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HYDRAULIC MECHANISM FOR ACTUATING VALVES

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Fig. 1

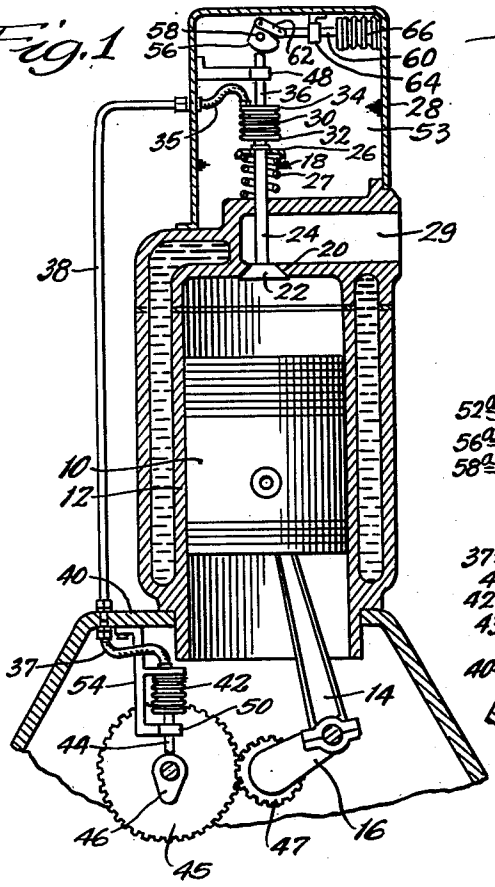
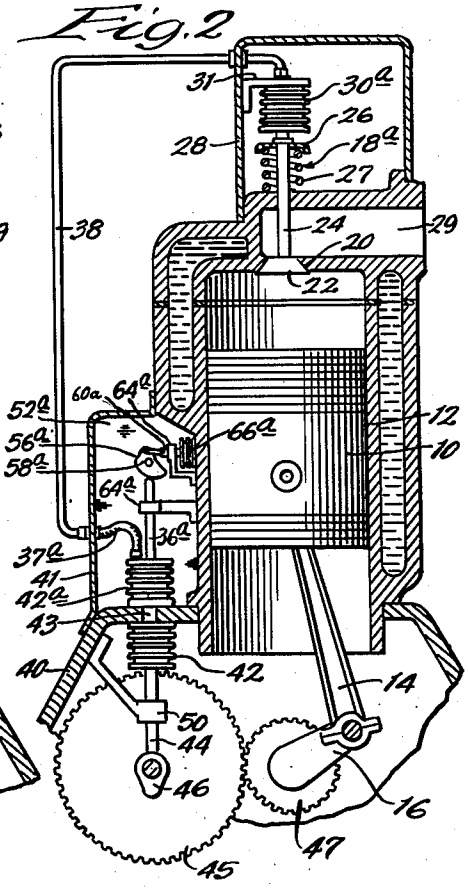


Fig. 2



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HYDRAULIC MECHANISM FOR ACTUATING VALVES

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5 Claims. (Cl. 123—90)

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My invention relates to an improved hydraulic mechanism for actuating valves and which is particularly suitable for actuating the valves of an internal combustion engine.

Hydraulic mechanisms for actuating poppet valves of internal combustion engines afford a means of eliminating the complex rocker arm and tappet mechanisms heretofore considered necessary on such engines. However, such mechanisms are necessarily exposed to the high temperatures achieved during engine operation and, since the volume of the control fluid changes with temperature, the valve operation changes as the engine warms up.

It is, accordingly, a general object of the present invention to provide an improved hydraulic mechanism for operating valves which is not sensitive to temperature changes associated with engine operation.

Further, it is an object of the present invention to provide an improved hydraulic mechanism for cyclically actuating a valve in accord with the movements of a cam.

Another object of the present invention is to provide an improved hydraulic mechanism for operating valves which is particularly suitable for use on automobile engines.

Yet another object of the present invention is to provide an improved hydraulic mechanism for operating the valves of an internal combustion engine which embodies features of construction, combination, and arrangement rendering it simple in construction and reliable in operation to the end that a maximum degree of utility is achieved.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, itself, however, both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which:

Figure 1 is a cross sectional view of one embodiment of the mechanism of the present invention showing fragmentary portions of an engine operably associated therewith; and

Figure 2 is a cross sectional view showing an alternative construction of the structure of Figure 1.

In Figure 1, a piston 10 of an internal combustion engine is shown in its associated cylinder 12, the cylinder being shown in cross section to display clearly the piston and associated mechanism.

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The connecting rod 14 is pivotally attached at its opposite ends to the piston 10 and crankshaft 16 to cause the latter to rotate in accord with the reciprocations of the piston.

