M. WOICULA.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 14, 1919.

1,342,368. **Patented June 1, 1920.**

7 SHEETS—SHEET 1.

Fig. 12.

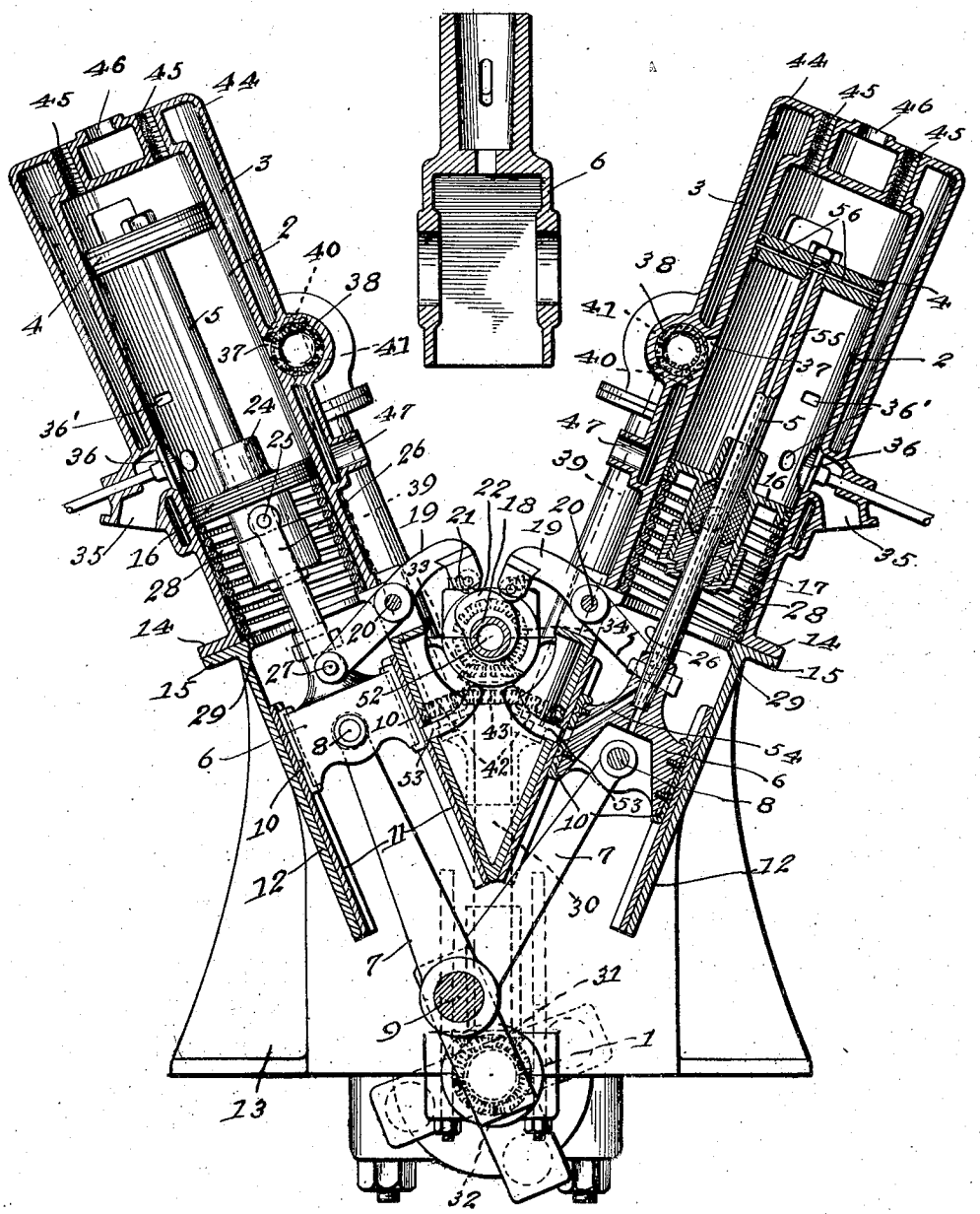


Fig 1.

