July 27, 1926.

1,593,989

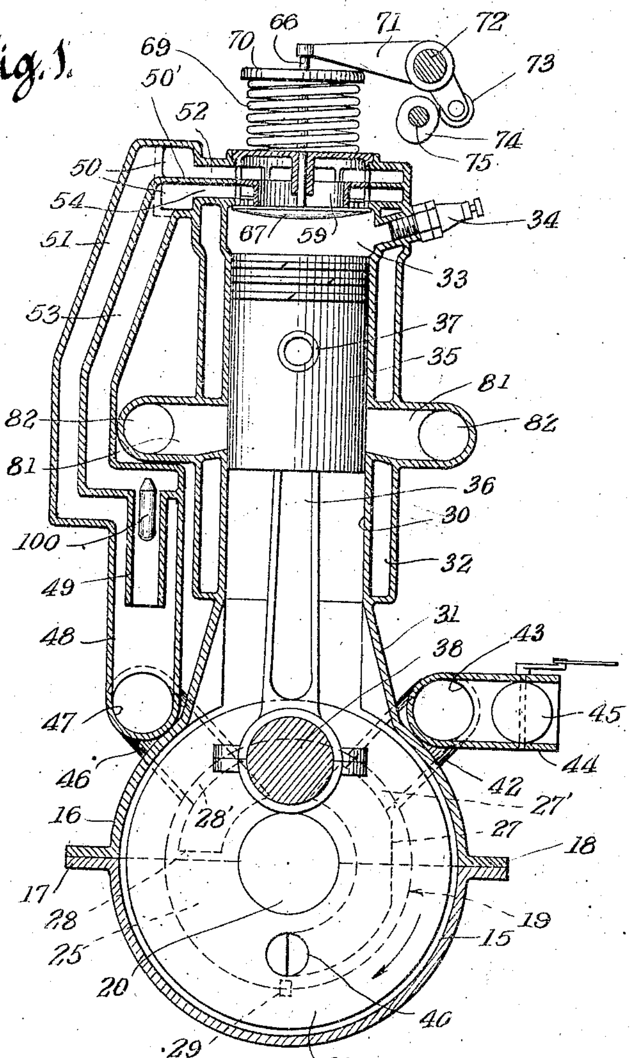
A. RAFTER

INTERNAL EXPLOSION ENGINE

Filed May 28, 1923

3 Sheets-Sheet 1

Fig. 1.



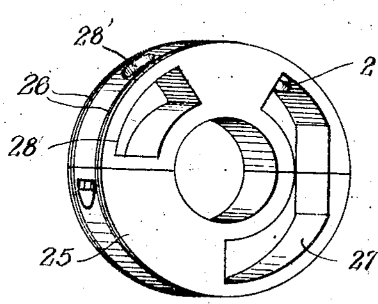


Fig. 7

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Fig. 2.

