United States Patent

[11] 3,626,469

[72] Inventor **Gerald J. Ashley**
23465 Lee Baker Drive, Southfield, Mich. 48075

[21] Appl. No. **775,063**
[22] Filed **Nov. 12, 1968**
[45] Patented **Dec. 7, 1971**

[54] **VALVE GEAR**
11 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** ..... **123/90.25,** 74/519, 123/90.27, 123/90.36, 123/90.41, 123/90.44, 123/188 A

[51] **Int. Cl.** **F01l 1/30,** F01l 1/18, F01l 1/04

[50] **Field of Search** 123/90.25, 90.27, 90.35, 90.36, 90.41, 90.42, 90.43, 90.44, 90.45, 90.46, 90.47

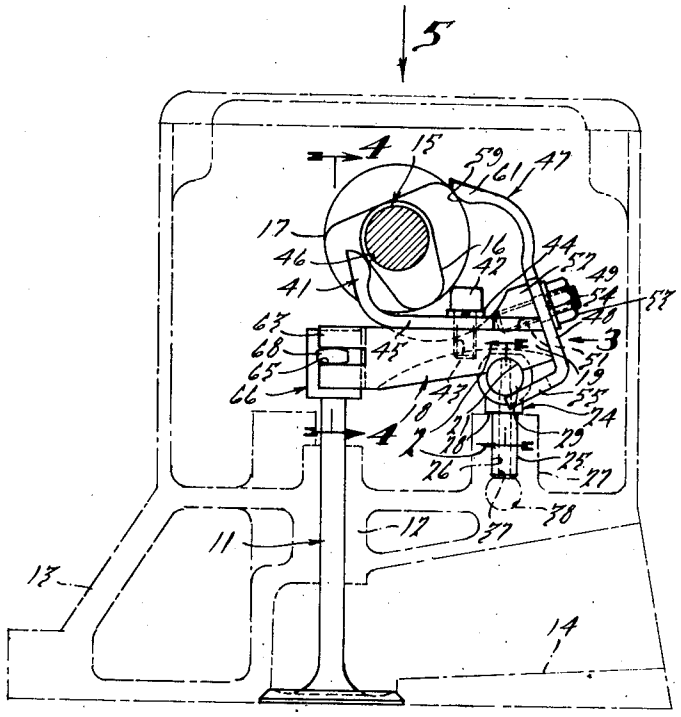
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Primary Examiner—Al Lawrence Smith
Attorney—Harness, Dickey & Pierce

ABSTRACT: A positively operated valve gear for an internal combustion engine embodying pivotally supported rocker arms that carry detachable spring fingers which fingers engage cams on a camshaft for pivoting the rocker arms upon rotation of the camshaft. The rocker arm is pivotally connected to the engine poppet valves for positively transmitting movement to these valves and may be formed as a casting, forging or stamping. The pivotal connection between the rocker arms and poppet valves is accomplished through an improved keeper arrangement. The rocker arm acts as a third-class lever so that the valves can be disposed on opposite sides of the axis of the rotation of the camshaft giving greater latitude to the positioning of the valves relative to the cylinder bore.



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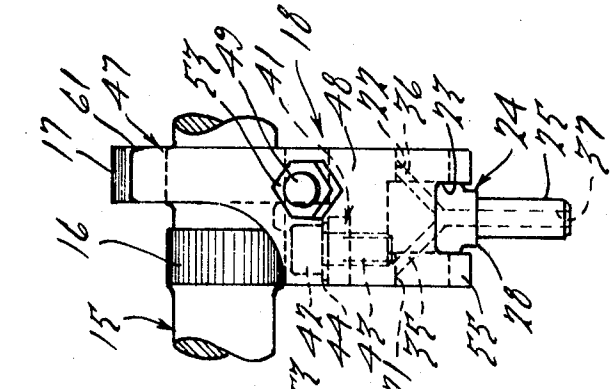


