A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

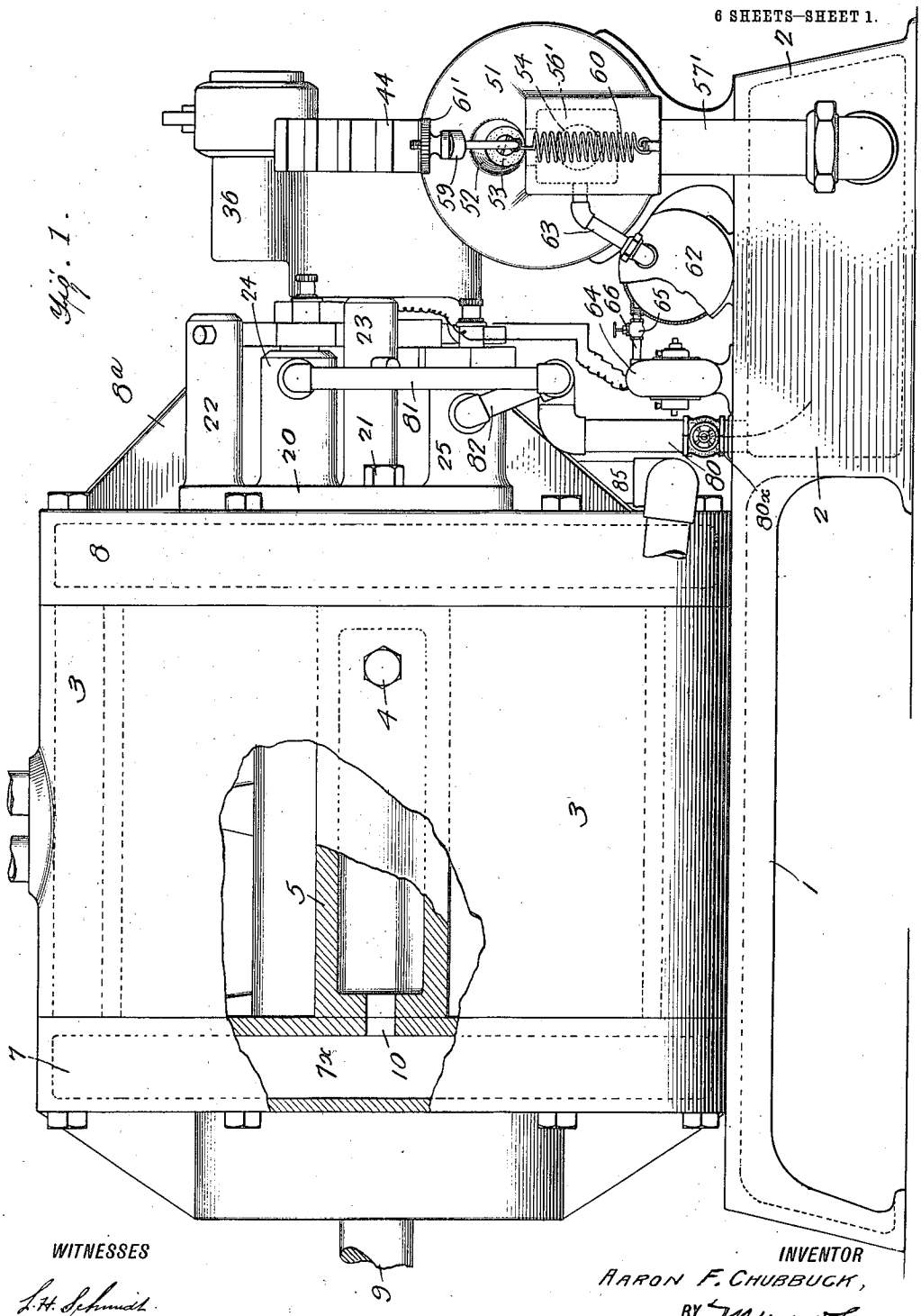
APPLICATION FILED OCT. 26, 1911.

1,042,322.

Patented Oct. 22, 1912.

6 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

L. H. Schmidt.

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK,

BY Munn & Co.

ATTORNEYS

A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 26, 1911.

1,042,322.

Patented Oct. 22, 1912.

