Aug. 7, 1928.

1,679,794

W. F. SMITH

VALVE GEAR

Filed Nov. 9, 1925

2 Sheets-Sheet 1

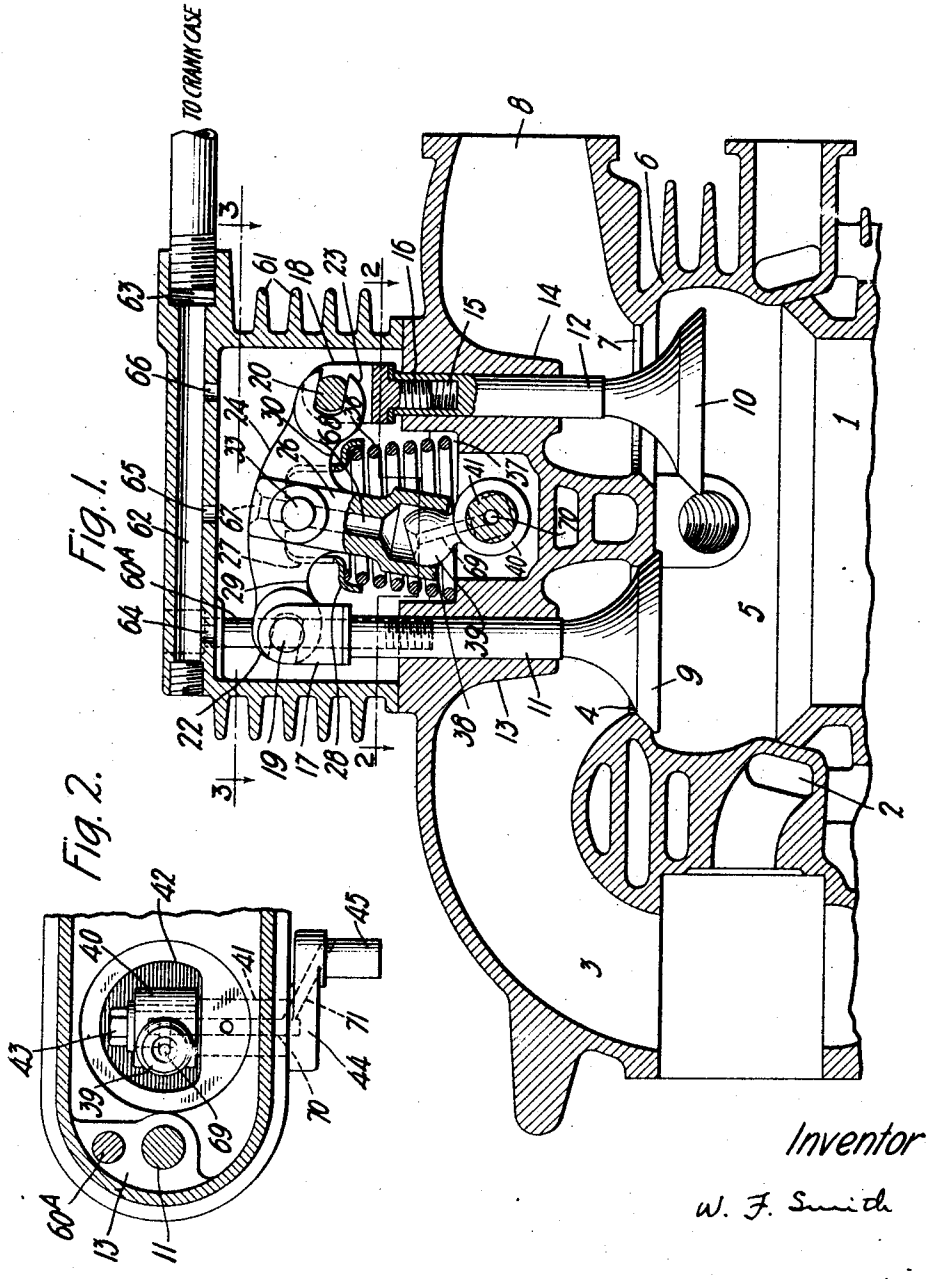


Fig. 1.

Fig. 2.

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2 Sheets-Sheet 2

Fig. 3.