FIG. 3

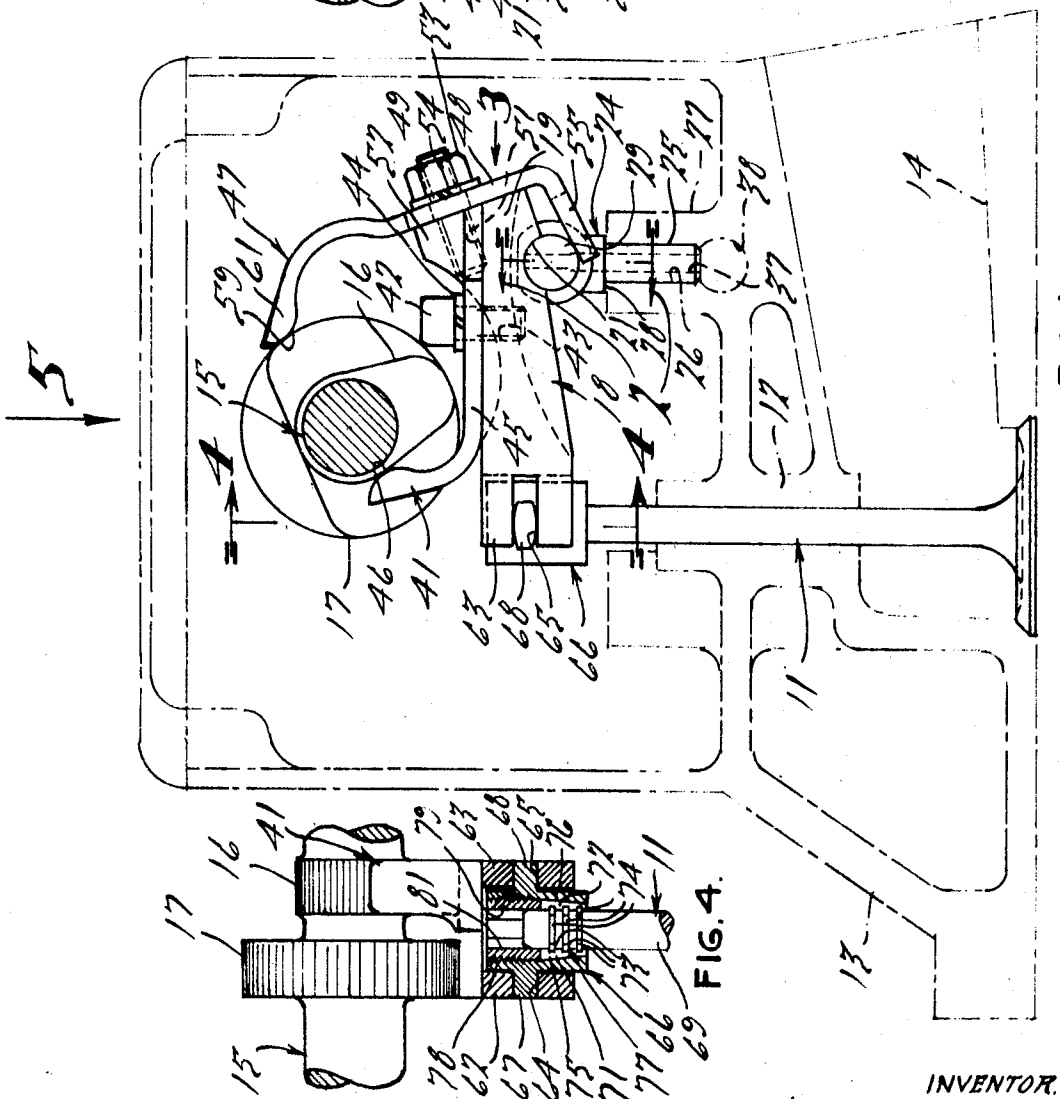


FIG. 1

FIG. 4

INVENTOR.
Gerald J. Ashley.
BY
Harness, Dickey & Pierce
ATTORNEYS

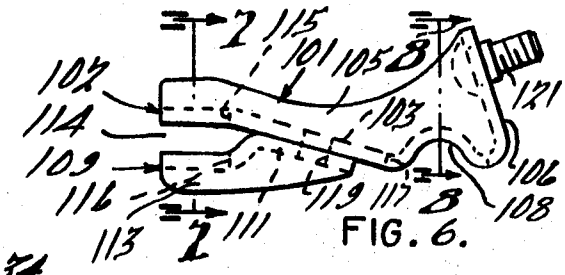


FIG. 6.

