

[54] **INTEGRATED ROCKER ARM RETURN SPRING AND VALVE STEM SHIELD**

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[51] Int. Cl. **F01I 1/32**

[58] Field of Search 123/90.67, 90.47, 90.65, 123/90.28, 90.66, 90.29; 267/168

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[57] **ABSTRACT**

An integrated rocker arm return spring and valve stem shield, wherein a coil spring, operating to independently bias a rocker arm, surrounds a valve spring. A valve stem shielding, shroud located at the upper end of the valve stem, shrouds the upper portion of the valve stem and is engaged on its underside by the rocker arm coil spring. The rocker arm coil spring engages the shroud and continuously biases it against the rocker arm so as to urge the rocker arm continuously to a valve closing condition.

5 Claims, 3 Drawing Figures

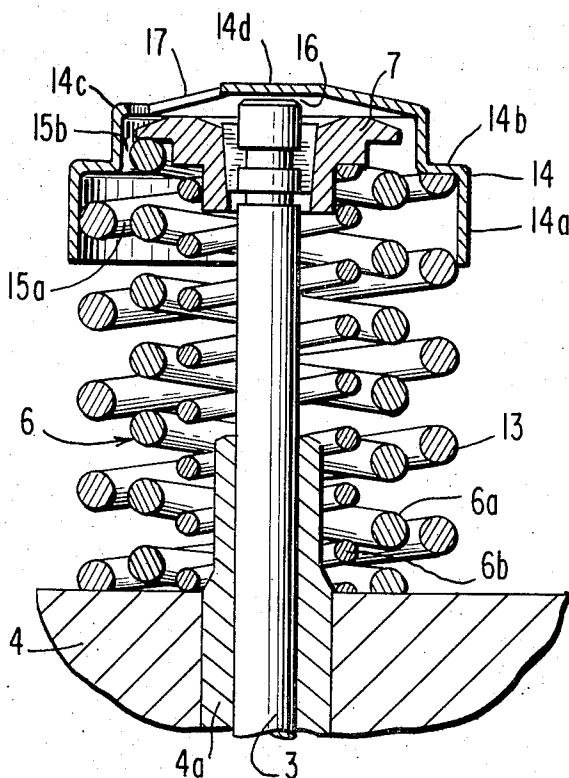


FIG 1

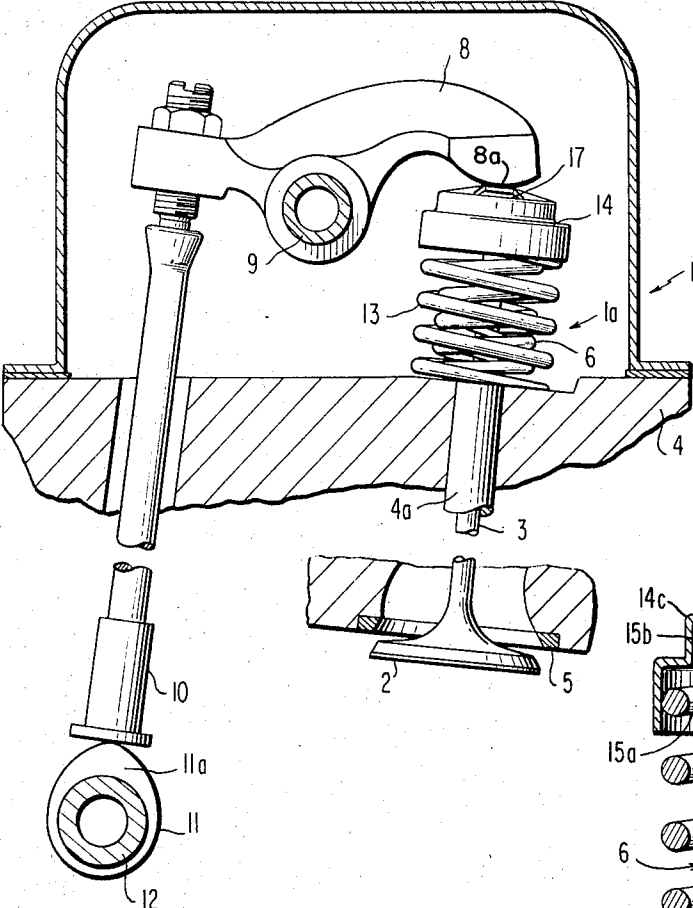


FIG 2

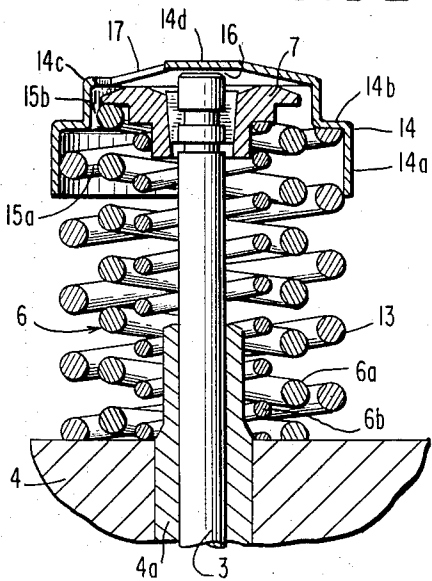
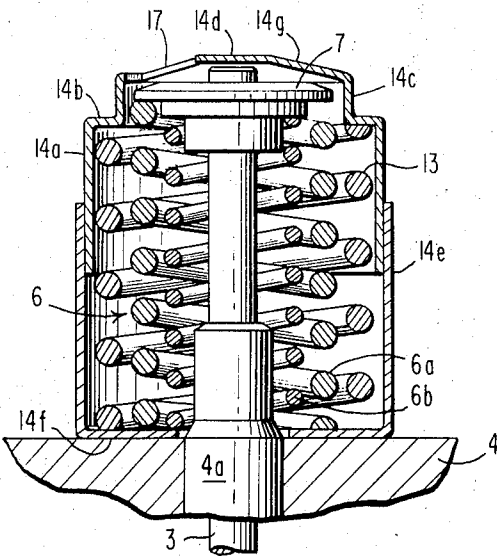


FIG 3



INTEGRATED ROCKER ARM RETURN SPRING AND VALVE STEM SHIELD

GENERAL BACKGROUND OBJECTS AND SUMMARY OF INVENTION

U.S. Iskenderian Pat. No. 3,280,806 discloses a significant advance in relation to internal combustion engine valve systems.

This United States Iskenderian patent pertains to an arrangement wherein a helper spring, operating independently of a valve closing spring, serves to bias a rocker arm to a valve closing condition.

