

A. B. BAKER.
 REVERSIBLE FOUR-CYCLE GASOLENE ENGINE.
 APPLICATION FILED APR. 26, 1911.

1,060,152.

Patented Apr. 29, 1913.
 3 SHEETS-SHEET 1.

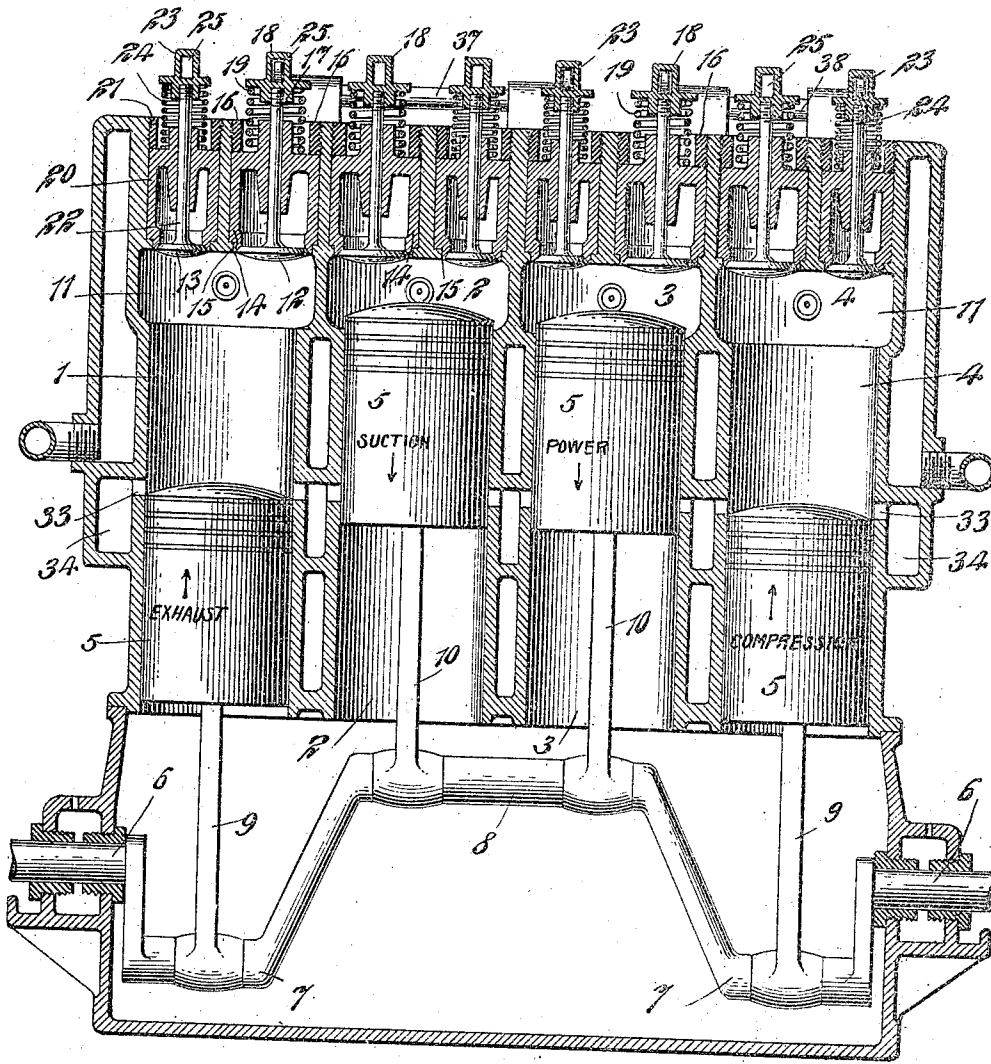


Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2.