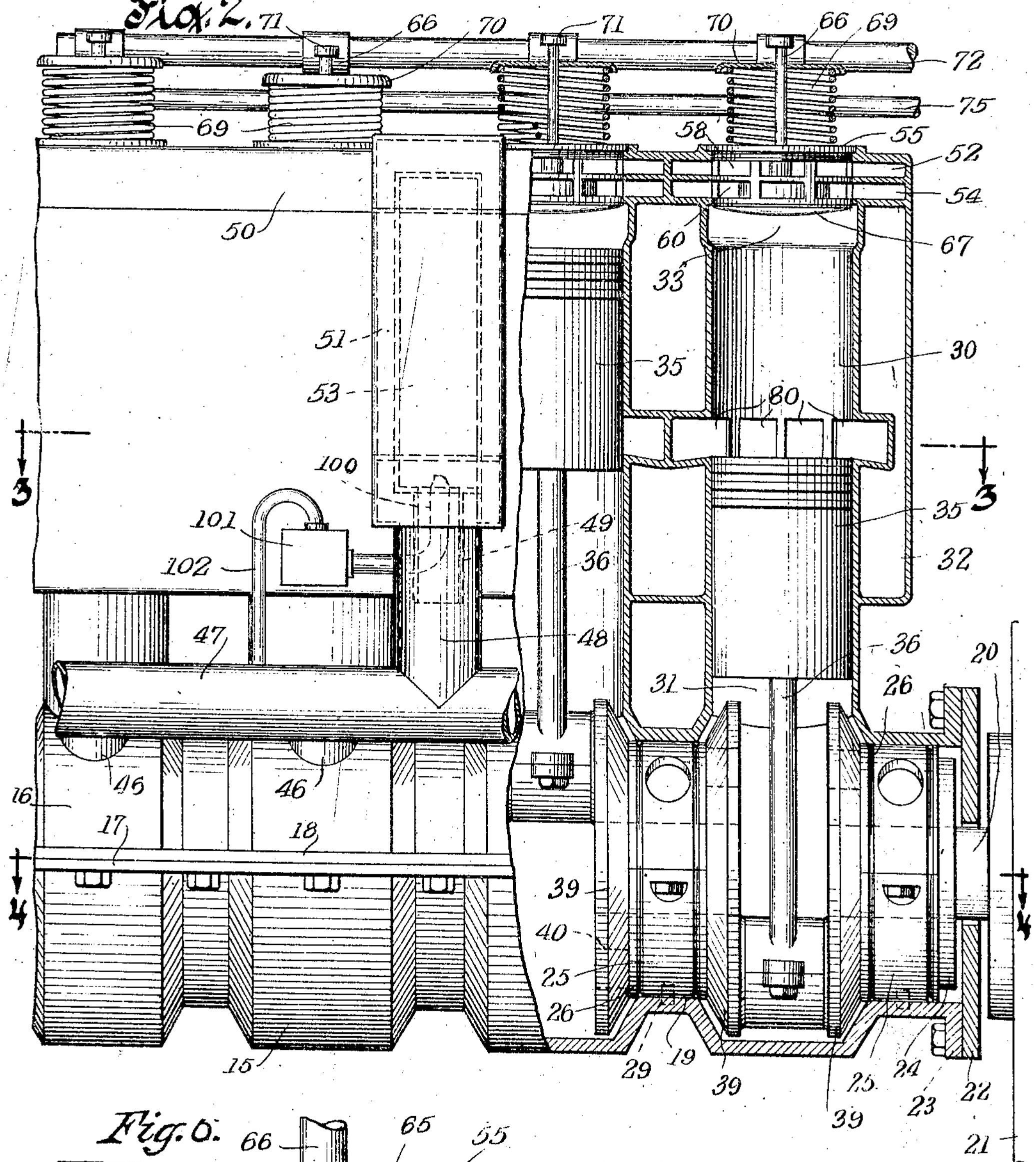

Fig. 6.

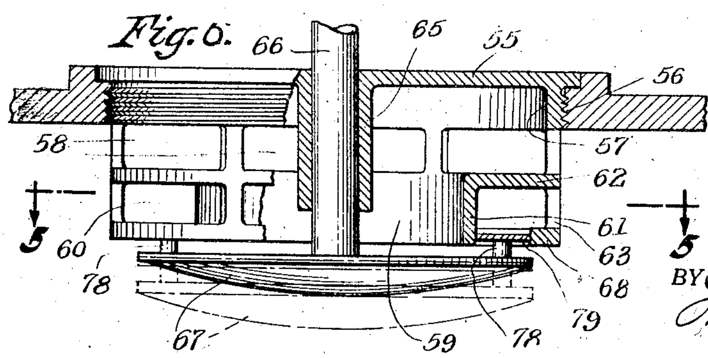

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Fig.3.

