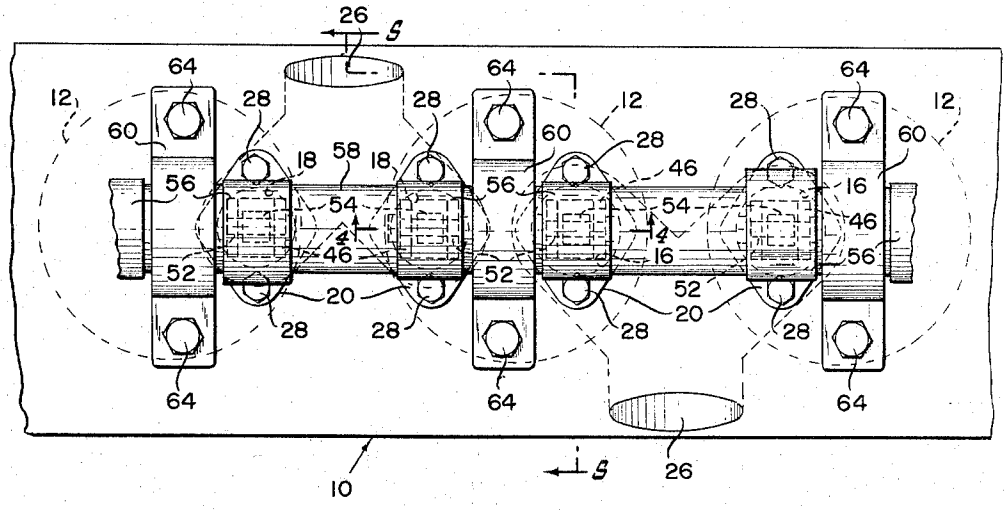
Dec. 6, 1966 T. A. SUROVEK, SR 3,289,658

VALVE ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 20, 1965 3 Sheets-Sheet 1

Fig. 1



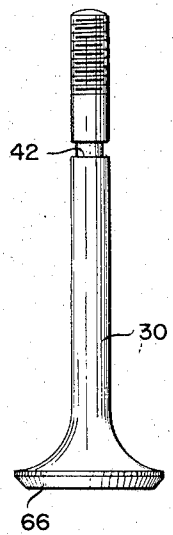


Fig. 2

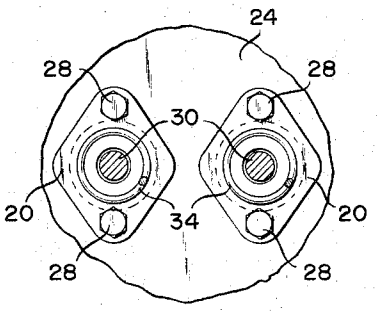


Fig. 3

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VALVE ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 20, 1965 3 Sheets-Sheet 2

Fig. 4

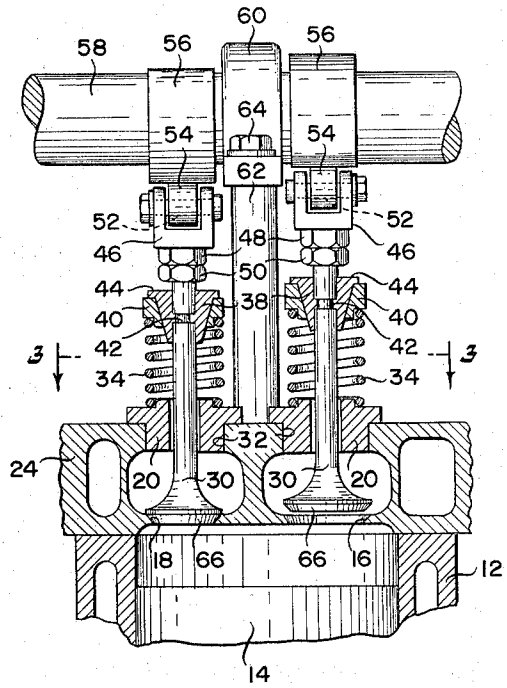
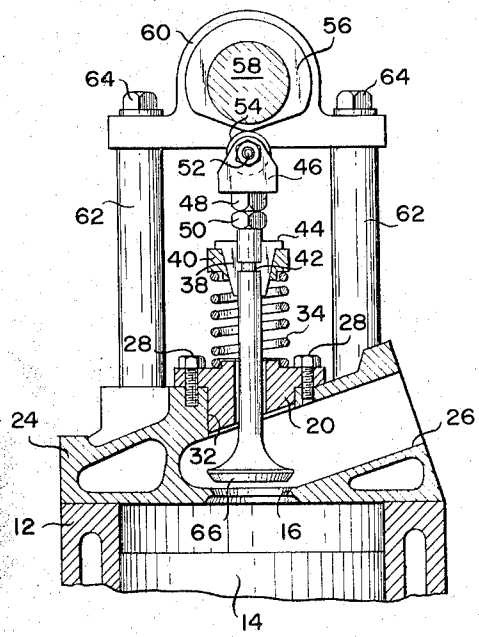


