Dec. 4, 1956 F. K. H. NALLINGER 2,772,667

VALVE-CONTROL

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Fig. 1

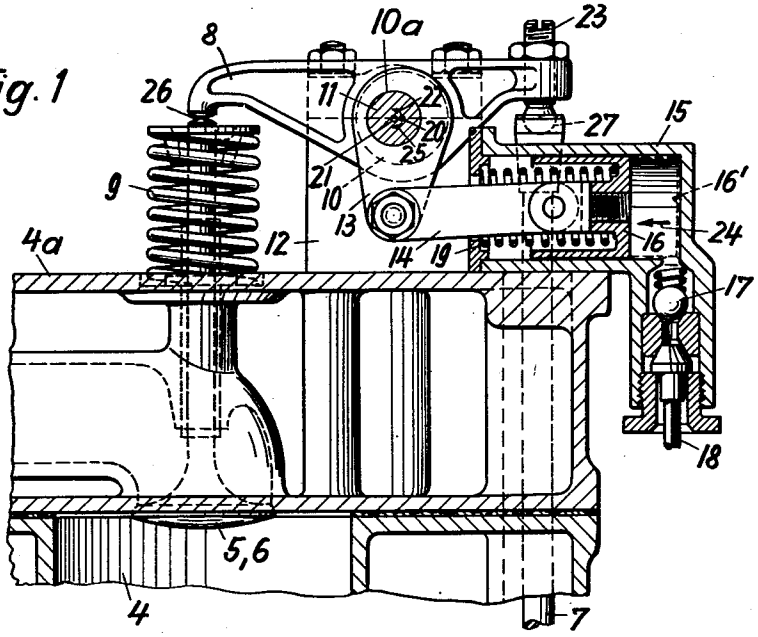
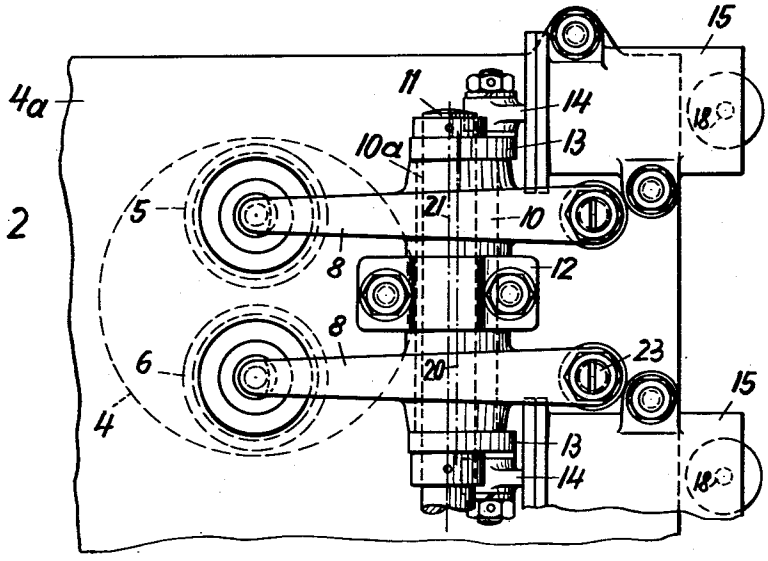


Fig. 2



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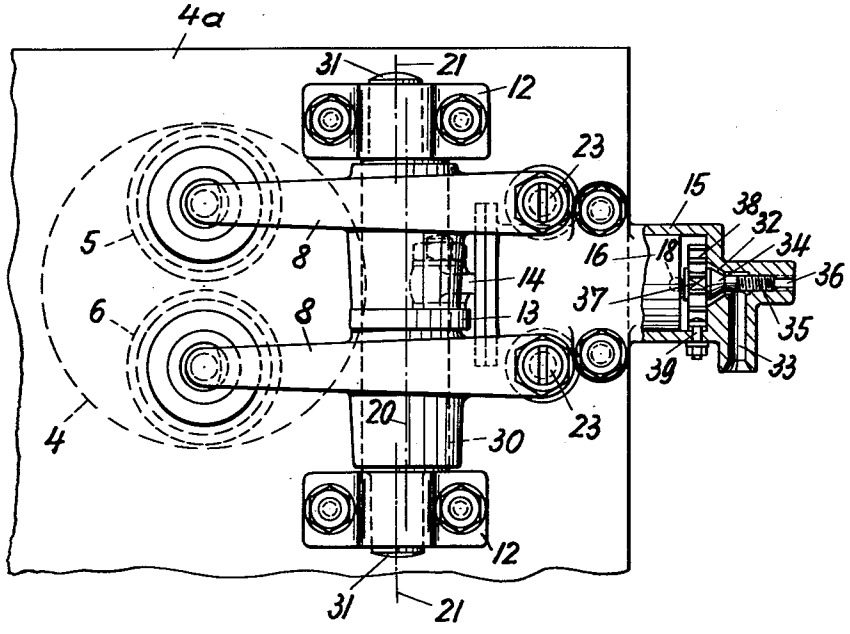
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Fig. 3