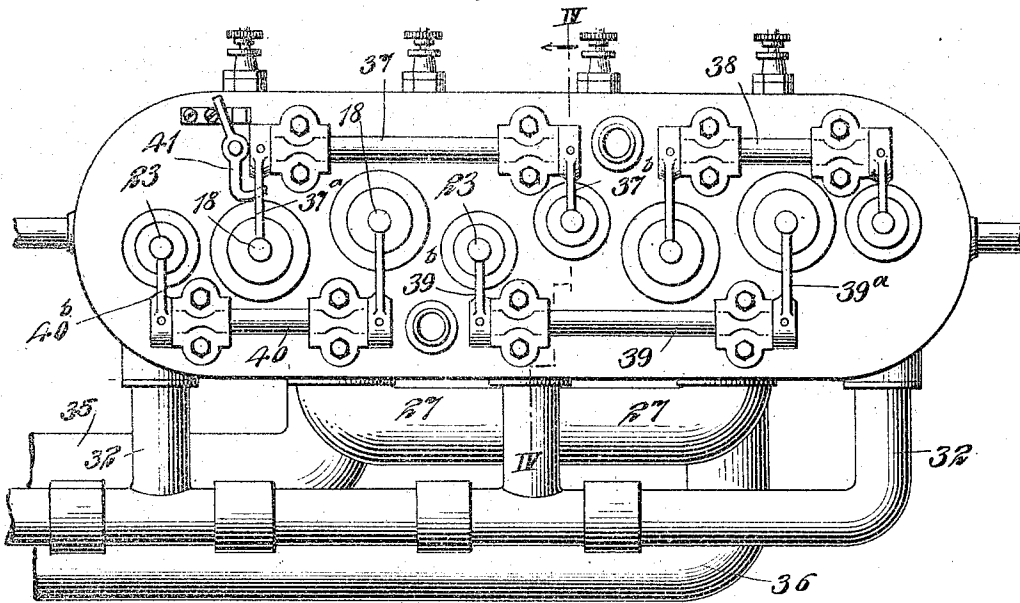
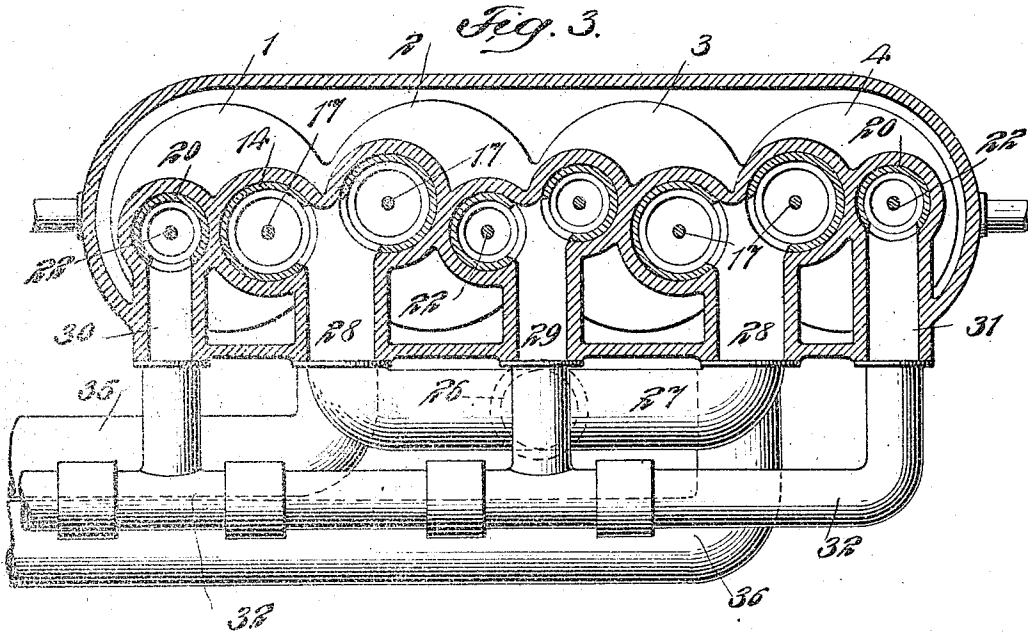


Fig. 3.