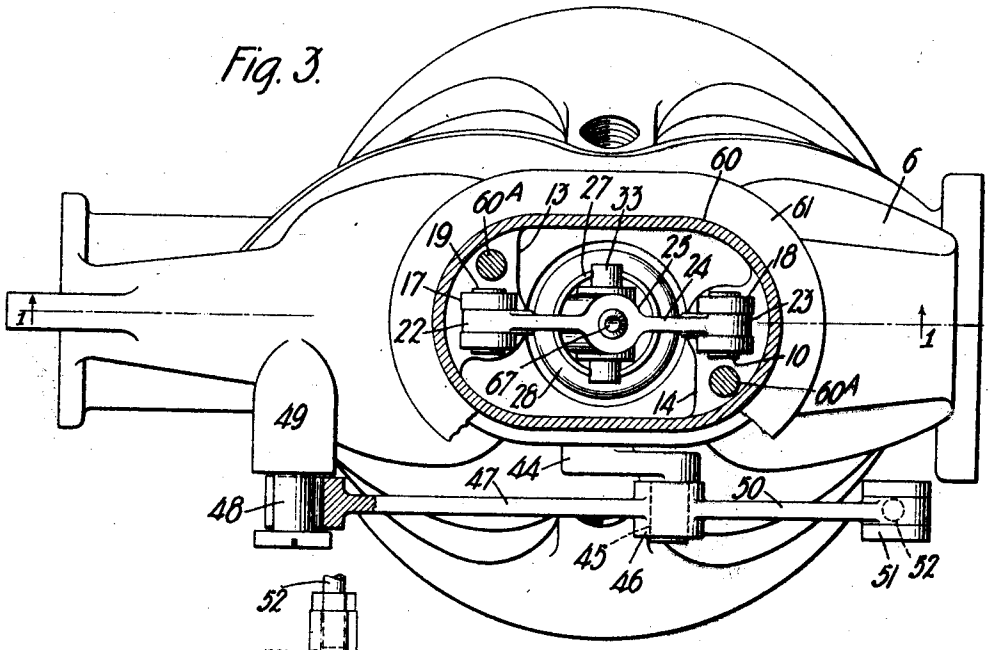


Fig. 4.

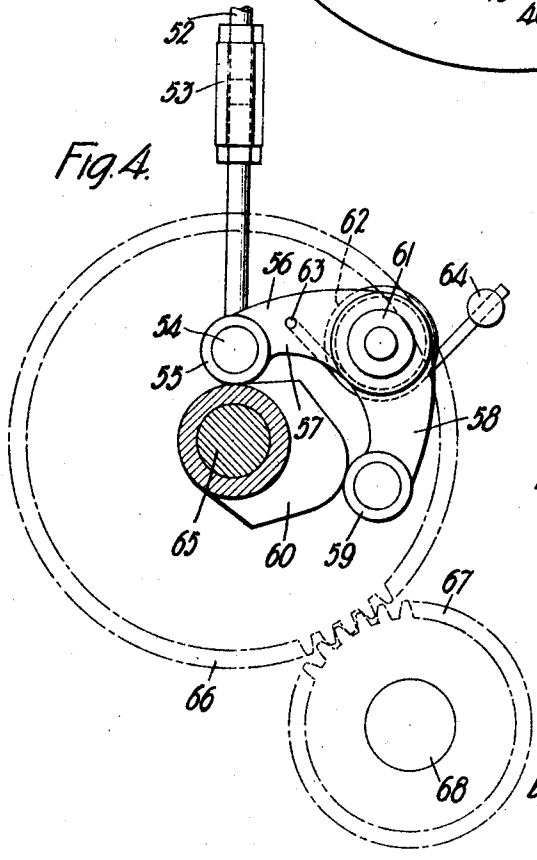


Fig. 5.

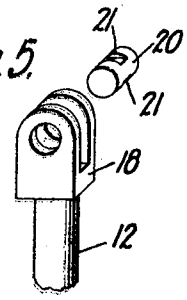
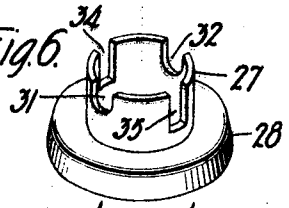


Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM F. SMITH, OF POUGHKEEPSIE, NEW YORK, ASSIGNOR OF ONE-HALF TO HERMAN A. SCHATZ, OF POUGHKEEPSIE, NEW YORK.

VALVE GEAR.

Application filed November 9, 1925. Serial No. 67,884.

This invention relates to new and useful improvements in valve operating mechanism, and more particularly to mechanism for controlling intake and exhaust valves of internal combustion engines.