Fig. 5



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VALVE ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 20, 1965 3 Sheets-Sheet 3

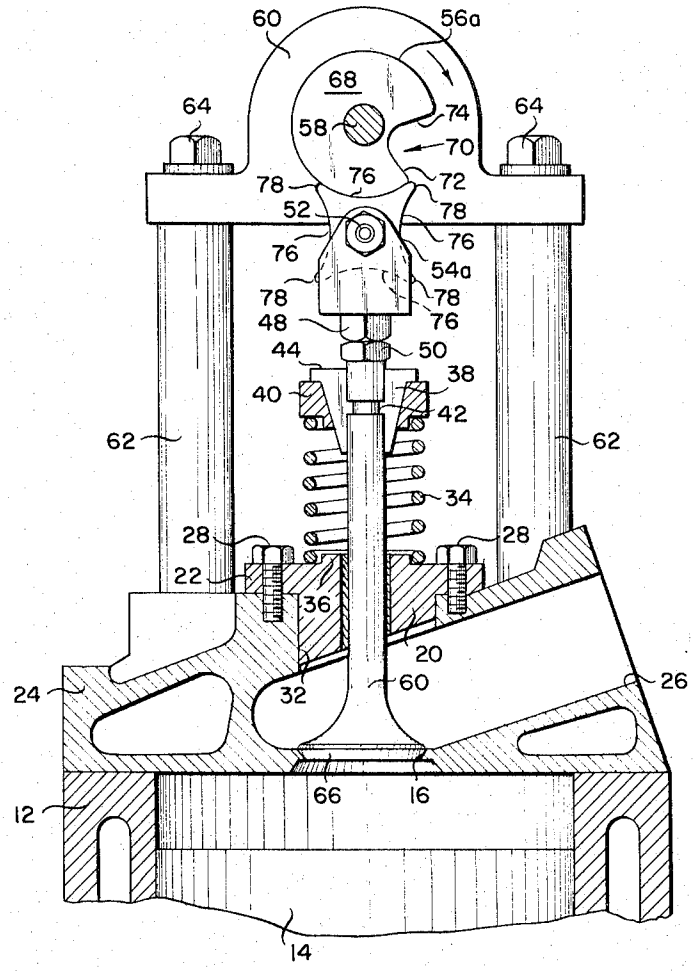


Fig. 6

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VALVE ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

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Filed Oct. 20, 1965, Ser. No. 502,772

9 Claims. (Cl. 123—90)

This application is a continuation-in-part of my copending application, Serial No. 391,111, filed August 21, 1964, and now abandoned.

This invention relates to a valve arrangement for the admission and exhaust of gaseous mixtures to and from the cylinders of internal combustion engines. The invention has particular reference to a valve mechanism therefor which is simple, positive in action, readily adjustable, and efficient.

In the field of internal combustion engines the demand has been for smaller and lighter weight engines with increased crank shaft speed. In attempting to develop engines to meet this demand, designers have encountered new and serious problems involving the weight, balance and inertia of movable parts and composite units, and the admission and discharge of gaseous mixtures to and from the engine cylinders. With respect to the means available for controlling the admission and exhaust of gaseous mixtures from the engine cylinders, it has been found that presently developed valve means do not perform adequately when used in engines designed for high speed operation. Consequently, in the field of high speed, light weight internal combustion engines, there has been a need for a valve arrangement which will perform well at high speeds, and my invention is directed to such an arrangement.