WITNESSES:

Julius B. Smith
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INVENTOR

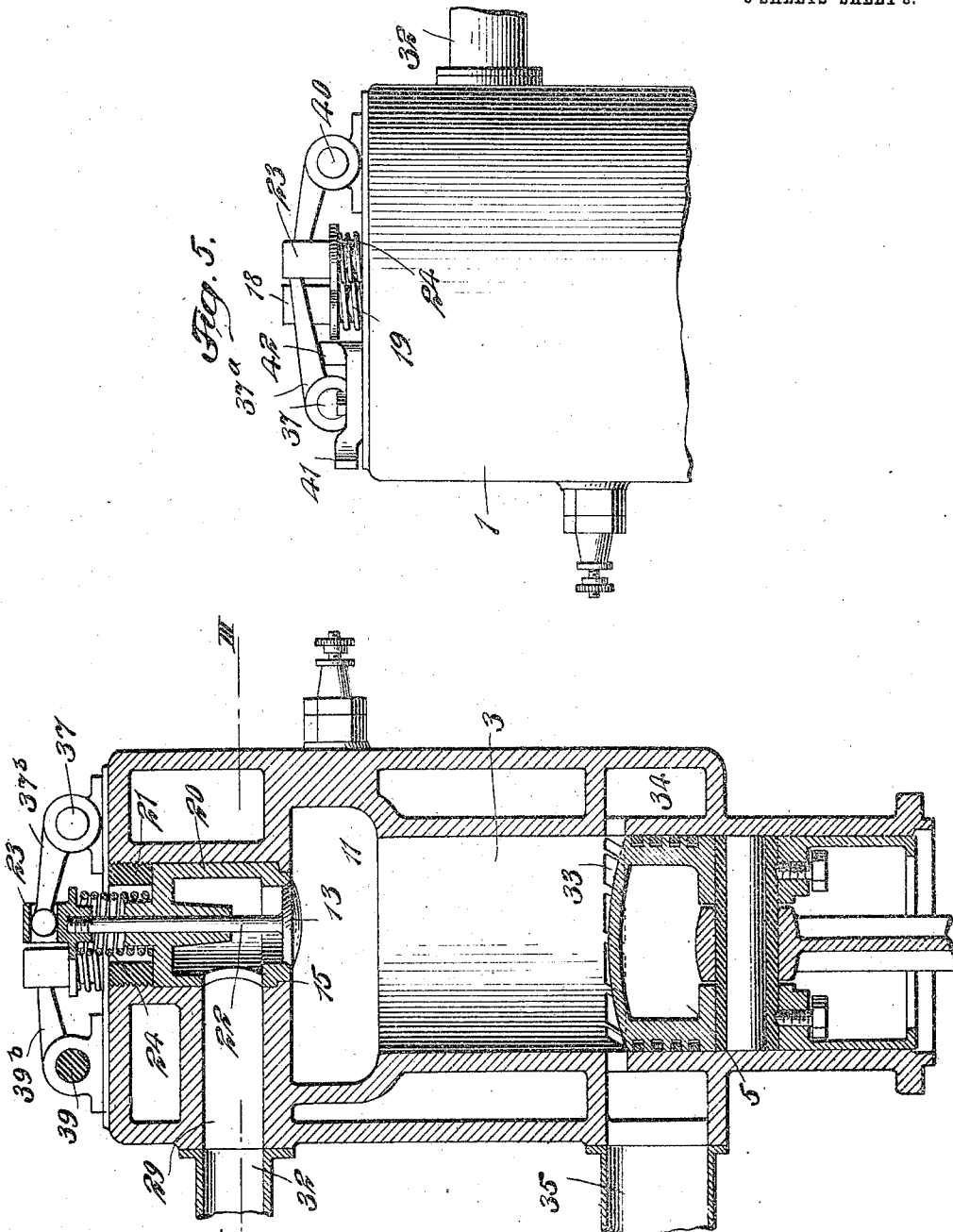
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3 SHEETS—SHEET 3.



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Fig. 4.

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UNITED STATES PATENT OFFICE.

ARTHUR B. BAKER, OF EAST ORANGE, NEW JERSEY.

REVERSIBLE FOUR-CYCLE GASOLENE-ENGINE.

1,060,152.

Specification of Letters Patent.

Patented Apr. 29, 1913.

Application filed April 26, 1911. Serial No. 623,396.

To all whom it may concern:

Be it known that I, ARTHUR B. BAKER, a citizen of the United States, residing at East Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Reversible Four-Cycle Gasolene-Engines, of which the following is a specification.

