shaft and the pistons may be made of a character different from that shown in the drawings, and, specifically, do not form part, of the present invention.

The two cylinders 2, which, as usual, are closed by means of heads 2^a, are provided at their ends with jackets which are horizontally divided into two compartments by means of partitions 10, the lower ones of these compartments at corresponding ends of the two cylinders are connected as shown in Figs. 3 and 4 of the drawings, the walls 21 of the jackets of the two cylinders being to this end cast integral with each other and the interposed connection. The connected lower compartments at one end of the cylinders, constitute a surge chamber 12 in

which the explosive mixture is stored before it is admitted into the spaces between the respective pistons in which the explosion takes place and which, by means of a conduit 13 is connected with the carbureter or other suitable supply of combustible gas. The separated upper compartments 14 at the same end of the cylinders each provide a transfer chamber through which the mixture compressed and displaced during the effective stroke of the respective piston 3, is conducted into the space between the two pistons. The connected lower compartments at the opposite end of the two cylinders constitute an air-receiving chamber 15 which may be connected with either the atmosphere or the carbureter by the adjustment of a three-way valve 16 applied at the intersection of a conduit 17 which opens into the chamber, and a pipe 38 which connects with the carbureter conduit 13, and the separated upper compartments 18 at the same end of the cylinders, each constitute an air-transfer chamber through which air compressed and displaced during the effective stroke of the respective piston 4 is conducted into the space between the two pistons during the scavenging period in the cycle of operations.

In engines of the single piston type the surge chamber and the air receiving chamber may be formed either by enlargements of the lower compartments of the cylinder jackets or they may be provided by separate receptacles of suitable construction which are connected with the respective jacket-compartments by means of conduits.

Inasmuch as in engines of the two-cylinder type the actions of the pistons in one cylinder are identical to those of the pistons in the other, it will only be necessary to explain in the following part of the description, the operation of the pistons of one cylinder independent from that of the pistons in the other. The mixture-receiving or surge-chamber 12 connects with the interior of the cylinder by a plurality of ports 22 disposed at the end of the chamber remote from the adjacent end of the cylinder, and the mixture transfer-chamber 14 connects with the interior of the cylinder, at one of its ends by means of a series of ports 23 through which the gases flow from the cylinder into the said chamber during the outward stroke of the piston, and at its opposite end by ports 24 through which the said gases are discharged into the space between the pistons when the corresponding piston reaches the end of its outward stroke. The air receiving chamber 15 connects at its innermost end with the interior of the cylinder by means of ports 25 and the air transfer chamber 18 is connected with the cylinder by means of ports 26 through which air contained in the cylinder, passes into the chamber, and ports 27 through which the said air is discharged into the space between the pistons to displace the burnt gases before a fresh charge is admitted.

In addition to the ports above described, the cylinder is provided with a series of ports 28 which connect with the exhaust conduit 29 and whose ends nearest the center of the cylinder, are formed slightly in advance of the corresponding ends of the ports 27 so that during outward movement of the piston 4, the exhaust will open a moment before the scavenging air is introduced into the cylinder. The pistons 3 and 4 which are preferably of the hollow type as shown in the drawings, divide the cylinder into three compartments, namely, the explosion-compartment 30, between the two pistons, a mixture-compression compartment 31 between the piston 3 and the adjacent end of the cylinder and an air compression compartment 32 between the opposite end of the cylinder and the piston 4. (See Fig. 5.) The cranks which connect the pistons of each cylinder with the shaft 6, are, as mentioned hereinbefore, displaced around the shaft at an angle of less than one hundred and eighty degrees, an angle of from one hundred and ten to one-hundred and forty degrees having been found to be most effective to produce the desired result. When the pistons are substantially at the end of their strokes, as is shown in Figs. 5 and 9 of the drawings, their cranks extend at equal angles at opposite sides of the dead centers in the crank movement, which are designated in the said figures by the letter C.