It is a principal object of this invention to provide a valve arrangement for operating the valves of an internal combustion engine without the usual push rods, valve lifters, etc., ordinarily associated with valve arrangements for internal combustion engines, to increase the compression ratio thereof.

Other objects and advantages of the invention will appear to those versed in the art from the following description and claims.

Referring to the accompanying drawings forming part of this application, and wherein like reference characters indicate like parts:

FIG. 1 is a plan view of a portion of the bank of cylinders in an internal combustion engine with my improved valve operating arrangement.

FIG. 2 is a side elevation of a typical push type valve.

FIG. 3 is a section taken on line 3—3 of FIG. 4.

FIG. 4 is a section taken on the line 4—4 of FIG. 1.

FIG. 5 is a section taken on the line 5—5 of FIG. 1.

FIG. 6 is a section, similar to FIG. 5, slightly enlarged, of a modified form of cam and cam follower;

Referring now to the drawings in detail, FIG. 1 shows a plan view of a portion of an internal combustion engine having a bank of cylinders 10, one of which is shown at 12, and the bank is cast as an integral unit with the crank case, not shown, and extending upward therefrom as is common in the art. The cylinder walls are cast with water jackets therein as clearly shown in the drawings, and as is common.

Reciprocable within each cylinder is a piston 14 in the skirt of which there is a wrist pin to which one end of a connecting rod is pivotally mounted. The other end of the connecting rod is pivotally mounted on the crank shaft of the engine, which crank shaft is rotatably mounted longitudinally of the bank of engine cylinders. The bottom of the engine block is closed by a drip pan mounted thereon. All of the foregoing is common in internal

combustion engine construction and is not shown as the cylinder block forms no part of the invention.

My invention relates in particular to the valve arrangement for such engines which is mounted on the engine head 24 secured as is common across the tops of the cylinders 12. Above each cylinder the engine head is provided with a pair of openings 16 and 18 which form the intake and exhaust ports of the cylinder. The engine head 24 is provided with a passageway 26 which leads to the manifold connected thereto as is common.

Engine head 24 is provided with openings 32 into which is fitted a combination valve guide bushing and spring guide 20, one for each port. The lower part fits snugly within the openings 32, and the bushings are provided with lateral flanges 22 through which stud bolts 28 extend and are threaded into the engine head to hold the valve guide bushing and spring guides 20.

The valve body 30 is assembled within the valve guide bushing and spring guide 20 before this bushing is mounted in place on the cylinder. The stem of said valve body extends upwardly above the bushing, as shown in FIGS. 4 and 5, through an expansion spring 34 seated on an embossment 36 on the valve guide bushing and spring guide 20, and through a split keeper block 38 within a spring guide 40. The split keeper block is cone-shaped and is received within the mating surface of the spring guide 40. A radial key is provided on the inner surface of the split keeper block 38 to engage a circumferentially disposed groove 42 at the upper end of the stem of the valve body 30 so as to retain the split keeper block in position on the valve stem. At the top portion of the split keeper block 38 there is a radial flange 44 that overlies the top surface of the spring guide 40 so that the expansion spring 34, which is positioned around the stem of the valve body 30, as disclosed in FIGS. 4 and 5 of the drawing, urges the spring guide 40 against the radial flange 44.

The top of the stem of each valve body 30 is threaded to receive a threaded clevis 46 as shown particularly in FIGS. 4 and 5 of the drawings. This clevis is adjustably retained on the stem of the valve body 30 by means of lock nuts 48 and 50. Mounted within the clevis on shaft 52 there is a follower roller 54 that is adapted to be urged by the action of the expansion spring 34 on valve body 30 into positive and continuous contact with the peripheral surface of a cam 56 integrally machined on the cam shaft 58. The cam shaft 58 is rotatably mounted in a plurality of pillow blocks 60 which are so arranged that there is one disposed over the center of each cylinder 12 in the bank of cylinders 10. Each pillow block is supported above the engine head 24 by means of spaced posts 62 suitably threaded into the top surface of engine head 24. The individual pillow blocks 60 are maintained in position on the tops of the posts 62 by means of cap nuts 64 screw-threaded onto the posts 62.