As is stated in the Iskenderian Patent, a major object of the invention presented in this patent is to provide a helper spring which biases a rocker arm toward a valve closing condition. This helper spring serves to maintain the rocker arm assembly in contact with a rocker arm actuating cam shaft and allows the valve spring to perform an independent single function, namely that of returning the valve to its closed position and maintaining the valve in this condition for the appropriate time duration.

The advantageous contribution of the Iskenderian Patent notwithstanding, it has now been recognized that the art could be further advanced in certain respects.

For example, it is now believed desirable to simplify the fabrication and installation of the helper spring by providing a helper spring which, in essence, coaxially surrounds the valve return spring. It has also been recognized that this coaxial disposition of the helper spring and valve spring will contribute to compactness and simplification of installation, servicing, and assembly.

It has been additionally recognized that the art may be further advanced by uniquely incorporating a coaxial helper spring (biasing a rocker arm as above described) with a shroud means which serves to concurrently shroud a valve stem, a valve return spring and the helper spring itself.

Likewise, it has been uniquely recognized that the art may be advanced by providing a unique combination of a shroud, as above described, and a coaxial helper spring, as above described, which coact so as to operatively engage a rocker arm and minimize the imposition of lateral force on the valve stem as the rocker arm and valve stem cooperate to effect valve opening movement.