Having thus described the mechanical construction of my improved engine, I will now proceed to explain the operation thereof, reference being had to the diagrammatic views shown in Figs. 5 to 12 inclusive of the drawings. Commencing at the time the explosion of the gases in the compartment 30 takes place, when the pistons are substantially at the end of their inward strokes and the cranks extend at equal angles from the dead center, as shown in Fig. 5, it will be observed that the piston 4, whose crank-connection was forward of the dead center with relation to the direction of rotation of the shaft, will uncover the exhaust ports 28 before the other piston has reached the admission ports 24, so that the exhaust of the spent gases will take place before a new charge is admitted, (see Fig. 6). The air-inlet ports 25 are at this time covered and after the exhaust ports are partly opened, the scavenge ports 27 are uncovered with the result that the air contained in the cylinder compartment 32 and the transfer chamber 18, which had been compressed during the outward movement of the piston past the ports 25, is forced into the space between the pistons, which thus is scavenged until

during the return movement of the piston 4 the scavenge ports are again closed which occurs before the exhaust ports are completely covered, (see Figs. 7 and 8). Shortly before the last action takes place the mixture admission ports 24 are uncovered by the piston 3, which at the commencement of its outward movement had closed the ports 22 through which the mixture contained in the surge chamber had entered the cylinder-compartment 31. The mixture contained within the said compartment and the transfer chamber 14, which was compressed during the outward movement of the piston, is thus forcibly introduced into the space between the two pistons until during the return stroke of the piston 3, the admission ports 24 are again closed when the charge contained between the two pistons is compressed by the movements of the latter toward the center of the cylinder, until they have reassumed their original position shown in Fig. 5, when it is ignited. The positions of the pistons shown in the last mentioned figure, have been referred to as being substantially at the end of the inward strokes, for the reason that, as shown in Figs. 11 and 12, the piston 4 in moving past the dead center momentarily approaches the center of the cylinder closer before it reaches the position which it occupies when the explosion takes place. During the inward movements of the two pistons past the ports 22 and 25, new mixture and air are drawn into the chambers 12 and 15, and when the load on the engine increases, the volume of the charge may be instantly augmented by connecting the air-receiving chamber 15 with the carbureter in place of with the open air by adjustment of the valve 16, when mixture will be introduced into the space between the pistons through the scavenge-ports 27 as well as through the charge-admission ports 24.

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

1. In an internal combustion engine a cylinder having admission ports at opposite sides of its center and an exhaust port at one side of the same, a rotary shaft, opposed pistons within the said cylinder in operative connection with the said shaft, a source of motive fluid in continuous communication with one of said admission ports, and a valve-controlled connection between the said source and the other admission port.

2. In an internal combustion engine, a cylinder having admission ports at opposite sides of its center and an exhaust port at one side of the same, a rotary shaft, opposed pistons within the said cylinder in operative connection with the said shaft, a source of motive fluid in communication with one of said admission ports, and means for connecting the other admission port with either the atmosphere or the said source.

3. In an internal combustion engine, a cylinder having at one side of its center a charge-admission port and at the other side of the center an exhaust port, a scavenge-port and an air discharge port in continuous communication with the latter by a by-pass, and an air admission port positioned between the said communicating ports, a rotary shaft, and opposed pistons having unbalanced movements of equal length within the said cylinder, in operative connection with the said shaft, the several ports being positioned so that during movement of the pistons the said exhaust port and the said scavenge port are uncovered and again covered before the admission port is opened for the admission of a fresh charge between the pistons.

4. In an internal combustion engine, a cylinder having at one side of its center a charge admission port and at the other side of the same, an exhaust port, a scavenge port and an air discharge port in continuous communication by a by-pass, and an air admission port positioned between the said communicating ports, a rotary shaft, opposed pistons within the said cylinder in operative connection with the said shaft, a source of motive fluid in connection with the charge-admission port, and means for connecting the air-admission port with either the atmosphere or the said source.

5. In an internal combustion engine, a cylinder having at one of its ends, a jacket partitioned into an air receiving chamber and an air transfer chamber, a rotary shaft, and opposed pistons within the said cylinder in operative connection with the said shaft, said cylinder having at one side of its center a charge-admission port and at the opposite side of the center, an exhaust port, a scavenge port and an air-discharge port in communication with said transfer chamber, and an air-admission port disposed between the last named ports in communication with the said air receiving chamber.

