Feb. 7, 1961 J. E. KNOBLOCK 2,970,583

VALVE GEAR

Filed July 27, 1959

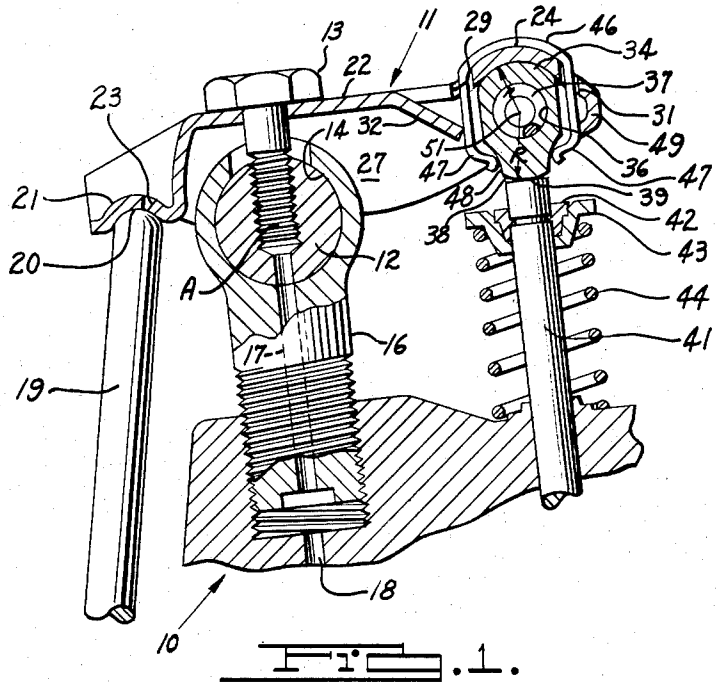


FIG. 1.

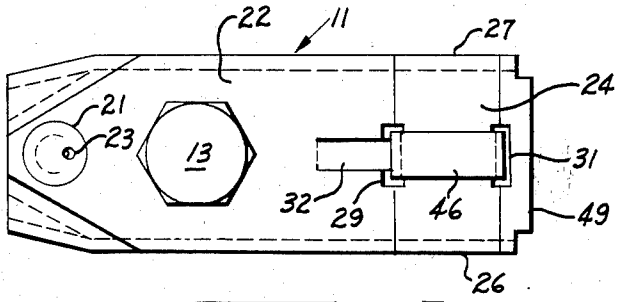


FIG. 2.

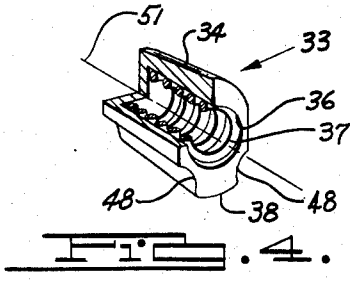


FIG. 4.

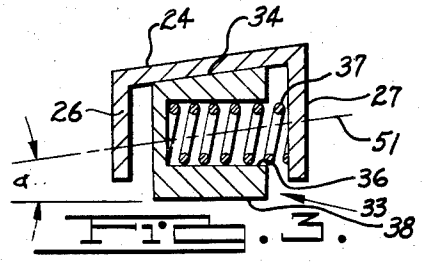


FIG. 3.

INVENTOR.

BY John E. Knoblock
John R. Faulkner
Thomas H Oster
ATTORNEYS

United States Patent Office 2,970,583 Patented Feb. 7, 1961

2,970,583

VALVE GEAR

John E. Knoblock, Detroit, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Filed July 27, 1959, Ser. No. 829,773

16 Claims. (Cl. 123—90)

This invention relates to an internal combustion engine valve gear and more particularly to an adjuster for automatically compensating for lash or growth in the valve gear train.