Bearing this general state of the art and these stated objectives in mind, it is believed that substantial objects of the invention are accomplished by a method of operating an internal combustion engine valve system, which system includes valve means having valve rod means and first spring means which cooperate with the valve rod means to bias the engine valve means to a closed position. This system further includes rocker arm means operable to move from a valve closing condition to a valve opening condition and in so doing move the engine valve means to an open condition. Cam means included in this system are operable to actuate the rocker arm means to move from the valve closing condition to the valve opening condition.

A second spring means included in the system, independent of the first spring means, is operable to bias the rocker arm means away from the valve opening condition to the valve closing condition.

The improvement presented in this general context involves in part, the shielding of the valve rod means with shroud means. The method further contemplates the provision, through the second spring means, of coil spring means. The coil spring means is maintained pre-compressed and in biasing engagement with the shroud means. The shroud means is caused to continuously engage the rocker arm means and continuously urge the rocker means away from the valve opening condition towards the valve closing condition while the valve means is in each of its closed and opened conditions. The biasing action of the coil spring means is maintained on the shroud means continuously effective and continuously independent of the position of the valve rod means relative to the coil spring means while the valve means is in both closed and open conditions. Rigid force transmitting cooperation between the rocker arm means and the valve stem means, in a laterally directed sense, is prevented. In both the closed and open conditions of the valve means, a lateral force absorbing, resilient connection between the rocker arm means and the valve rod means is continuously provided and maintained.

In particular, the invention contemplates certain apparatus combinations operable, in a uniquely effective coacting manner, to accomplish the foregoing method steps.

The invention further contemplates a unique shroud means which provides both top shielding and lateral shielding of at least portions of the valve stem, valve return spring, and rocker arm spring.

The apparatus aspects of the invention additionally contemplate a unique telescoping shroud which provides complete lateral shielding of the valve stem, a coil spring means engaging the rocker arm, and coil spring means acting to return the valve stem to the closed valve condition.

A still further apparatus aspect of the invention involves the utilization of a unique passage means in the shroud means to afford access to a gauge area between the top of the valve stem and an under portion of the shroud means.

In describing the invention reference will be made to certain preferred embodiments illustrated by way of example in the accompanying drawings.

DRAWINGS

In describing the invention, reference will be made to the appended drawing FIGS. 1-3 which illustrate certain preferred aspects of the present invention.

FIG. 1 illustrates a fragmentary view of a portion of a valve system of an internal combustion engine system, illustrating, in partial section, the basic cooperation and arrangement existing between a cam means, rocker arm means, valve and valve stem means, and spring means associated independently with each of the valve means and rocker arm means;

FIG. 2 provides an enlarged, vertically sectioned view of the spring and shroud portion of the FIG. 1 assembly, illustrating structural details of a shroud means associated with the valve stems, and the valve spring means and rocker arm spring means and illustrating the manner in which the rocker arm spring means is coaxially arranged relative to the valve stem and operable to continuously bias the shroud means against the rocker arm means;

FIG. 3 illustrates an alternative form of the FIG. 2 embodiment, illustrating a unique telescoping, cylinder type shroud means which is operable to completely laterally shield the exposed portion of the valve stem and the various coil spring means associated with the valve and the rocker arm means.

In describing the preferred embodiments of the invention, reference will be made to the foregoing Figures in conjunction with the following detailed description.

DETAILED DESCRIPTION

In describing the advance in the engine valve art which is effective through this invention, the overall context of the invention will first be set forth.

Context of Invention

FIG. 1 schematically sets forth the context within which the present invention is practiced.

FIG. 1 illustrates, in fragmentary and partially sectioned form, a valve system 1, of which a single valve rocker arm and cam are illustrated.

As shown in FIG. 1, the portion of the valve system there shown includes an engine valve means 2 which is supported on a valve rod means 3. Valve rod means 3 is reciprocally mounted in cylinder head means 4. As shown in FIG. 1, valve stem 3 may be reciprocally supported within a tubular guide 4a which is fixedly mounted in cylinder head 4.

Valve means 2 is operable to seatingly engage a valve seat 5 also secured in cylinder head 4.

A first spring means 6 cooperates with valve rod means 3 to bias the valve means 3 to a closed condition.

This biasing phenomenon may be best understood by referring to both FIGS. 1 and 2.