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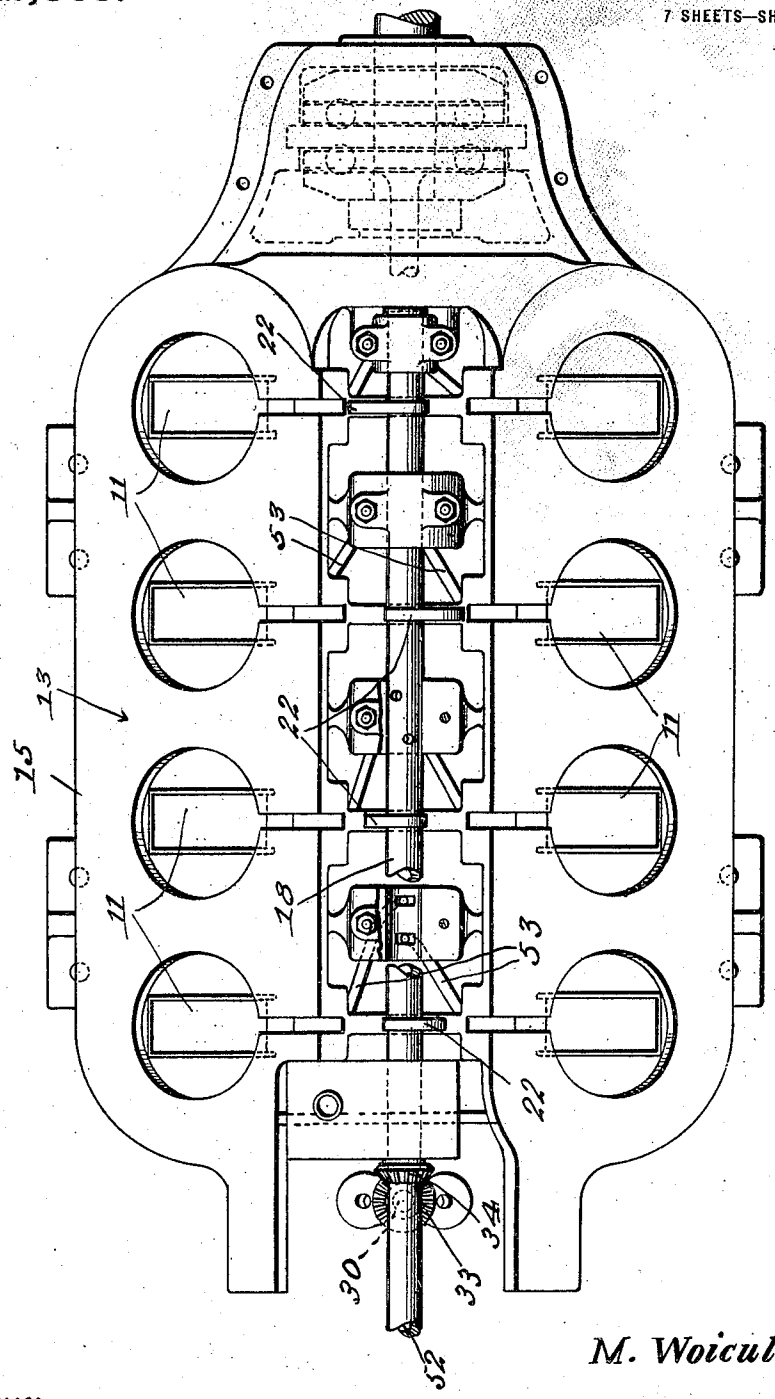
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7 SHEETS—SHEET 2.

Fig. 2.



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7 SHEETS—SHEET 3.

