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VALVE CONTROL MECHANISM OF INTERNAL-COMBUSTION ENGINES

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Fig. 1

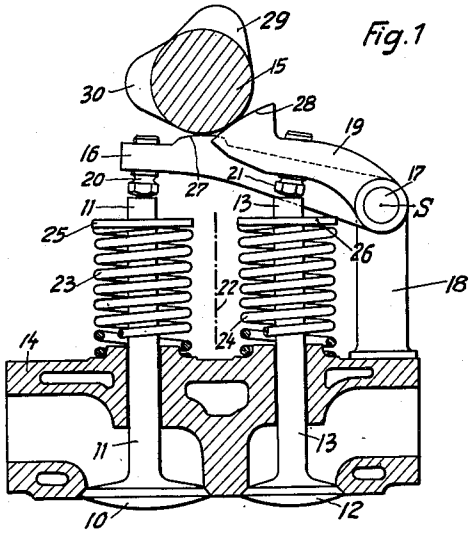


Fig. 2

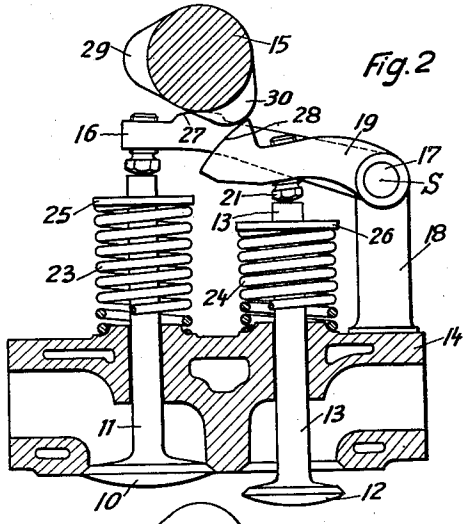
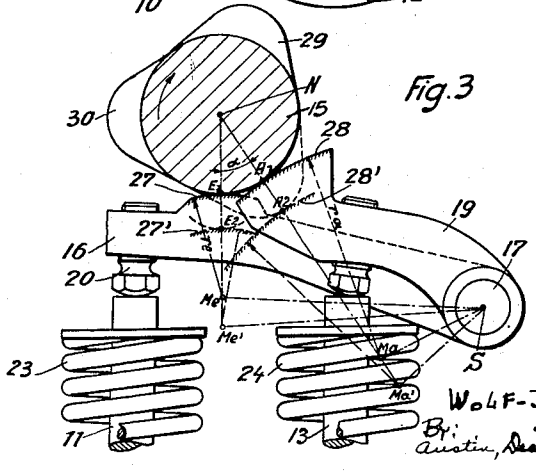


Fig. 3



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VALVE CONTROL MECHANISM OF INTERNAL-COMBUSTION ENGINES

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11 Claims. (Cl. 123—90)

My invention relates to a valve control mechanism of an internal combustion engine and, more particularly, to a control mechanism of the type in which two valves mounted out of alignment with a common actuating cam shaft are adapted to be controlled by the latter through the intermediary of levers.

It is an object of the present invention to provide a control mechanism of that kind which is compact and simple comprising a minimum of parts and lending itself to cheap manufacture. It is another object of the present invention to reduce the weight of the control mechanism to a minimum. Further objects of my invention will appear from the description of a preferred embodiment with reference to the accompanying drawings and the features of novelty will be pointed out in the claims.

In the drawings,

Fig. 1 is a sectional view of a cylinder head of an internal combustion engine equipped with the novel control mechanism, the valves being in closed condition, while

Fig. 2 is a similar view showing the outlet valve in opened condition while the inlet valve is closed, and

Fig. 3 is a diagrammatic representation of some of the elements shown in Fig. 1 illustrating their geometrical relationship.

A pair of valves, such as an inlet valve **10** of larger diameter having a stem **11** and an outlet valve **12** of smaller diameter having a stem **13**, is guided for sliding movement by suitable means rigid with the cylinder of the internal combustion engine, such means comprising in the present embodiment a cylinder head **14** of any suitable design from which the stems **11** and **13** project upwardly in substantially parallel relationship. A cam shaft **15** extends transversely to the stems **11** and **13**, preferably in a plane intermediate the two stems. A first lever **16** extends transversely of the cam shaft **15** between the same and the stem **11** of the inlet valve **10** and is mounted on a shaft **17** for rocking motion about the axis S thereof. The shaft **17** extends substantially parallel to the cam shaft **15** and may be suitably supported on the internal combustion engine by a plurality of brackets **18** fixed to the cylinder head **14**.

A second lever **19** overlies the stem **13** of the outlet valve **12** and, for rocking motion about an axis which, in the present embodiment, coincides with the axis S, is likewise pivoted on the shaft **17**. The lever **16** carries an actuator **20** rigidly connected therewith in a position for engagement with the upper end face of the valve stem **11**. The second lever **19** is provided with a similar actuator **21** mounted for engagement with the upper end face of the stem **13** of the outlet valve. Helical springs **23** and **24** surrounding the valve stems are mounted in the customary manner between the cylinder head **14** and washers **25** and **26** suitably attached to the valve stems, thereby tending to keep the valves closed.