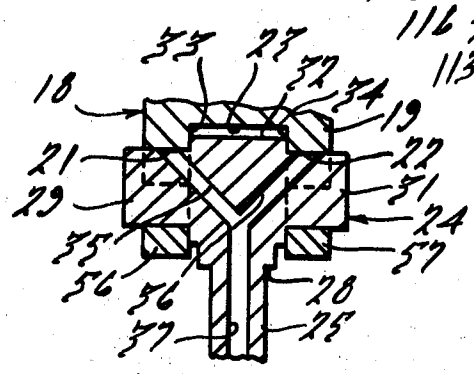


FIG. 2.

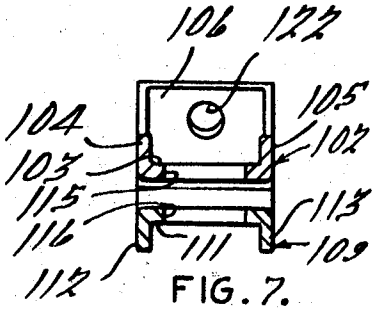


FIG. 7.

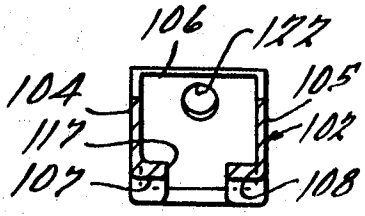


FIG. 8.

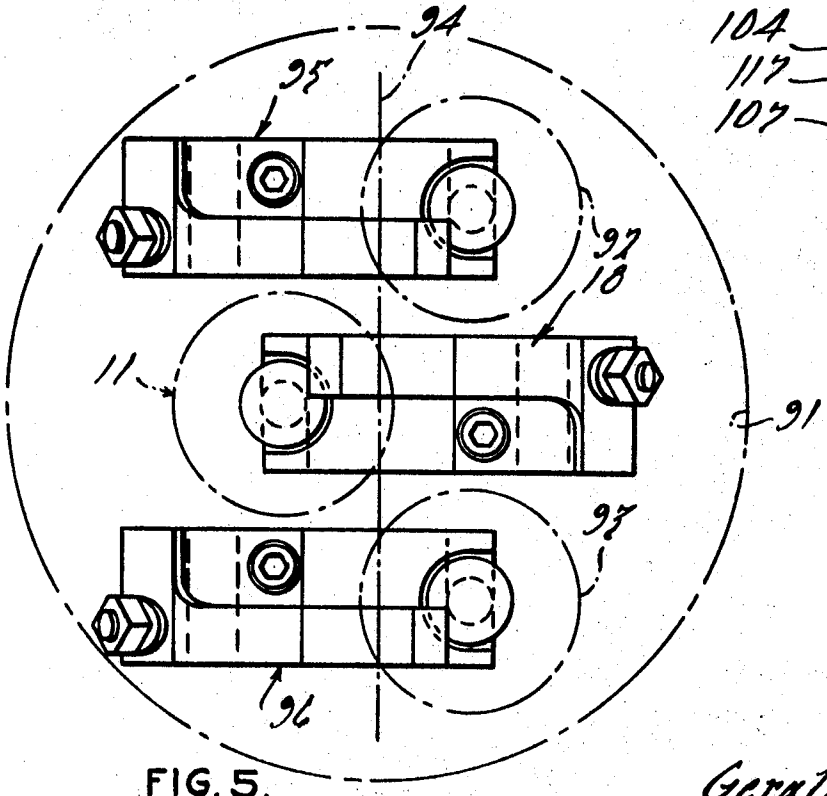


FIG. 5.

INVENTOR.
Gerald T. Ashley.
BY
Harness, Dickey & Pierce
ATTORNEYS.

VALVE GEAR

BACKGROUND OF THE INVENTION

This invention relates to a valve gear and particularly to an improved valve gear for use with an internal combustion engine.

The valve train of an internal combustion engine is widely recognized as one of the factors that limits the efficiency and, accordingly, the power output of the engine. In a conventional valve train, the valves are opened in a relatively positive manner but springs are relied upon for the valve closing. Since the closing force of the spring must be opposed during the valve opening, this conventional type of valve train requires a relatively high amount of power merely to drive the valve system. Recognizing this disadvantage, it has been proposed to provide a so-called positive or desmodromic valve activation. In such a valve train both the opening and the closing of the valves is positively controlled. The application of such valve-operating mechanisms has, however, been limited to certain high-output racing engines due to high cost and other factors. The high costs associated with the previously proposed positive valve trains have been a result of the extremely high tolerances required to insure complete closure of the valve. In addition, the previously proposed layouts with this type of valve mechanism have seriously limited the serviceability of the engine thus rendering the designs unsuited for wide commercial usage.