The novel arrangement of this invention may be used with valve gear arrangements employing mechanical tappets. This invention provides a rocker arm which has a ramp-like configuration at the valve foot end of the rocker arm. Inside of the ramp-like configuration is a horizontally disposed spring biased adjuster which moves laterally and rotates on the ramp to compensate for any change in the length of valve gear train. The ramp surface and the mating surface of the adjuster are cylindrical in shape. The foot of the adjuster is conical in cross section. The center line of the ramp which is coincident with the center line of mating surface of the adjuster is also coincident with the center line of the foot of the adjuster. It can thus be seen that as the adjuster moves laterally, it may also rotate.

In mechanical gear trains, lash is required because of the need to provide for the normal thermal expansion of the parts. With this device, the expansion (or shrinkage) is compensated for by the lateral adjuster by changing its position on the ramp. The loss of contact between any of the valve gear parts is prevented in this arrangement. The construction is simple, dependable and capable of mass production. It can replace existing rocker arms with a minimum of cost and part changes.

Other objects and advantages of this invention will be made more apparent as this description proceeds, particularly when considered in connection with the accompanying drawings, wherein:

Figure 1 is a front elevational view partly in vertical section of a part of a valve gear train embodying the invention;

Figure 2 is a plan view of the rocker arm shown in Figure 1;

Figure 3 is a cross sectional view taken through the valve foot end of the rocker arm and showing the lateral adjuster; and

Figure 4 is a perspective view, partly in section, of the adjuster.

Referring now to the drawings, and in particular to Figure 1, a portion of the internal combustion engine is indicated at 10. The valve gear portion of the engine comprises a rocker arm 11 connected to a cylindrical bearing 12 by bolt 13. Bearing 12 is received in cavity 14 of rocker arm support 16 for oscillatory movement. The support 16 is threaded or pressed into the internal combustion engine 10 and has an oil passage 17 which is connected to a source of oil supply 18 in the engine for positively lubricating the surface between the bearing 12 and the spherical cavity 14.

Oscillatory movement is imparted to the rocker arm 11 through push rod 19 (shown in part) which has a semi-spherical tip 20 which is received by a concave portion 21 located in the rocker arm web 22. An aperture 23 is provided in concave portion 21 for the passage of engine oil to lubricate the push rod tip 20.

The other end of the rocker arm 11 is provided with a ramp section 24 between the depending sides 26 and 27 of the rocker arm. Ramp section 24 is cylindrical in cross section as shown in Figure 1 and angled in cross section as shown in Figures 3 and 4. On each side of the ramp section 24 are slots 29 and 31 for a purpose to be later described. Slot 29 is T shaped which is achieved by punching out a leg 32 to angle downwardly and inwardly as shown in Figure 1.

The lateral adjuster is indicated generally at 33 and has a cylindrical upper guide surface 34 which cooperatively engages the underside of the ramp section 24. The adjuster is further provided with a bore 36 which houses a spring 37 of a predetermined rate which, in turn, biases the adjuster 33 from the high side of the ramp in the direction of the low side of the ramp. A conical shaped foot portion 38 is provided on the underside of the adjuster and engages the foot 39 of a poppet valve 41 (shown in part). The poppet valve 41 is provided with a spring retainer 43 secured to the valve foot by locking means 42 and valve spring 44.

The cylindrical portion of the adjuster 33 is kept within the confines of the ramp section 24 and the conical portion of the adjuster 33 in contact with valve foot 39 by legs 47 of a resilient U shaped spring clip 46 which extend through the slots 29 and 31 respectively to resiliently bear upon the necked-down portion 48 of the adjuster. Leg 32 angles inwardly and downwardly as stated before and engages one of the legs 47 of the clip 46. Flange 49 extends downwardly from the web 22 to engage the other leg 47 thereby providing means for limiting the oscillation of the adjuster 33 within the ramp 24.

Referring now to Figures 3 and 4, the center line of the conical foot portion 38 is indicated by line 51 and is coincident with the center line of the cylindrical ramp surface 34 which is also indicated by line 51. It can be seen, therefore, that the lateral movement of the adjuster 33 within the ramp section 24 simply takes up the lash which may be in the valve gear mechanism in the vertical direction.