It will be noted from Fig. 1 that the shaft **17** extends transversely to the stems **11** and **13** on one side thereof and that, with this arrangement, the stem **13** of the outlet valve is located substantially intermediate the axis S of the rocking motion of the levers **16** and **19** and the stem **11** of the first valve, whereby the first lever **16** will have a longer effective length than the second lever **19**. As a result, the control mechanism will require a minimum of space and a minimum of parts since a single pivot shaft **17** will suffice for the mounting of both levers.

Preferably, in the manner described hereinafter, the axis S, the cam shaft **15** and the two valve stems **11** and **13** are so correlated and shaped that notwithstanding the lack of symmetry of my novel control mechanism with respect to the vertical central plane indicated by the dash-dotted line **22**, both valves will be imparted strokes of equal length, and that the valve lift diagrams illustrating the valve stroke as a function of the time will be symmetrical with respect to the central ordinate indicating the time at which the valve is fully opened.

For this purpose, the lever **16** is provided between its ends with a curved face **27** adapted to engage the cam shaft and a dwell **29** thereof. The lever **19** extends beyond actuator **21** and such extension has a curved face **28** for engagement with the cam shaft **15** and a dwell **30** thereof, it being understood that the two levers **16** and **19** are mounted on shaft **17** in adjacent relationship, the dwells **29** and **30** being axially displaced relative to one another on cam shaft **15**.

It will be noted that the curved faces **27** and **28** are convex, being substantially constituted by arcs of a circle, the centers of such arcs being indicated in Fig. 3 at *Me* for lever **16** and at *Ma* for lever **19**.

In the position shown in Fig. 3, both of the dwells **29** and **30** are out of engagement with the levers **16** and **19**, the valves being kept by their springs in closed condition, the clearance between the convex faces **27** and **28** and the cam shaft **15** being suitably adjusted to the minimum required for safe operation. Upon rotation of the cam shaft, the dwell **30** will depress lever **19** and the outlet valve **12** to the position shown in Fig. 2 and shown at **28'** in Fig. 3. Similarly, the dwell **29** is adapted to depress the curved face **27** to the position indicated at **27'** for the purpose of opening the inlet valve **10**.

Moreover, it will appear from Fig. 3 that when the outlet valve **12** is partly opened, the line connecting the center of curvature *Ma* of the convex face **28** with the axis S of the rocking motion forms a right angle with the line connecting *Ma* with the axis N of the cam shaft. Similarly, the line connecting the center *Me* of curvature of the convex face **27** with the axis S forms a right angle with the line connecting *Me* with N.

As a result, when the levers **19** and **16** are actuated by the cam shaft to open the valves, the points *Me* and *Ma* will describe paths away from the axis N of the cam shaft to the points *Me'* and *Ma'*, such paths coinciding substantially with the radii of the cam shaft **15** forming an angle α. The point of engagement of lever **16** with the cam shaft is designated E1 and the point of engagement of the lever **19** with the cam shaft is designated A1. It will be noted that the radius N-E1-*Me* of the point of engagement E1 of the lever **16** with the cam shaft is spaced a longer distance from the rocking axis S than the radius N-A1-*Ma* of the point of engagement A1 of the second lever **19**. The distances of the rocking axes of the levers **16** and **19** which, in the present embodiment, coincide with one another at S from the axes of the valve stems **11** and **13** are substantially proportional to the distances S-*Me* and S-*Ma*.

Actuation of lever **16** by dwell **29** will cause the point of engagement E1 to travel to the point E2 indicated on the dotted representation **27'** of the convex face **27**. Similarly, when lever **19** is rocked by the dwell **30** of the cam shaft, the point A1 will travel on the convex face **28** to the point A2 shown on the dotted indication **28'** of such face.

Furthermore, it is characteristic of the geometric shape and relationship of the various elements that the radii of curvature *re* and *ra* of the two convex faces **27** and **28** are approximately inversely proportional to the distance of the axis S from the axes of the valve stems **11** and **13**.

The dwell **30** of the cam shaft may be formed with less inclined sides when it is desired to obtain lesser accelerations of the outlet valve **12**. But, at any rate, the two dwells **29** and **30** may be given the same height.

The cam shaft is journalled in bearings carried by brackets which are attached in the customary manner to the cylinder head **14**.

From the foregoing description of the embodiment illustrated in the drawings it will appear that a simple and compact structure of the valve control mechanism

will result from the disposition of the pivotal axes of the two levers on the same side of the valves outside of the space therebetween, and that irrespective of the resulting asymmetry with respect to the central plane **22**, the two valves will be given symmetrical lifting diagrams resulting in similar controlling conditions for both valves without requiring dwells of different height. While the use of different radii of curvature for the two faces **27** and **28** will result in different accelerations, such accelerations are admissible as a rule and are even desirable where the two valves **10** and **12** are of different size. The valve adjacent to the rocking axis S will have a higher acceleration and, therefore, is preferably made smaller than the valve **12** being used as the outlet valve, while the larger valve **10** is preferably the inlet valve.