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VALVE-CONTROL

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10 Claims. (Cl. 123—90)

The present invention relates to a valve-control, as used for combustion machines, and provides means to eliminate the clearance which takes place in the transmitting members by the expansion thereof due to heat while operating.

One object of the present invention is to provide a device, by means of which this clearance is automatically eliminated in a simple and effective manner.

It is a further object of the present invention to provide for compensation of the clearance depending on the operation of the machine, in order to account for the different heat-expansions within the control mechanisms of the valves with either a warm or cold machine.

A further object of the present invention resides in the provision of a compensating effect for the viscosity-difference of the pressure-medium which serves as adjustment for different operating temperatures.

Thus, a feature of the present invention is the provision of means by which the bearing members or the transmitting members, particularly of rocker-arms, are automatically adjustable either separately or in conjunction.

In particular, this feature is achieved by means of adjustable eccentric bearings on the rocker-arms which in turn are connected to an adjustment-device which is acted on by a pressure-medium during the operation of the machine.

In one embodiment, for example, a pressure-means may be used which acts as a positioning device for a piston, acted on by the lubricant of the machine.

According to a further feature of the present invention, the piston positioning device is slidably mounted within a cylinder which is connected to the pressure medium, for instance, to the lubricant pump of the machine by a return-check-valve.

A push-back or return spring may be provided on the side of the piston opposite to that which is operated by the pressure-medium, which returns the piston to its resting position, after the machine has cooled off. The lubricant may leave the cylinder by means of a throttling slot, for instance, by way of the circular space formed by the difference in diameter between the piston and the cylinder.

Further objects, details and advantages of the present invention will become readily apparent from the following description when taken in connection with the accompanying drawings which show for purposes of illustration only several preferred embodiments, and wherein:

Figure 1 is a vertical section of the cylinder head of a combustion machine in accordance with the present invention;

Figure 2 is a plan view of the cylinder head shown in Figure 1, and

Figure 3 is a plan view of a second form of embodiment in accordance with the present invention.

Referring more particularly to the drawing wherein like reference numerals are used throughout the various views to designate like parts, reference numeral 4 designates the cylinder-block which may comprise one or a plurality of cylinders. Cylinder-head 4a is mounted in a known manner on cylinder-block 4, and includes the intake- and exhaust-valves 5 and 6. Valves 5 and 6 also operate in a known manner and at a predetermined rhythm. The opening of valves 5 and 6 is controlled by means of a cam-shaft, intermediate push-rods 7 and rocker-arms 8, and the closing thereof by means of expansion-springs 9. According to the illustrated embodiment of Figures 1 and 2, each rocker-arm is pivotally mounted on the outer surface of a journal-bushing 10, which in turn is rotatably mounted on a shaft 11, unitary for all journal-bushings, by means of an eccentric bore 10a. Shaft 11 is rigidly mounted on the cylinder head 4a by means of brackets 12. An adjustment-arm 13 is attached to each one of the journal-bushings 10, the free end of which is pivotally connected to adjustment-piston 16, which is slidably mounted within the cylinder 15. Cylinder 15 is connected to the pressure lead 18 of the lubricant-pump of the machine by return-check-valve 17.

When the machine is not operating, lead 18 is without pressure. The piston 16 returns under those conditions to the position indicated by dotted lines 16' by reason of the pressure-spring 19. The remainder of oil within cylinder 15 is at the same time released or drained off by means of the circular space between the piston and cylinder. The return movement of the piston 16 to the position 16' causes the center line 20 of the journal-bushing 10, which forms the pivot axis of rocker-arm 8 to be pivoted about center line 21 of shaft 11 in a direction indicated by arrow 22. Obviously, when the piston 16 reaches the position indicated by dotted lines 16', center line 20 reaches its highest position. In this position, while the machine is cold, adjustment of screw 23 controls the basic manual setting of the valve-play.

