E. R. BURTNETT.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAY 2, 1918.

1,315,538.

Patented Sept. 9, 1919.

7 SHEETS—SHEET 1.

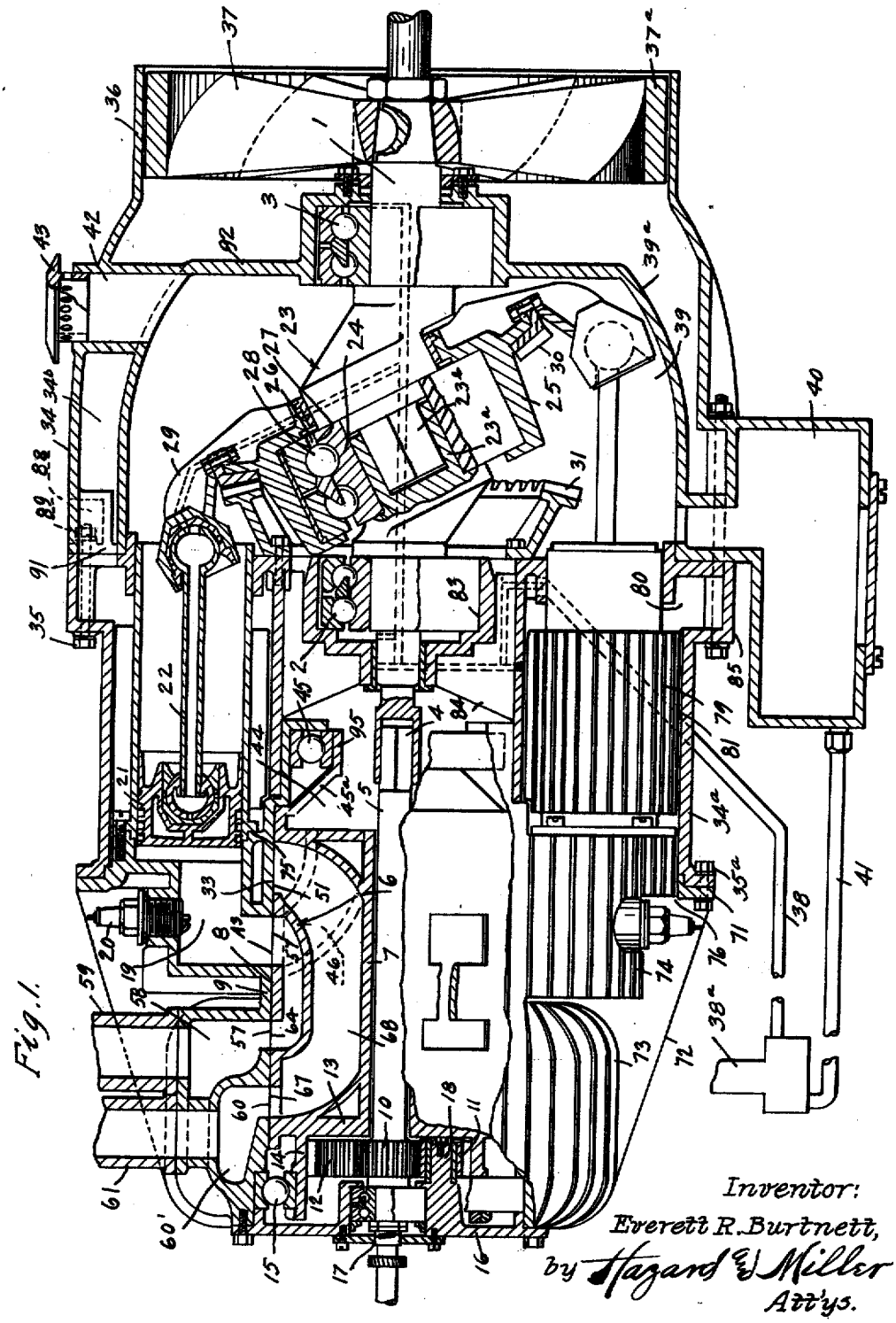


Fig. 1.

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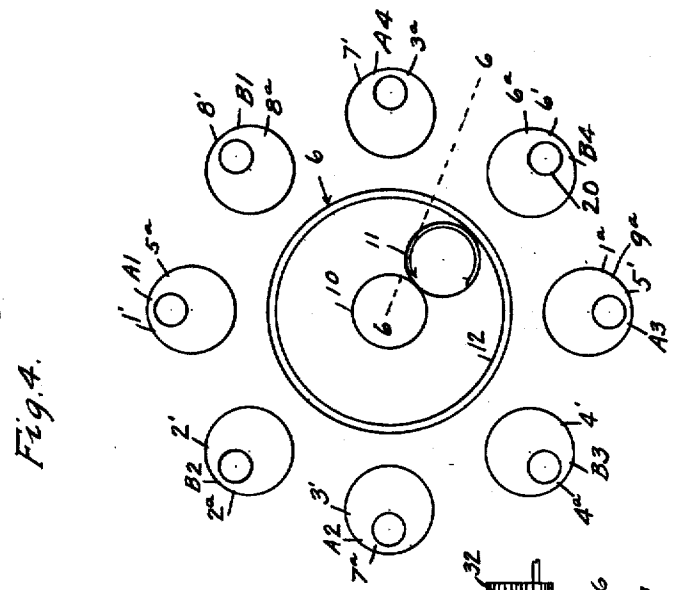


Fig. 4.