The object of the invention is to provide a simple valve gear in which the quick and accurate operation of the valves is insured and in which the valve stems are safeguarded against undue strains. With this object in view I provide a mechanism in which a single lever, spring, push rod, lifter and cam are required to operate the two valves. The construction is so provided as to permit the use of short valve stems and relatively long valve guides. The lever arrangement which directly bears on the valves is so provided that upon the opening of either valve there is no resistance caused by spring pressure, eliminating thus all side thrust on the valve stems. No clearance is required between the valve stems and the actuating lever, whereby the objectionable noise and wear due to the hammering action is safeguarded against. A spring is used to maintain the valves closed, but the pressure of the spring is equalized between the two valves. When either valve opens, the resulting increase of pressure caused by the compression of the spring is automatically transferred to the stationary valve.

These and other features of the invention will more clearly appear from the following detailed description of a preferred embodiment of the invention and the appended claims.

In the drawings a preferred embodiment of the invention is illustrated as applied to a single cylinder internal combustion engine of the type disclosed in my copending applications Serial No. 715,338, filed May 23, 1924 and No. 722,580, filed June 26, 1924. Fig. 1 is a vertical cross-section of the engine head illustrating the valve mechanism; Fig. 2 is a horizontal cross-section of half of the valve actuating mechanism along line 2—2 of Fig. 1; Fig. 3 is a top plan view of the valve actuating mechanism, the valve box being horizontally cut away along line 3—3 of Fig. 1; Fig. 4 is a side elevation of the cam and rocker arm arrangement forming parts of the valve gear; and Figs. 5 and 6 are perspective views of details of the valve mounting.

A piston (not shown) operating within cylinder 1 draws a mixture of air and vaporized gasoline from a vaporizing chamber 2 surrounding the cylinder 1, through intake passage 3 and intake port 4 into a compression chamber 5 provided in the cylinder head 6. After compression and explosion, the residual gases are expelled through exhaust port 7 and exhaust channel 8 in the usual manner. The opening and closing of the ports 4 and 7 are controlled, respectively, by intake valve 9 and exhaust valve 10. These valves are provided with sloping shoulders adapted to register with tapered seats in the ports 4 and 7, and with short stems 11 and 12. The valve stems pass through and are vertically movable within guides constituted by perforated bosses 13 and 14 in the head 6 above the ports 4 and 7. The ends of stems 11 and 12 projecting through bosses 13 and 14 are internally screw-threaded, as indicated at 15, for the purpose of receiving externally screw-threaded lugs such as 16 projecting from forked stem heads 17 and 18. As clearly shown in Fig. 5, these forked heads are provided with perforations through which pins 19 and 20 pass. The middle portions of these pins are squared, as indicated at 21 in Fig. 5, and are engaged by jaws 22 and 23 provided at the ends of a lever or rocker arm 24, affording a gripping or clamping connection between the ends of lever 24 and the valve stems.

The central portion of the lever 24 is enlarged, as indicated at 25 (Fig. 3), and in alignment with this enlarged portion an arm 26 projects downward substantially at right angles from the lever. The lever 24 is seated in an upright collar 27 of a cup 28 (see Figs. 1 and 6) in such a manner that the arm 26 projects through the collar 27 and cup 28 and the curved lower faces 29 and 30 of the lever lie within the notches 31 and 32 of the collar. The ends of pin 33 projecting through the center of the lever 24 are seated in the rectangular slots 34 and 35 of collar 27. The cup 28 and therefore the lever 24 are spaced from the cylinder head 6 by means of a coiled spring 36 surrounding the arm 26, the upper end of the spring being seated in the cup 28 and the lower end within a cavity 37 provided in the top of the cylinder head. The lower part of the lever 26 is enlarged at 38 and within this enlarged portion is held the ball-shaped

projection 39 provided on a sleeve 40. The sleeve 40 is rigidly mounted on a shaft 41. The shaft 41 and sleeve 40 are on the outside of the cylinder head between the bosses 13 and 14, the contour of said space being illustrated in Fig. 2 at 42. The sleeve is held against longitudinal displacement between the flat side of the cavity 42 and a nut 43 provided on one end of shaft 41. The other end of the shaft projects to the outside of the cylinder head and is there fastened to one end of a crank 44. The free end of the crank 44 carries a pin 45 which is rotatably held within a sleeve 46. A rigid arm 47 projecting from the sleeve 46 is pivoted at its free end around a bolt 48 screwed in an embossing 49 of the cylinder head. In the opposite direction an arm 50 projects from the sleeve 46 and carries at its end a clevis 51 of the push rod.