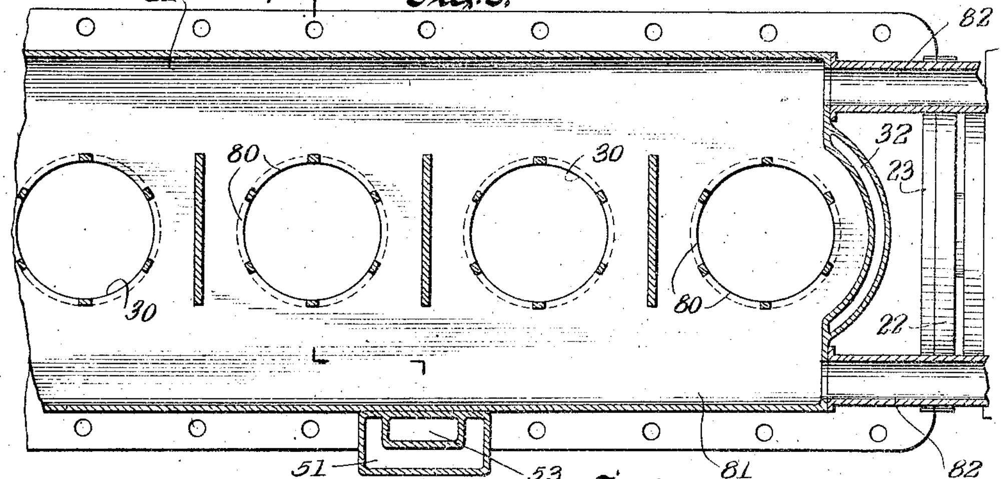


Fig.4.

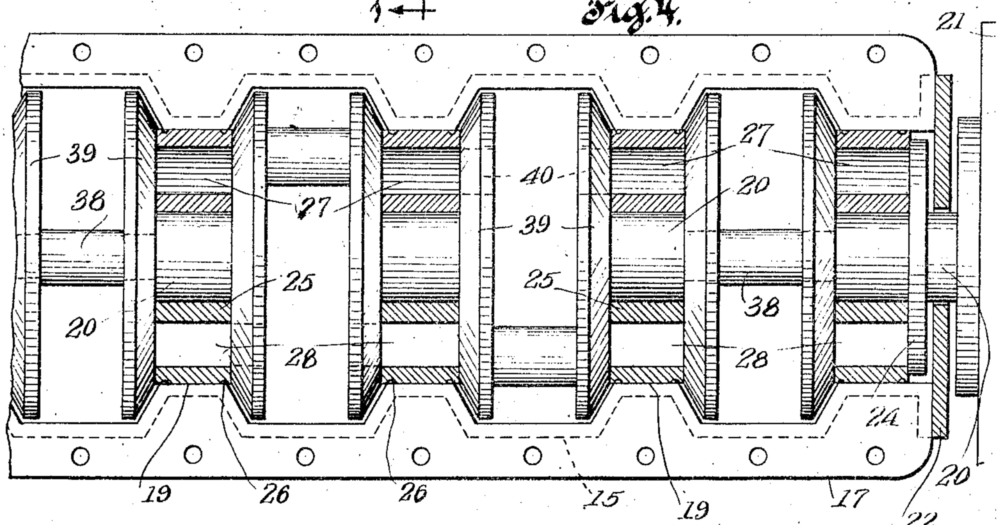
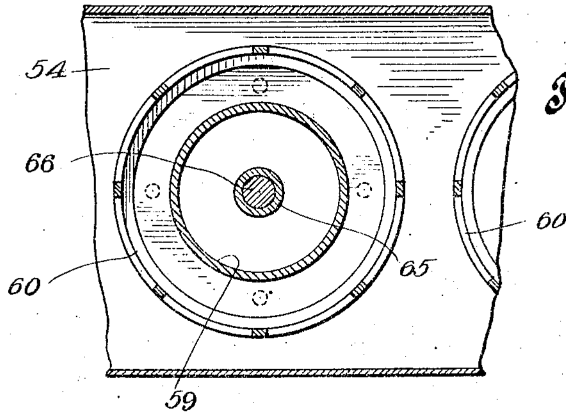


Fig.5.



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Patented July 27, 1926. 1,593,989

UNITED STATES PATENT OFFICE.

ALBERT RAFTER, OF NEWARK, NEW JERSEY.

INTERNAL-EXPLOSION ENGINE.

Application filed May 28, 1923. Serial No. 641,845.

This invention relates to engines in which charges of explosive gases are fired at fixed intervals within the cylinders, of which preferably several are used, the charges being compressed at each alternate upward stroke of the pistons, as is usual in engines of the two cycle type.