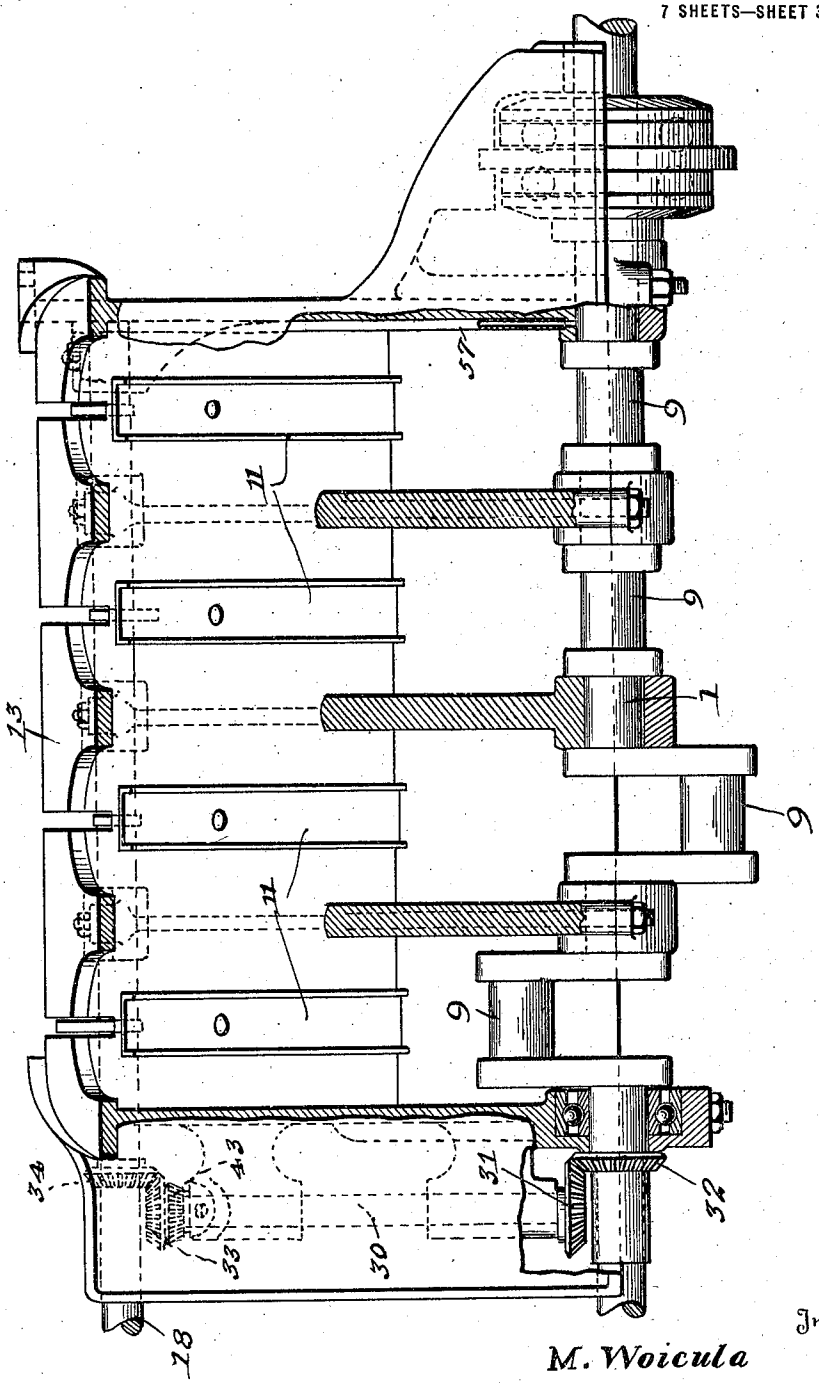


Fig. 5.

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7 SHEETS—SHEET 4.

Fig. 11.

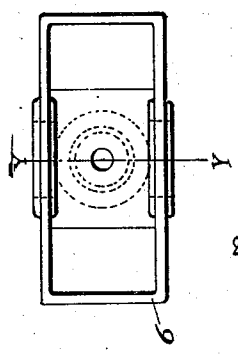
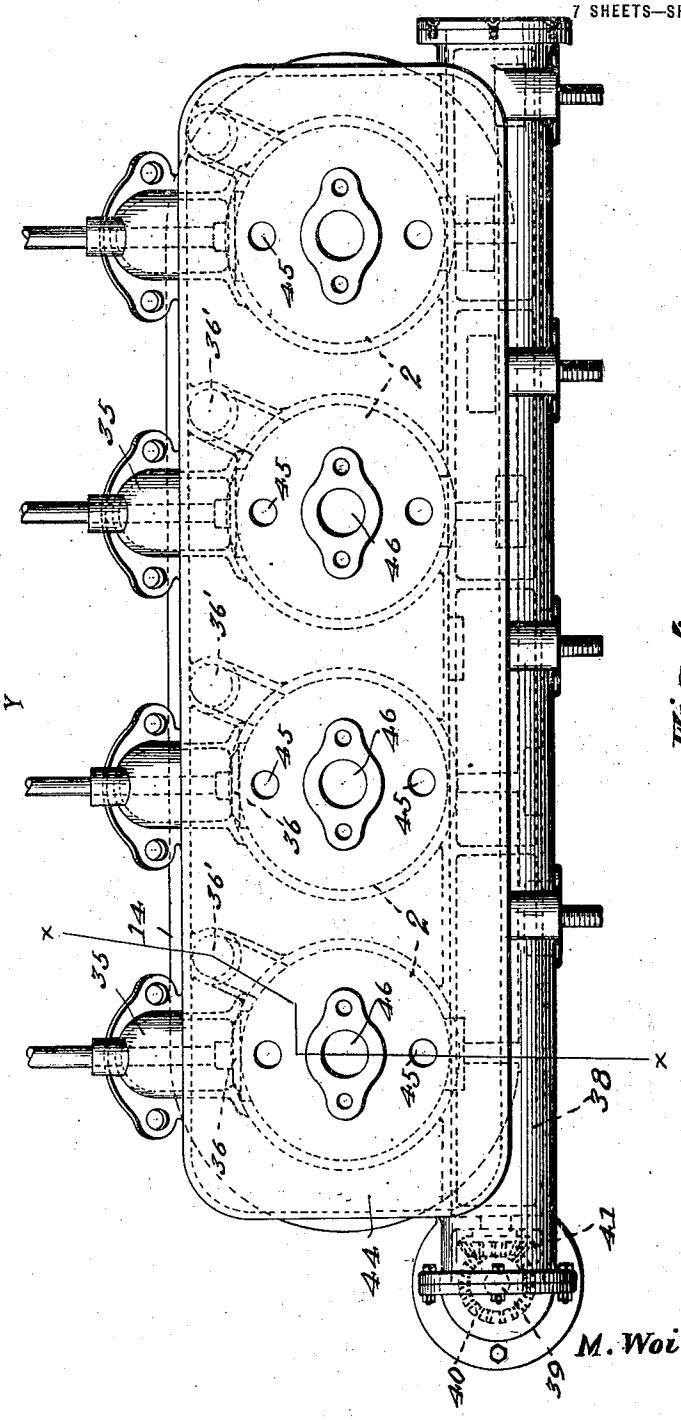


Fig. 4.