6 SHEETS—SHEET 2.

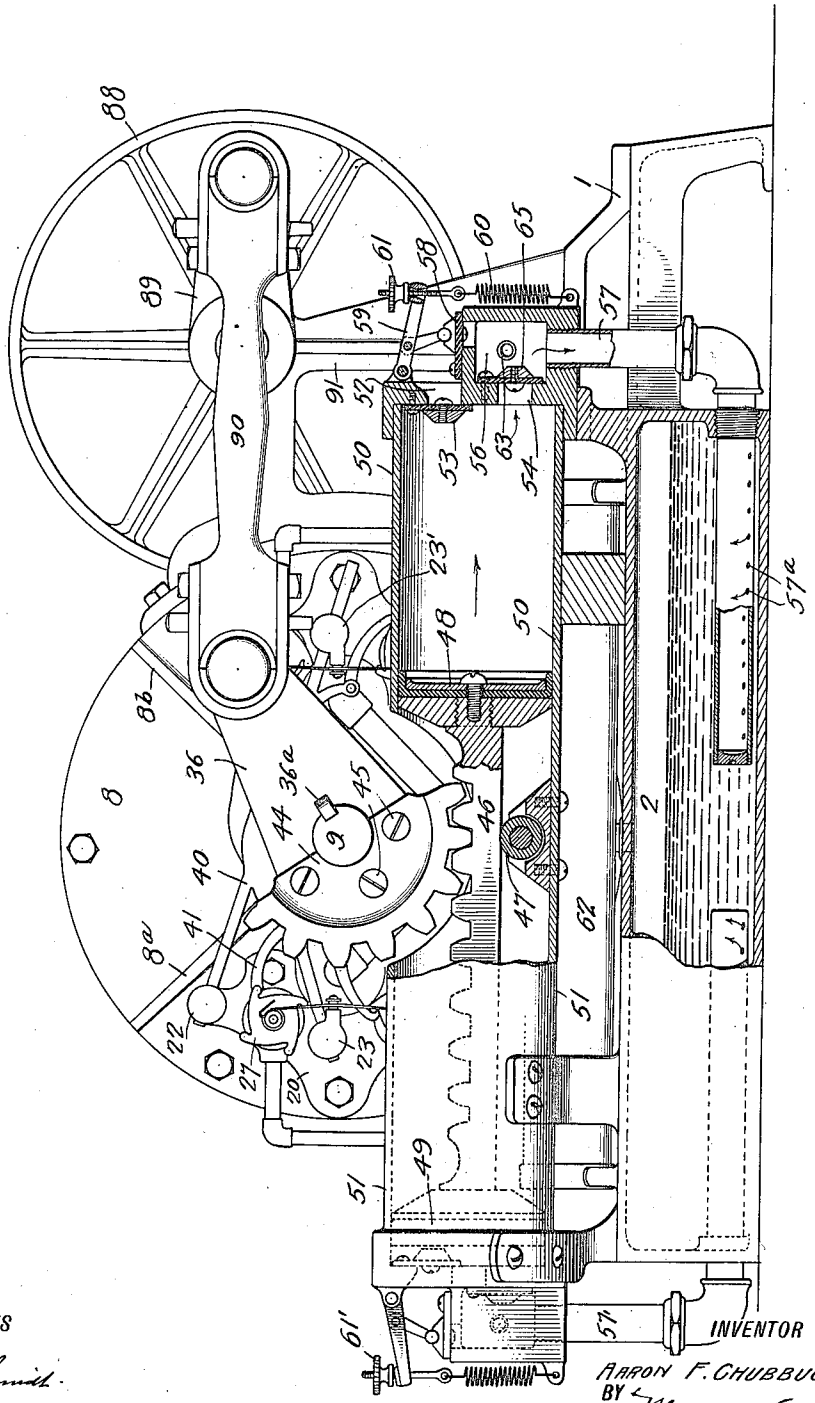


Fig. 2.

WITNESSES

L. H. Schmidt.

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK,

BY Munn & Co.

ATTORNEYS

A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 26, 1911.

1,042,322.

Patented Oct. 22, 1912.

6 SHEETS—SHEET 3.

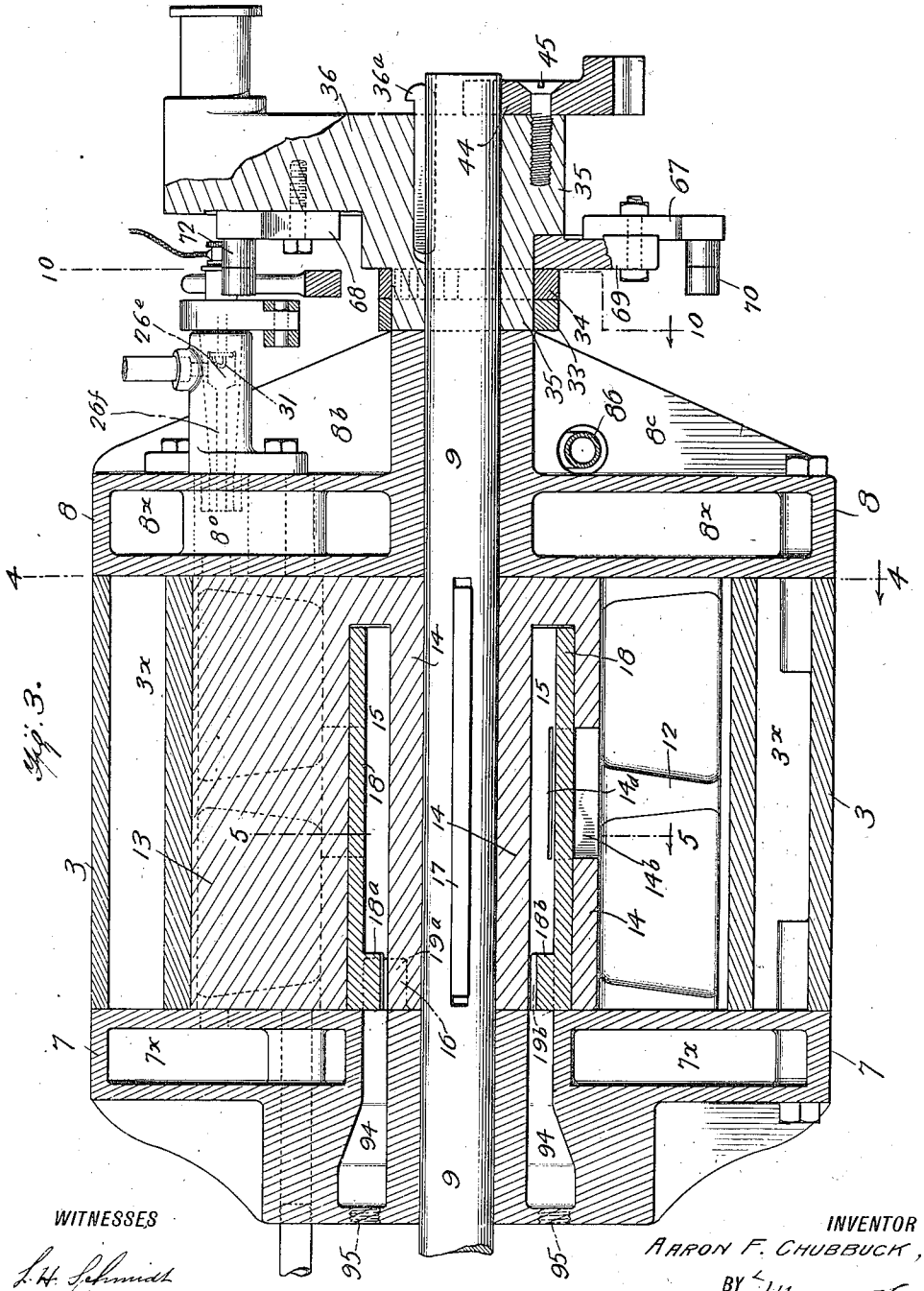


Fig. 3.