It is, therefore, a principal object of this invention to provide an improved positively operated valve gear suitable for use in internal combustion engines or the like.

It is another object of the invention to provide a positive valve gear that facilitates servicing.

It is a further object of the invention to provide a low-cost positive valve gear.

As has been noted, the use of positive valve actuation has necessitated high tolerances in previously proposed systems to insure complete closure of the valves. With such high tolerances, it has additionally been necessary to provide for periodic adjustment to compensate for wear in the system.

It is, therefore, another object of the invention to provide a positively operated valve gear that can be built with relatively low tolerances.

It is a further object of the invention to provide a positive valve train that does not require frequent adjustment.

In many forms of valve trains embodying poppet valves, a rocker arm is employed to operate the valves. The use of a rocker arm for valve operation has several advantages. In addition to facilitating servicing of the engine, the rocker arm permits a motion amplification thus permitting wide valve openings for a given degree of cam lift. The use of a rocker arm, however, requires the provision of a pivotal support for the rocker arm, generally upon the cylinder head of the associated engine. It has alternatively been proposed to support all of the rocker arms or groups of them upon a common rocker arm shaft or to individually support the rocker arms. The individual rocker arm support has several advantages such as lower cost and great latitude in valve placement. The previously proposed methods for individually supporting the rocker arms have had the effect of making serviceability more difficult.

It is, therefore, still another object of the invention to provide an improved rocker arm arrangement for the valve gear.

It is another object of the invention to provide an improved individual supporting arrangement for a rocker arm.

As has been noted, there are many advantages to the positive operation of the valves of an internal combustion engine. In most instances, the application of positive valve operation has been in connection with engines embodying overhead camshafts. Most of these arrangements have accomplished valve openings in a manner similar to the more conventional overhead camshaft engines embodying springs for closing the valves. That is, the opening cams directly engaged the valve or a valve cup. Such an arrangement has several disadvantages.

As with most conventional overhead camshaft engines, this type of arrangement necessitates removal of camshaft to set valve clearances or to otherwise service the valve mechanism. In addition, the overall height of the engine is generally increased and if high lifts are to be employed, the relatively large cam lobes aggravate the situation.

It is, therefore, another object of the invention to provide an improved valve train for an overhead camshaft engine embodying rocker arms for transmitting motion between the cam and the valve.

It it another object to provide a positive valve-operating mechanism embodying a rocker arm for both opening and closing the valves.

Due to the aforenoted defects in the method of positively operating valves, the valve placement relative to the cylinder bore has been relatively limited unless multiple camshafts are employed.

It is, therefore, another object of the invention to provide a valve gear arrangement that permits a greater latitude in valve placement. In many forms of valve gears a keeper arrangement is carried by the upper end of the stem of the poppet valve. These keepers are used for transmitting a force, which may be either an opening or closing force, to the valve. In a conventional engine, the valve-closing spring operates through the keepers to hold the valve in its closed position. Such keepers normally rely upon the spring force for holding the keeper in its engaged position with the valve stem. With such an arrangement, assembly and disassembly may be difficult and damage to the valve stem can result.

It is, therefore, an even further object of the invention to provide an improved keeper arrangement for a valve.

The advantages of the use of rocker arms for transmitting motion to the valves has been noted. Although such rocker arms are normally cast or forged, it has been proposed recently to use a stamping for such components. The use of stamping reduces the cost of the component and may, in some instances, permit a weight saving. It is, therefore, still another object of the invention to provide an improved, stamped rocker arm.

SUMMARY OF THE INVENTION

A first feature of the invention is adapted to be embodied in a positive gear valve for an internal combustion engine or the like. Such a valve gear comprises a valve, a rocker arm supported for pivotal movement between a valve opening position and a valve closing position and means for positively connecting the rocker arm to the valve for movement of the valve simultaneously with the movement of the rocker arm between both of the positions. Operating means are provided for moving the rocker arm between its positions thereby positively moving the valve between its open position and its closed position.