One of the main objects of this invention is to provide a multiple-cylinder, four-cycle engine in which the exhaust valves of one cylinder will be operated by the suction of the piston in an adjacent cylinder on the intake stroke of the said piston.

Another object of the invention is to provide a multiple-cylinder, four-cycle engine in which both the intake and exhaust valves will be operated by the suction of the pistons on their intake movements, whereby all mechanical connections between the crank shaft and the valve mechanism will be avoided.

Another object of the invention is to provide a multiple-cylinder engine wherein the movement of the intake valve of one cylinder operates the exhaust valve of an adjacent cylinder.

Another object of the invention is to provide a multiple-cylinder engine with a valve mechanism wholly carried by the cylinder head, so that if it be desired to make the cylinder head removable or detachable the valves and the entire valve mechanism will be removable with the cylinder head.

Another object of the invention is to provide in a four-cycle engine means whereby the intake and exhaust valves will be controlled by the movements of the pistons, and wherein there will be no mechanical connections between the crank shaft and said valves, whereby the engine will be reversible and the crank shaft rotated in either direction in starting the engine.

Other important objects and advantages of the invention will appear hereinafter.

In the drawings, Figure 1 is a vertical, longitudinal, sectional view through the engine, the line of the section passing through all of the valves; Fig. 2 a plan view of the engine; Fig. 3 a horizontal sectional view taken on the line III—III of Fig. 4; Fig. 4 is a vertical sectional view through one cylinder on line IV—IV of Fig. 2; and Fig. 5 a side elevation of the left-hand end cylinder, as shown in Fig. 2.

Referring to the various parts by nu-

merals, 1, 2, 3 and 4 designate four cylinders in each of which reciprocates a piston 5. The crank shaft 6 is formed with the two end cranks 7—7 and with the center crank 8. The pistons of cylinders 1 and 4 are connected by pitmen 9 to the crank 7, and the pistons of cylinders 2 and 3 are connected by pitmen 10 to the crank 8. The cranks 7 are precisely alike so that the pistons operated thereby move synchronously and as a pair. It is manifest that the pistons in the cylinders 2 and 3 also move together as a pair so that when the pistons of the cylinders 2 and 3 are at the limit of their inward stroke the pistons connected to the cranks 7 are at the end of their outward stroke, said pistons making their inward stroke when the pistons in cylinders 2 and 3 are making their outward stroke.

Each cylinder is formed with a compression and ignition chamber 11 and with an intake valve 12 and an exhaust valve 13. These valves are arranged in suitable openings in the ends of the cylinders. Each intake valve consists of a chambered bushing 14 having a valve seat at its inner end and shouldered to fit against an annular flange 15 at the inner end of the valve receiving opening in the cylinder end. This chambered bushing is held in place by means of a threaded ring 16. The valve 12 is carried by a stem 17 centrally supported in the bushing 14 and provided on its outer end with a head 18, a compression spring 19 being arranged between said head and the outer end of the valve bushing, said spring serving to yieldingly hold the valve 12 to its seat. The exhaust valve 13 is somewhat smaller in diameter than the intake valve and also consists of a chambered bushing 20 held in place by a threaded ring 21 and through which the valve stem 22 extends. A head 23 is secured to the outer end of this stem and between said head and the bushing is arranged a spring 24 which holds the exhaust valve to its seat. The heads 18 and 23 on the valve stems 17 and 22 are apertured at 25 to receive valve operating arms, as will be hereinafter described.

The explosive mixture is admitted through pipe 26 to the branch pipes 27, these latter pipes communicating with the intake passages 28, these latter passages opening into the intake valve chambers. One intake 28 is in communication with the intake valve chambers of cylinders 1 and 2, the other in-

take being in communication with the intake valve chambers of cylinders 3 and 4, as shown clearly in Fig. 3. The exhaust valve chambers of cylinders 2 and 3 are in communication with an outlet 29 and the exhaust valve chambers of cylinders 1 and 4 are in communication with outlets 30 and 31, respectively, all of these outlets being in communication with a pipe 32.