WITNESSES

L. H. Schmidt

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK,

BY Munn & Co.

ATTORNEYS

A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 26, 1911.

1,042,322.

Patented Oct. 22, 1912.

6 SHEETS—SHEET 4.

Fig. 5.

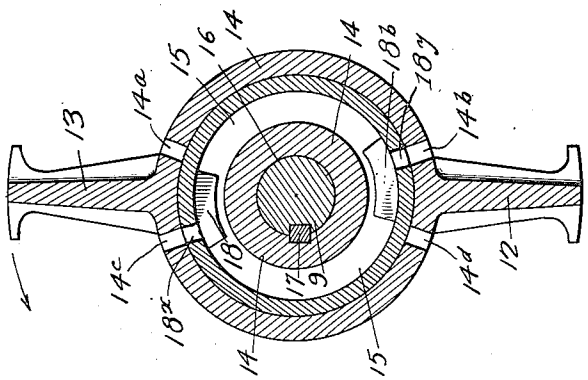
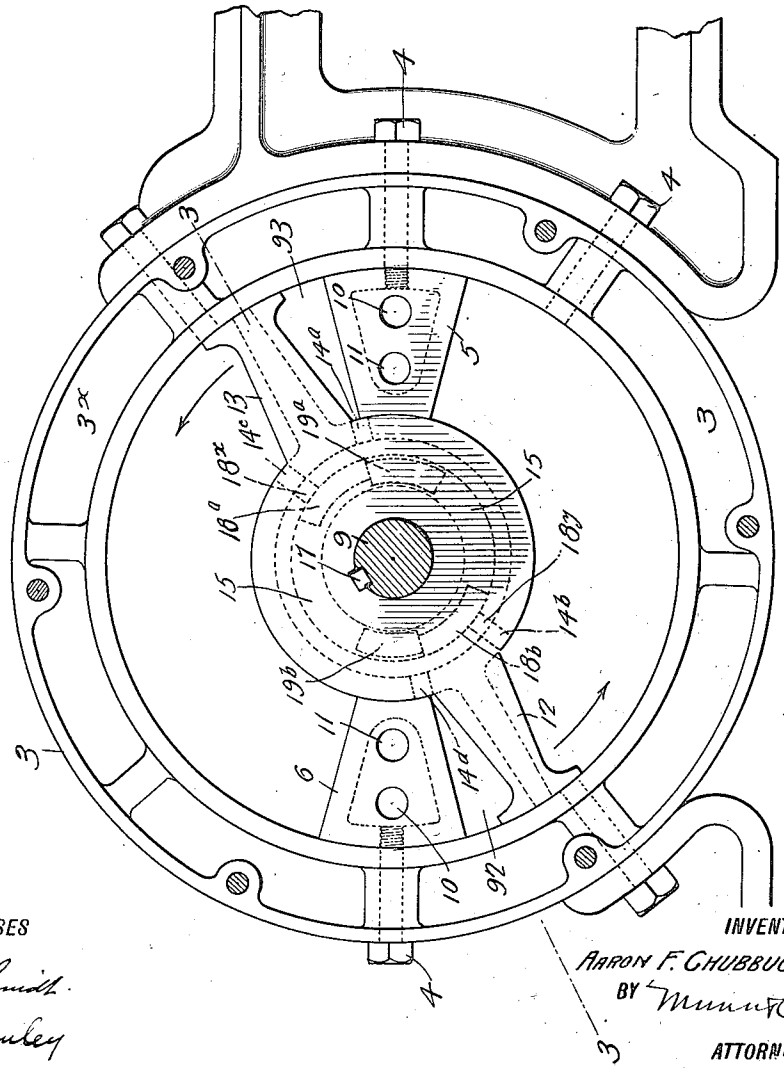


Fig. 4.



WITNESSES

L. H. Schmidt.

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK,

BY Munn & Co.

ATTORNEYS

A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 26, 1911.

1,042,322.

Patented Oct. 22, 1912.

6 SHEETS—SHEET 5.

Fig. 6.