The locking angle of the foot portion 38, designated by the symbol alpha, is designed for optimum compensation but small enough so that the adjuster 33 will be held in position by the combined static friction between the surfaces of mating ramp surface 34 and the ramp section 24 and the foot portion 38 and the poppet valve foot 39.

When the rocker arm 11 is actuated by the push rod 19, which is, in turn, actuated by the camshaft (not shown), the rocker arm 11 will oscillate about the axis A which causes the foot portion of the adjuster 33 to traverse the foot 39 of the valve stem 41. The friction moment due to the friction at the point of contact between the adjuster and the valve stem acting on the moment arm R being greater than the friction moment due to the friction at the area of contact between the ramp surface 34 and the rocker arm ramp section 24 acting on the smaller moment arm r therefore allows the adjuster to rotate in the ramp and roll on the valve stem tip.

When rotation of the adjuster in the rocker arm ramp is initiated, the coefficient of friction of the adjuster surface upon the mating rocker arm ramp surface immediately declines to a value substantially below that existing under static conditions. Because of the decrease in friction due to the initiation of rotation of the adjuster in the rocker arm ramp, the thrust generated by the resistance of valve spring 44 and the inertia of the valve train is enabled to cause the adjuster 33 to move against the

force of spring 37 and approximately parallel to axis 51. This movement in effect shortens the valve train and creates a small amount of lash when the pressure from the push rod is removed, i.e., when the valve completely closes.

The relaxation of the forces in the valve train incident upon valve closing permits the adjuster 33 to move axially under the urging of spring 37 to take up the lash previously created. The valve train maintains this length through substantially all of the next valve cycle.

The adjustment for lash take up is simply accomplished without excessive complexity in design or structure. The mechanism lends itself to mass production techniques with a minimum of close tolerances. Although the embodiment shown is of a steel stamped rocker arm, it is obvious that the rocker arm may be made from a multitude of materials, either stamped or cast, and that the angle of the ramp may be selected by the designer. Although the adjuster is shown on the poppet valve side of the rocker, it can be used on the push rod side as well.

It will be understood, therefore, that the invention is not to be limited to the exact construction shown and described but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In an overhead valve mechanism for an internal combustion engine, a rocker arm, said rocker arm having means for taking up slack in a valve train, said slack take up means comprising a cylindrically shaped ramp extending transversely of the rocker arm and formed at one end of the rocker arm, an adjuster having a complementary surface to said cylindrically shaped ramp yieldably mounted upon said rocker arm for movement along said ramp, and a helical spring having one end positioned against a portion of the rocker arm and the opposite end positioned against said adjuster and urging said adjuster unidirectionally along said ramp.

2. In an overhead valve mechanism for an internal combustion engine, a rocker arm, said rocker arm having means for taking up slack in a valve train, said slack take up means comprising a ramp section extending transversely of the rocker arm, said ramp section having a cylindrical cross sectional shape, an adjuster mounted upon said rocker arm, said adjuster having a ramp surface complementary to said ramp surface of the rocker arm and a conical shaped foot surface adapted to engage a poppet valve foot, means for yieldably mounting said adjuster upon said ramp section with the complementary ramp surface of the adjuster engaging the ramp section of the rocker arm, and spring means urging the adjuster in one direction along said ramp section.

3. A device for taking up lash in a valve gear mechanism comprising a rocker arm arranged to oscillate about an axis, a push rod for imparting oscillatory movement to one end of said rocker arm, lash adjusting means on the opposite end of said rocker arm, a poppet valve having a foot portion engaged by said lash adjusting means, said lash adjusting means comprising a ramp on said rocker arm, an adjuster engaging said ramp for lateral movement with respect to said rocker arm and said poppet valve foot portion whereby said lateral movement along said ramp varies the distance between the rocker arm ramp and the poppet valve foot portion.

4. In an internal combustion engine valve gear having a poppet valve with a generally vertically guided stem and a push rod, an oscillatable rocker arm, means on one end of the rocker arm for engaging the push rod, slack take up means on the other end of said rocker arm for engaging the valve stem, said slack take up means comprising a transversely extending angled surface on said rocker arm, a spring urged adjuster mounted upon said angled surface and movable laterally with respect to said rocker arm and said valve stem.