Cam shaft 58 overlies the bank of cylinders 10 and at each cylinder 12 there is a cam 56 disposed on opposite sides of the pollow block 60. One of these cams 56 is associated with the valve body 30 at the intake port 16 and the other cam 56 is associated with the valve body 30 at the exhaust port 18.

When the internal combustion engine is running, the cam shaft 58 is driven in a conventional manner, as for example, by either a gear or chain drive (not shown). As the cam shaft is rotated, each of the cams on the shaft will be in continuous contact with its associated follower roller and during each revolution of the cam shaft the associated follower roller will roll completely around the peripheral surface of its associated cam. During the time that any particular follower roller is rolling on the lobe surface of its associated cam, the valve body on which the roller is carried is forced downwardly to seat

the valve. For example, as shown in FIG. 4 of the drawing, the valve head 66 is seated in the exhaust port 18, and consequently the port is effectively closed during this time. During the remaining period of time of revolution of the cam shaft the associated follower roller will roll along the peripheral surface of the cam which is outside the lobe portion of the cam so that there is no positive force forcing the valve body downward. During this period of time the expansion spring 34 associated with that particular valve body is effective to urge the valve body upward to a position shown, for example, in FIG. 4 of the drawings where the valve head 66 is unseated from intake port 16.

It should be pointed out that the only fixed bearing means provided to take care of the reciprocable movement of each valve body is that of the valve guide bushing and spring guide 20 through which the valve stem passes. However, the upper portion of the valve stem is positively engaged by the split keeper block 38 in spring guide 40, and this upper support means for the valve stem is associated with the valve guide bushing and spring guide 20 by means of the expansion spring 34. This floating bearing arrangement has proved to be very effective in maintaining the vertical alignment of the stem of the valve body 30 so that the valve body 30 can reciprocate without titlting or skewing.

FIG. 6 of the drawings discloses another type of a cam and follower which is ideally adapted for use in my improved valve operating arrangement. The cam 56A is shown mounted on cam shaft 58 in the same manner as cam 56. Likewise, follower 54A is mounted on shaft 52 in clevis 46 in the same manner as follower 54. However, experience has shown that by using the cam and follower arrangement 56A and 54A, the seating and unseating of the valve heads in the intake and exhaust ports 16 and 18, respectively, can be accomplished more efficiently than with the cam and follower arrangement heretofore described.

The cam 56A is generally round with a peripheral surface 68 which is indented, as generally indicated at 70. If the direction of rotation of cam 56A on cam shaft 58 be arbitrarily indicated by the arrow, then the leading edge of the indented peripheral surface 68 is indicated at 72 and the trailing edge at 74. It should be noted that follower 54A has a plurality of curved peripheral surfaces 76 on which that portion of the peripheral surface 68 of cam 56A, that is not indented, can mate when follower 54A is pressed into contact with cam 56A by expansion spring 34. It should also be noted that the ends of adjacent peripheral surfaces 76 merge together at rounded corners 78.

In general, each cam 56A comprises a base circular surface, and a single indented surface 70 of somewhat sector shape. Each of the followers comprises a plurality of radially extending lobes 78 which are subsequently engaged in the indented surface 70. The lobes 78 are equally spaced and separated by concave circular surfaces which mate and slide against the cam base circular surface between lobe engagements.

Assume, now, that at a particular instant cam 56A and follower 54A are in the position illustrated in FIG. 6 of the drawings. The center of cam shaft 58 generally overlies the center of shaft 52, and because of the floating bearing arrangement, previously described, this condition will prevail during the reciprocation of the valve body 30. Now, assume further that the cam 56A is being rotated by cam shaft 58 so that the peripheral surface 68 in front of the leading edge 72 is rolled along the surface 76 on follower 54A, and the leading edge 72 of the indented portion 70 is moved leftward as viewed in FIG. 6. During this period of leftward advance of the leading edge 72, valve body 30 is urged downward against the action of expansion spring 34 and the valve head 66 is seated in its respective port 16 or 18. When, however, the leading edge 72 reaches and passes a position approximately at the line between the centers of cam shaft 58 and shaft 52, the trailing corner 78 on follower 54A rolls downward into the indented portion 70. This permits the expansion spring 34 to snap valve body 30 upward and quickly unseat the valve head 66 from its port.