Witnesses

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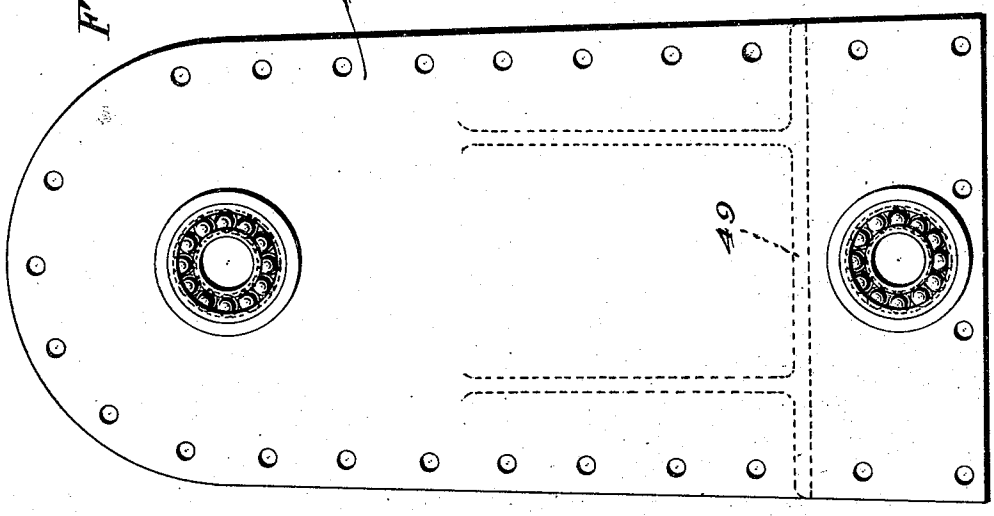
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7 SHEETS—SHEET 5.

Fig. 8.



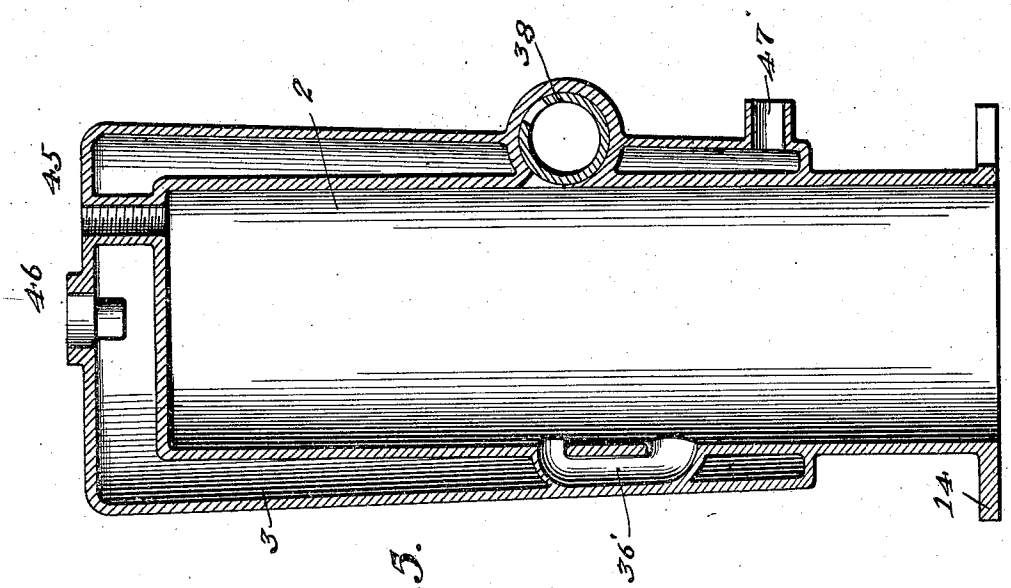


Fig. 5.

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7 SHEETS—SHEET 6.