When the machine, after starting, warms up, the valve-play increases due to the heat-expansion of cylinder-block 4 and cylinder-head 4a. Due to the fact that the lubricant-lead 18 is also under pressure at that time, a certain amount of lubricating-oil enters the cylinder by opening of return-check-valve 17, and pushes piston 16 against the spring-action of spring 19 in the direction of arrow 24, thus moving the pivoting axis 20 of rocker-arm 8 downwardly in the direction of arrow 25, whereby the increased valve-play at points 26 and 27 is removed or compensated for. The size of the surface of the piston-cross section, the tension of spring 19, the length of lever arm 13, and the eccentricity of journal-bushing 10 are determined in such relation with respect to each other that even the highest practical lubricating-oil-pressure, which may occur in lubricant-lead 18, cannot open one of the valves 5 or 6 against the effect of the valve-spring 9, by moving piston 16 in the direction of arrow 24 if no valve play exists, as the piston 16 would then have to overcome the spring pressure of the spring 9 which it is unable to do even with maximum pressure in lubricant lead 18. Consequently, lubricating fluid under pressure can only flow into the cylinder space between piston 16 and cylinder 15 through valve 17 when valve play exists as the piston 16 cannot move otherwise to change the volume in the cylinder space, as explained above. The movement of piston 16 is thus limited to the necessary extent to remove or compensate the valve-play, which takes place only when the valves are closed and the entire-valve mechanism is relieved. With the valves 5 or 6 either opened or closed, journal-bushing 10 cannot give way in the direction of arrow 22, for the return-check-valve 17 prevents a backward movement

of adjusting-piston to resting position 16' thereof, owing to the incompressibility of the lubricating fluid within cylinder 15, thereby eliminating an increase of the valve-play.

A certain length of time elapses for the machine to cool off after it is stopped or the load on it is decreased. During that time, sufficient pressure fluid escapes from the cylinder through the annular gap or play between the cylinder and the piston, which gap or play is necessary for proper sliding movement of piston 16 within cylinder 15 by means of the reaction of spring 19 and by the backward moving forces acting on the lever-arm 20, 21 of the valve mechanism, to permit a backward movement of the piston 16 to the resting position 16'. At the same time, continued flow of lubricating fluid through valve 17 is also prevented for reasons pointed out above, unless undesirable play occurs in the valve mechanism, especially as during standstill or idling of the engine no pressure or relatively low pressure respectively of the lubricating fluid exists in lead 18.

As the lubricant pressure within pressure-lead 18 substantially decreases, due to change in viscosity of the lubricant while the machine is warming up, it is particularly necessary, on the other hand, to have adequate pressure acting on piston 16 for producing the re-adjustment forces while the machine is in this condition. For that reason, according to a further improvement of the present invention, piston 16 consists of a material having a greater heat-expansion coefficient than that of cylinder 15. Thus the piston, for instance, may consist of a light metal or bronze-alloy, and the cylinder of common cast iron. A decrease of the circular space between piston and cylinder is attained thereby, when the machine warms up, thereby producing an adequate liquid-pressure in front of piston 16. The increase of liquid-pressure within lead 18 is largely compensated for by the increasing diametric dimension of the circular space in cylinder 15, when the machine cools off.

The embodiment illustrated in Figure 3 differs from that shown and described with respect to Figures 1 and 2 by the pivotal mounting of the rocker-arms thereof. Accordingly, rocker-arms 8 of both valves 5 and 6 of one cylinder are pivotally mounted directly on a unitary shaft 30, without the use of intermediate bushings, which shaft 30 in turn may pivot around eccentric projections 31, rotatably mounted within brackets 12 or firmly mounted on the cylinder head. Thus the axis 20 of shaft 30 may be rotatably moved upwardly or downwardly around axis 21 of eccentric shaft-projections 31 in order to re-adjust the valve-play while operating the machine. Firmly affixed to shaft 30 is the adjustment-arm 13 connected to piston 16 by means of an adjustment-rod 14. Piston 16 moves slidably within cylinder 15.

The drawing shows the piston in its resting position, when the machine is cold. The automatic re-adjustment of the valve-clearance takes place, in principle, in the same manner as described with respect to Figures 1 and 2. On the other hand, it incorporates a substantial manufacturing simplification, for only one adjustment-piston is required for the adjustment of the clearance of all valves of one cylinder, or, if so desired, even for the entire machine. The same effect may also be obtained with the use of eccentric bushings according to Figures 1 and 2, if one unitary bushing is used for rotatably mounting a plurality of rocker-arms. It is, of course, presupposed for an unobjectionable functioning of the device under those circumstances that the valve-clearance has been manually adjusted carefully and uniformly for all valves by means of the adjustment-screw 23 while the machine is cold.