The head 22 of poppet valve 18 is received in a beveled seat 20 formed in the upper wall of the cylinder 12. This valve includes a stem portion 24 terminating in a cap portion 26. The spring bottoms against the top wall of cylinder 12 and the portion 26 of valve 18 to urge the head 22 to a closed position against seat 20.

The purpose of valve 18 is to admit fuel to cylinder 12 at predetermined points in the piston operating cycle. To that end, a chamber 29 is formed about valve seat 20 and is connected to source of operating fluid, such as a carburetor, (not shown) so that the cylinder 12 is supplied with fuel when valve 18 opens.

The valve 18 is cyclically opened in accord with the movements of piston 10 by the bellows 30. This bellows includes a lower end member 32 which bottoms against the end of the valve stem 24 and an upper end member 34 which is attached to the cam follower 36.

A pipe 38 is in fluid communication with bellows 30 and extends outside of housing 28 to the mounting plate 40. The bellows 42 is fixedly supported at one end from the mounting plate 40 by bracket 54 and is in fluid communication with the interior of pipe 38. The other end of bellows 42 bottoms against cam follower 44 which rides against cam 46.

The cam 46 is driven by gears 45 and 47 in accord with the rotations of the crank shaft 16.

The cam followers 36 and 44 are held for axial shifting movements by sleeve bearings 48 and 50 respectively. The former bearing is sustained by a bracket on the housing 28 and the latter by the bracket 54 which is held by mounting plate 40.

Hose connections 35 and 37 provide flexible connections between bellows 30 and 42, respectively, and pipe 38.

The position of cam follower 36 is fixed by the cam 56 against which it rides. This cam is pivotally attached to panel 53 by pin 58 and to arm 60 by link 62. The panel 53 forms part of the housing 28 and extends in direction substantially parallel to cam 56. The arm 60 is held in position for axial shifting movements by the sleeve bearing 64 and is attached to one end of the bellows 66. The opposite end of bellows 66 is attached to the wall of housing 28.

The pipe 38 and the bellows 30 and 42 are filled with a suitable hydraulic control fluid, such

as a mixture of alcohol and castor oil. As the cam **46** periodically shifts the cam follower **44**, this fluid is driven from bellows **42** into bellows **30**, thereby depressing the lower end **32** of bellows **30** and opening valve **18**. This cyclical valve operation is in timed sequence with the movements of piston **10** and thereby admits fuel to the cylinder **12** at the proper times for good engine operation.

As the engine operates, the temperature of bellows **30** and **42**, as well as pipe **38**, increases. This increases the size of the cavity defined by these members and, in addition, increases the volume occupied by the hydraulic liquid. Since the linear coefficient of expansion of the material of bellows **30** and **42** and pipe **38** does not ordinarily correspond with the volumetric rate of expansion of the fluid, the bellows **30** must expand or contract to make up the difference, thereby opening or closing valve **18** in the absence of movements of cam follower **44**. In practical engine construction, the fluid expands at a greater volumetric rate than the rate corresponding to the linear expansion of the bellows **30** and **42** and pipe **38** and thus causes valve **18** to tend to open as the engine warms up.

In the apparatus of Figure 1, the valve actuating tendencies associated with engine heating are compensated or off-set by rotation of cam **56** which is rotated by bellows **66** and crank arm **60** as the engine temperature rises. Since the bellows **30** rides against cam follower **36**, counter-clockwise rotation of the cam **56** bodily moves valve **18** to a more nearly closed position and thereby off-sets the tendency of increased fluid volume to open that valve.

The bellows **66** is mounted on housing **28** and thus participates in the engine heating. Since the bellows **30** and **42**, as well as pipe **38**, are subject to heating from the engine, they also participate in this heating. Consequently, bellows **66** partakes of temperature determined by the temperature of the fluid in the valve actuating mechanism.

Bellows **66** expands with temperature since a constant quantity of fluid is entrained therein, and the pressure in the chamber defined by housing **28** does not vary sufficiently to prevent such expansion. Thus, cam **56** is rotated in the counter-clockwise direction with increased engine temperature. The curvature of this cam is so proportioned that the resulting shifting movement of cam follower **36** varies the volume of bellows **30** by an amount just sufficient to off-set the difference in volume change of the hydraulic fluid and the volume change in the bellows **30** and **42** and pipe **38** associated with linear expansion.

In the modified form of the present invention shown in Figure 2, the bellows **42** has an extended portion **42***a* extending above the mounting plate **40**. Passage **43** provides fluid communication between the two portions of bellows **42** so defined. The portion **42***a* is held against expansion under fluid pressure by the cam follower **36***a* which rides on cam **56***a* and which is held for shifting movements by the sleeve bearing **64***a*. The cam **56***a* is pivotally supported from panel **52***a* by the pin **58***a*, panel **52***a* being substantially parallel to cam **56***a* and forming part of housing **41**.