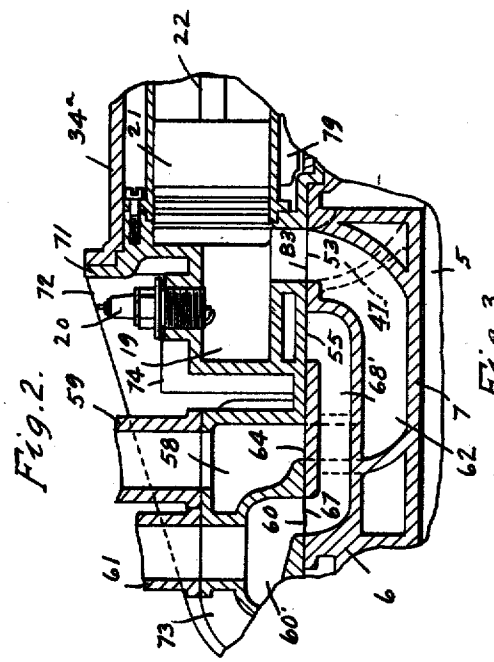


Fig. 2.

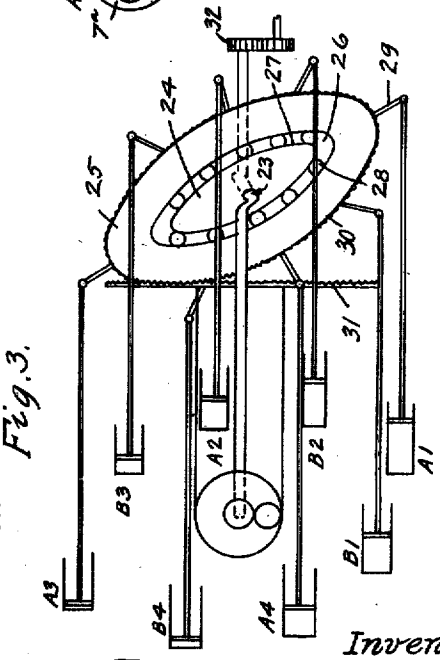


Fig. 3.

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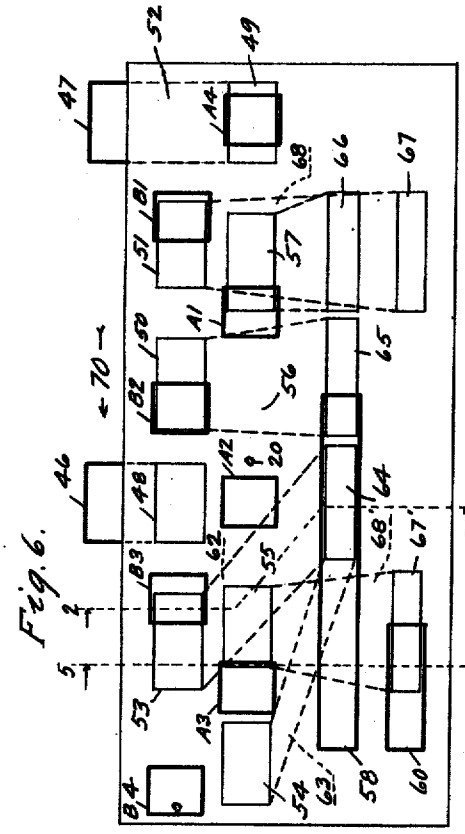


Fig. 6.

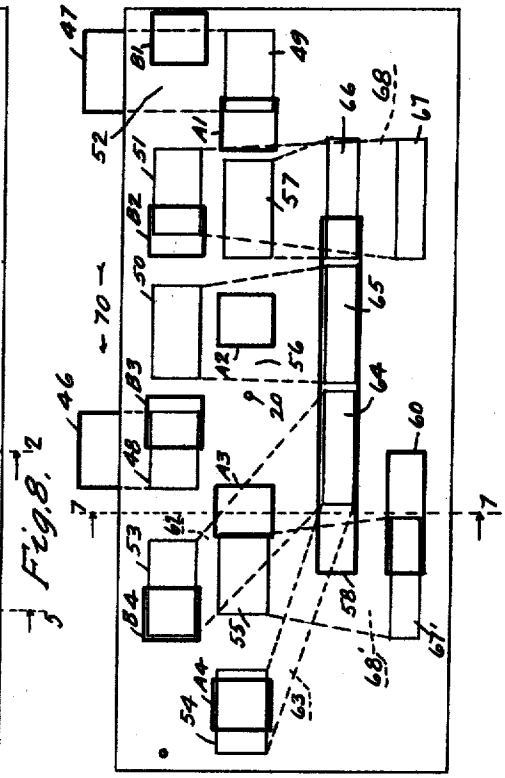


Fig. 8.

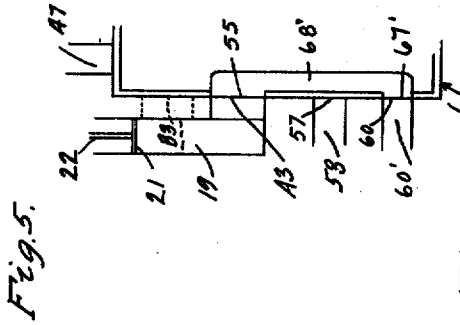


Fig. 5.

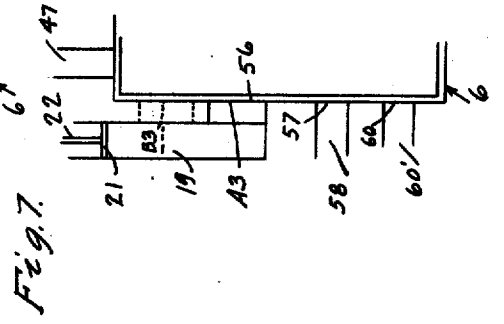


Fig. 7.