One of the objects of the invention is to provide means for scavenging the cylinders with compressed fresh air after the explosions have taken place and effectively dispose of the burned and exhausted gases through exhaust ports of unusually large area disposed circumjacently of each cylinder and connected with common headers, one on each side of the engine.

Another purpose is to produce means for supplying a current of air under compression to force the liquid fuel through spray heads into the mixing chambers and also to mix with the gas in forming explosive charges.

A further aim is in the provision of valves adapted to control and direct the inlet of air and explosive mixture in a new and practical manner.

These and other objects, tending to effect a high degree of economy in fuel, power in operation, simplicity in construction and other valuable improvements, which will become apparent as the description progresses, are accomplished by the novel construction, combination and arrangement of parts hereinafter described and illustrated in the accompanying drawings, forming an essential part of this disclosure, and in which:—

Figure 1 is a transverse sectional view taken approximately on lin 1—1 of Fig. 3 through the center of one of the cylinders and associated parts of an engine made in accordance with the invention.

Figure 2 is a partial side, partial longitudinal sectional view of the engine, the casing being broken away showing a plurality of cylinder units.

Figure 3 is a horizontal sectional view taken on line 3—3 of Fig. 2.

Figure 4 is a similar sectional view taken on line 4—4 of Fig. 2.

Figure 5 is a fragmentary sectional view taken on line 5—5 of Fig. 6.

Figure 6 is a partial side and sectional view of a cylinder head and valve showing the progressive position of the latter element in broken lines and drawn to an enlarged scale.

Figure 7 is a perspective detail view of the combined air dispensing valve and shaft support disposed normally within the crank case.

Beginning with the frame of the engine, which may be supported in any convenient manner, the lower section of the crank-case is designated by the numeral 15, the same being attached to the upper section 16 by bolted flanges 17 and 18 thus constituting an essentially cylindrical casing, both parts of which are reduced in diameter and internally bored, as at 19, at the ends and between the portions in which the cranks operate, the connecting walls between the larger and smaller sections being continuous and shaped in conical sectional form.

A shaft 20 passes axially through the casing and may have attached to its extending ends driving and fly wheels, as indicated at 21. Said shaft passes through wiper washers 22, attached to the end flanges 23 of the casing, acting to prevent the entrance of dust to the interior.

Fixed to the shaft, adjacent the inner side of the washer 22, is a rigid disc 24, against which is disposed one of a series of cylindrical valves 25 made in two equal semi-circular sections and bolted together.

These valves are bored to act as bearings in which the shaft 20 is rotatably mounted and finished on their periphery to fit the bores 19 of the reduced portions of the casing, they being further provided with shallow annular grooves 26 near their smoothly finished sides which fill with oil and serve as packings.

One each of these valves are used at the ends and intermediate the cranks as shown, being slightly wider than the surfaces 19 and formed through the valves are ports, respectively 27 and 28, communicating with apertures 27′—28′ extending through their outer walls, the valves being held from rotating by means of pins 29 entered through the casing wall.

The cylinders 30 are shown as integral with the upper section of the casing, being supported by convergingly inclined walls 31 and are provided with water jackets 32 extending their entire length around and between each cylinder.

These cylinders are expanded at their upper ends to form a space 33 to deflect the air towards the center of the cylinder and into which the spark plug 34 enters at a point above the piston 35, the latter being provided with packing rings as usual, and to which the upper end of the connecting rod 36 is attached by the pivot 37.

The lower end of the connecting rod is mounted on crank pins 38 fixed to extend between discs 39 rigidly secured to sections of the shaft 20, intermediate the spaces in which the cranks operate, these discs having their outer faces bevelled to agree with the interior of the casing in which they rotate and arranged to slightly clear the same, their sides opposite the crank pins being closely adjacent the sides of the valves 25.

The outer faces of one of each pair of the discs contain openings 40 opposite the crank pins into which air enters from the larger ports 27, due to the suction of the piston as it moves upwardly, and is forced through the corresponding opening by the piston moving downwardly, into the port 28 in the opposite side of the valves 25.