As shown in FIGS. 1 and 2, the valve biasing, first spring means 6 may include one or more coil spring means, each operable to biasing engage a spring retainer 7 fixedly carried by the upper end of the valve stem 3. In the embodiment shown in FIG. 2 the valve biasing, first spring means 6 includes an outer coil spring 6a and an inner coil spring 6b, both of which abuttingly and biasing engage the spring retainer 7.

When the rocker arm 8 of the FIG. 1 valve system 1 is disposed in a valve closed condition, the spring means 6 will be operative to move the valve 2 into valve closing cooperation with valve seat 5, in a manner well understood in the internal combustion engine valve art and generally discussed in the aforesaid Iskenderian U.S. Pat. No. 3,280,806.

The rocker arm means 8, shown in FIG. 1 is pivotally mounted on a rocker arm shaft 9. A push rod 10 included in the rocker arm 8 is engaged by a rotary cam 11. Rotary cam 11 is mounted on a drive shaft 12 which is rotated in timed coordination with the engine crank shaft.

Rocker arm means 8 includes a portion 8a which is disposed in continuous engagement with the valve and spring assembly 1a comprising valve 2, valve stem 3, and spring means 6.

In the manner described in the aforesaid Iskenderian U.S. Pat. No. 3,280,806, the rocker arm means 8 is operable to move from a valve closing condition, where valve 2 is engaged with seat 5 to a valve opening condition illustrated in FIG. 1 where the valve 2 is disposed in its open condition.

The cam means 11, as it rotates with shaft 12, is operable to oscillatingly actuate the rocker arm 8 so as to sequentially move the valve 2 from the valve closing condition where valve 2 engages seat 5 to the condition illustrated in FIG. 1, i.e., the valve opening condition.

Valve system 1 further includes a second spring means 13. Spring means 13 is operably independent of the first spring means 6 and is operable to bias the rocker arm means 8 away from the valve opening condition, depicted in FIG. 1, to the valve closing condition where valve 2 engages seat 5.

The invention herein presented, involves the unique arrangement of the rocker arm biasing, second spring means 13, and an associated shroud means. These distinguishing aspects of the invention will now be described.

DETAILS OF NOVELTY OF PRESENT INVENTION

As shown in the embodiment depicted in FIG. 1 and FIG. 2, the improvement concept of the present invention involves the utilization of a unique, generally stepped top, cylindrical shroud means 14.

Shroud means 14 includes a cylindrical side wall portion 14a disposed on the outside of and coaxial with spring means 13. This means, of course, that shroud means portion 14a peripherally encircles each of the spring means 6 and 13, along with the portion of the valve stem 3 which projects above the cylinder head 4.

Shroud means 14 includes a generally annular abutment shoulder 14b which is abuttingly and biasingly engaged by the upper end of the helical coil spring 13.

Another generally cylindrical shroud portion 14c, of smaller diameter than cylindrical portion 14a, peripherally encircles spring retainer 7 and the upper end of valve stem 3.

Shroud means 14 includes a somewhat convex shield means 14d extending across the top of valve stem 3 and closing the top portion of cylindrical wall portion 14c.

The second spring means is characterized by the precompressed helical coil spring comprising spring means 13. This helical coil spring means 13 is coaxially arranged with respect to spring means 6 and stem 3 and laterally surrounds each of these components.

Coil spring means 13 is precompressed so as to constantly bias the shroud top shield means 14d against the underside of rocker arm portion 8a, when the overall system is installed as shown in FIG. 1. As a result, the spring means 13 causes the shroud means 14 to continuously engage the rocker arm means 8 and continuously urge the rocker arm means 8 away from the valve opening condition, depicted in FIG. 1, towards the valve closing condition where valve 2 seatingly engages seat 5. Significantly this continuous biasing exists while the valve means 2 is in each of its closed and opened conditions, i.e., regardless of the position of stem 3.

