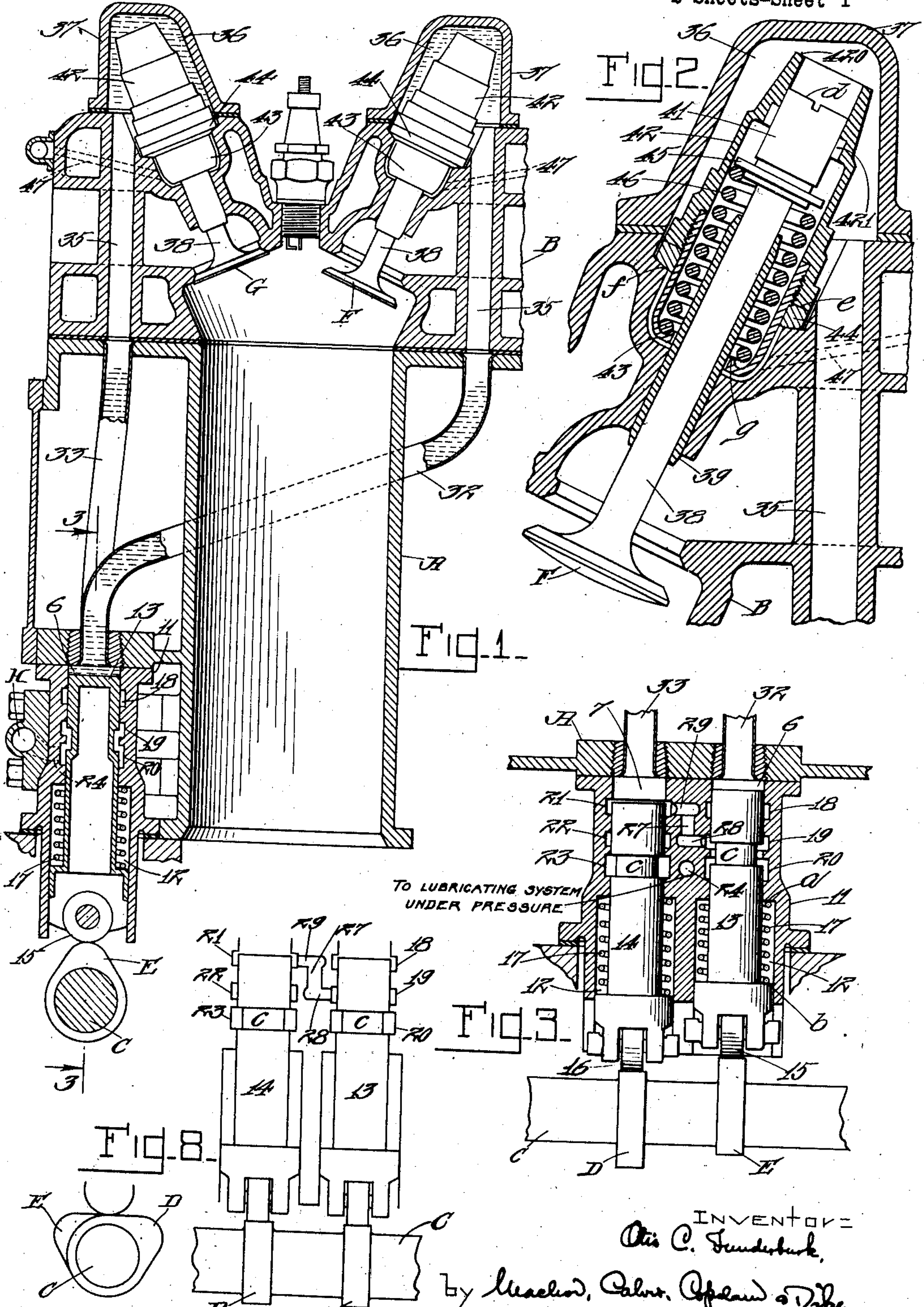
April 5, 1927. 1,623,177

O. C. FUNDERBURK

VALVE FOR INTERNAL COMBUSTION ENGINES

Filed Sept. 20, 1923 2 Sheets-Sheet 1




Inventor:
Otis C. Funderburk,
by Meachem, Calver, Copeland & Dike,
Attys.