5. An internal combustion engine valve gear comprising a rocker arm having a transversely extending angled ramp section, an adjuster unidirectionally spring biased mounted upon said angled ramp section and having a complementary angled surface frictionally engaging said angled ramp section and an additional horizontally disposed foot portion adapted to engage the stem of a spring loaded valve.

6. An internal combustion engine valve gear comprising, a stamped rocker arm having a webbed section and a pair of depending sides, said rocker arm having a ramp section at one end of said rocker arm in said web section between said depending sides, an adjuster having a complementary surface to said ramp section mounted upon rocker arm for limited movement along said ramp section, said adjuster having a foot portion adapted to engage the stem of a spring loaded valve, biasing means engaging one of said depending sides and said adjuster urging said adjuster in one direction.

7. An internal combustion engine valve gear comprising a rocker arm having a transverse angled ramp section, an adjuster mounted upon said transverse angled ramp section and having a complementary angled surface engaging said angled ramp section and a foot portion adapted to engage the stem of a spring loaded poppet valve, means connecting said adjuster to said angled ramp section for bidirectional movement along said ramp and spring means engaging said rocker arm and said adjuster urging said adjuster along said ramp in one direction.

8. In a valve mechanism for an internal combustion engine, a rocker arm having an angled ramp extending transversely of the rocker arm, an adjustment member having a complementary angled surface engaging said ramp, said adjuster being of a length shorter than the length of said ramp, spring means urging said adjuster along said angled ramp in one direction, and means yieldably securing said adjuster to said ramp section for both sliding and rotary motion.

9. An internal combustion engine valve gear comprising a rocker arm having a transversely extending cylindrically shaped ramp section at one end of the rocker arm, a push rod engaging portion at the other end of said rocker arm, an adjuster having a complementary surface to said transversely extending cylindrically shaped ramp section mounted upon said rocker arm for engagement with said ramp seceion, a horizontally disposed conically shaped foot portion on said adjuster adapted to engage the stem of a spring loaded valve, a helical spring having one end positioned against said rocker arm and the other end positioned against said adjuster urging said adjuster in one direction along said ramp section, said adjuster being rotatable in any position along said angle ramp section.

10. An automatic lash adjuster for a motor vehicle internal combustion engine comprising in combination a rocker arm, a push rod adapted to engage one end of the rocker arm for imparting oscillatory movement to said rocker arm and a lash adjuster mounted upon the other end of said rocker arm, said lash adjuster comprising an angled ramp extending transversely of the rocker arm and having a curved cross section, an adjuster having a mating surface complementary to said ramp mounted upon said rocker arm in surface engagement with said ramp, said adjuster having a length shorter than the length of said ramp, spring means between the rocker arm and the adjuster normally urging said adjuster to move along the angled ramp from the high side of the ramp to the low side of the ramp whereby the angularity of the ramp permits sliding movement of the adjuster in said ramp and the curved cross section of the ramp permits a rotary motion of the adjuster in the ramp.

11. An internal combustion engine valve gear comprising a rocker arm having a ramp portion cylindrical

in cross section, an adjuster having a complementary surface engaging said angled ramp portion and a conical shaped foot portion adapted to engage the stem of a spring loaded valve, spring means engaging said rocker arm and said adjuster urging said adjuster to move along the angled ramp portion, means yieldably holding said adjuster in frictional engagement with said angled ramp portion, said adjuster being rotatable about an axis which is the common center line of both the cylindrical ramp portion and the conically shaped foot portion.