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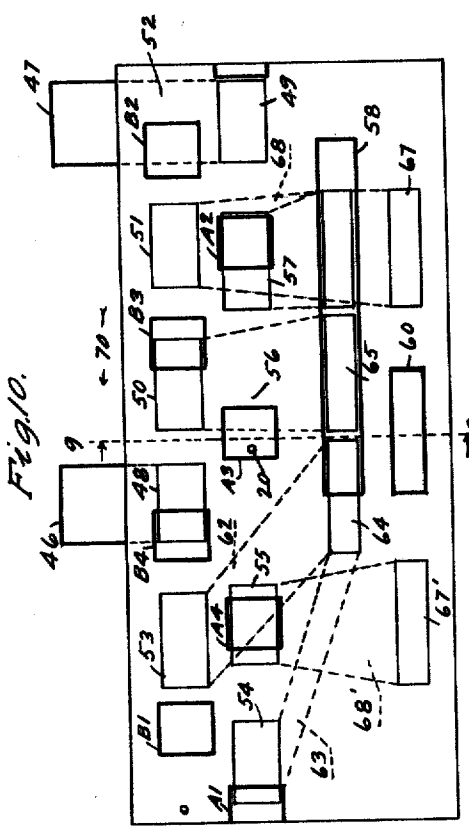


Fig. 10.

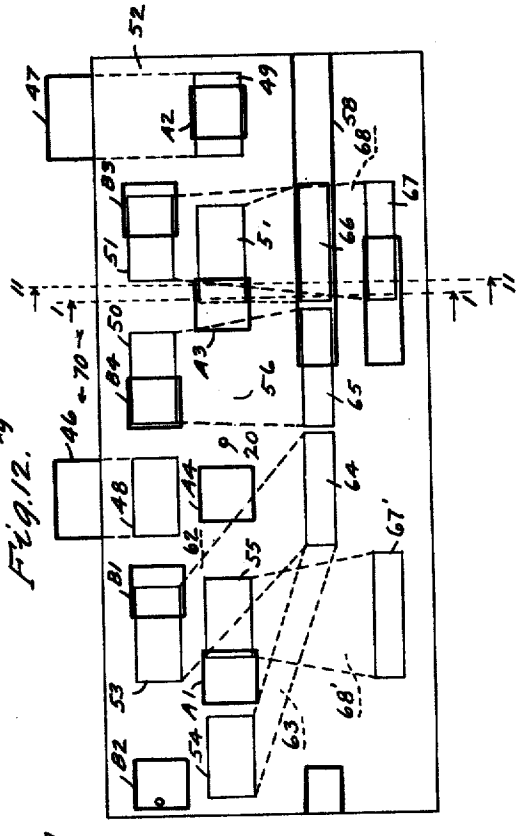


Fig. 12.

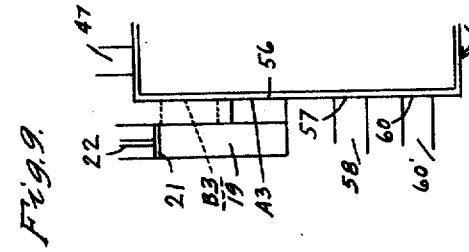


Fig. 9.

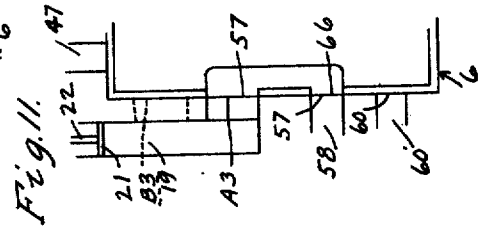


Fig. 11.

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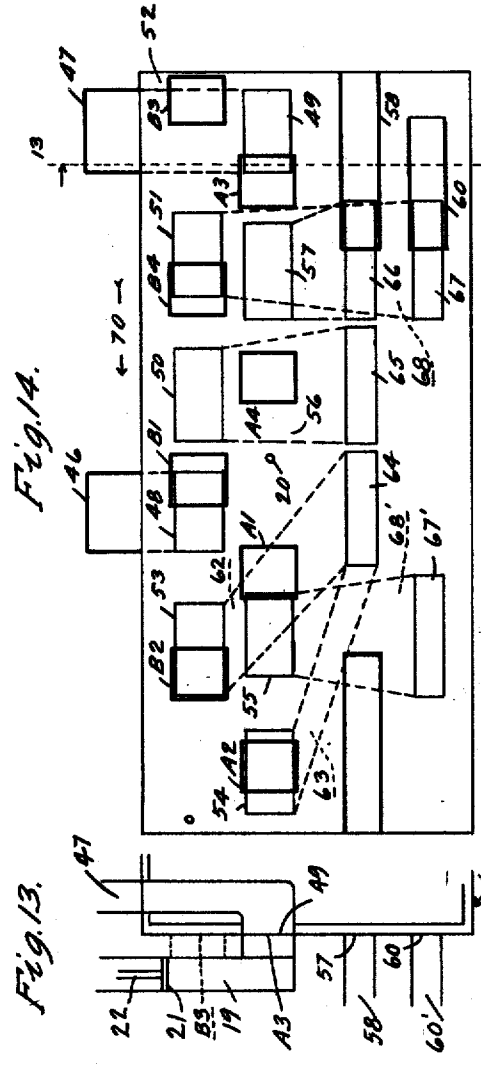


Fig. 14.