April 5, 1927.

O. C. FUNDERBURK

1,623,177

VALVE FOR INTERNAL COMBUSTION ENGINES

Filed Sept. 20, 1923

2 Sheets-Sheet 2

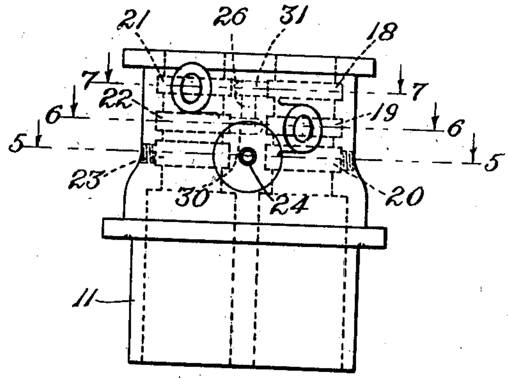



Fig.4.

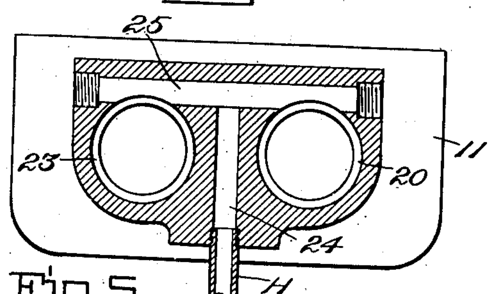



Fig.5.

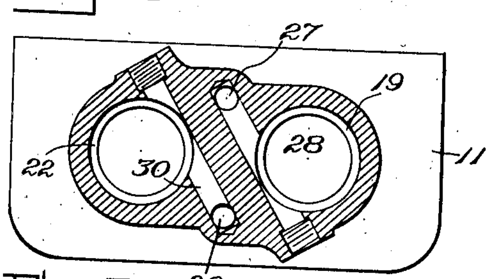



Fig.6.

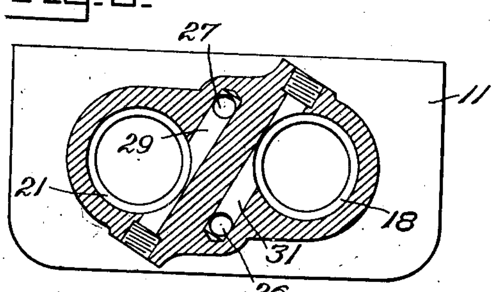



Fig.7.

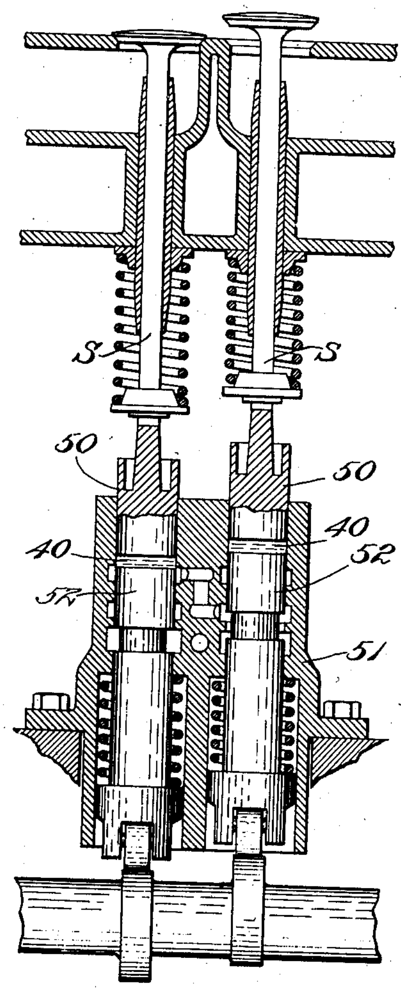



Fig.9.