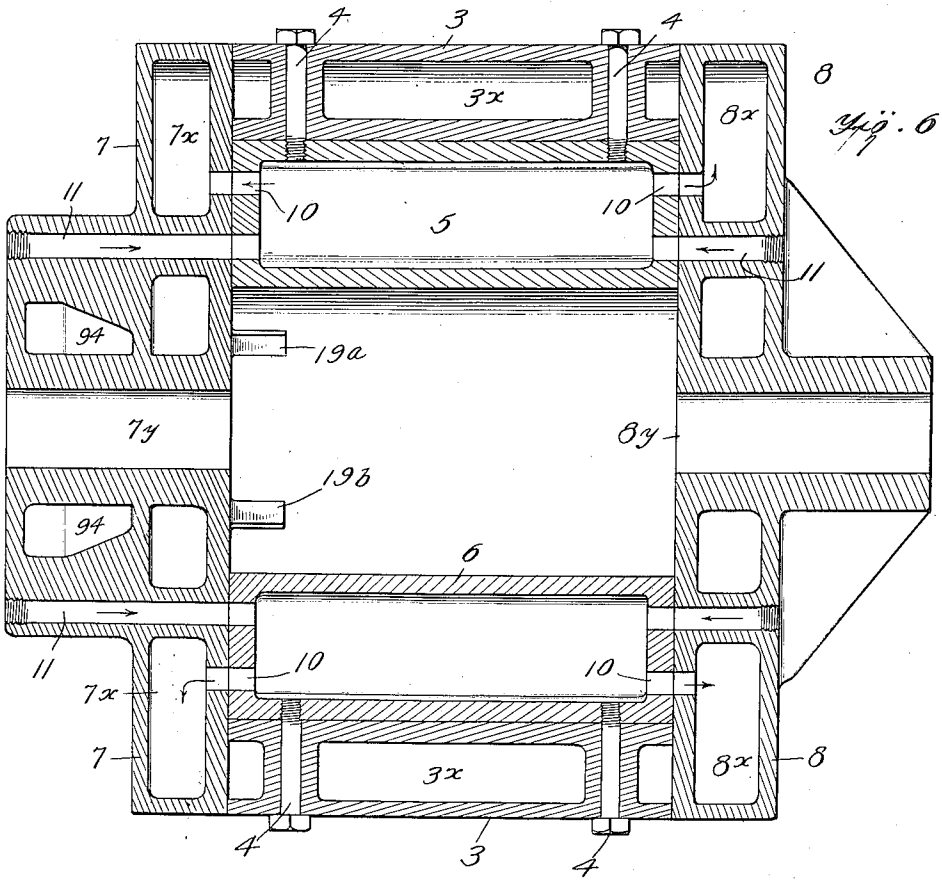


Fig. 7.

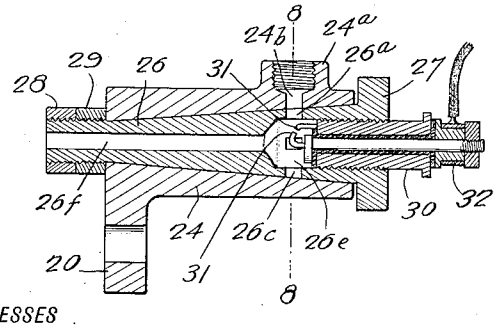
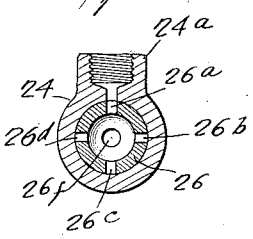


Fig. 8.



WITNESSES

L. H. Schmidt.

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK,

BY Munn & Co.

ATTORNEYS

A. F. CHUBBUCK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 26, 1911.

1,042,322. Patented Oct. 22, 1912.

6 SHEETS—SHEET 6.

Fig. 9.

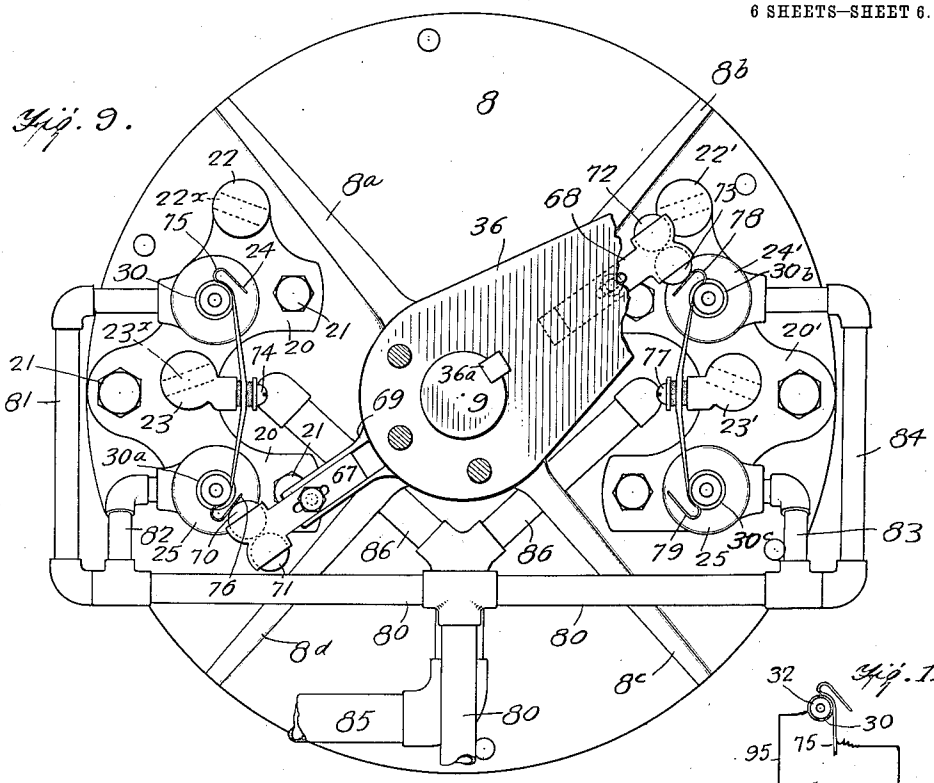


Fig. 11.