Air enters the ports 27 by way of ducts 42 through the aperture 27′ leading to each unit from a common header 43 supplied by a single inlet 44 controlled by a damper valve 45, the air being discharged through ducts 46 to another header 47 on the opposite side of the engine.

Engaged with the header 47 is a duct 48 of rectangular cross section, in the relatively large area of which is disposed the open end of another, smaller duct 49, into which is connected a spray nozzle 100 leading from a chamber 101 see Fig. 2 containing a supply of gasoline, maintained under pressure by air delivered through the pipe 102 from the header 47.

The attenuated portion 51 of the duct 48 extends to the top of the cylinder, to a horizontal header 50 eventually entering an open annular chamber 52 above the cylinder and the continuation 53 of the gas duct enters below a partition 50′ in the header 50 to a similar but lower chamber 54.

Covering the chamber 52 is a circular plate 55 see Fig. 6 secured therein by screw threads 56 and presenting a chamber 57 in its upper portion having ports 58 communicating with the surrounding chamber 52.

Below and open to the chamber 57 is another chamber 59 of lesser diameter and interjacent the chambers 59 and 54 is another annular chamber 60 having imperforate inner and top walls, respectively 61 and 62 but fully open at the bottom and provided with ports 63 in its outer wall communicating with the chamber 54.

A hub-like extension 65 reaches down from the plate 55 and is bored to receive a slidable stem 66 having on its end a disc valve 67 adapted to contact and form an air and gas tight joint with the lower edge of the circular partition wall 61 and ring element 79 at the lower peripheral edge of the outer wall of the chamber 57.

This valve is held normally closed by a coiled expansion spring 69 abutting at its respective ends the plate 55 and a washer plate 70 through which the stem 66 fixedly passes, this stem being periodically depressed by a tappet lever 71, fulcrumed on a fixed rod 72 and having at its opposite end a roller 73 actuated by a cam 74, adjustably fixed on a shaft 75 and driven in timed relation to the rotation of the engine shaft 20.

Fixed in the valve disc 67 are a plurality of posts 78 their upper ends being set in a valve plate ring 79 of washer-like formation, operating in the space between the walls 61 and 68 controlling the outlet of the chamber 60.

It will now be clear that the current of atmospheric air forced into the duct 48 becomes divided, one portion being delivered from the annular chamber 52 to the chambers 58 and 60 and held therein by the valve 67.

When this valve starts to descend the air rushes through these chambers directly into the cylinder, effectually scavenging the same and passing out, when the piston is in its lowest position, through ports 80 extending through the cylinder wall and water jacket 32, into the headers 81 common to all the units, and thence into the discharge pipes 82 one of which is on each side of the motor.

During the earlier stage of movement of the valve 67 nothing but air is entered into the cylinder, the ring 79 retaining the over rich gas mixture in the chamber 60, but eventually the ring will be withdrawn as the valve descends and gas flows into the cylinder, mixes with air from the duct 49 and is further diluted by pure air as received in the main chambers above the valve 67, which upon rising, first cuts off the mixed gas and air and then the pure air.

In operation, fresh air is sucked in a controllable quantity through the inlet 44 to the header 43 and distributed to each cylinder unit by the ducts 42 leading to the apertures 27′ communicating with the ports 27 of the fixed valves 25, these ports being in communication with the openings 40 in the crank carrying discs 39 during a portion of their revolution, at which time suction is caused by the upward movement of the piston 35 within its cylinder, thus filling the space in the crank-case between the discs.

Upon the downward movement of the pistons, the discs will be rotated into position to close the openings 40 to the ports 27, compressing the air in the crank case, eventually bringing the openings 40 into communication with the ports 28, forcing the air through the apertures 28′, into the ducts 46, header 47 and dispenser 48, where, as has been seen, it is distributed, part of the air being used for scavenging purposes for the cylinders and part to commingle with the gasoline spray to form explosive charges within the cylinders.

The compressed air is also led from the header 47 to the gasoline reservoir 101 so that the pressure upon it is equalized with that in the distributor 48.