12. An internal combustion engine valve gear comprising a rocker arm having one end adapted to engage a push rod and provided at the other end with a transverse inclined surface having a cylindrical cross section, an adjuster having a complementary surface engaging the underside of the inclined surface, said adjuster having a length less than the length of said inclined surface and movable along the underside of the inclined surface and further movable in a rotary motion about an axis which is the radius of the cylindrical surface, a foot portion on said adjuster having a conically shaped cross section and adapted to engage a valve stem, holding means yieldably maintaining said adjuster in engagement with the underside of the inclined surface and permitting said adjuster to move along the underside of the inclined surface and rotate about the axis of said cylindrical surface, a spring having one end positioned against said rocker arm and the other end positioned against said adjuster urging said adjuster to move along the underside of the inclined surface from the high side of the inclined surface to the low side of the inclined surface, the center line of said conically shaped foot portion being coincident with the axis of said cylindrical portion.

13. In an internal combustion engine valve gear, a rocker arm having a means for taking up slack in a valve train, said slack take up means comprising a transversely extending inclined surface having a cylindrical cross section, a spring biased adjuster having a complementary surface engaging said inclined surface for movement along said surface, a conically shaped foot portion on said adjuster adapted to engage a poppet valve stem, said conically shaped surface having a center line coincident with the center line of said cylindrical surface whereby said adjuster is permitted to slide in said cylindrical surface as well as to rotate about the common center line.

14. In an internal combustion engine valve gear comprising a poppet valve, a rocker arm having a transversely extending ramp, an adjuster having a first surface engaging said ramp and a second surface engaging said poppet valve, said adjuster having a tendency to rotate about an axis and having a further tendency to slide up the ramp in the direction of the axis during the valve operating cycle, the sliding movement of said adjuster being opposed under static loads by a frictional moment existing betwen the ramp and the adjuster first surface and an additional frictional moment between the adjuster second surface and the poppet valve, the combined frictional moments decreasing in value upon the initiation of the rotation of the adjuster thereby permitting sliding movement of the adjuster in said ramp.

15. In an internal combustion engine valve gear train comprising a poppet valve, a poppet valve spring, a rocker arm having a transversely extending ramp cylindrical in cross section, an adjuster having a first surface complementary to the ramp and engaging said ramp and a second surface engaging said poppet valve, said adjuster having a tendency to rotate about an axis transverse to said rocker arm and having a further tendency to slide up the ramp in the direction of the axis during the valve operating cycle, the sliding movement of said adjuster being opposed by frictional moments existing between the ramp and the adjuster first surface and between the adjuster second surface and the valve stem, said combined frictional moments being great enough under static loads to prevent the adjuster from sliding up the ramp, said combined frictional moments decreasing upon the initiation of the rotation of the adjuster to a value less than the thrust generated by the resistance of the poppet valve spring and the inertia of the valve gear train to permit sliding movement of the adjuster along the ramp.

16. In an internal combustion engine valve gear train comprising a poppet valve, a poppet valve spring, a rocker arm having a transversely extending ramp, an adjuster having a first surface complementary to the ramp and engaging said ramp and a second surface engaging said poppet valve, said adjuster having a tendency to rotate about an axis transverse to said rocker arm and having a further tendency to slide up the ramp in the direction of the axis during the valve operating cycle, spring means interposed between the adjuster and the rocker arm urging the adjuster to slide down the ramp, the sliding movement of said adjuster being further opposed by frictional moments existing between the ramp and the adjuster first surface and between the adjuster second surface and the valve stem, said combined frictional moments being great enough under static loads to prevent the adjuster from sliding up the ramp, said combined frictional moments decreasing upon the initiation of the rotation of the adjuster to a value less than the thrust generated by the resistance of the poppet valve spring and the inertia of the valve gear train to permit sliding movement of the adjuster along the ramp against the spring means and creating a momentary lash in the valve gear train, said spring means urging said adjuster back to a position on the ramp to take up the lash upon the removal of the poppet valve spring resistance and the valve gear inertia thrust.

References Cited in the file of this patent

UNITED STATES PATENTS

1,872,083	Hutchison	Aug. 16, 1932
1,986,579	Johnson	Jan. 1, 1935
2,053,743	Russell	Sept. 8, 1936
2,120,617	Manning	June 14, 1938
2,863,431	Marietti	Dec. 9, 1958