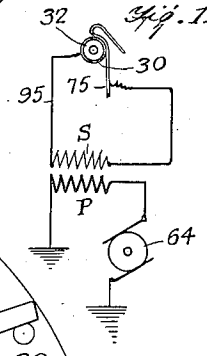
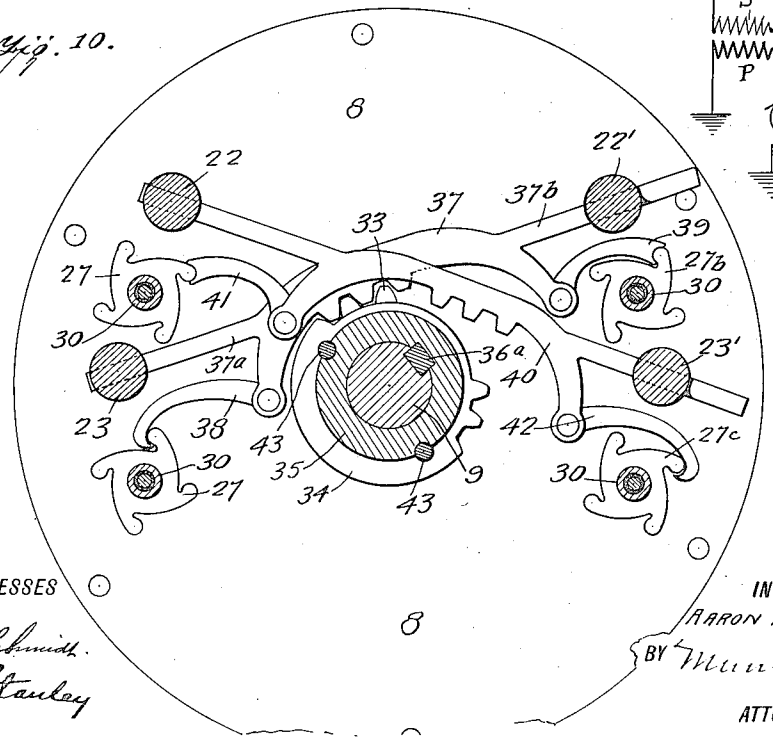


Fig. 10.



WITNESSES

L. H. Schmidt.

L. A. Stanley

INVENTOR

AARON F. CHUBBUCK

BY Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

AARON F. CHUBBUCK, OF GRAND RAPIDS, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

1,042,322. Specification of Letters Patent. Patented Oct. 22, 1912.

Application filed October 26, 1911. Serial No. 656,806.

To all whom it may concern:

Be it known that I, AARON F. CHUBBUCK, a citizen of the United States, and a resident of Grand Rapids, in the county of Kent and State of Michigan, have made certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to improvements in internal combustion engines and it consists in the combinations, constructions and arrangements herein described and claimed.

An object of my invention is to provide an internal combustion engine having a pair of oppositely directed arms secured to a common shaft in a cylinder with means for exploding charges between an arm on one side and an abutment head and the arm on the other side, and a second abutment head whereby the joint effect of the simultaneous explosions causes an oscillating movement of the two arms thereby doubling the efficiency of the engine.

A further object of my invention is to provide a novel form of cut-off valve for working in conjunction with the movement of the two arms or pistons.

A further object of my invention is to provide novel forms of intake valves and novel means for operating the same, said means being dependent upon the movement of the two arms or pistons.

A further object of my invention is to provide means for supplying an explosive mixture under pressure.

A further object of my invention is to provide novel means for timing the sparking circuit.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings forming part of this application in which similar reference characters indicate like parts in the several views, and in which,

Figure 1 is a side elevation of the device, certain portions being shown in section, Fig. 2 is a view in elevation at right angles to Fig. 1, certain portions being shown in section, Fig. 3 is a central longitudinal section of the main cylinder and crank arm, Fig. 4 is a sectional view along the line 4—4 of Fig. 3, looking in the direction of the arrows, Fig. 5 is a section along the line 5—5 of Fig. 3, Fig. 6 is a section through the main cylinder and the cylinder heads, showing the water jacketing, Fig. 7 is a section through one of the intake valves and spark plugs, Fig. 8 is a section along the line 8—8 of Fig. 7, Fig. 9 is a view of one of the cylinder heads which bears the circuit making contacts, Fig. 10 is a sectional view along the line 10—10 of Fig. 3, looking in the direction of the arrow, and Fig. 11 is a diagrammatic view showing one of the sparking circuits.

In carrying out my invention I provide a base 1, one end of which contains a chamber 2 for the liquid fuel. Mounted upon the base 1 is the main cylinder 3, which has double walls to provide water jacketing 3^x. Secured to the inner walls of the cylinder 3, by means of the bolts 4, are the two hollow abutment members 5 and 6 respectively. At one end of the cylinder is a head 7, which is provided with water jacketing 7^x, while a similar head 8 is secured to the other end of the cylinder 3, and is also provided with a water jacketing 8^x. These two heads are bored at 7^y and 8^y respectively to form bearings for the main shaft 9. The interiors of the hollow heads 7 and 8 are connected with the interiors of the hollow abutment members 5 and 6, by means of communicating passages such as those shown at 10, to provide for water circulation, and each of the heads is provided with passages 11 arranged to communicate with water circulating pipes on the exterior of the device for supplying the interior of the abutment members with water, as clearly shown in Fig. 6.

In Figs. 3 and 4, I have shown a pair of oscillating arms 12 and 13 respectively. The extremities of these arms are curved to fit closely the inner wall of the main cylinder 3. These arms or pistons are secured to an integral collar 14 (see Fig. 5), which is provided with the ports 14^a and 14^b on one side of the arms, and with similar ports 14^c and 14^d on the opposite sides of the arms. The arms 12 and 13 extend the length of the cylinder, as shown in Fig. 3 and abut the heads 7 and 8. An examination of Figs. 3 and 5 will show that there is an annular recess 15, which extends into the collar from one end, (in Fig. 3 from the left end), this recess being concentric with the bore 16 in the collar for receiving the shaft 9. The latter is secured to the collar 14 by means of the key 17. Disposed in the annular recess or cham-

ber 15 is a movable sleeve 18 which serves as a cylindrical cut-off and exhaust valve and which is provided with a pair of inwardly projecting lugs 18^a and 18^b, which are arranged to engage inwardly extending lugs 19^a and 19^b respectively on the head 7 (see Figs. 3, 4 and 6). The sleeve 18 is provided with a port 18^x arranged to register with the ports 14^e and 14^x on one side of the arms 12 and 13, and the port 18^y arranged to register with the ports 14^a and 14^b on the other side of the arms. The sleeve 18 constitutes a valve whose action will be described later in the description of the operation of the device.