It is contemplated that in the closed valve condition, the system components will assume the disposition shown in FIG. 2, where the valve will have seated, so as to arrest the upward movement of the valve stem 3. The precompressed condition of the coil spring means 13 will be operative, even after the valve 2 has seated against the seat 5, to urge the rocker arm 8, via the intervening shroud 14, to a valve closing condition, as

permitted by rotation of the cam 11. This movement will continue to the point where the lifting cam portion 11a is rotated away from engagement with the cam follower portion 10a of rod 10 and the shroud is moved by spring 13 clear of the top of rod 3.

The distinguishing aspects of the invention further involve coil spring action isolating means which are operable to maintain the biasing action of coil spring means 13 on the shroud means 14 continuously independent of the position of the valve means 3, relative to the coil spring means 13, while the valve means 2 is in both of its closed and opened conditions.

This coil spring action isolating means includes a "free floating" mounting (i.e., wholly disconnected from stem 3) of the shroud 14 on spring 13 such that it is not connected with or impeded by any position of the valve stem 3. In conjunction with the precompressed nature of the spring 13, the "free floating" mounting provides a constant biasing force urging the shroud 14 against the rocker arm portion 8a.

In other words, regardless of the position of the valve stem 3, the "free floating" nature of the shroud 14 relative to the valve stem 3 and the precompressed nature of the spring 13 will insure continuously effective biasing action of the coil spring means 13 relative to the rocker arm means 8.

An additionally significant and characterizing aspect of the invention entails means operable to prevent laterally directed, rigid force transmitting cooperation between the rocker arm means 8 and the valve stem means 3.

This lateral force control aspect, which serves to minimize friction between the valve stem 3 and the sleeve 4a is achieved by the vertically and laterally "free floating" nature of the shroud 14 relative to the valve stem 3 and the spring retainer 7. This "free floating" capacity is illustrated in FIG. 2 and results due to the clearance 15a between the spring means 13 and 6, due to the substantially equivalent clearance 15b between the shroud portion 14c and the lateral peripheral of the spring retainers 7, and the vertical clearance 16 between the top of stem 3 and the underside of shroud portion 14d. Through this arrangement, lateral force imposed on the top of the shroud portion 14d, as a result of oscillating movement of the rocker arm 8, will tend to be absorbed by limited lateral flexing of the spring means 13 rather than be transmitted as frictional or rigidly transmitted force directly to the stem 3. As will be appreciated, this phenomenon contemplates the maintenance of clearance 16 between the top of the valve stem 3 and the underside of the top shield 14d when the valve 2 is in the closed valve condition. As a result of this structural arrangement, when the rocker arm 8 commences its downward movement so as to start to exert valve opening force on the shroud spring and valve assembly 1a, lateral force generated between the rocker arm portion 8a and the top shield portion 14d will be minimized with respect to its being laterally transmitted to the valve stem 3. Even when the shroud 14d is pressed against the top of the stem 3 so as to start to commence actual opening movement of the valve 2, the clearance areas 15a and 15b will provide a more or less resilient shock absorbing connection acting laterally between the shield 14 and the stem 3.

In this latter respect, it will be recognized that the mounting of the upper end of coil spring 13 on shroud shoulder 14b, coupled with the clearance zones 15b

and 15a, serve to continuously provide and maintain a lateral force absorbing, resilient connection means between the rocker arm 8 and the valve rod 3.

AUGMENTATIVE FEATURES OF PREFERRED EMBODIMENT

FIG. 3 illustrates a modified shield means 14 of the present invention which serves to provide a particularly efficacious shielding action.

Thus as shown in FIG. 3, shield means 14 includes portions 14b, 14c and 14d as heretofore described. Shield portion 14a has been lengthened, in relation to the FIG. 2 embodiment, so as to extend to a position terminating closer to the cylinder head 4.

Lengthened shroud 14a is telescopically fitted with a cylindrical shroud portion 14e. Shroud portion 14e may be connected with an annular, centrally a apertured shroud portion 14f. Shroud 14f may be anchored, as by fastening means, to cylinder head 4. However, it is believed that shroud means 14e and 14f may be adequately anchored by having the lower end of spring means 6 biasingly engage the shroud portion 14f so as to urge this shroud portion, in a continuously biased manner, against the cylinder head 4.