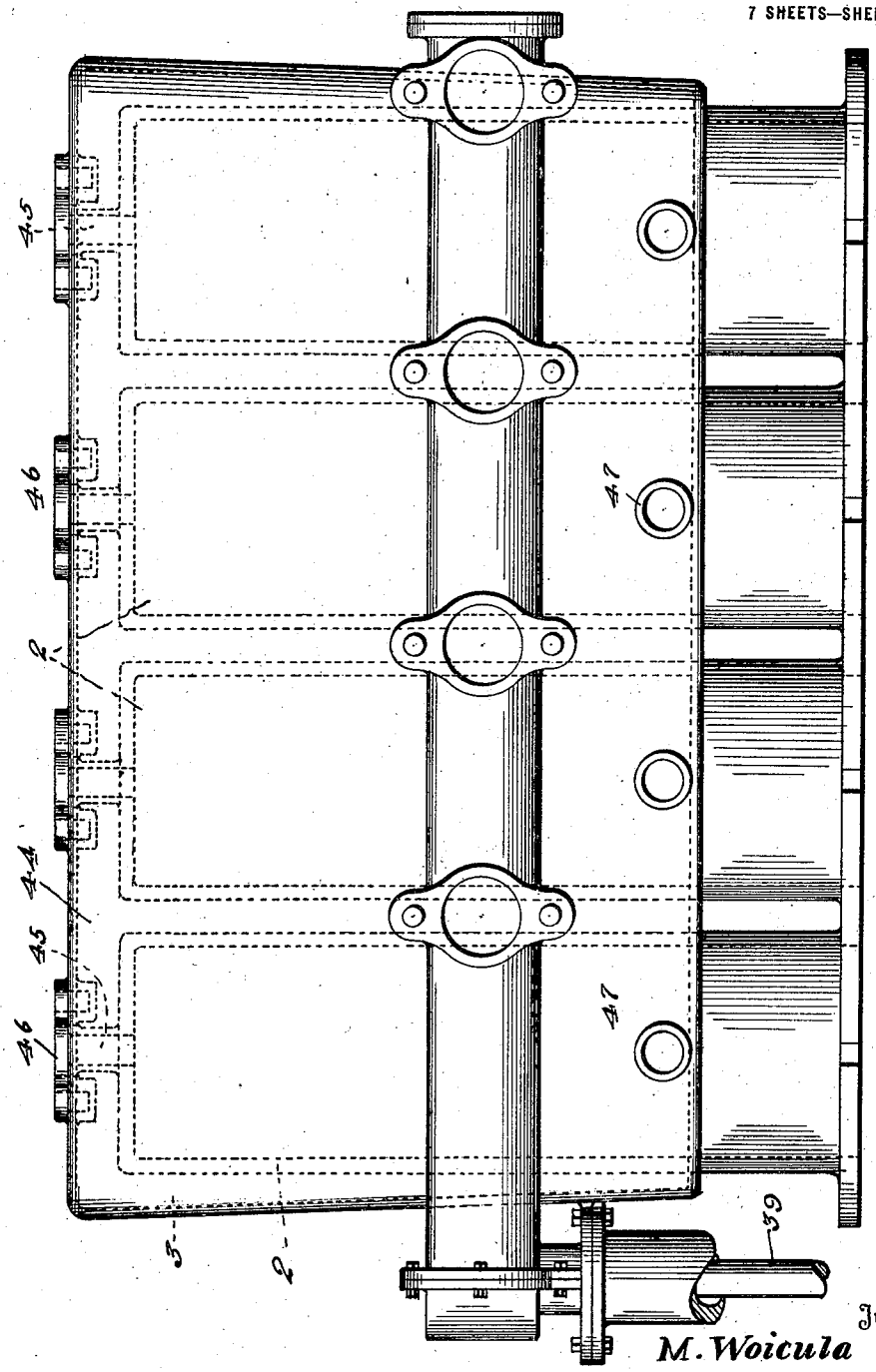


Fig. 6.

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APPLICATION FILED NOV. 14, 1919.

1,342,368.