6. In an internal combustion engine, a cylinder having jackets at opposite ends thereof, and each partitioned into two compartments, the compartments in one of said jackets constituting respectively a surge chamber and a mixture transfer chamber and those in the other jacket, an air receiving chamber and an air-transfer chamber, a rotary shaft, and opposed pistons having unbalanced movements within the cylinder in operative connection with said shaft, the said cylinder having at one side of its center an exhaust port, at the same side, a scavenge port and an air discharge port in communication with the air-transfer chamber and an air admission port disposed between the last named ports in communica-

tion with the air receiving chamber, and at the opposite side of its center a discharge port and an admission port in communication with the mixture-transfer chamber and an admission port positioned between the said ports in communication with the surge chamber.

7. In an internal combustion engine, a cylinder having jackets at opposite ends thereof, and each partitioned into two compartments, the compartments in one of said jackets constituting respectively a surge chamber and a mixture transfer chamber and those in the other jacket, an air receiving chamber and an air-transfer chamber, a rotary shaft, and opposed pistons having unbalanced movements within the cylinder in operative connection with said shaft, the said cylinder having at one side of its center, an exhaust port, at the same side, a scavenge port and an air discharge port in communication with the air-transfer chamber and an air admission port disposed between the last named ports in communication with the air-receiving chamber, and at the opposite side of its center, a discharge port and an admission port in communication with the mixture-transfer chamber and an admission port positioned between the said ports in communication with the surge chamber, a source of a motive fluid in communication with the said surge chamber and the said receiving chamber, and a valve for connecting the latter with either said source or the atmosphere.

8. In an internal combustion engine, two cylinders each having at one side of its center a charge admission port and at the other side of the center an exhaust port, a scavenge port and an air discharge port in communication with the latter by a by-pass, and an air admission port disposed between said communicating ports, an air-receiving chamber in communication with the air admission ports of the two cylinders and provided by communicating jackets which partly surround the cylinders, a rotary shaft, and opposed pistons within said cylinders in operative connection with said shaft.

9. In an internal combustion engine, two cylinders each having at one side of its center a charge admission port and at the other side of the center an exhaust port, a scavenge port and an air discharge port in communication with the latter by a by-pass, and an air admission port disposed between said communicating ports, an air-receiving chamber in communication with the air admission ports of the two cylinders, a rotary shaft, and opposed pistons within said cylinders in operative connection with said shaft.

10. In an internal combustion engine, a cylinder, a rotary shaft and a pair of opposed pistons of equal lengths having unbalanced movements of equal length within the said cylinder, in operative connection with the said shaft, the said cylinder having ports which are disposed to be covered and uncovered by the said pistons for the successive admission and discharge of fluid to and from the space between the pistons.

11. In an internal combustion engine, a cylinder having at one side of its center an exhaust port and at the opposite side of the same, an admission port and a therewith communicating discharge port, a rotary shaft, and opposed pistons in said cylinder having crank connections with said shaft, the said connections and the said ports being arranged so that when the exhaust opening is covered by movement of one of said pistons in one direction, the said discharge port is opened for the admission of a charge of explosive mixture between the pistons, by movement of the other piston in the same direction.

12. In an internal combustion engine, a cylinder having at one side of its center, a charge-admission port and at the other side of its center, an exhaust port, a scavenge port and an air discharge port in communication with the latter by a by-pass, and an air admission port positioned between the said communicating ports, a rotary shaft, and opposed pistons having unbalanced movements of equal length in the said cylinder, in operative connection with said shaft, the several ports being positioned so that during movement of the pistons, the said exhaust port and the said scavenge port are uncovered and again covered before the admission port is opened for the admission of a fresh charge between the pistons, and the scavenge port is covered before the exhaust port is covered.

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

FRANK H. SUMMERIL.

Witnesses:
L. RHOADES,
G. J. ROLLANDET.