INVENTOR:
Otis C. Funderburk,
by Macleod, Calver, Copeland & Dike.
ATTYS

Patented Apr. 5, 1927.

1,623,177

# UNITED STATES PATENT OFFICE.

OTIS C. FUNDERBURK, OF BOSTON, MASSACHUSETTS.

## VALVE FOR INTERNAL-COMBUSTION ENGINES.

Application filed September 20, 1923. Serial No. 663,883.

My present invention relates to valve operating mechanism for internal combustion engines, the particular object being to provide mechanism which will not require adjustment of the clearance between the valve lifter and valve stem after assembling or after grinding the valves as has heretofore been necessary and also which will do away with the noises caused by the valve lifter striking the valve stem. As is well known to those skilled in the art, the blow struck by the valve lifter on the lower end of the valve stem is one of the chief causes of noise in an internal combustion engine. This is particularly the case in internal combustion engines having overhead valves and cam shafts adjacent the crank shaft since large clearances are necessary owing to the large amount of expansion in internal combustion engines running at high temperatures. It is also well understood that in V-type engines the work of adjusting the valve lifters after the valves have been ground occupies as much time as or more than the work of grinding the valves. It is also understood that this adjustment requires great skill and must be done very carefully, otherwise the engine will not operate properly or will be noisy.

Attempts have been made to overcome these difficulties by interposing a column of lubricating oil between the valve lifter and the valve stem but such attempts have not been successful chiefly because no effective means of keeping the column of oil supplied with the varying quantities required has been devised.

The device embodying my invention is applicable both to L-head and T-head engines as well as to overhead valve engines, but since the problem of noise is particularly serious in overhead valve engines, and since, by increasing the length of the oil column, it is possible to do away altogether with the long push rod and rocker arms. I have shown my invention in its preferred form as embodied in an engine having overhead valves.

The invention will be fully understood from the following description when taken in connection with the accompanying drawings, and the novel features thereof will be pointed out and clearly defined in the claims at the close of this specification.

Referring now to the drawings:

Fig. 1 is a section of an internal combustion engine having overhead valves equipped with a valve gear embodying the invention.

Fig. 2 is a section on a larger scale showing one valve and connected parts.

Fig. 3 is a section on line 3—3, Fig. 1, showing two adjacent valve lifters together with the casing in which they operate and the cams.

Fig. 4 is a side elevation of the casing in which the valve lifters operate.

Fig. 5 is a section on line 5—5, Fig. 4.

Fig. 6 is a section on line 6—6, Fig. 4.

Fig. 7 is a section on line 7—7, Fig. 4.

Fig. 8 is a diagram illustrating the action of the parts.

Fig. 9 is a section showing my invention as applied to an L-head motor.

Referring now to the drawings, and particularly to Fig. 1, there is shown at A a cylinder block, and at B the removable head casting. A cam shaft is shown at C; two cams being shown at D and E (see Fig. 3). One inlet valve is shown at F and one exhaust valve at G. These parts are of ordinary construction, except as stated in the claims, and form no part of my invention.

The valve operating mechanisms which will now be described are arranged in pairs, the valve operating mechanism for each valve being in part dependent for its operation on the other valve operating mechanism of the pair.

At H is shown a pipe leading to the lubricating system of the engine (not shown) and supplying the valve operating mechanism with a continuous supply of oil under pressure.