A second feature of the invention is also adapted to be embodied in a valve gear for an internal combustion engine or the like. Such a valve gear also includes a rocker arm adapted to cooperate with the valve for opening the valve upon pivotal movement of the rocker arm. A pivot member is provided for pivotally supporting a rocker arm. The pivot member has a shank portion adapted to be affixed to the associated component of the engine or the like and a pair of spaced oppositely extending bearing portions. The bearing portions extend perpendicularly to the shank portion. The rocker arm defines bearing surfaces in engagement with the pivot member bearing portions for pivotally supporting the rocker arm.

Another feature of the invention is also adapted to be embodied in the valve gear of an internal combustion engine or the like. Such an embodiment of the invention also includes a rocker arm member and a poppet valve member. Means are provided for supporting the rocker arm member for pivotal movement and actuating means are employed for pivoting the rocker arm member, The rocker arm member is pivotally connected to the valve member for actuating the valve member

upon pivotal movement of the rocker arm. The pivotal connection between these members is accomplished by means on one of the members that defines an elongated opening and bearing means on the other of the members that is received in this opening,

Still another feature of the invention is adapted to be embodied in an engine having at least one cylinder bore and a cylinder head that is adapted to form a closure for the cylinder bore. In such an embodiment a camshaft is supported for rotation relative to the cylinder head. First and second poppet valves are supported for reciprocation relative to the cylinder head on opposite sides of the axis of rotation of the camshaft. A first rocker arm having valve-engaging means engaged with the first poppet valve is pivotally supported relative to the cylinder head about a pivot axis that is disposed on the same side of the camshaft axis of rotation as is the second poppet valve. A second rocker arm has valve-engaging means engaged with the second poppet valve and is supported for pivotal movement relative to the cylinder head about a pivot axis on the same side of the camshaft axis of rotation as is the first poppet valve. Cooperating means on the camshaft and each of the rocker arms are provided for pivoting the rocker arms upon rotation of the camshaft about its axis.

Another feature of the invention is adapted to be embodied in a valve keeper arrangement for a poppet valve. Such a valve keeper arrangement comprises a pair of keepers that are adapted to engage and hold the stem of the poppet valve. These keepers have tapered outer surfaces that are received in a complementary tapered surface formed at one end of an opening in a sleeve. The other end of the sleeve opening is threaded and receives a threaded member that engages the ends of the keepers for moving the keepers and sleeve axially relative to each other whereupon the tapered surface of the sleeve and keepers urges the keepers into engagement with the valve stem.

Yet another feature of the invention is adapted to be embodied in a stamped rocker arm for an internal combustion engine valve gear or the like. Such a stamped rocker arm comprises a web portion and integrally connected flange portions formed at the sides of the web portion for reinforcing the rocker arm. Means on the web portion define a pair of spaced bearing surfaces having the shape of segments of a cylinder for supporting the rocker arm for pivotal movement about an axis defined by the bearing surfaces. Means on the web spaced from the bearing surfaces define a valve-engaging surface for operating a valve or the like upon pivotal movement of the rocker arm.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a valve gear having an internal combustion engine embodying this invention showing certain of the components in phantom and taken along a plane perpendicular to the axis of rotation of the camshaft.

FIG. 2 is an enlarged cross-sectional view taken along the line 2—2 of FIG. 1.

FIG. 3 is an end view taken generally in the direction of the arrow 3 in FIG. 1.

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 1.

FIG. 5 is a top plan view taken generally in the direction of the arrow 5 in FIG. 1.

FIG. 6 is a side elevational view of another embodiment of this invention employing a stamped rocker arm.

FIG. 7 is a cross-sectional view taken along the line 7—7 of FIG. 6.

FIG. 8 is a cross-sectional view taken along the line 8—8 of FIG. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the preferred embodiment the invention is utilized in conjunction with a positively operated overhead camshaft valve train for an internal combustion engine. Certain features of the invention, however, may find application in other types of valve trains or in other mechanisms. Such uses for the invention will be obvious to those skilled in the art. Referring now to the preferred embodiment, a poppet valve **11** is supported for reciprocation in a valve guide **12** formed in a cylinder head **13** for controlling the flow through a port **14**. The port **14** may be an intake port or an exhaust port and in FIG. 1 an intake port is illustrated. A camshaft assembly **15** is journaled for rotation in the cylinder head assembly **13** in any known manner and has an opening cam **16** and closing cam **17** which cams cooperate with a rocker arm assembly, indicated generally by the reference numeral **18**, in a manner which will become more apparent as this description proceeds, for positively opening and closing the valve **11**.