Each cylinder at its outer end is formed with an annular series of exhaust ports 33 which communicate with an exhaust chamber 34, said chamber being in turn in communication with an exhaust pipe. The exhaust chambers 34 of cylinders 1 and 2 are both in communication with an exhaust pipe 35 and the exhaust chambers of cylinders 3 and 4 are in communication with an exhaust pipe 36 so that the exhaust from the cylinders 1 and 2 cannot reach cylinders 3 and 4, and likewise the exhaust from cylinders 3 and 4 cannot reach cylinders 1 and 2 so that there will be no possibility of the exhaust from one cylinder igniting the explosive mixture in any one of the other cylinders.

Mounted in suitable bearings on the cylinder head are rock shafts 37, 38, 39 and 40. Shaft 37 is provided with two valve operating arms 37^a and 37^b. Arm 37^a is considerably longer than arm 37^b and its free end operates in the aperture 25 of the head 18 secured to the stem of the intake valve 12 of cylinder 1 so that when said valve is drawn inwardly by the suction of the piston in said cylinder shaft 37 will be rocked. Arm 37^b engages the aperture 25 in the head 23 secured to the stem of the exhaust valve 13 of cylinder 3 so that when the intake valve of cylinder 1 is opened on the suction stroke of the piston therein the exhaust valve of cylinder 3 will be opened. By reason of the arrangement of the cranks on the crank shaft the piston 5 of cylinder 3 will be at the end of its power stroke when the piston in cylinder 1 is beginning its intake or suction stroke. Shaft 38 carries the valve operating arms 38^a and 38^b. Arm 38^a is connected to the intake valve of cylinder No. 3 and its arm 38^b is connected to the exhaust valve of cylinder No. 4, said valves and arms operating in the same manner as described with respect to the cylinders No. 1 and 3. Shaft 39 carries the valve operating arms 39^a and 39^b. Arm 39^a is connected to and operates the intake valve of cylinder No. 4, and arm 39^b is connected to and operates the exhaust valve of cylinder No. 2. Shaft 40 likewise carries valve operating arms 40^a and 40^b. The arm 40^a is connected to and operates the intake valve of cylinder No. 2 and arm 40^b is connected to and operates the exhaust valve of cylinder No. 1.

From the foregoing it is manifest that when the intake valve of cylinder No. 3 is

being operated the exhaust valve of cylinder No. 4 is likewise operated; also that when the intake valve of cylinder No. 4 is opening the exhaust valve of cylinder No. 2 is opening. The intake of cylinder No. 2 operates the exhaust of cylinder No. 1. It is manifest that in order to permit the complete cycle of movements of the pistons in a four-cycle engine and so arrange the valve operating means to secure the proper valve movements, it is necessary to employ four cylinders, or multiples of four cylinders. As shown in Fig. 1 the piston in cylinder No. 1 is at the end of its power stroke and just beginning its exhaust or clearing stroke; piston in cylinder No. 2 is just beginning its suction stroke. It is, therefore, manifest that the intake valve in cylinder No. 2 will be open and that through shaft 40 and its valve operating arms the exhaust port of cylinder No. 1 will be opened. The piston in cylinder No. 3 is beginning its power stroke and piston in cylinder No. 4 is beginning its compression stroke. It is, therefore, to be noted that both the intake and exhaust valves of cylinders Nos. 3 and 4 will be closed. In the next cycle of operations the piston in cylinder No. 4 will begin its power stroke while piston in cylinder No. 2 will begin its compression stroke. The piston in cylinder No. 1 will begin its suction stroke, thereby opening the exhaust valve in cylinder No. 3 while the piston in this latter cylinder makes its clearing or exhaust stroke.

By providing the supplemental exhaust through the ports 33 the pressure in the cylinders is greatly reduced, thereby permitting the operation of the exhaust valves through the suction or intake valves of adjoining cylinders. The intake valves are considerably larger in diameter than the exhaust valves so that the suction of the pistons will act with greater force on said intake valves thereby insuring the opening of the said valves and their connected exhaust valves. The valve operating arms connected to the intake valves are considerably longer than the arms operating the exhaust valves, whereby the power applied to each intake valve will be ample to effect the opening of the connected exhaust valve of an adjacent cylinder.

It is manifest that by providing means for exhausting the burned gases at both ends of each cylinder a thorough cleaning out of each cylinder is secured.