Hose **37***a* flexibly connects pipe **38** and bellows **42***a*.

The extended portion of bellows **42***a* is connected to pipe **38** which is in fluid communication with bellows **30***a* which operates to actuate valve **18***a* in the same manner as in the structure of Figure 1. However, the bellows **30***a* is supported by bracket **31** which is attached to the wall of housing **28**.

The position of cam **56***a* is controlled by bellows **66***a* which engages crank arm **60***a* to shift that arm and rotate the cam. The crank arm **60***a* is held for shifting movements by the sleeve bearing **64***a*.

Since the bellows **66***a* is mounted on the wall of cylinder **12**, it partakes directly of the engine temperature and, hence, varies in temperature in accord with the temperature of the fluid in bellows **30***a*, pipe **38**, and bellows **42** and **42***a*. As the engine temperature increases, the cam **56***a* is rotated to allow bellows **42***a* to expand, thereby off-setting the tendency of the corresponding increase in fluid volume in bellows **30***a*, pipe **38**, and bellows **42** and **42***a* to open valve **18***a*.

It will be observed that in the structures disclosed herein, I have provided an improved mechanism for cyclically actuating a valve in accord with rotations of crankshaft **16** and which is unaffected by engine temperature changes. This is accomplished by providing compensating elements (bellows **66**, Figure 1) positioned to partake of temperature determined by the temperature of the hydraulic fluid and operative to vary the size of the chamber containing the hydraulic fluid, this operation being achieved by cam **56**, Figure 1.

It will, of course, be apparent to those skilled in the art that the bellows **30**, **42**, **30***a*, and **42***a* may be replaced by piston-cylinder combinations or other mechanisms defining cavities of variable volume and having spaced points movable relative to each other in accord with that volume. Moreover, it will be apparent that the bellows **66** and **66***a* may be replaced by other temperature responsive elements such as, for example, bimetallic elements.

While I have shown two particular embodiments of my invention, it will, of course, be understood that I do not wish to be limited thereto since many modifications both in the parts themselves and in their cooperative structure may be made without departing from the spirit and scope of my invention. I, of course, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What is claimed is:

1. A mechanism for actuating a valve in accord with the rotations of a cam, said mechanism comprising means defining a first fluid chamber of variable size and including a cam follower positioned for operative engagement with said cam and operable to control the size of said first chamber, elements defining a second fluid chamber of variable size and in fluid communication with said first chamber and operable to move said valve in accord with the size of said second chamber, a fluid in said chambers having volume variable in accord with temperature to actuate said valve in accord with rotations of said cam, a movable member to limit movement of one of said chambers, and temperature responsive means operable to move said member thereby to vary the effective size of the chambers.

2. A mechanism for actuating a valve in accord with the rotations of a cam, comprising a first device defining a cavity of size determined by the distance between two spaced points and attached to said valve at one of said points, a second device defining a cavity in fluid communication with said first cavity and of size determined by the distance between two spaced points, a cam fol-

lower operably associated with said cam and in engagement with said last device at one of said points, a fluid in said cavities having a variation in volume with temperature, and means limiting movement of the other points on each of said devices, one of said means including temperature responsive elements disposed to partake of the temperature of said fluid and operable to shift the position of the corresponding other point to compensate for the temperature changes of said fluid.

3. A mechanism for actuating a valve in accord with the rotations of a cam, comprising a first bellows fixedly supported at one end, a cam follower in operative engagement with said cam and in engagement with said bellows, a second bellows having one end in engagement with said valve, means defining a fluid passage between said bellows, a fluid in said bellows having a change in volume with temperature, and temperature responsive elements shiftably engaging the other end of said second bellows to limit movement thereof, said last named elements being positioned to partake of the temperature of said fluid and operable to compensate for the volume changes thereof with temperature.

4. A mechanism for actuating a valve in accord with the rotations of a cam, comprising a first bellows fixedly supported at one end, a cam follower in operative engagement with said cam and in engagement with said bellows, a second

bellows in fluid communication with said first bellows and fixedly supported at one end, the other end of said second bellows being in engagement with said valve, a fluid in said bellows having a change in volume with temperature, a third bellows fixedly supported at one end and in communication with said first and second bellows, movable means to limit movement of the other end of the third bellows, and means operative to shift the movable means in accord with the temperature of said fluid to compensate for expansion thereof.

5. Mechanism for actuating a valve comprising a pair of expansible chambers each including two relatively movable parts, a conduit connecting the chambers in a closed fluid system, and means to limit movement of one of the parts of each chamber, the means to limit movement of at least one of the chambers being movable and including temperature responsive elements to move it.

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