Push rod 52 is secured to lever 50 at clevis 51. As shown in Fig. 4, the push rod is in two sections held together by a turnbuckle 53 provided with left and right-hand thread for the purpose of adjustment. The lower end of the push rod is pivotally carried by a pin 54 in a boss 55 provided at the end of one arm or lifter 56 of a two-armed rocker 57. With its two lifters 56 and 58 carrying bosses 55 and 59, respectively, the rocker 57 straddles a cam 60. The rocker is pivotally mounted by means of a bolt 61 on the motor, and is surrounded by a spiral spring 62, one end of which is fastened to the arm 56 at 63 and the other end to the motor at 64. The cam 60 is rigidly mounted on the shaft 65 of a crown gear 66, which meshes with a gear wheel 67 mounted on the crankshaft 68 of the motor.

Through the gears 67 and 66 the shaft 68 causes the double faced cam 60 to revolve in a clockwise direction. When the cam surface is not in contact with either roller 55 or 59, then the spring 62 is neutral. At this time both valves 9 and 10 are closed, being pressed against their seats by the coiled spring 36 through the agency of the lever 24. As the cam turns to the right and moves the rocker 57 in a clockwise direction, the spring 62 builds up tension. The tension of this spring is so proportioned that at maximum speed it will overcome the inertia of the lifter or rocker 57, the push rod 52, and the lever 47—50. It would be possible to proportion spring 36 so as to perform all this work, but if this were done the entire mechanism would be subject to the increased power of the spring and would increase the wear on the valve mechanism. For this reason the spring 36 is so proportioned that its tension is sufficient to operate the valve, the lever 24 and the shaft 41. As the push rod 52 ascends it turns through the crank 44 the shaft 41, whereby the ball 39 is tilted to the left and through the agency of the arm 26 rotates the rocker 24 in a clockwise direction around a pivot point constituted by the stem head 17 and pin 19. This will permit the exhaust valve 12 to open. During the further revolution of the cam, the rockers 57 and 24 will again reach the neutral position, and then by pressure of cam 60 against the roller 59, an intake position will be reached in which the arm 24 will be tilted in the opposite direction from the one illustrated in the drawing. At this time the pivot point of the arm is constituted by the stem head 18 and pin 20.

Owing to the proper proportioning of the two coil springs and the provision of a single spring between the two valves, the valve stems are about an inch and a quarter shorter than would be necessary if the springs were applied to each valve in the usual manner. This, of course, results in a saving of space, material, facilitates the manufacture, and reduces the tendency of warping of the valve stems. Furthermore, on opening either valve no resistance is offered by spring pressure, each valve being free to open and close under the action of lever 24. Since the valve stems are lifted and permitted to drop vertically, there is no side thrust on the stems, which eliminates wear on the stems and the guides. A further feature of this construction resides in the possibility of eliminating the usual clearance between the valve stems and the lever 24, avoiding thus the objectionable noise and wear caused by hammering action which would otherwise take place. With both valves closed, the pressure of spring 36 is equalized between the two valves. When either valve opens, the resulting increase of pressure caused by the compression of spring 36 is automatically transferred to the stationary valve which will insure tight seating thereof. Owing to this continuous transfer of energy from one valve to the other, the spring 36 may be of low tension. It will be seen also that with this construction, it will be impossible for both valves to be open at the same time, as one valve must open before the other closes. In the present construction the expansion of the valve stems or other parts does not affect the seating of the valves since, in the neutral position of the lever 24, they are always firmly held against their seat. If a clearance space were provided between the stem heads and the lever 24, then such space could be easily taken up by the expansion of the stems. Owing to the absence of springs directly applied to the valve stems, fluttering of the valves at high speed is eliminated.

The operating gear of the valves is enclosed within a casing 60 which is secured to the cylinder head 6 by means of bolts 60^a. The cooling by air of casing 60 is facilitated

by ribs 61. In order properly to lubricate the valves and their operating mechanism, a chamber 62 provided in the top of casing 60 is connected at 63 with an oil reservoir (not shown), preferably with the crank case of the engine. The chamber 62 communicates through apertures 64, 65, 66 with the valve casing 60, and owing to the pumping action of the valve stems, lubricant will be drawn into said chamber. Through the opening 65, oil will flow into a cavity 67 provided in the enlarged section 25 of rocker arm 24, and through a longitudinal passage 68 in arm 26, within the head 38 of this arm. This will supply lubricant between head 38 and the ball 39. Oil will flow also through a channel 69 provided in the ball 39 into a longitudinal channel 70 provided in shaft 41, and then through a bore 71 to the bearing surface of pin 45. Oil dripping through apertures 64 and 66 will insure lubrication of the valve stems 11 and 12 and the stem heads 17 and 18.