Patented June 1, 1920

7 SHEETS—SHEET 7.

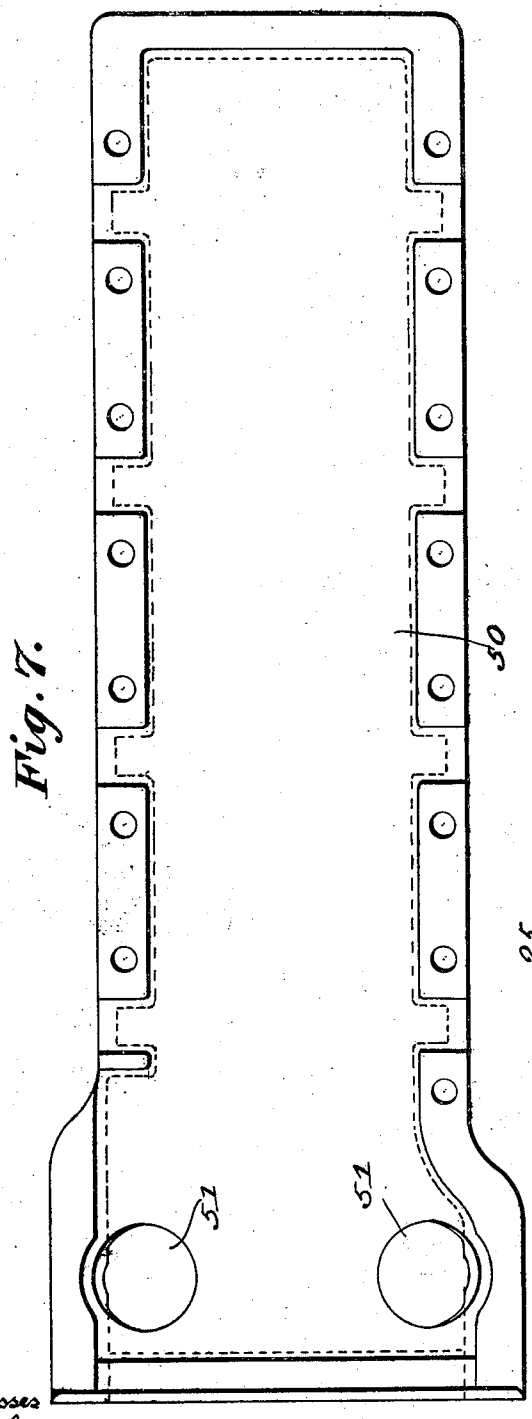


Fig. 7.

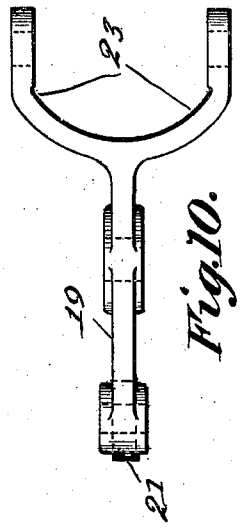


Fig. 10.

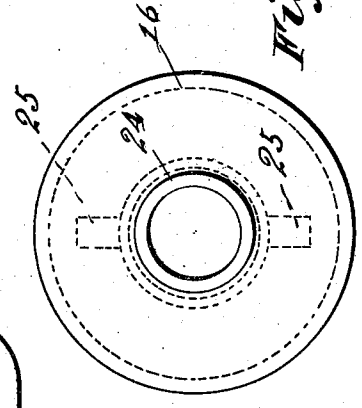


Fig. 9.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,342,368. Specification of Letters Patent. Patented June 1, 1920.

Application filed November 14, 1919. Serial No. 337,974.

To all whom it may concern:

Be it known that I, MICHAEL WOICULA, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines and is designed to operate on the two cycle principle.

One of the main objects in view is to obtain as high compression of the charges as desirable without employing crank case compression and the objections incident thereto, at the same time rendering the compression uniform and the efficiency of the engine constant and dependable.

Another object in view is to insure full and uniform charges by providing for increased suction during the intake cycle of the engine.

A still further object in view is to relieve the resistance to the working stroke of the power piston during the most efficient part of such stroke.

The features above referred to contribute to increased efficiency, power, smoothness of operation, a steady flow of energy, greater reliability, and a better distribution of the stresses on the working parts of the engine.

With the above and other objects in view, the invention consists in the novel construction, combination and arrangement herein fully described, illustrated and claimed.

In the accompanying drawings:

Figure 1 is a vertical transverse section of the engine.

Fig. 2 is a plan view of the same omitting the cylinder head block.

Fig. 3 is an inclined longitudinal section in line with the crank shaft, which is shown in elevation.

Fig. 4 is a top plan view of one battery of cylinders, showing the respective rotary exhaust valve.

Fig. 5 is a vertical transverse section on the line x—x of Fig. 4.

Fig. 6 is an inside elevation of one battery of cylinders, showing the respective rotary exhaust valve.

Fig. 7 is a plan view of the cam shaft housing plate or cover.

Fig. 8 is an elevation of one of the end frame pieces or housing plates.

Fig. 9 is a plan view of one of the auxiliary pistons.

Fig. 10 is a plan view of one of the rocker arms.

Fig. 11 is a plan view of one of the cross heads.

Fig. 12 is a section through the same on the line y—y of Fig. 11.

In illustrating the present invention, I have shown the principles of the invention applied to an eight cylinder V type engine, operating on a two cycle principle, there being two batteries of cylinders arranged at any suitable angle with relation to each other and each containing a piston, the pistons being all connected by suitable means to a centrally arranged low down common crank shaft.

Referring to the drawings 1 designates a common crank shaft connected to which are all of the power pistons hereinafter referred to. The cylinders are arranged in two batteries or series each cylinder being represented by the reference character 2. All of the cylinders have their longitudinal axes intersecting the center of the common crank shaft 1 as shown for example in Fig. 1. The two batteries of cylinders are preferably arranged at an angle of forty-five degrees from each other, although this is not essential as the angle between the cylinders may be varied to suit the will of the manufacturer and the purpose for which the engine is designed.