The rocker arm assembly **18** is comprised of a rocker member **19** that is formed with a pair of spaced semicylindrical journal surfaces **21** and **22** (FIG. 2) that are separated by a cutout portion **23**. A pivot member, indicated generally by the reference numeral **24**, has a shank portion **25** which may be press fitted or threaded into a complementary opening **26** formed in the boss **27** of the cylinder head **13**. The shank **25** is disposed on one side of a vertical plane containing the axis of rotation of the camshaft **15** while the poppet valve **11** is disposed on the other side of this plane. The shank portion **25** terminates at a shoulder **28** that abuttingly engages an upper surface of the boss **27**. Adjacent the shoulder **28**, the pivot member **24** is formed with a pair of outwardly extending bearing portions **29** and **31** that engage the rocker arm bearing portions **21** and **22**, respectively, for pivotally supporting the rocker arm **18** relative to the cylinder head **13**. The bearing portions **29** and **31** extend perpendicularly to the shank portion **25**. An enlarged portion **32** of the pivot member **24** extends into the rocker arm recess **23** and engages facing shoulders **33** and **34** of the rocker arm adjacent the bearing portions **21** and **22** for holding the rocker arm **18** against transverse and rotary movement relative to the pivot member **24**.

In order to lubricate the bearing surfaces **21** and **22** of the rocker arm and the engaging surfaces of the pivot member portions **29** and **31**, a pair of converging oil passages **35** and **36** extend through the pivot member from these surfaces and intersect a vertically extending oil passage **37** that extends through the shank portion **25**. The passage **37** intersects a main oil gallery **38** formed in the cylinder head for delivery of oil to the bearing surfaces.

An opening springfinger follower **41** is affixed to the upper surface of the rocker member **19** by means of a socket-headed bolt **42** that is received in a tapped opening **43** formed in the rocker member **19**. A lockwasher **44** engages the head of the bolt **42** and a flattened portion **45** of the spring follower **41**, The follower **41** has an arcuate surface **46** that is cantilevered relative to the flattened portion **45** and which engages the opening cam **16** of the camshaft **15**. The springfinger **41** is under a pretension when the valve **11** is in its closed position as shown in FIG. 1. That is, the portion on which the surface **46** is formed is deformed relative to the flattened surface **45** so that the surface **46** bears with a pressure against the cam **16** thus eliminating any need for mechanical adjustment.

A closing springfinger, indicated generally by the reference numeral **47**, has a flattened portion **48** that is held to the rocker member **19** by means of a stud **49** that is received in a tapped opening **51** in a boss **52** of the rocker member **19**. A nut **53** and lockwasher **54** engage the upper surface of the springfinger portion **48** and hold it in engagement with the rocker member **19**.

At its lower end, the closing springfinger **47** is formed with a bifurcated tang **55** having legs **56** and **57** which engage the underside of the pivot member bearing portions **29** and **31**. The tang **55** is under some pretension when assembled so that the pivot member bearing portions **29** and **31** will be captured between the legs **56** and **57** and the rocker arm bearing surfaces **21** and **22**. The legs **56** and **57** are in rubbing contact with the pivot member portions **29** and **31** for fixing the rocker

arm assembly 18 about the pivot axis defined by these bearing portions of the pivot member 24.

The upper end of the closing springfinger 47 is formed with a curved follower surface 59 that engages the profile of the closing cam 17 for transmitting movement of this cam to the rocker arm assembly 18. The surface 59 is formed on a portion 61 of the closing springfinger that is offset to the flattened portion 48 and which is deformed upon installation so as to exert a pressure on the cam lobe 17. It will be noted that the spring follower surfaces 46 and 59 are disposed 180° apart and the force exerted on the cam lobe 17 by the follower 47 is greater than the force exerted on the cam lobe 16 by the spring follower 41. The spring forces thus exerted eliminate the necessity for mechanical adjustment and insure that the valve 11 will be completely closed when the follower surface 59 is disposed in engagement with the closing cam lobe 17 and regardless of engine speed.