What I claim is:

1. In combination, two valves, stems for said valves, a spring-pressed arm engaging at its two ends the heads of said stems, and means centrally located intermediate the ends of said arm for rocking said arm around pivots constituted by said stem heads.

2. In combination, two valves, stems for said valves, a lever engaging at its two ends the heads of said stems, a spring bearing against the centre of said lever, an arm projecting from the centre of said lever, and means for rocking said lever by means of said arm around pivots constituted by said stem heads.

3. In an internal combustion engine, intake and exhaust valves, stems for said valves, a spring-pressed arm engaging at its two ends the heads of said stems, and means centrally located intermediate the ends of said arm for rocking said arm around pivots constituted by said stem heads.

4. In an internal combustion engine, intake and exhaust valves, stems for said valves, an arm engaging at its two ends the heads of said stems, a spring placed under tension against the centre of said arm, and means for rocking said arm around pivots constituted by said stem heads.

5. In an internal combustion engine, a cylinder head, intake and exhaust valves therein, stems for said valves projecting through said head, an arm engaging at its two ends the heads of said stems, a spring placed under tension between the centre of said arm and said cylinder head, and means for rocking said arm around pivots constituted by said stem heads.

6. A valve gear comprising two valves, stems for said valves, a lever engaging at its two ends said stems, means for alternately opening and closing said valves through said lever, a single spring cooperating with the midpoint of said lever and placed under tension by the valve operating movement of said lever, and a mounting for said spring and lever whereby the increase of pressure caused by the compression of said spring is transferred to the stationary one of said valves.

7. A valve gear comprising two valves, stems for said valves, a single spring normally tending to maintain both of said valves in a closed position, a lever pivoted at its two ends in said stems transmitting the pressure of said spring thereto, and means for rocking said lever.

8. A valve gear comprising two valves, stems for said valves, a single resilient means normally tending to maintain said valves in a closed position, a lever against which said resilient means exerts pressure, and gripping connections between the ends of said lever and said stems.

9. A valve gear comprising a valve having a stem, means including a lever for reciprocating said stem, a spring bearing against said lever intermediate its ends, a gripping connection between one end of said lever and said stem, a pivot for the other end of said lever, and means for moving said pivot parallel with said stem but in the opposite direction.

10. A valve gear, two valves, means including a spring and a lever for operating said valves, a cam, a lifter cooperating therewith, a push rod connecting said lifter with said lever, and a normally neutral spring bearing against said lifter so proportioned that when placed under tension it tends to overcome the inertia of said lifter and push rod.

11. In a valve gear, two valves, a lever, the two ends of which are attached to the two valves for operating said valves, a spring pressing against the lever intermediate the ends thereof for normally keeping both valves closed, a cam, a lifter cooperating therewith, a push rod connecting said lifter with said lever, and a second spring placed under tension only when said cam actuates said lifter.

12. A valve gear, two valves, stems for said valves, valve-operating mechanism comprising a lever engaging at its two ends said stems, a spring bearing against the centre of said lever, a shaft for rocking said lever, a cam, a lifter cooperating therewith, a push rod connecting said lifter with said shaft, and a second spring opposing the movement of said lifter, said springs being so proportioned that they jointly tend to overcome the inertia of said valve-operating mechanism.

13. In a valve gear, two valves, stems for said valves, a lever engaging at its two ends said stems, a spring bearing against the

centre of said lever, a shaft for rocking said lever around pivot points constituted by said stems, the tension of said spring being proportioned to operate said valves and to overcome the inertia of said lever and shaft, a cam, a lifter cooperating therewith, a push rod connecting said lifter with said shaft, and a normally neutral spring connected with said lifter so proportioned that when placed under tension it tends to overcome the the inertia of said lifter and push rod.

14. In an internal combustion engine, a cylinder head, intake and exhaust valves therein, stems for said valves projecting through said head, a lever engaging the heads of said stems at its two ends, a spring placed under tension between the centre of said lever and the cylinder head, a shaft for rocking said arm around pivot points constituted by said stem heads, the tension of said spring being proportioned to operate said valves and to overcome the inertia of said lever and shaft, a cam, a lifter cooperating therewith, a push rod connecting said lifter with said shaft, and a normally neutral spring connected with said lifter so proportioned that when placed under tension it tends to overcome the inertia of said lifter and push rod.

In testimony whereof, I have signed my name to this specification this 2nd day of November, 1925.

WILLIAM F. SMITH.