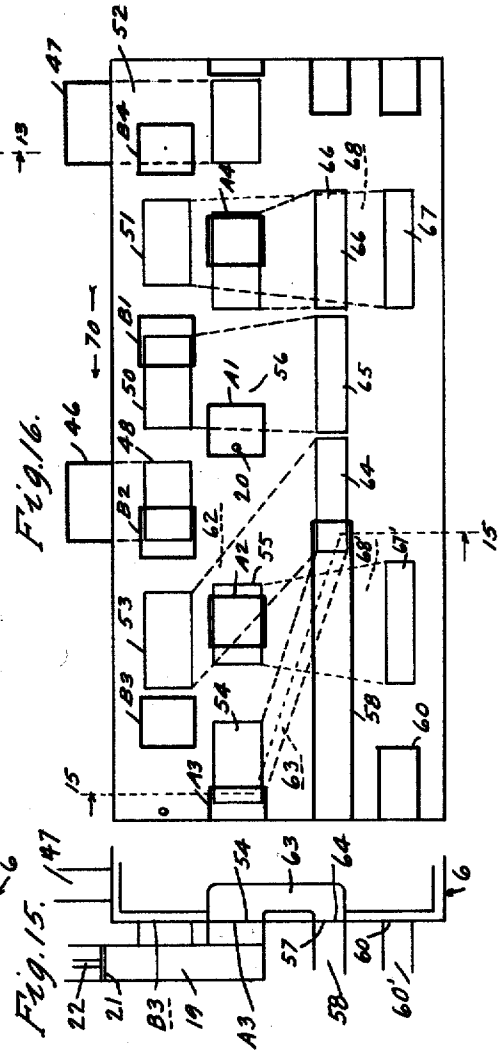


Fig. 16.



Fig. 13.



Fig. 15.

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Fig. 19.

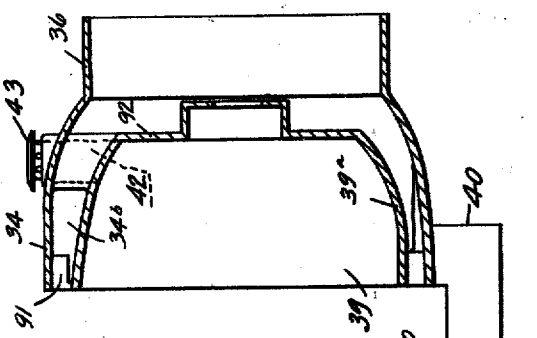



Fig. 18.

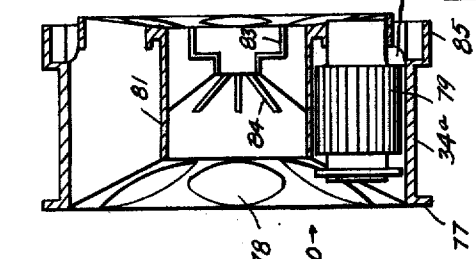



Fig. 17.

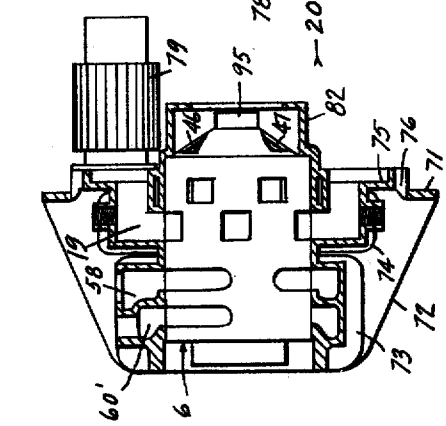



Fig. 21.

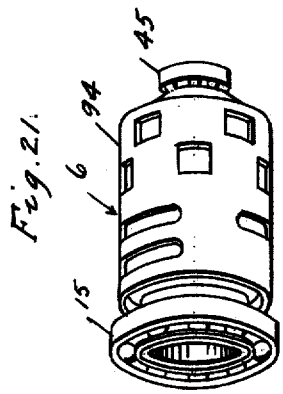
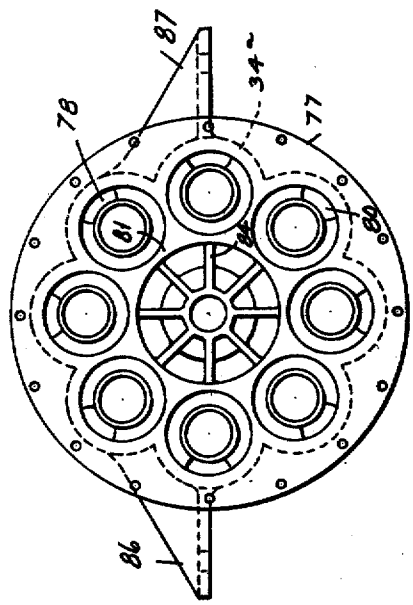



Fig. 20.




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7 SHEETS—SHEET 7.

Fig. 22.