Referring now to Figs. 1, 3 and 9 it will be seen that the head 8 is provided with cross braces 8^a, 8^b, 8^c and 8^d, extending radially from the center of the head. Between the cross braces 8^a and 8^d on one side is a plate 20, which is bolted to the head 8 by means of the bolts 21, and which is provided with the cylindrical lugs 22 and 23 having transverse bores 22^x and 23^x respectively. The plate 20 is also provided with the larger cylindrical lugs 24 and 25. A similar plate 20′ is provided between the braces 8^b and 8^c (see Fig. 9) having cylindrical lugs 22′, 23′, 24′ and 25′, corresponding to the lugs 22, 23, 24 and 25. Each of the lugs 24, 25, 24′, 25′ is similar to that shown at 24 in Fig. 7, and a description of one will suffice for all four. In this figure it will be seen that the lug is provided with a tapering bore arranged to receive a tapering valve 26 having four intake ports 26^a, 26^b, 26^c and 26^d (see Fig. 8), communicating with the hollow interior 26^e of the valve. The latter communicates by means of a passage 26^f with an opening 8^o in the head 8, leading to the interior of the cylinder 3. This opening is shown in Fig. 3 in dotted lines. Each of the valves has a similar communication with the interior of the cylinder 3. The valve 24 is provided with an integral ratchet wheel 27 on one end and with the nuts 28 and 29 on the opposite end for holding the valve in position with respect to the lug. By adjusting the nuts 28 or 29 the proper position of the valve may be secured. A spark plug 30 is screwed into the end of the valve, so that its terminals 31 are disposed within the chamber 26^e. A contact sleeve 32 is provided for each spark plug whose operation will be explained later. The valve 24 is provided with an internal threaded integral collar 24^a which communicates by means of a passage 24^b with the interior 26^e of the valve when the intake openings are in position.

Referring now to Fig. 10, I have shown four ratchets 27, 27^a, 27^b and 27^c. The means for actuating the valves is also shown in this figure. It consists of a pair of segmental gears 33 and 34 (see Figs. 3 and 10) which are mounted on a collar 35, which forms part of the crank arm 36. The latter is secured to the shaft 9 by means of a key 36^a (see Fig. 3). Arranged to coöperate with the teeth of the gear 33 is a rack 37 (see Fig. 10) having cylindrical extensions 37^a and 37^b arranged to pass through the transverse bores in the cylindrical lugs 23 and 22′. The rack 37 is provided at one end with a pivoted pawl 38, and at the other end with a pivoted pawl 39. These pawls 38 and 39 are designed to move the ratchet wheels 27 and 27^b simultaneously in the same direction, the pawl 38 pulling the ratchet 27 around and the pawl 39 pushing the ratchet 27^b around when the ratchet moves to the right in Fig. 10. A second rack 40 is provided, which is adapted to be engaged by the gear 34. This rack slides in the lugs 22 and 23′, and the pawls 41 and 42 are designed to operate in precisely the same manner as the pawls 39 and 38, the movement of the ratchet wheels 27 and 27^c, of course, being in opposite directions from that of the ratchets 27 and 27^b. The gears 33 and 34 are arranged to be held in position on the collar 35 by means of the pins 43, the holes for which are designed to be located after the valves have been correctly timed.

Referring now to Figs. 2 and 3, I have shown therein a segmental gear 44, which is secured to the collar 35 of the crank 36 by means of screws 45. This gear is designed to engage a rack 46 (see Fig. 2) whose center is supported by an anti-friction roller 47. The rack constitutes a common piston rod for the pistons 48 and 49 in the cylinders 50 and 51 respectively. A description of one of these cylinders will suffice, since they are both alike. In Fig. 2, the cylinder 50 is provided with an air intake port 52, this port being controlled by a valve 53, which closes when the pressure on the inside of the cylinder is greater than that on the outside. An outlet port 54 is provided in the end of the cylinder, and is controlled by a flap valve 55. The outlet port 54 communicates with a chamber 56, which is in turn connected by means of a pipe 57 with the interior of the fuel chamber 2, the pipe 57 being perforated at 57^a to permit the entrance of air. A safety valve 58 is provided at the top of the chamber 56, and is held in position by means of a swinging arm 59, this arm being normally kept down by means of the spring 60. A nut 61 is provided for adjusting the tension of the spring. The cylinder 51 is provided with similar valves, and with a pipe 57′ for permitting the entrance of air into the interior of the fuel chamber 2.

In Fig. 1, I have shown a tank 62, which communicates by a pipe 63′ with the interior of the valve chamber 56′ of the cylinder 51. The valve chamber 56 of the cylinder

50 communicates by means of a pipe 63 with the opposite end of the cylinder 62. A dynamo 64 is provided for ignition and is designed to be run by compressed air from the tanks 62, the dynamo being controlled by the valve 65 and the pipe 66. A similar dynamo (not shown) is provided on the opposite side of the engine.

Referring once more to Fig. 3, it will be seen that I have provided the arms 67 and 68, the former being secured to a slotted extension 69 of the collar 35 and the latter being secured directly to the crank 36 in a slotted portion thereof (see Fig. 9). The securing bolts permit the adjustment of these arms radially with respect to the shaft 9. The arm 67 bears a pair of rollers 70 on one side thereof, and a similar pair 71 on the opposite side, while the arm 68 bears similar rollers 72 and 73. Secured to the cylindrical lug 23 by the screw 74 is a contact spring having two arms bent at their ends and arranged to be brought into engagement with the spark plugs, such as that shown in Fig. 7. Thus the bent spring contact 75 is adapted to be brought into engagement with the portion 30 of the spark plug in the cylindrical lug 24. Similarly the contact 76 engages the plug 30^a. A screw 77 on the opposite side of the head holds the spring contacts 78 and 79, which are arranged to engage the spark plugs 30^b and 30^c respectively. In Fig. 9, the spring contact 78 is forced into engagement with the spark plug 30^b by the roller 73, while the spring contact 76 is forced into engagement with the spark plug 30^a by the roller 70. It will be understood that when the crank arm is oscillated to its extreme position the spring contact arms 75 and 79, which now are out of contact, will be brought into contact with their respective spark plugs 30 and 30^c by means of the respective rollers 72 and 71.