At 11 is shown a casing mounted on the cylinder block and having within two cylindrical bores 12 in which operate valve lifters 13 and 14. In the drawings as shown, each casing 11 has two cylindrical bores therein the whole being arranged for the operation of a pair of valves. It will be understood, however, that I do not limit myself to this construction since, if more convenient, multiples of this unit may be formed in a single casting. The valve lifters 13 and 14 are supplied with cam rolls 15 and 16 in the well known manner, and the said rolls are held against the cams by springs 17, the upper end of each spring resting against a shoulder *a* in the casing and the lower end resting against a shoulder b on the valve lifter. Each valve lifter is turned down, as shown at c, to form an annular space, below and above which are cylindrical portions which fit tightly in the bore of the casing. Each bore is supplied with three annular enlargements of oil grooves; those in the right-hand bore which operate the inlet valve being marked 18, 19, and 20, while those in the exhaust valve bore are marked 21, 22 and 23. It will be seen that the top grooves are therefore designated 18 and 21, the middle grooves are designated 19 and 22 and the lower grooves are designated 20 and 23. The sections shown in Figs. 5, 6 and 7 are taken on horizontal planes through the three sets of oil grooves; thus Fig. 5 is taken through the bottom oil grooves 20 and 23, Fig. 6 is taken through the middle oil grooves 19 and 22 and Fig. 7 is taken through the top oil grooves 18 and 21. The pipe H leading from the pressure lubricating system of the engine enters through a port 24 which branches, as shown at 25, to connect with the lower oil grooves 20 and 23 of each bore. The middle grooves 19 and 22, respectively. on each bore are connected with the top grooves 21 and 18 of the opposite bore by passages which will be clearly seen by an examination of Figs. 3 to 7, inclusive, and the diagram which is shown in Fig. 8. Thus the middle groove 19 of the right-hand bore is connected with the top groove 21 of the left-hand bore by horizontal passages 28 and 29 and the vertical bore 27. Likewise the middle groove 22 of the left-hand bore is connected with the top groove 18 of the right-hand bore by the horizontal passages 30 and 31 and the vertical passage 26. The arrangement of these passages in simplified form will be readily understood from an examintion of the diagram comprising Fig. 8. The turned-down portions c on the valve lifters act as valves which connect the lower oil grooves 20 and 23 with the middle oil grooves 19 and 22 at certain times during their travel. The effect of this is to connect the source of oil supply from the lubricating system under pressure with the top oil groove 18 or 21 depending upon the position of the valve lifters. The top of the valve lifter when in its lowest position is slightly below the top of the upper oil groove so that this oil groove then opens into the space above the valve lifter. The spaces above the tops of the valve lifters, designated 6 and 7, respectively, consitute the oil column by which the valve stem is moved. In the form shown in Figs. 1 to 3, this oil column extends through the pipes 32 and 33, passages 35 and into the chamber 36 formed in the cover 37, thereby exerting pressure on the end face d of the valve stem 38. In the form shown in Fig. 9, however, as will be later explained, the oil column is very short, being designated 40. The length of the oil column is clearly dependent on the distance between the valve lifter and the valve stem and it is one of the advantages of the system embodying my invention that the lifter and valve stem can be placed at any desired distance apart, since the oil column can be contained within any connecting pipe or passage and being flexible, the design is not affected by the necessity of providing a mechanical connection between the two parts.

The mechanism above the oil column as embodied in an overhead valve mechanism will now be described.

The valve stem 38 slides in a tubular guide 39 in the head casting B. The upper end of the valve stem is provided with an enlarged cylindrical member 41 forming a plunger or piston which slides in a hollow valve spring cage 42. The piston 41 fits an upper cylinder portion 420 of the cage 42, which cylinder portion is open at its upper end to the chambers 36 and at its inner end is enlarged or counterbored, as shown at 421. The cage 42 screws onto a thimble 43 and has a shoulder e seating against a gasket 44 having a ground spherical face f which contacts with a complementary spherical face or seat in the head casting B. Within the thimble 43 and valve cage 42 is a valve spring 46, one end of which seats against the inturned shoulder g of the thimble 43 and the other end of which seats against a washer 45 secured to the valve stem. It will therefore be seen that the valve spring 46 tends to hold the valve closed and that the ground seat f between the head and the washer 45 permits the valve cage 42 to adjust itself so that the bore within which the plunger 41 moves will be perfectly alined concentrically with the axis of the valve stem 38. The joint at e is also a ground joint. The spherical joint f takes care of misalignment and the flat joint at e takes care of eccentricity.