Each of the cylinders 2 is shown water jacketed as at 3 and as containing a single reciprocatory power piston 4 which is fastened to the outer end of a piston rod 5, said piston rod being connected at its inner end to a sliding cross head 6. The sliding cross head 6 is in turn connected to the crank shaft 1 by means of a connecting rod 7, the same being connected by a wrist pin or pivot 8 to the sliding cross head and by the usual connection rod bearing to a crank pin 9 of the crank shaft. The crank shaft 1 is shown as of the four throw type, being provided

with four sets of crank pins 9 arranged at ninety degrees apart. The connecting rods of all of the pistons are attached to the common crank shaft 1 as clearly indicated in the drawings.

Each of the sliding cross heads is of rectangular shape in plan as shown in Fig. 11, and is of hollow formation to receive the adjacent end of the connecting rod 7 through which the pin 8 is inserted. At its opposite ends, as the sliding cross head 6 is provided with brass shoes 10 which slide in contact with iron guides 11 secured to the opposite inner wall of an extension 12 of the inner end of the respective cylinder 2. The extension 12 is preferably formed as an integral part of the engine case 13 and each cylinder is provided at its inner end with a flange 14 by means of which it is bolted to a corresponding flange 15 on the base 13.

Mounted to reciprocate for a limited distance in each cylinder is an auxiliary or suction piston 16 which surrounds the piston rod 5 and is provided with an internal bearing or bushing 17 of brass or other suitable material to form a tight joint where the piston rod 5 passes through the auxiliary piston 16. Motion is imparted to all of the auxiliary pistons by means of a common cam shaft 18 which is mounted down in the angle between the two batteries of cylinders as shown for example in Fig. 1. In connection with each auxiliary piston, and as a part of the operating means therefor, I employ a rocker arm 19 which is pivotally mounted between its ends at 20 on the engine frame and which carries at its inner end a roller 21 which moves in contact with the respective cam face 22 of the cam shaft 18. The outer end of the rocker arm 19 is formed with fork arms 23 which straddle the upwardly extending tubular portion on the cross head and pivotally supported at 20. The forked ends are pivoted to the links 26 by the pins 27 and said links 26 are pivotally connected to the auxiliary piston 16 by the pins 25. The means just described provides for moving each of the auxiliary pistons 16 inwardly toward the crank shaft 1. Each auxiliary piston 16 is restored to its outward or normal position by means of a spring 28 which is interposed between the piston 16 and a shoulder 29 within the respective cylinder 2.

The cam shaft 18 is driven by means of a vertical transmission shaft 30 arranged centrally of one end of the engine and connected by bevel gears 31 and 32 to the crank shaft 1, said shaft 30 being connected by other bevel gears 33 and 34 to the cam shaft 18. Power is thus transmitted from the crank shaft to the cam shaft for operating all of the rocker arms 19 and all of the auxiliary pistons 16 for a purpose which will presently appear.

Each of the cylinders 2 is provided with an intake port 35 in conjunction with which I employ an automatic inwardly opening intake valve 36. In connection with each cylinder I also employ a bypass 36′ for conducting the mixture compressed between the two pistons to the combustion chamber above or beyond the power piston 4. Each cylinder is also provided with an exhaust port 37 and in conjunction with each battery of cylinders 2 I employ a manifold or common tubular rotary positively acting exhaust valve 38, said rotary exhaust valve being provided with a plurality of exhaust ports, one port being used for each of the cylinders and said ports being arranged so as to successively register with the ports 37 of the cylinders to provide for the exhaust of the burned gases therefrom at the proper intervals. The downward stroke of piston 4 ends at a point immediately above the inlet valve 36 and the upward stroke of piston 16 ends immediately below said valve so that the gases are compressed between the two pistons, the pressure causing the piston 16 to move downwardly slightly against the action of its spring. As soon as the piston 4 uncovers the upper end of the by-pass 36′ on its downward stroke the compressed gases will flow from the space between the two pistons through the by-pass into the explosion chamber above piston 4. Then the pistons move away from each other so that the mixture in the explosion chamber is compressed by the piston 4 and this movement of the two pistons will suck in another charge through the inlet passage 35.

The two rotary exhaust valves 38 are driven by two upwardly diverging operating shafts 39, each of which is connected by bevel gears 40 and 41 to the respective rotary exhaust valve. It will be noted that the gears 40 and 41 are so arranged that the rotary valves turn in opposite direction, the left hand valve preferably turning to the left and the valve of the right hand battery of cylinders turning to the right. The shafts 39 converge toward their lower ends where they are provided with gears 42 arranged at opposite sides of and meshing with a central gear 43 on the shaft 30 above referred to. The last named shaft 30 thus drives the cam shaft 18 and by means of the shaft 30 also serves as a driving element for the rotary exhaust valve 38.

Each battery of cylinders is provided with a cylinder head block 44 shown as provided with two spark plug openings 45 for each cylinder and also provided with a circulating water outlet 46, the water entering the jacket 3 through a water inlet connection 47 at the inner side of the battery of cylinders and adjacent to the inner or lower portion of the water jacket.