In starting the engine I find it desirable to first bring the piston of cylinder No. 1 to the top or inner end of said cylinder at the beginning of its power stroke. I then lock the intake valve of said cylinder, and connected exhaust valve of cylinder No. 3, by means of a locking lever 41 having a locking dog 42 on its inner end adapted to

fit under and to lock the valve operating arm 37^a. By this means the said intake valve will be locked against opening movement. I then give the crank shaft a one-half revolution, bringing the piston of cylinder No. 3 to the end of its compression stroke, said cylinder No. 3 being then ready for firing. I then release lock 41 from arm 37^a and crank the engine in the usual manner.

From the foregoing it is manifest that I combine in this engine the advantages of both the two-cycle engine and the four-cycle engine. The engine may be started by rotating the crank shaft in either direction. There are no mechanical connections between the crank shaft and the valves so that the engine is reversible. I provide an engine having an exhaust at both ends of each cylinder, thereby securing a very complete expulsion of the burned gases and insuring a complete charge of fresh explosive mixture. By operating both the intake and exhaust valves by means of the suction of the piston I avoid the use of all valve operating cams and rods. I have combined the simplicity of a two-cycle engine with the efficiency of a four-cycle engine.

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

1. An internal combustion engine comprising a plurality of cylinders, a piston for each cylinder, a suction-operated inlet valve for each cylinder, an exhaust valve for each cylinder and means operatively connecting the inlet valve of each cylinder with the exhaust valve of another cylinder, whereby when each inlet valve is opened by suction the connected exhaust valve will be opened.

2. An internal combustion engine comprising a plurality of cylinders, a suction operated inlet valve for each cylinder, an exhaust valve for each cylinder, means operatively connecting the inlet valve of one cylinder to the exhaust valve of another cylinder, whereby the said two connected valves will operate together to simultaneously open the ports controlled by them and the exhaust port will be opened solely by the suction applied to the connected inlet valve of another cylinder, each cylinder being provided with an exhaust port at its outer end for the escape of a part of the burned gases when each piston has completed its power stroke.

3. A gasoline engine of the four-cycle type comprising cylinders 1, 2, 3, 4, pistons therein, a crank shaft, means connecting the pis-

tons to the crank shaft, a suction-operated inlet valve and an exhaust valve for each of said cylinders, means connecting the exhaust valve of cylinder No. 1 with the inlet valve of cylinder No. 3, means connecting the exhaust valve of cylinder No. 3 with the inlet valve of cylinder No. 4, means connecting the exhaust valve of cylinder No. 4 with the inlet valve of cylinder No. 2, and means connecting the exhaust valve of cylinder No. 2 with the inlet valve of cylinder No. 1, whereby when the inlet valve of one cylinder is operated the connected exhaust valve of another cylinder will be operated.

4. An internal combustion engine comprising a plurality of cylinders, a piston for each cylinder, a suction-operated inlet valve for each cylinder, an exhaust valve for each cylinder, each of said exhaust valves being of smaller area than the inlet valves, and means operatively connecting the inlet valve of one cylinder with the exhaust valve of another cylinder whereby one inlet valve and the connected exhaust valve of another cylinder will be simultaneously opened by the suction on the inlet valve.

5. An internal combustion engine comprising a plurality of cylinders, a piston for each cylinder, a suction-operated inlet valve for each cylinder, an exhaust valve for each cylinder, a rock shaft for each two cylinders of the series, an arm carried by said rock shaft and connected to the inlet valve of one cylinder, a second arm on said rock shaft connected to the exhaust valve of another cylinder, this latter arm being longer than the arm connected to the inlet valve.

6. An internal combustion engine comprising a plurality of cylinders, a piston for each cylinder, a suction-operated inlet valve for each cylinder, an exhaust valve for each cylinder, a rock shaft for each two cylinders of the series, an arm carried by said rock shaft and connected to the inlet valve of one cylinder, a second arm on said rock shaft connected to the exhaust valve of another cylinder, this latter arm being longer than the arm connected to the inlet valve, and exhaust ports at the outer end of the cylinder to permit the burned gases to escape when the cylinder has completed its power stroke.

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

ARTHUR B. BAKER.

Witnesses:

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F. R. MILLER.