In order to compensate for changes in viscosity of the lubricant, caused by differences of temperature, another arrangement is provided, according to the embodiment of Figure 3. It consists of a conically-shaped throttling bore 32 at the outer end of cylinder 15 which is connected to the lubricant return-duct by channel 33, and which may more or less be closed by a conically-shaped pin 34, which projects into throttling bore 32. For that purpose pin 34 is provided at the outer end 35 with a screw-threaded part, which rotatably engages a corresponding female thread in bore 36 of cylinder 15. The inner end of pin 34 is provided with a square, which holds the inner end of a spiral spring 38, made of a strip of bimetal, the outer end of which is firmly secured to the walls of cylinder 15 by means of screw 39. The arrangement is made in such manner that with an increase in temperature of the lubricant entering cylinder 15 by lead 18, the several windings or turns of the bimetallic spring 38 become increasingly curved or tensioned, which results in screwing the pin 34 deeper into bore 32, and, consequently, also in throttling the exit of lubricant out of the cylinder 15 more effectively. Thus not only the decrease of viscosity of the lubricant is compensated for, but even an increase of the liquid-pressure within the cylinder 15 may be obtained while the machine is warm, should this become desirable. When the machine and consequently the lubricant is cooling off the process is being reversed. Instead of the bimetal-spring 38 any other kind of thermo-couple may be used for controlling the throttling-pin 34.

The invention is not limited to the illustrated exemplary form of embodiment, but may be suitably varied with the scope of the invention.

What I claim is:

1. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylinder, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occurring in the direction of movement of said rocking lever, and means located on the other side of said piston for constantly urging said piston in the direction from the other side toward said one side.

2. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder in which said piston member may perform a forward and backward movement, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation for play occurring in the direction of movement of said rocking lever, and a resilient element for adjusting said piston member against the direction of pressure of said pressure medium.

3. Valve control according to claim 2, in combination with means operatively connected with the pressure medium system consisting of said pressure means, said duct means, said cylinder and said piston member for compensating for changes in pressure of said pressure medium caused by changes of temperature and consequently by changes in the viscosity thereof.

4. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylin-

der, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occurring in the direction of movement of said rocking lever, and variable discharge means extending through said cylinder and operative in dependence on the temperature of said pressure medium for varying the discharge opening thereof to discharge different amounts of said pressure medium therethrough with different temperatures of said pressure medium.

5. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylinder, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occurring in the direction of movement of said rocking lever, and spring means continuously acting against said pressure medium, said piston member and said cylinder having such clearance therebetween to provide for escape of said pressure medium past said piston member out of said cylinder solely by means of the forces exerted by said spring means during falling temperatures of said machine.

6. Valve control according to claim 2 wherein said piston member is manufactured of a material having a higher heat-expansion coefficient than that of said cylinder.

7. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylinder, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occurring in the direction of movement of said rocking lever, an exit opening for conducting said pressure medium out of said cylinder, and means for adjustably throttling said exit opening including an adjustment member and a throttle member operated by said adjustment member in dependence on the temperature of said pressure medium to increasingly throttle said exit opening with rising temperatures of said pressure medium.

8. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylinder, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occuring in the direction of movement of said rocking lever, an exit opening to conduct said pressure medium out of said cylinder, and means for adjustably throttling said exit opening including a bimetallic spring exposed to the temperature of said pressure medium and a throttle member to increasingly throttle said exit opening with rise in temperature of said pressure medium.

9. Valve control for machines comprising a valve, a push rod, a rocking lever for transmitting the control motion from said push rod to said valve, means for supporting said rocking lever including an eccentric member, a lever connected with said eccentric member, a piston member connected with said lever, a rigidly arranged cylinder for said piston member, said piston member performing a forward and backward movement in said cylinder, a pressure means having a pressure medium, duct means from said pressure means to one side of said piston member for urging said piston member and said eccentric member by said pressure medium in the direction of compensation of play occurring in the direction of movement of said rocking lever, a conical exit opening to conduct said pressure medium out of said cylinder, a conical throttle-pin within said exit opening, adjustment means operative in dependence on the temperature of said pressure medium, and means for adjusting said throttle-pin by said adjustment means to increasingly throttle said exit opening with rising temperatures of said pressure medium.

10. Valve according to claim 1 having means for throttling the escape of the pressure medium from the cylinder, and means for adjusting said throttling means in dependence on the temperature of the pressure medium.

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