With the shield arrangement or shroud arrangement shown in FIG. 2, both the side and upper end of the valve stem 3 are shrouded or protected against oil accumulation. It is believed that this form of shrouding or shielding may serve in a particularly advantageous way to prevent oil from moving downwardly along the valve stem and through the mounting sleeve 4a and into the interior of the working chamber of the engine associated with the valve 2.

Certainly the completely enclosed telescoping shroud means arrangement shown in FIG. 3 will serve to provide particularly effective and entirely enclosed shrouding, operable to virtually isolate the valve stem 3 from oil which may tend to migrate along the valve stem 3 into such a working chamber.

As has been previously indicated, it is desirable to maintain the clearance gap 16 when the valve 2 is seated on the seat 5 to insure that the rocker arm 8, as influenced by the cam 11 will permit the valve 2 to completely seat and close.

Evaluation or monitoring of this clearance gap may be most effectively handled by utilization of a passage aperture means 17 formed in sloping frusto-conical wall means portion 14g of top shield 14d.

Thus, as it is shown in FIGS. 1, 2, and 3, passage means 17 affords access to clearance area 16 between the top portion of the valve rod 3 and an under portion of the top shield means 14d.

This passage means or aperture 17 is operable to permit conventional "feeler" gauge means to be inserted between the top of the stem 3 and the under portion of the shield 14d to determine an appropriate clearance between the shroud 14 and the valve stem 3.

GENERAL ADVANTAGES AND OVERALL SUMMARY OF THE INVENTION

A principal advantage of the invention resides in the simplicity, conservation of space, and ease of assembly and servicing of the helper spring means 13, as presented in a coil spring context encircling the valve spring means 6 and stem 3.

Significantly, this mounting arrangement is effective, in total isolation with respect to the rocker arm 8. Fur-

ther, the mounting and positioning of the "helper" spring means 13, in essence involves little or no practical space requirement beyond that required for the valve spring installation itself.

By effectively and continuously avoiding any rigid force transmitting connection, in a laterally directed sense, between the shroud 14 and the valve stem 3, and by providing a continuously, laterally operable resilient shock absorbing connection between these components, lateral force transmission between the rocker arm means 8 and the valve stem 3 is effectively reduced and minimized. This reduction and minimization of lateral force transmission will serve to effectively reduce frictional interaction and wear between the sleeve 4a and the valve stem 3 and thereby improve operating efficiency of the valve system and prolong its operating life.

The shrouding function of shroud means 14, with respect to the prevention of oil drainage along valve stem 3, is believed to probably contribute significantly to a minimization of oil transmittal along the valve stem 3 into the working chamber so as to thereby prevent or minimize oil contamination of the working chamber and valve and valve seat components.

As will be recognized the invention may be practiced in a variety of formats and would be applicable or operable in conjunction with a variety of valve and rocker arm installations.

It will also be recognized that the invention may be practiced with a variety of spring arrangements. For example, the spring means 13 may comprise composite spring assemblies, i.e., one or more coaxial coil springs, and the spring means 6 may comprise a single coil spring or a plurality of coil springs depending, upon particular operational requirements.

As will also be recognized the shape and configuration of the shroud means 14 may be varied substantially while maintaining the top and lateral shield functions heretofore described.

In short, those skilled in the internal combustion engine valve art and familiar with the disclosure of this invention may well recognize additions, deletions, substitutions, or other modifications which would be deemed to fall within the scope of the invention as set forth in the appended claims.