At 47 is shown a bleed port which carries away from the interior of the valve cage 42 any oil which may leak by the pistol 41. It will therefore be seen that there is no oil pressure within the valve cage 42 and therefore the pressure exerted by the oil on the face d of the piston tends to compress the spring 46 and open the valve.

It will be understood that the structure of the exhaust valve G is the same as that of the valve F and that the column of oil leading to the exhaust valve is enclosed within the pipe 33.

The operation of the valve mechanism embodying my invention is as follows: Oil under pressure from the lubricating system enters through the pipe h and passes through the port 24 and the ports 25 to the lowest oil grooves 20 and 23. When the cam E is raising its valve lifter 13 as shown in Fig. 3, the turned-down portion c connects the oil groove 20 with the oil groove 19 and oil flows freely from the lubricating system into the passage 28, vertical passage 27, passage 29 to the upper oil groove 21 of the other valve-lifter 14. At this time the valve-lifter 14 is in its low position and the exhaust valve G is closed. The oil therefore fills the oil pipe 33 and chamber 36 if it is empty or supplies any deficiency if there has been any leakage, but the pressure exerted by the lubricating system is not sufficient to compress the spring 46 and open the valve. Thereafter, the revolution of the cam shaft causes the cam E to permit the valve lifter 13 to drop, the cam D still holding the cam lifter 14 in substantially the same position. The cam lifter 13 reaches its lowest position before the cam lifter 14 starts to rise, and the turned-down portion *c* drops below the lower edge of the middle groove 19, so that the valve lifters are then in the position shown in the diagram forming Fig. 8. At this time the oil passage from the lubricating system to the oil column above the cam lifter 14 is closed, and this takes place before the cam lifter 14 begins to rise. Thereafter, the cam lifter 14 rises, pushing the oil column ahead of it and lifting the valve, but since the other cam lifter has cut off communication with the lubricating system, none of the oil can be pushed back into the lubricating system, and the action in lifting the valve is positive. At the next revolution of the cam shaft the valve-lifters assume the reverse positions, and the lubricating system supplies oil through the ports 30, 26 and 31 to the upper oil groove 18 on the inlet valve-lifter 13. At the same time the lifter 14 rises above the top of the upper oil groove 21 of the exhaust valve lifter, and raises the column of oil in the pipe 33 between the end of the lifter and the end of the valve stem, and opens the valve. It will therefore be seen that when one valve lifter is pushing up the oil column to open its corresponding valve, the other valve lifter is down and is being supplied with oil to replace any deficiency caused by leakage, or otherwise. It will also be seen that the lifters operate not only to lift the columns of oil, but also as a slide valve to make the connections between the ports necessary to accomplish the replenishment of the oil column for the adjacent valve. The extent of opening movement of each valve is limited by the length of the cylinder 420 between its upper end and the counterbore 421, since, if the piston 41 be driven inwardly too far, said counterbore will provide a by-pass through which the oil from the chamber 36 may escape around the piston to the interior of the cage 42 and be exhausted through the bleed port 47

Referring now to Fig. 9, I have shown therein my improved valve mechanism as applied to an ordinary L-head engine having the inlet and exhaust valves on the same side. The construction of the valve lifter is exactly the same as that already described in connection with Figs. 1 and 3 to 8 inclusive. In this construction, however, the valve stem S is provided at the lower end with a piston 50 operating in the upper end of the bore of the lifter casing 51. Between the lower end of the plunger 50 and the upper end of the valve lifter 52 is a space 40 within which is the oil column which transmits the movement of the valve lifter to the valve stem. This oil column as will be seen is very small indeed and the valve lifter is so near to the lower end of the valve stem that in case there should be a failure of the lubricating system to supply oil to the valve mechanism the lower end of the valve stem would rest on the upper end of the lifter and the mechanism would still operate through with a reduced valve opening. This is an important feature of this embodiment of my invention, because failure of the oil column resulting from leakage or otherwise will not interrupt the action of the valve mechanism. Furthermore it makes it possible to start the engine even though the oil columns are empty.