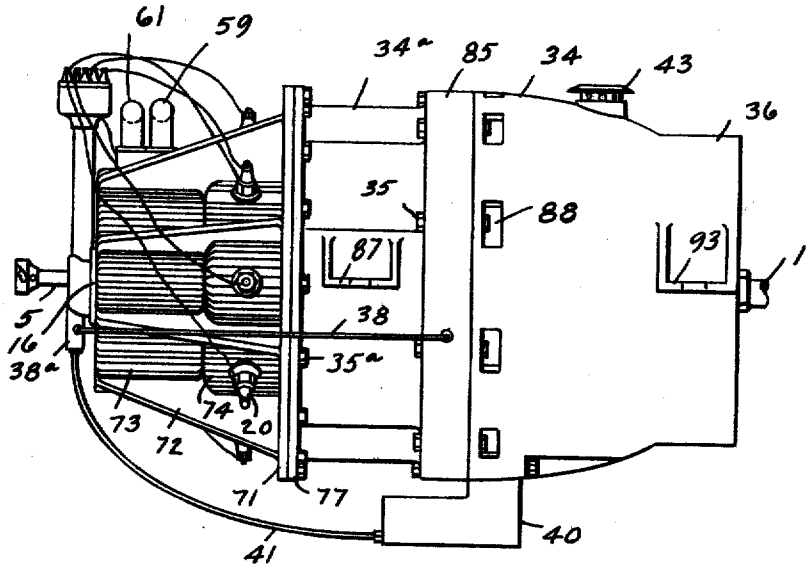
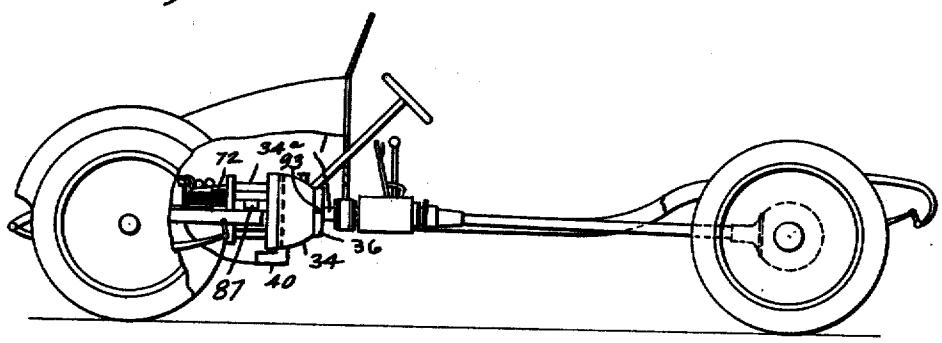



Fig. 23.




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THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

EVERETT R. BURTNETT, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-HALF TO TITUS E. BERRY, OF LOS ANGELES, CALIFORNIA.

## INTERNAL-COMBUSTION ENGINE.

1,315,538. Specification of Letters Patent. Patented Sept. 9, 1919.

Application filed May 2, 1918. Serial No. 232,122.

*To all whom it may concern:*

Be it known that I, EVERETT R. BURTNETT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, 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 consists of the novel features herein shown, described and claimed.

A leading feature of my invention is the provision of means for producing a six-stroke or three-revolution cycle, the extra two strokes or one revolution being devoted to pumping fresh air through the cylinder for internally cooling the cylinder.

Another leading feature of my invention is the elimination of the usual valves and the provision of a single valve mechanism for controlling the eight cylinders of the engine, said valve mechanism being rotatably mounted in line with the drive shaft and rotatably mounted for support in the casing or frame rigid with the extension frame carrying the eight cylinders, said cylinders being arranged parallel with the drive shaft and in a concentric plane around the valve mechanism and concentric to the drive shaft, and there being an angular crank and stroke plate transmission between the pistons and drive shaft.

Another important feature of my invention is the arrangement of parts by which the center of gravity is substantially on a horizontal plane with the drive shaft.

Figure 1 is an irregular sectional detail of an internal combustion engine embodying the principles of my invention, the parts being shown in position as at the completion of the exhaust of fresh air from one of the A series of cylinders, the point in the cycle being indicated by the line 1—1 in Fig. 12, and said point being the finish of the cycle ready to begin a new cycle.

Fig. 2 is a fragmentary sectional detail analogous to Fig. 1 and showing the parts in position at the end of the exhaust stroke of one of the B series of cylinders, the point in the cycle being shown by the line 2—2 in Fig. 6.

Fig. 3 is a diagram showing the transmission from the eight concentric cylinders to the drive shaft around which the cylinders are arranged, said drive shaft being parallel with the strokes of the pistons and said transmission being adapted for changing the rectilinear motion of the pistons in planes parallel with the drive shaft to a rotatory motion of the drive shaft, by an angular crank and stroke plate.

Fig. 4 is a diagram in end elevation or cross section showing the drive shaft, the valve rotating in line with the drive shaft and geared to the drive shaft and the eight cylinders arranged concentric to the valve and drive shaft.

Fig. 5 is a diagram showing the circulation back and forth across the line between the periphery of the valve and the inner face of the valve casing at the beginning of a cycle of a cyclinder as indicated by the line 5—5 in Fig. 6.

Fig. 6 is a diagram longitudinally of the diagram shown in Fig. 4 and showing the same registration as Fig. 5, Fig. 6 being constructed by splitting the diagram of Fig. 4 on the line 6—6 and spreading it out flat with the diagram of the inner face of the valve casing as a back ground and the diagram of the valve against the back ground, it being understood that the back ground is the rigid engine frame and valve seat standing still and that the valve is moving in the direction indicated by the arrow, the stationary parts being shown in heavy lines and the moving parts being shown in light lines.

Figs. 5 and 6 show the operation of taking in fuel on the out stroke of a piston, the first stroke of the cycle, and the beginning of the first revolution of the drive shaft.

Fig. 7 is a view analogous to Fig. 5 and taken on the line 7—7 of Fig. 8.

Fig. 8 is a view analogous to Fig. 6.

Figs. 7 and 8 show the operation of compressing the gas on the in-stroke of the piston, the second stroke of the cycle and the end of the first revolution of the drive shaft.