In Figs. 1 and 9, I have shown a pipe 80, which leads from the fuel chamber 2, and which communicates with the interior of the valves by means of the respective pipes 81, 82, 83, and 84. The pipe 80 has a control valve 80^x. In this figure may also be seen the water pipe 85 having the branches 86 and 87, leading to the interior of the abutment members 5 by means of the passages 11 (see Fig. 6). The water circulation system forms no part of the present invention, and the water may be forced through the engine by any suitable means.

In Fig. 2 is shown the fly wheel 88 of the engine. It is connected by means of the crank 89 and pitman 90 with the crank arm 36, the fly wheel being journaled on a suitable standard 91 secured to the base 1.

From the foregoing description of the various parts of the device the operation thereof may be readily understood.

In starting the engine the valve 80 is first closed, the fly wheel 88 is turned by hand, and this causes the oscillation of the crank arm 36, which, through the medium of the gear 44 and rack 46, causes the reciprocations of the pistons 48 and 49. As the piston 48 is forced in the direction of the arrow in Fig. 2 the valve 65 opens to permit air to pass down the pipe and out into the openings 57^a into the liquid fuel. When the piston is reciprocated in the opposite direction from that shown by the arrow, air is forced in through the opening 52 past the valve 53, thus supplying the cylinder with air preparatory to its being forced into the fuel chamber. If the valve (such as that shown at 65 in Fig. 1) controlling the pipes leading from the air tank 62 to the air driven dynamos, such as that shown at 64, is closed, then the sparking circuit will be rendered inoperative and the only effect of the reciprocation of the pistons 48 and 49 will be to increase the air pressure in the fuel chamber 2. In starting the device this pressure is allowed to increase until the safety valve 58 is lifted when the pressure exceeds twenty pounds. The valve 65 of the pipe 66 which supplies both dynamos with air is opened thus causing the running of the dynamos. The wheel 88 is now started and the engine will begin to run. As the air passes through the body of the liquid it takes up the vapor forming a combustible mixture, and passes through the pipe 80 to the various valves by means of the pipes 81, 82, 83 and 84. The oscillation of the crank arm 36 causes an oscillatory movement of the gears 33 and 34, and hence of the racks 37 and 40. The valves which are actuated by any one rack, as for instance the rack 37, have their intake ports open at the same time, and the explosive charge therefore passes through the head 8 and into the space 92 between the arm 12 and the abutment member 6 through one of the valves, and into the space 93 between the arm 13 and the abutment member 5 by way of the other valve. Here the charge is exploded by a spark, this spark being caused to pass by the engagement of the roll 70 with the spring contact 76, the latter being pressed against its spark plug 30^a, thereby closing the circuit through the spark plug of the hollow valve leading into the space 92, while a similar action takes place with the roll 73 against the arm 78 for igniting the charge in the hollow valve leading to the space 93 on the opposite side of the abutment member 5. The explosion of the charge drives the arms in the direction shown by the arrows in Fig. 4. The cylindrical valve 18 is carried around and during this movement it will be noted that the ports 18^x and 14^c are in registration and the ports 18^y and 14^b are in registration, thus the air or gases in front of the pistons 12 and 13 will escape

through these registering ports into the annular space 15, and out of the annular space 15 into the passages 94, and by means of the exhaust openings 95 to the outer atmosphere. As soon as the lugs 18^a and 18^b engage the lugs 19^b and 19^a respectively, then the cylindrical valve 18 is shifted so as to bring the port 18^x in the valve into registration with the port 14^a in the collar and the port 18^y in the valve into registration with the port 14^d in the collar. The gear 34 engages the rack 40 at practically the end of the oscillating stroke of the arm, so as to open the intake valves to permit the entrance of the explosive charge between the arm 12 and the abutment member 5 on one side, and between the arm 13 and the abutment member 6 on the other. It will be understood that the uncovering of the intake ports of these valves is of comparatively short duration and that during the time when the gears are not in contact with the racks, the intake ports are closed. The second explosion drives the pistons in the opposite direction, the exhausts now taking place through the ports 14^a and 14^d in the collar, and the registering ports of the cylindrical valve 18 as already described. The oscillatory movement of the arms or pistons 12 and 13 causes the oscillatory movement of the shaft 9, and hence the rotation of the fly wheel 88 through the medium of the crank 89 and pitman 90.

In Fig. 11 I have shown a diagrammatic view of the sparking circuit in which one terminal of the dynamo 64 is grounded, the other terminal being connected with the primary P of the induction coil, the other end of the primary of the induction coil being grounded. One end of the secondary of the induction coil is connected by means of the conductor 95 with the sleeve 32 on the spark plug 30. This sleeve, it will be observed from Fig. 7, is insulated from the body portion of the spark plug. The other terminal of the secondary is connected with one of the spring contacts such as 75. It will be apparent from what has already been said that when the spring 75 is pressed by the roller 72 against the body portion of the spark plug 30, a jump spark will pass between the terminals 31, shown in Fig. 7. The other sparking devices are similarly arranged. The rollers 70, 72, etc., are adjustable so as to cause the contact of the spring arms and the spark plugs at the end of the travel of the arms 12 and 13.