Attention is further called to the general simplicity and compactness of the engine and the economical manner in which the gasoline is used without the interposition of a carbureter or other extraneous and trouble giving parts of like character.

The spray head 100 delivers the gasoline in minute jets directly into the mixing chamber below the hot exhausting gases in the discharge pipes and from which it derives a very considerable degree of heat, which heat is materially conserved by reason of the duct 53 being partially enshrouded by the air duct 51, its uncovered side facing the cylinders as shown.

The foregoing disclosure is to be regarded as descriptive and illustrative only, and not as restrictive or limitative of the invention, of which obviously an embodiment may be constructed including many modifications without departing from the general scope herein indicated and denoted in the appended claims.

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

1. An internal combustion engine comprising, in combination with working cylinders, pistons operating reciprocatively therein, a crank shaft and rods connecting between the pistons and crank shaft, of a closed crank case, constituting a compression chamber, means for admitting air to said chamber at the piston upstroke, a dispensing header common to all of the cylinders, means for discharging the air under compression to said header, means for dividing the stream of air into portions one of which is used for scavenging the cylinders and the other to dilute the gaseous explosive mixture and a compound valve for the admission of air first, followed by the gaseous mixture, said valve being provided with means for cutting off the supply of the gaseous mixture prior to the cutting off of the air supply.

2. An internal combustion engine comprising in combination with a working cylinder and a piston reciprocatively operative therein, of a water jacket surrounding said cylinder, a plurality of ports through the wall of said cylinder and water jacket, said ports being above the plane of the piston when in its lowermost position, and having an area equal to the cross section of the cylinder, means for supplying compressed air to scavenge the cylinder during the time the ports are open, and a compound valve for supplying an explosive mixture subsequent to the entrance of the compressed air and prior to the return stroke of the piston during one cycle of its movement said valve being provided with means for cutting off the supply of the gaseous mixture prior to the cutting off of the air supply.

3. In an internal explosion engine, a valve for the inlet of air and explosive charge, said valve comprising a cylindrical body having a chamber in its outer portion containing a plurality of ports communicating with a source of compressed air, an annular chamber having imperforate inner and upper walls in its lower portion, said annular chamber having ports in its outer wall communicating with a source of gaseous fuel and being open at its bottom, the annular chamber enclosing an open space concentric with the upper chamber, a spring actuated disc normally held to close both chambers, means for depressing said disc to uncover the open space, and a washer-like plate ring carried by said disc to maintain said annular chamber closed until the disc has reached a definite point in its downward passage less than its full stroke.

4. In an internal explosion engine, a valve for the inlet of air and explosive charge, said valve comprising a cylindrical body having chambers respectively communicating with a source of compressed air and an explosive gaseous mixture, a spring impelled disc normally closing both of said chambers, means carried by said disc for retarding the opening of the second named chamber, and means for depressing said disc whereby air is first delivered followed by the gaseous mixture which is cut off prior to the closing the air chamber.

5. In an internal explosion engine, means in the crank case for producing compressed air, a gasoline tank into which a portion of the air is entered, a plurally chambered head on the working cylinder, a duct conveying a portion of the compressed air to one of the chambers in said head, a second duct partially enveloped in the first named duct leading to another of the chambers, a spray head in the last named duct communicating with the gasoline tank and receptive of another portion of the compressed air, a valve disc controlling the exit of air and of gas from said chambers, and means carried by said disc for both opening and closing the gas chamber in advance of opening and closing the air chamber.

6. In an internal combustion engine, a cylindrical crank case, means operative in said case for drawing in air, compressing

and forcing the air outward, a gasoline tank subjected to the compressed air, a spray head through which the gasoline is vaporized, a duct surrounding said spray head, a second duct partially surrounding the first named duct, connections from said case to each duct whereby compressed air is entered thereto, means for controllably entering the combined air and vaporized gasoline into the cylinders of the engine, means for entering pure air from the second duct to scavenge the cylinders and a compound valve for the admission of air first, followed by the gaseous mixture, said valve having means for cutting off the supply of the gaseous mixture prior to the cutting off of the air supply.

This specification signed and witnessed this 25th day of May, 1923.

ALBERT RAFTER