Fig. 9 is taken on the line 9—9 of Fig. 10, and Figs. 9 and 10 show the position of parts at the time of the gas explosion, the out-stroke of the piston, the third stroke of the cycle and the beginning of the second revolution of the drive shaft.

Fig. 11 is taken on the line 11—11 of Fig. 12, and Figs. 11 and 12 show the position of parts at the time of the burnt gas ex-

haust, and in-stroke of the piston, the fourth stroke of the cycle and the end of the second revolution of the drive shaft.

Fig. 13 is taken on the line 13—13 of Fig. 14, and Figs. 13 and 14 show the position of the parts at the time of the fresh air intake and out-stroke of the piston, the fifth stroke of the cycle and the beginning of the third revolution of the drive shaft.

Fig. 15 is taken on the line 15—15 of Fig. 16, and Figs. 15 and 16 show the position of the parts at the time of the fresh air exhaust, and in-stroke of the piston, the sixth stroke of the cycle, and the last part of the third revolution of the drive shaft, and ready to begin a new cycle.

Figs. 5 to 16 show the operation of a complete cycle of the cylinder $A^3$, said cycle comprising six strokes of the piston in the cylinder $A^3$, and three revolutions of the drive shaft.

Figs. 5 and 6 show the out-stroke for taking in gas; Figs. 7 and 8 show the in-stroke for compressing the gas; Figs. 9 and 10 show the out-stroke caused by the gas explosion; Figs. 11 and 12 show the in-stroke producing the burnt gas exhaust; Figs. 13 and 14 show the out-stroke taking in fresh air for cooling the cylinder; and Figs. 15 and 16 show the in-stroke for exhausting the fresh air ready to start a new cycle.

Fig. 17 is a vertical longitudinal central section of the valve casing with the valve and one piston cylinder in place and all the other parts removed.

Fig. 18 is a vertical longitudinal central section of the cylinder casing with one cylinder in place and all the other parts removed.

Fig. 19 is a vertical longitudinal central section of the air distributing head.

Fig. 20 is an end elevation of the cylinder casing as seen looking in the direction indicated by the arrow 20 in Fig. 18.

Figs. 17, 18, 19 and 20 show the three main parts of the engine frame consisting of a valve casing, a cylinder casing and an air distributing head adapted to be rigidly connected together.

Fig. 21 is a perspective of the valve.

Fig. 22 is a side elevation of the complete engine on a plane parallel with Fig. 1.

Fig. 23 is a side elevation of an automobile, parts being broken away to show the location of the engine shown in Fig. 22, the view being drawn especially to show the low center of gravity, the center of the engine being the drive shaft.

The engine end or front end of the drive shaft 1 is mounted in bearings 2 and 3 and the extreme front end of the shaft 1 has a socket 4 in which the valve shaft 5 is slidingly non-rotatably mounted, said valve shaft 5 being an extension of the drive shaft. The valve 6 has a central sleeve 7 loosely revolving around the extension shaft 5. The valve 6 has a straight cylindrical periphery 8 fitting closely in the valve casing 9. The valve casing 9 is a part of the main frame of the engine and is held rigid against rotation and reciprocation. The valve 6 rotates freely in the casing 9, there being a gear 10 upon the front end of the extension shaft 5, an idler 11 meshing with the gear 10 and an internal gear 12 rigid with the valve 6 and meshing with the idler 11.

The ratio of speed between the gear 10 and the gear 12 is three to one, so that the valve shaft 5 and the drive shaft 1 make three revolutions to one revolution of the valve 6. A head 13 extends outwardly from the front end of the sleeve 7, an annular rim 14 extends forwardly from the head 13 and the internal gear 12 extends inwardly from the annular rim 14. A ball bearing construction 15 is mounted between the rim 14 and the valve casing 9. A head 16 is fixed against the forward end of the valve casing 9 and has a central bearing 17 through which the valve shaft 5 extends, and a stud 18 extends backwardly from the head 16 to support the idler 11.

Eight combustion chambers 19 are formed in the valve casing 9, said chambers being evenly spaced radially and concentrically around the valve shaft 5 and there being a spark plug 20 for each combustion chamber.

One-half of the combustion chambers 19 have ports leading from their front sides to the valve 6, as shown in Fig. 1, and the other half of the combustion chambers 19 have ports leading from their rear sides as shown in Fig. 2, and in order to distinguish the two sets of ports I have called the first set the A series and the second set the B series. There is an engine cylinder communicating with each explosion chamber 19, and I have designated the cylinders connecting with the A series of ports as $A^1$, $A^2$, $A^3$ and $A^4$, and the series of cylinders connecting with the B series of ports are designated as $B^1$, $B^2$, $B^3$, and $B^4$. Each of the eight cylinders is provided with a piston 21 and a piston rod 22, the strokes of the pistons being parallel with the drive shaft 1.

The drive shaft 1 is provided with an angular crank 23 between the bearings 2 and 3. By angular crank I mean a crank having an axis diagonal to the axis of the shaft. A circular crank plate 24 is fixed upon the angular crank 23, the periphery of the crank plate 24 being concentric to the crank 23 and inclined to the drive shaft 1, and a circular stroke plate 25 is mounted in the same plane as the plate 24; said stroke plate 25 having a central opening 26 larger than the periphery 27 of the crank plate 24. Ball bearings 28 connect the stroke plate 25 to the crank plate 24. The angular crank 23 is made in two pieces and

consists of the socket $23^a$ having a squared opening and a squared shank $23^b$ fitting in the squared opening so that the parts may be separated for applying or removing the ball bearing 28. Arms 29 extend radially from the stroke plate 25 and the outer ends of the piston rods 22 are connected to the outer ends of these arms 29, so that as the pistons reciprocate, the shaft 1 will rotate. A bevel gear 30 is formed upon the periphery of the stroke plate 25 and meshes with the bevel gear rack 31 fixed upon the engine frame at the rear end of the cylinder casing, said gear 30 serving to hold the stroke plate 25 from rotating. The transmission gear 32 is connected to the shaft 1 for communicating power thereto.