In order to transmit the positive pivotal movement of the rocker arm assembly 18 into opening and closing movement of the valve 11, a pivotal connection is provided between the rocker arm assembly 18 and the valve 11 in the manner now to be described. The outer end of the rocker member 19 is bifurcated so as to form two outstanding arms 62 and 63 FIG. 4) each of which arms is formed with a respective elongated slot 64 and 65. A keeper assembly, indicated generally by the reference numeral 66, has a pair of outstanding projections 67 and 68 that extend into the slots 64 and 65, respectively. Each of the projections 67 and 68 is formed with arcuate upper and lower surfaces as clearly seen in FIG. 1, which surfaces engage the surfaces of the respective arm defining the slot in which the projection is received. Hence, pivotal movement of the rocker arm assembly 18 is transmitted into reciprocatory movement of the valve 11. The projections 67 and 68 will transverse the slots 64 and 65 slightly during this movement due to the differences in the movements.

The keeper assembly 66 is positively connected to a stem 69 of the valve 11 by means of a pair of keeper collars 71 and 72 which keepers are slotted as at 73 to receive projections 74 formed on the valve stem 69. The keepers 71 and 72 have conical outer surfaces 75 and 76 that are engaged by a complementary surface 77 formed in a sleeve 78 from which the projections 67 and 68 integrally extend. The upper end of the sleeve 79 is formed with a female threaded opening 79 in which a socket-headed screw 81 is received. The lower end of the socket-headed screw engages upper surfaces of the keepers 71 and 72. Upon tightening of the socket-headed screw 81, the keepers 71 and 72 will be cammed into engagement with the valve stem 69 thus positively coupling the keeper assembly 66 to the valve stem 69.

It should be readily apparent that the described construction permits removal of the rocker arm 18 without the necessity of removing the camshaft 15. The rocker arm may be removed, as should be readily apparent, by removal of the springfingers 41 and 47. In addition, the use of the rocker arm assembly 18 for transmitting motion to the valve 11 permits a lesser degree of lift on the cam lobes 16 and 17 since the rocker arm assembly 18 acts as a third-class lever and amplifies the motion transmitted to the valve 11. The orientation of the components also permits a greater latitude in the valve placement with respect to the cylinder, as should be apparent by reference to FIG. 5.

In FIG. 5, the intake valve 11, which has been previously described, is operated by the rocker arm assembly 18. The cylinder bore of the associated engine is identified by the dot-dash circle 91. Exhaust valves 92 and 93 are disposed in registry with the cylinder bore 91 and are disposed on the opposite side of a vertical plane intersecting the axis of rotation of the camshaft 15, which axis is indicated by the dot-dash line 94, from the intake valve 11. The exhaust valves 92 and 93 are operated by respective rocker arm assemblies 95 and 96 as is the intake valve 11. The rocker arm assemblies 95 and 96 are the same as the rocker arm assembly 18 and each of these rocker arm assemblies is engaged by respective cams on the camshaft 15, which is not shown in FIG. 5, as should be readily apparent.

In the embodiments shown in FIGS. 1 through 5, the rocker members 19 are illustrated as being formed as forgings or castings. In some instances, it may be desirable to use a stamped rocker member for cost and/or weight saving. FIGS. 6 through 8 show such an embodiment wherein a stamped rocker member is indicated generally by the reference numeral 101. The rocker member 101 is adapted to carry springfingers and to cooperate with a cam for operating the valve in The manner as in the previously described embodiments.

The rocker member 101 includes a first stamping 102 having a web portion 103 that is reinforced at each side by upwardly extending flanges 104 and 105. At the rear end the flanges 104 and 105 are joined by an upstanding flange 106. Adjacent the flange 106, the web 103 is formed with a pair of upset portions 107 and 108, which portions have the shape of a segment of a cylinder and define the bearing portions for pivotally supporting the rocker arm assembly 101 upon a pivot member as in the previously described embodiments.

A second stamping 109 has a web 111 and downwardly extending flanges 112 and 113 that serve to reinforce this stamping. A portion of the web 111 is welded to the web 103 of the stamping 102 with the outer ends of the webs 103 and 104 being spaced from each other to define a slot 114 into which the bearing portions of the valve keeper extend for transmitting movement from the rocker member 101 to the valve as in the previously described embodiments. The outer ends of the webs 103 and 11 are relieved, as at 115 and 116, to pass the valve stem.