From the foregoing it will be seen that the mechanism embodying my invention provides a continuous supply of oil for the replenishment of the oil columns and at the same time affords a substantially rigid connection between the valve lifter and the valve stem without the presence of a clearance which necessarily results in objectionable noise. It will also be seen that the mechanism automatically compensates for any change in adjustment and therefore after the valves are ground or the parts have been assembled, no adjustment of the valve lifters is required, thus doing away with at least half the labor resulting from valve grinding.

Moreover, the arrangement in pairs, in consequence of which the oil column over one valve lifter is being replenished by the action of the other valve lifter, makes it possible to attain the full lift of the valve in every instance, which is a great improvement over constructions heretofore attempted in which some of the oil in the oil column is pushed back into the lubricating system, thereby cutting down the amount which the valve is lifted. In my present device, this does not take place. because communication with the lubricating system is completely cut off before the valve lifter begins to push the column of oil up. Therefore, since at this time none of the oil can escape, the movement of the valve lifter produces an equal movement of the valve stem.

It will also be seen that while the arrangement of parts in pairs, so that one oil column is being replenished while the other oil column is acting to operate the valve, is desirable, it is not necessary to have the valves themselves on the same side of the engine as the valve lifters. Furthermore the invention is capable of embodiment in various other forms or arrangements, thus making possible greater flexibility in the design of the engine than has heretofore been possible where it has been necessary to have a direct mechanical connection between the valve stem and the valve lifter.

What I claim is:

1. The oil operated valve mechanism in which cooperating ports in a valve lifter and the casing therefor establish communication between a source of oil supply under pressure and the oil space between another lifter and its cooperating valve stem whereby one lifter acts as a valve to control the supply of oil to the oil space of another lifter during the idle period of the latter.

2. The oil operated valve mechanism for a pair of valves in which cooperating ports in a valve lifter and its casing act as a valve to control the flow of oil from a source of oil supply under pressure to the oil space between another lifter and its cooperating valve stem, while ports in the latter lifter and its casing control the flow to the oil space between the first mentioned lifter and its cooperating valve stem.

3. The oil operated valve mechanism for a pair of valves in which cooperating ports in a pair of adjacent valve lifters and the casing for them alternately act as valves so that oil from a source of oil supply under pressure is alternately supplied to the spaces between said valve lifters and the valves operated by them.

4. In combination, a casing having therein two bores each with three oil grooves about them, and having passages connecting a groove of one bore with a groove of another bore, and having a passage leading from a source of oil supply under pressure to one of the grooves of each bore, valve lifters in each bore each having a port which in one position of the lifter will connect two adjacent grooves, said casing also forming at least in part a space to contain an oil column to support the valve stem, said parts being arranged so that the oil column space for one valve lifter will be connected by the port in the other lifter with the grooves in its bore and thereby with the source of oil supply.

5. The oil operated valve mechanism for a pair of valves in which cooperating ports in a pair of adjacent valve lifters and the casing for them alternately act as valves so that oil from a source of oil supply under pressure is alternately supplied to the oil spaces between the valve lifters and the valves operated by them, said ports being arranged so that the communication between the source of oil supply and the oil space is wholly cut off before the valve lifter begins its lifting movement.

6. In combination with a lifter and a casing therefor, a valve chamber, a passage connecting said casing and said valve chamber, a valve stem and a cage containing the spring within the chamber, there being a combined flat and spherical joint between the cage and its seat so that the cage can adjust itself to the position of the valve stem.

In testimony whereof I affix my signature.

OTIS C. FUNDERBURK.