The valve seat 33 is the inner face of the valve casing 9. A cylinder casing $34^a$ is secured to the rear end of the valve casing 9 by bolts $35^a$. An air distributing head 34 is secured to the rear end of the cylinder casing $34^a$ by bolts 35, said head covering the transmission from the piston rods 22 to the shaft 1 and said head supporting the bearing 3. A fan casing 36 extends backwardly from the head 34 around the bearing 3, and a fan 37 is mounted upon the shaft 1 within this fan casing 36. A heavy rim $37^a$ is formed integral with the outer ends of the blades of the fan 37, so that the fan and rim serve as a fly-wheel. The fan draws fresh air around the valve casing 9, through the cylinder casing $34^a$ around the cylinders $A^1$ to $A^4$ and $B^1$ to $B^4$ and through the outer chamber $34^b$ within the outer shell of the head 34, to externally cool the engine.

A force feed oil system $38^a$ is connected to the pipe 38 and the pipe 38 is connected to deliver oil through the parts wherever oil is needed and this oil drains into the inner chamber 39 within the inner shell $39^a$ of the head and from the chamber 39 into the sump chamber 40 from which it may return through the pipe 41 to the oil feed system $38^a$. A fresh air piped opening 42 is formed through the inner and outer shells of the head 34 at the upper side, and this opening is covered by a screen 43. The air passes through the screen 43, through the opening 42 to the chamber 39 and around the bearing 2 to the chamber 44 in the rear end of the valve 6. A ball bearing 45 is inserted between the head $45^a$ of the valve 6 and the casing 9. From the chamber 44 an air intake passage 46 leads through the valve 6 for the A series of ports, and a second intake passage 47 leads through the valve to the B series of ports, said intake passages being arranged diametrically opposite each other, and for internally cooling the cylinders.

The air intake passage 46 terminates at the port 48 in the periphery of the valve 6, and the air intake passage 47 terminates at the port 49. In the same plane with the port 48 is an air exhaust 50, a gas intake port 51, a blank compression and expansion space 52 and a gas exhaust port 53, and in the same plane with port 49 is an air exhaust port 54, a gas intake port 55, a blank compression and expansion space 56 and a gas exhaust port 57. The ports 48, 50, 51, the blank space 52 and the port 53 all register successively with the B series of ports in the valve seat 33 and through this B series of ports communicate with the cylinders $B^1$, $B^2$, $B^3$, and $B^4$, and in a like manner the ports 49, 54, 55, the blank space 56 and the port 57 register successively with the A series of ports in the valve seat 33 and through these ports communicate with the cylinders $A^1$, $A^2$, $A^3$ and $A^4$. The spark plugs 20 are timed to ignite the charges at the end of the compression stroke and in the diagrams the spark plugs are located at the centers of the blanks 52 and 56. An exhaust chamber 58 is formed in the casing 9 and an exhaust pipe 59 leads from this chamber. In the same manner a fuel mixture chamber 60′ having a port 60 is formed in the casing 9 and the carbureter pipe 61 leads to this chamber. The ports 53 and 54 lead from the periphery of the valve 6 inwardly through the passages 62 and 63 to the port 64 and from said port 64 to the exhaust chamber 58, and in a like manner the port 50 leads to the port 65 and the port 57 leads to the port 66, and said ports 65 and 66 lead to the exhaust chamber 58. The ports 67 and 67′ lead inwardly through the passages 68 and 68′ to the ports 51 and 55.

The valve 6 makes one revolution to a cycle of a cylinder, and the eight cycles of the eight cylinders overlap and are going on continuously, each of the eight cycles being controlled by the single valve 6. If the cylinders are numbered 1, 2, 3, 4, 5, 6, 7, and 8, the order of the cycles will be 1, 4, 7, 2, 5, 8, 3, 6, 1, and so on.

In Fig. 4 the cylinders are numbered $A^1$, $B^a$, $A^2$, $B^3$, $A^3$, $B^4$, $A^4$, $B^1$, in order to designate that alternate cylinders have ports A and the other cylinders have ports B. Then the cylinders are chronologically numbered 1′, 2′, 3′, 4′, 5′, 6′, 7′, and 8′. Then the sequence of cycles, beginning with the cylinder $A^3$ are numbered, $1^a$, $2^a$, $3^a$, $4^a$, $5^a$, $6^a$, $7^a$, $8^a$, and $9^a$, so that on the chronological numbers the cycles read 5′, 2′, 7′, 4′, 1′, 6′, 3′, 8′, 5′, and so on.

In the diagram in Figs. 3 to 16 I have followed the cycle of the cylinder $A^3$. In Fig. 3 the piston in the cylinder $A^3$ is at the bottom of the compression instroke and fired, and the stroke plate 25 has passed the dead center ready for the out-stroke. In Figs. 5

and 6 the port A leading to the cylinder $A^3$ is in registration with the port 55 and the port 67 is in registration with the fuel mixing chamber 60 and continued operation moving the valve in the direction indicated by the arrow 70 takes in fuel to the cylinder $A^3$. In Figs. 7 and 8 the valve has moved until the port of the cylinder $A^3$ has passed out of registration with the port 55 and the gas is being compressed. In Figs. 9 and 10 the compression is complete and the spark plug 20 will ignite the charge. In Figs. 11 and 12 the port of the cylinder $A^3$ is in registration with the port 57 and the cylinder is being exhausted. In Figs. 13 and 14 the port of the cylinder $A^3$ is passing into registration with the port 49 and fresh air is being taken through the passage 47 into the cylinder for internally cooling the cylinder. In Figs. 15 and 16 the port of the cylinder $A^3$ has moved into registration with the port 54 and the fresh air is passing through the passage 63 and the port 64 to the exhaust chamber 58, thus completing the cycle, and returning the parts to position to start a new cycle for that cylinder.