What is claimed is:

1. In an internal combustion engine valve system comprising

engine valve means including valve rod means;

first spring means, cooperating with said valve rod means, and biasing said engine valve means to a closed condition;

rocker arm means operable to move from a valve closing condition to a valve opening condition and in so doing move said engine valve means to an open condition;

cam means operable to actuate said rocker arm means to move from said valve closing condition to said valve opening condition; and

second spring means, independent of said first spring means, and operable to bias said rocker arm means away from said valve opening condition to said valve closing condition;

the improvement comprising:

shroud means in said system and including

top shield means extending over the top of said valve rod means, and

said second spring means being characterized by precompressed coil spring means,

said precompressed coil spring means engaging said shroud means and causing said shroud means to continuously engage said rocker arm means and continuously urge said rocker arm means away from said valve opening condition towards said valve closing condition, while said valve means is in each of said closed and open conditions;

coil spring action isolating means operable to maintain the biasing action of said coil spring means on said shroud means continuously effective and continuously independent of the position of said valve rod means relative to said coil spring means while said valve means is in both said closed and open conditions;

means operable to prevent laterally directed rigid, force transmitting, cooperation between said rocker arm means and said valve stem means;

means operable in both said closed and open conditions of said valve means to continuously provide and maintain lateral force absorbing, resilient connection means between said rocker arm means and said valve rod means.

2. In an internal combustion engine valve system comprising

engine valve means including valve rod means;

first spring means, cooperating with said valve rod means, and biasing said engine valve means to a closed condition;

rocker arm means operable to move from a valve closing condition to a valve opening condition and in so doing move said engine valve means to an open condition;

cam means operable to actuate said rocker arm means to move from said valve closing condition to said valve opening condition; and

second spring means, independent of said first spring means, and operable to bias said rocker arm means away from said valve opening condition to said valve closing condition;

the improvement comprising:

shroud means in said system and including

top shield means extending over the top of said valve rod means and said first and said second spring means, and side shield means laterally surrounding at least part of said valve rod means;

said second spring means being characterized by precompressed coil spring means surrounding, at least in part, said first spring means,

said precompressed coil spring means engaging said shroud means and causing said shroud means to continuously engage said rocker arm means and continuously urge said rocker arm means away from said valve opening condition towards said valve closing condition, while said valve means is in each of said closed and open conditions;

coil spring action isolating means operable to maintain the biasing action of said coil spring means on said shroud means continuously effective and continuously independent of the position of said valve rod means relative to said coil spring means while said valve means is in both said closed and open conditions;

means operable to prevent laterally directed rigid, force transmitting, cooperation between said rocker arm means and said valve stem means; means operable in both said closed and open conditions of said valve means to continuously provide and maintain lateral force absorbing, resilient connection means between said rocker arm means and said valve rod means.

3. An internal combustion engine valve system as described in claim 2;

wherein said side shield means includes mutually telescoping first and second wall means entirely circumferentially surrounding each of said first and second spring means;

said telescoping first and second wall means being operable to mutually converge as said valve means moves from said closed condition to said open condition.

4. An internal combustion engine valve system as described in claim 2 wherein said top shield means includes:

passage means affording access to an area between a top portion of said valve rod means and an under portion of said top shield means;

said passage means being operable to permit gauge means to be inserted between said top portion of said valve rod means and said under portion of said top shield means to determine an appropriate clearance there between.

5. In a method of operating an internal combustion engine valve system comprising

engine valve means including valve rod means; first spring means, cooperating with said valve rod means, and biasing said engine valve means to a closed condition;

rocker arm means operable to move from a valve closing condition to a valve opening condition and in so doing move said engine valve means to an

open condition;

cam means operable to actuate said rocker arm means to move from said valve closing condition to said valve opening condition; and

second spring means independent of said first spring means, and operable to bias said rocker arm means away from said valve opening condition to said valve closing condition;

the improvement comprising:

shielding the top of said valve rod means with shroud means;

providing, through said second spring means, coil spring means;

maintaining said coil spring means precompressed and in biasing engagement with said shroud means;

causing said shroud means to continuously engage said rocker arm means and continuously urge said rocker arm means away from said valve opening condition towards said valve closing condition, while said valve means is in each of said closed and open conditions;

maintaining the biasing action of said coil spring means on said shroud means continuously effective and continuously independent of the position of said valve rod means relative to said coil spring means while said valve means is in both said closed and open conditions;

preventing laterally directed rigid, force transmitting, cooperation between said rocker arm means and said valve stem means;

in both said closed and open conditions of said valve means, continuously providing and maintaining a lateral force absorbing, resilient connection between said rocker arm means and said valve rod means.

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