In a like manner, the space in the web 103 between the bearing portions 107 and 108 is relieved, as at 117 (FIG. 8), so as to clear the enlarged portion of the pilot member and for engagement with this portion to preclude the rocker member 101 from rotary or lateral movement.

A tapped hole 119 is formed in the webs 103 and 111 for receipt of a shouldered stud to secure the opening springfinger as in the previously described embodiment. A threaded rivet 121 is affixed in an opening 122 formed in the flange 106 for securing the closing springfinger to the rocker member 101. As in the previously described embodiment, the closing springfinger will have a tang that overlies the pivot member for securing the rocker arm assembly for pivotal movement with respect to this pivot member.

What is claimed is:

1. A positive valve gear for an internal combustion engine or the like comprising a valve, a rocker arm, a pivot member pivotally supporting said rocker arm, said pivot member having a shank portion adapted to be affixed to an associated component of the engine or the like and a pair of spaced, oppositely extending bearing portions, said bearing portions extending substantially perpendicular to said shank portion, said rocker-arm-defining bearing surfaces in engagement with said pivot member bearing portions for supporting said rocker arm upon said pivot member for pivotal movement between a valve-opening position and a valve-closing position, said bearing surfaces of said rocker arm extending through substantially less than 360° and engaging said portions on one side thereof, means for positively connecting said rocker arm to said valve for movement of said valve simultaneously with movement of said rocker arm between both of said rocker arm positions, and operating means for moving said rocker arm between said positions thereby positively moving said valve between its opened position and its closed position, said operating means comprising rotary cam means and cooperating follower means carried by said rocker arm and engaged with said cam means for pivoting said rocker arm upon rotation of said cam means, at least one of the follower means being spring biased into engagement with the cam means for eliminating lash, said follower means being fixed to said rocker arm and engaging said pivot member bearing portions on the side thereof opposite to the side engaged by said rocker arm bearing surfaces.

2. A positive valve gear as set forth in claim 1 wherein both of the follower means are spring biased into engagement with the cam means.

3. A positive valve gear as set forth in claim 1 wherein the spring bias is accomplished by employing a resilient spring arm follower.

4. A positive valve gear as set forth in claim 3 wherein the spring bias is accomplished by using two spring arm followers.

5. A positive valve gear as set forth in claim 4 wherein at least one of the spring followers is detachably connected to the rocker arm.

6. A positive valve gear as set forth in claim 5 wherein both of the spring arm followers are detachably connected to the rocker arm.

7. A positive valve gear as set forth in claim 1 wherein the means for positively connecting the rocker arm to the valve comprises means for pivotally and slidably connecting the rocker arm to the valve.

8. A positive valve gear as set forth in claim 1 wherein the rocker arm is formed as a stamping and is comprised of a web portion and integrally connected flange portions formed at the side of the web portion for reinforcing the rocker arm.

9. A valve gear for an internal combustion engine or the like comprising a rocker arm adapted to cooperate with a valve for operating said valve upon pivotal movement of said rocker arm, a pivot member pivotally supporting said rocker arm, said pivot member having a shank portion adapted to be affixed to an associated component of the engine or the like and a pair of spaced, oppositely extending bearing portions, said bearing portions extending substantially perpendicularly to said shank portion, said rocker-arm-defining bearing surfaces in engagement with said pivot member bearing portions for pivotally supporting said rocker arm upon said pivot member, said bearing surfaces of the rocker arm extend through substantially less than 360° and engaging the pivot member bearing portions on one side thereof, and follower means adapted to engage a cam for pivoting said rocker arm, said follower means being fixed to said rocker arm and engaging said pivot member bearing portions on the side thereof opposite to the side engaged by said rocker arm bearing surfaces.

10. A valve gear as set forth in claim 9 further including lubricating passage means formed in said pivot member and extending from said shank portion to each of said bearing portions for lubricating said bearing portions and the rocker arm bearing surfaces.

11. A valve gear as set forth in claim 9 wherein the rocker arm is bifurcated for receiving a projection formed on the associated valve for pivotally connecting said rocker arm to the associated valve.

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