The lower portion of the engine at each end thereof is closed by means of an end

frame piece or housing plate 48 having on the outside thereof a magneto supporting shelf or bracket 49. A housing or cover plate 50 extends over the cam shaft 18 and protects the same, said plate 50 being formed with openings 51 for the passage therethrough of the exhaust valve operating shaft 39.

For the purpose of properly lubricating the working parts of the engine, the cam shaft 18 is formed with a lubricant holding bore 52 and has an outlet opening through the wall thereof adapted intermittently to communicate with oil ducts 53 leading to the guide for the respective cross heads 6. Each cross head is also formed with oil ducts or passage 54 which communicates in the back and forth movement of the piston head with the oil passage or duct 53. Each passage 54 in turn communicates with a central longitudinal oil bore 55 in the respective piston rod 5, oil flowing from said last named passage through lateral passages 56 in the piston bore to the piston and cylinder walls. Oil will find its way down the piston rod 5 and lubricate the rod where it passes through the auxiliary piston 16 and will also work its way down to the wrist pin 8 and the connecting rod bearings. Other oil passages 57 lead from the tubular cam shaft downwardly to the main bearings of the crank shaft 1 so as to lubricate the latter.

The operation of the engine may be understood by reference to a single cylinder, the same operation taking place in all of the cylinders at different times. As the two pistons are moving away from each other a charge of explosive mixture will be drawn into the cylinder between the two pistons and in the reverse movement of the pistons this charge will be compressed and as soon as piston 4 passes the upper end of the by-pass 36′ this charge will pass into the explosion chamber above said piston 4. When the power piston is on its working stroke, the charge between the two pistons is compressed and the spring under the auxiliary piston allows the latter to move away from the power piston, thereby proportionately reducing the resistance to the power piston during its working stroke. As soon however, as the power piston on its return stroke, uncovers the upper end of the by-pass 36′ the auxiliary piston is moved toward the power piston by its spring, and the compressed mixture is thereby forced to the combustion chamber.

Due to the features above referred to, increased efficiency, power, smoothness of operation, a steady flow of energy, greater reliability, and a better distribution of stresses on all parts of the engine are produced.

What I claim is:

1. In an internal combustion engine, a cylinder, a reciprocatory power piston therein, a sliding cross head, a crank shaft to which said cross head is connected, a piston rod connecting said cross head with the power piston, an auxiliary piston in said cylinder, and means whereby said auxiliary piston is actuated from the crank shaft independently of the power piston to inspire a charge, the cylinder having a by-pass arranged to be over-run by the power piston to permit the charge compressed between the two pistons to flow into the explosion chamber and spring means for causing the auxiliary piston to move toward the power piston to force the charge through the by-pass.

2. In an internal combustion engine, a cylinder, a reciprocatory power piston therein, a sliding cross head, a crank shaft to which said cross head is connected, a piston rod connecting said cross head with the power piston, an auxiliary piston in said cylinder, and means whereby said auxiliary piston is actuated from the crank shaft independently of the power piston to inspire a charge, the cylinder having a by-pass arranged to be overrun by the power piston for permitting the charge compressed between the two pistons to pass into the explosion chamber and cushioning means for permitting the auxiliary piston to give when the charge is being compressed between the two pistons, such means restoring the piston to its normal piston when the by-pass is uncovered.

3. In an internal combustion engine, a cylinder, a reciprocatory power piston therein, a sliding cross head, a crank shaft to which said cross head is connected, a piston rod connecting said cross head with the power piston, an auxiliary piston in said cylinder, and means whereby said auxiliary piston is actuated from the crank shaft independently of the power piston to inspire a charge, said means including a cam shaft driven from the crank shaft, and a rocker arm actuated by said cam shaft and connected with the auxiliary piston.

4. In an internal combustion engine, a cylinder, a reciprocatory power piston therein, a sliding cross head, a crank shaft to which said cross head is connected, a piston rod connecting said cross head with the power piston, an auxiliary piston in said cylinder and means whereby said auxiliary piston is actuated from the crank shaft independently of the power piston to inspire a charge, said means including a cam shaft driven from the crank shaft, a rocker arm, and links connecting said rocker arm and auxiliary piston and lying at opposite sides of the piston rod.

5. In an internal combustion engine, a cylinder, a reciprocating power piston therein, a sliding cross head, a crank shaft to which said cross head is connected, a piston rod connecting said cross head with the

power piston, an auxiliary piston in said cylinder, means whereby said auxiliary piston is actuated from the crank shaft independently of the power piston to inspire a charge, the cylinder having a by-pass arranged to be overrun by the power piston to permit the charge compressed between the two pistons to pass to the cylinder above said power piston, a spring for returning the auxiliary piston to its normal position and exhaust means for the cylinder.

In testimony whereof I affix my signature.

MICHAEL WOICULA.