Owing to the construction and operation of the valves the engine is automatically governed. If these valves should work too fast, as for instance when the engine is running too fast, the vapor will not have time to pass through, and hence the force of the explosive charges will be less and the engine will slow down, thereby giving the valves more time to operate and permitting a greater flow of the vapor. I desire also to call attention to the fact that the valves are thoroughly balanced, and automatic in their operation. This applies also to the cylindrical cut-off and exhaust valve 18. At the time of explosion and exhaust the pressure is the same at opposite sides. The valve is balanced thereby, and hence its movement is accomplished easily and without the usual effort necessary where the valve is subject to back pressure or to friction.

I claim:—

1. In an internal combustion engine, a cylinder, a shaft disposed centrally of said cylinder, heads for said cylinder, a series of hollow rotatable intake valves carried by one of said heads and having communication with the interior of the cylinder, a fuel chamber, pipes adapted to establish communication between said fuel chamber and each of said intake valves, means actuated by the movement of said shaft for supplying an explosive mixture under pressure to said intake valves, said means comprising an air compressor having a piston and a rack, and a gear secured to said shaft and arranged to operate the rack through the movement of the shaft.

2. In an internal combustion engine, a cylinder, a shaft disposed centrally of said cylinder, a pair of oscillating pistons secured to said shaft, a pair of abutment members within said cylinder, hollow intake valves for admitting an explosive charge into the cylinder, a crank arm secured to said crank shaft, a segmental gear secured to said crank arm, a rack arranged to be operated by said gear, a piston head secured at each end to said rack, an air cylinder for each piston head, an inlet and an outlet valve for each air cylinder, a fuel chamber, a pipe leading from each of said air cylinders into said fuel chamber, and means for delivering an explosive charge from said fuel chamber to said hollow intake valves.

3. In an internal combustion engine, a cylinder, a shaft centrally disposed of said cylinder, a collar secured to said shaft, heads carried by said cylinder, a series of rotatable valves carried by one of said heads, a pair of intermittent gears carried by said collar, a rack for each gear, a ratchet wheel secured to each valve, and a pawl at both ends of each of said racks arranged to operate one of said ratchet wheels.

4. In an internal combustion engine, a cylinder, a shaft centrally disposed of said cylinder, a collar secured to said shaft, heads carried by said cylinder, a series of rotatable valves carried by one of said heads, a pair of intermittent gears carried by said collar, a rack for each gear, a ratchet wheel secured to each valve, a pawl at both ends of each of said racks arranged to operate one of said ratchet wheels, a spark plug carried by

each rotatable valve, a conducting contact spring for each spark plug, and means operated by the movement of said shaft for bringing said conductive contact spring into electrical engagement with each of said spark plugs.

5. In an internal combustion engine, a cylinder, a shaft centrally disposed of said cylinder, a collar secured to said shaft, heads carried by said cylinder, a series of rotatable valves carried by one of said heads, a pair of intermittent gears carried by said collar, a rack for each gear, a ratchet wheel secured to each valve, a pawl at both ends of each of said racks arranged to operate one of said ratchet wheels, a spark plug carried by each rotatable valve, a conducting contact spring for each spark plug, means operated by the movement of said shaft for bringing said conductive contact spring into electrical engagement with each of said spark plugs, said means comprising a crank arm secured to said main shaft, a pair of adjustable arms secured to said crank arm, and a pair of rollers carried by each of said adjustable arms, each roller being arranged to engage a contact spring for forcing it into engagement with the spark plug.

6. In an internal combustion engine, a cylinder, a pair of abutment members disposed within said cylinder, a shaft centrally disposed of said cylinder, a pair of radial arms or pistons secured to said shaft, means for delivering an explosive charge between one of said pistons and one of said abutments, means for delivering an explosive charge between the other of said pistons and the other of said abutments, the force of said explosive charges tending to rotate the pistons in the same direction, means for supplying two explosive charges at the ends of the strokes of said pistons for jointly driving the pistons in the opposite directions, the means for supplying said explosive charges comprising four hollow rotatable intake valves secured in one of the cylinder heads, each intake valve having one end in close proximity to one side of an abutment member, the other end being without the cylinder, and means for simultaneously actuating one pair of said intake valves.

7. In an internal combustion engine, a cylinder, a pair of abutment members disposed within said cylinder, a shaft centrally disposed of said cylinder, a pair of radial arms or pistons secured to said shaft, means for delivering an explosive charge between one of said pistons and one of said abutments, means for delivering an explosive charge between the other of said pistons and the other of said abutments, the force of said explosive charges tending to rotate the pistons in the same direction, means for supplying two explosive charges at the ends of the strokes of said pistons for jointly driving the pistons in the opposite directions, the means for supplying said explosive charges comprising four hollow rotatable intake valves secured in one of the cylinder heads, each intake valve having one end in close proximity to one side of an abutment member, the other end being without the cylinder, means for simultaneously actuating one pair of said intake valves, said valve actuating means comprising a ratchet wheel secured to each valve, a rack for operating each ratchet wheel, and intermittent gears carried by said shaft for operating said racks.

8. In an internal combustion engine, a cylinder, a shaft disposed centrally of said cylinder, heads for said cylinder, a series of hollow rotatable intake valves carried by one of said heads and having a communication with the interior of the cylinder, a fuel chamber, pipes adapted to establish communication between said fuel chamber and each of said intake valves, and means actuated by the movement of the shaft for alternately rotating simultaneously a pair of said intake valves.

9. In an internal combustion engine, a cylinder, a shaft disposed centrally of said cylinder, heads for said cylinder, a series of hollow rotatable intake valves carried by one of said heads and having communication with the interior of the cylinder, a fuel chamber, pipes adapted to establish communication between said fuel chamber and each of said intake valves, means actuated by the movement of the shaft for alternately rotating simultaneously a pair of said intake valves, a spark plug carried by each rotatable valve, and means operated by the movement of the shaft for completing a circuit through each of said spark plugs.

AARON F. CHUBBUCK.

Witnesses:
JURGEN H. PLETT,
RALPH W. GRISWOLD.