In a like manner the cycles of the other cylinders start as the ports A or B of the cylinders are passed by the gas in-take ports 50 and 51, said cycles starting in their turn one after the other and continuing as required to produce a continuous operation of the drive shaft 1.

Referring especially to Fig. 17, the valve casing 9 has an annular flange 71 extending outwardly around the combustion chambers 19 to receive the bolts $35^a$, and supporting ribs 72 extend from the extreme forward end of the casing backwardly and outwardly to the outer edge of the flange 71 so as to brace the flange. Radiating ribs 73 extend outwardly between the ribs 72 from the forward half of the casing 9 to cool the material around the intake and exhaust ports. The material forming the combustion chambers 19 is located between the supporting ribs 72 and radiating ribs 74 extend outwardly from this material to cool the combustion chamber. The seats 75 are formed at the rear ends of the combustion chambers 19 to receive the forward ends of the cylinders, there being passages 76 through the flange 71 around the seats 75 for the in-take of fresh air under the influence of the fan.

Referring to Figs. 18 and 20, the details for the cylinder casing $34^a$ are as follows:

An annular flange 77 extends outwardly all the way around to match with the flange 71 and receive the bolts $35^a$. A series of eight chambers 78 is formed within the annular shell or casing $34^a$, within the flange 77 and the cylinders fit loosely in these chambers; said cylinders having radiating ribs 79 so that the air passing in through the passage 76 will pass through the chambers 78 and along the radiating ribs 79, there being out-let openings 80 at the rear ends of the chambers. An inner shell 81 is formed concentric to the cylinder casing $34^a$ inside of the chambers 78 and fitting over the head 82 extending backwardly from the valve casing 9. An outer bearing housing 83 is centrally located in the inner shell 81 and connected to the shell by ribs 84. An enlargement extends all the way around from the rear end of the cylinder casing $34^a$ to form an annular chamber into which the out-let openings 80 lead the fresh air. The bearing 2 is mounted within the outer bearing housing 83. Suspension brackets 86 and 87 extend outwardly from the sides of the cylinder casing $34^a$ the lower faces of the brackets being on a line with the axial center of the drive shaft 1.

Referring to Fig. 19 the details of the air distributing head 34, are as follows:

The front edge of the outer shell of the air distributing head 34 fits against the rear edge of the enlargement 85, there being pockets 88 around the shell to receive the nuts 89 upon the bolts 35 inserted longitudinally through the enlargement 85 so as to connect the head rigidly to the cylinder casing. Passages 91 lead the fresh air from the enlargement 85 to the outer chamber $34^b$. The inner shell $39^a$ is concentric to the outer shell, the outer chamber $34^b$ being between the two shells. A plate 92 forms a head for the inner shell $39^a$ and supports the bearing 3. Referring to Fig. 22 suspension brackets 93 extend outwardly from the fan casing 36 and in line with the suspension brackets 86 and 87.

Referring to Fig. 21 the valve 6 has a smooth straight periphery 94 fitting the valve seat 33, and the valve has a neck 95 through which the chamber 44 extends and the ball bearing 45 fits around this neck 95 within the head 82 of the valve casing.

Thus I have produced in a single compact organization an eight cylinder engine, each cylinder having a six stroke or three revolution cycle.

Various changes may be made without departing from the spirit of my invention as claimed.

I claim:

1. In an internal combustion engine, a single multiple function rotary valve, a plurality of cylinders, said cylinders being arranged in two series, each cylinder having a port for communication with the plurality of passages within said valve, said cylinder ports extending to the inner face of the valve casing and located in a separate path of valve travel, corresponding in series with that of the cylinder of which it is a part.

2. In an internal combustion engine, a valve casing mounted horizontally and having intake and exhaust chambers in its front

end and combustion chambers in its rear end and having a central valve seat, a valve mounted in the valve seat, cylinders extending backwardly from the combustion chambers, pistons in the cylinders, a drive shaft extending backwardly from the axis of the valve and connections between the pistons and the drive shafts so that the operation of the piston operates the drive shaft.

3. In an internal combustion engine, a valve casing having a central valve seat and having combustion chambers arranged around one end of the valve seat, and an exhaust chamber and an intake chamber arranged around the other end of the valve seat, a valve rotatably mounted in the valve seat and having passages for leading fresh air to the combustion chambers, a passage for leading fuel mixture from the intake chamber to the combustion chamber, and a passage for leading exhaust from the combustion chamber to the exhaust chamber.

4. In an internal combustion engine, a valve casing mounted horizontally and having intake and exhaust chambers in its front end and combustion chambers in its rear end and having a central valve, a valve mounted in the valve seat, cylinders extending backwardly from the combustion chambers, pistons in the cylinders, a drive shaft extending backwardly from the axis of the valve and connections between the pistons and the drive shaft so that the operation of the pistons operates the drive shaft, the hot ends of the pistons being at the front.

In testimony whereof I have signed my name to this specification.

EVERETT R. BURTNETT.

**Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."**