During the further rotation of cam 56A the trailing corner 78 is rolled out of the indented portion 70 with a reverse snap action to quickly seat the valve head 66 in its port against the action of expansion spring 34. During this reverse snap action, follower 54A is turned one-quarter revolution about its shaft 52 and the trailing edge 74 and trailing portion of peripheral surface 68 on cam 56A commences to move across the next following surface 76, shown at the right side of follower 54A as viewed in FIG. 6. As the unindented portion of surface 68 rolls in contact across this next surface 76, valve head 66 will be maintained seated in its port until the leading edge 72 again passes over surface 76 in the manner described above.

It will be noted that in both modifications the valve head 66 seats on its respective seat against the compression in the cylinder during the compression stroke of piston 14.

This permits an increase in the compression ratio, a marked decrease in the cam speed, and results in a substantial increase in gasoline mileage.

From the above description it can be seen that I have provided a cam and follower arrangement which permits a snap action to effectively reduce the transitional period for unseating and seating a valve head in its associated port. The cam and follower arrangement finds particular use in high speed engines and particularly in the valve arrangement for internal combustion engines. The cam and follower arrangement is not only effective to reduce the above mentioned transitional period, but it is also effective to insure that the valve head remains properly seated in its associated port during those periods when there is no unseating or seating of the valve in the engine cycle.

What I claim is:

1. In an internal combustion engine, valve means for controlling the intake and exhaust of gaseous mixtures from the intake and exhaust ports in the cylinders of the engine, said means including valve bodies associated with each port, each of said valve bodies having a valve head at one end adapted to be seated in the port to close said port to the passage of the gaseous mixture against the cylinder compression, and a cam follower rotatably mounted on the other end, a cam, engageable with said follower, said cam having a base circle surface and an indented surface, said follower having a plurality of radially extending lobes which are sequentially engaged in the indented surface of the cam, said lobes being separated by concave circular surfaces which mate and slide against the cam base circle surface between lobe engagements.

2. The combination as in claim 1, wherein said cam follower is rotatably mounted at the end of the valve body which is opposite the valve head.

3. The combination as set forth in claim 1, wherein said valve means includes spring means associated with each valve body, said spring means being disposed between the top portion of the cylinder and a floating bearing enclosing the stem of said valve body.

4. The combination as specified in claim 3 wherein the stem of the valve body extends through a bearing means fixed at the top portion of said engine cylinder and through said floating bearing disposed an appreciable distance above said fixed bearing.

5. In an internal combustion engine, valve means for controlling the intake and exhaust of gaseous mixtures from the intake and exhaust ports in the cylinders of the engine, said means including valve bodies associated with each port, each of said valve bodies having a valve head adapted to be seated in the port to close said port to the passage of the gaseous mixture, a cam shaft driven by said engine and carrying a plurality of cams, each of said valve

bodies having a follower which is adapted to be moved by an associated cam on said cam shaft, each of said cams having a base circle surface and a single indented surface, each of said followers having a plurality of radially extending lobes which are sequentially engaged in the indented surface of the cam, said lobes being separated by concave circular surfaces which mate and slide against the cam base circle surface between lobe engagements, and means associated with the valve body to urge said follower against said cam surface.

6. The combination as set forth in claim 5, wherein the surfaces of said cams and followers are designed so that when a follower lobe is engaged within the indented surface of said cam the valve head is unseated.

7. The combination as set forth in claim 5, wherein the lobe of said follower which is received within said indented surface of said cam is disposed between adjacent peripheral surfaces on said follower that are designed to mate with the base circle surface on said cam.

8. The combination as set forth in claim 5, wherein said means includes a spring which is disposed between the top portion of the cylinder and a floating bearing enclosing the stem of said valve body.

9. The combination as set forth in claim 5, having means biasing said valve body from its port and also coacting with said valve body to guide said body as the body is reciprocated.

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