While I have described my invention with reference to a preferred embodiment thereof, I wish it to be clearly understood that the same is in no way limited to the details thereof but is capable of numerous modifications within the scope of the appended claims.

What I claim is:

1. In an internal combustion engine, the combination comprising a cylinder head, two valves mounted therein having upright stems, a cam shaft extending at right angles to said stems in a plane intermediate the latter, two levers extending between said cam shaft and said cylinder head and overlying the upper ends of said stems for actuation of said valves, and means attached to said cylinder head and supporting said levers for rocking motion about an axis extending outside the space between said valves substantially parallel to said cam shaft, said levers having curved faces of different curvature, said faces engaging cams of said cam shaft for actuation by the latter.

2. In an internal combustion engine, the combination comprising a cylinder head, two spring-controlled valves mounted therein having upright stems, a pair of levers overlying said stems and being individually co-ordinated thereto for actuation thereof, the first one of said stems being located between the pivotal axes of said levers and the second one of said stems, a cam shaft extending substantially transversely of said levers and having cams for actuating the same, said levers being provided with convex faces of different curvature for engagement of said cams, the convex face of the lever co-ordinated to said first one of said stems having larger radii of curvature than the convex face co-ordinated to said second one of said stems.

3. In an internal combustion engine, the combination set forth in claim 2 in which the curvature of each of said convex faces is the arc of a circle.

4. In an internal combustion engine, the combination comprising a first valve having a stem, a second valve having a stem extending substantially parallel thereto, means rigid with a cylinder of said engine for guiding said valve stems, a cam shaft extending at right angles to said valves in a plane intermediate the latter, a first lever extending transversely of said cam shaft between the same and said first valve for actuation of the latter and being mounted for rocking motion about an axis extending substantially parallel to said cam shaft, the stem of said second valve being located substantially intermediate said axis and the stem of said first valve, a second lever overlying the stem of said second valve and mounted for rocking motion about an axis substantially coinciding with said first mentioned axis, said levers being provided with convex faces adapted to engage cams of said cam shaft, and helical springs co-ordinated to said valve stems for closing said valves and for keeping said convex faces of said levers in engagement with cams of said cam shaft, each of said levers being so shaped that in partly actuated position thereof the lines connecting the center of curvature of its convex face with said axis of its rocking motion and with the axis of said cam shaft form a right angle.

5. In an internal combustion engine, the combination set forth in claim 4 in which the radii of curvature of said convex faces of said levers are inversely proportional to the distances of said axes of the rocking motion of said levers from the axes of said valve stems.

6. In an internal combustion engine, the combination

comprising a pair of valves having stems, a cam shaft extending transversely of said stems in a plane intermediate the same, levers mounted for actuation by said cam shaft and overlying said stems for actuating said valves, the rocking axes of said levers being located outside of the space between said stems and extending substantially parallel to said cam shaft and substantially coinciding with one another, whereby the first one of said levers will have a longer effective length than the second one of said levers and will actuate the second one of said valves which is located intermediate the first one of said valves and said rocking axes, said levers being so shaped that the radius of the point of engagement of said first lever with a cam of said cam shaft is spaced a longer distance from the rocking axis of said first lever than the radius of the point of engagement of said second lever with a cam of said cam shaft.

7. In an internal combustion engine, the combination set forth in claim 6 in which the distances of the rocking axes of said levers from the axes of said valve stems are substantially proportional to the distances of said rocking axes from the radii of said points of engagement of said levers with said cams.

8. In an internal combustion engine, the combination comprising an inlet valve having a stem, an outlet valve having a stem extending substantially parallel thereto and being smaller than said inlet valve, means rigid with a cylinder of said engine for slidingly guiding said valve stems, a first lever overlying the stem of said inlet valve for actuation thereof and being mounted for rocking motion about an axis extending transversely of said stems, a second lever overlying the stem of said outlet valve and being mounted for rocking motion about an axis substantially coinciding with said first mentioned axis, said outlet valve being located between said axes and said inlet valve, and a cam shaft extending transversely of said levers for actuating the same, said levers having convex faces with the centers of curvature lying in a direction toward said valves and adapted to engage different cams of said cam shaft.

9. In an internal combustion engine a pair of valves mounted therein having stems, shaft means extending transversely of said stems on one side thereof, levers pivotally mounted on said shaft means and overlying the stems, a cam shaft extending substantially parallel to said shafts intermediate the axis of said stems, and cams on said cam shaft co-ordinated with said levers, said levers having convex faces with the radii thereof extending in the direction of said valves and adapted to engage said cams and to permit rocking of said levers causing the same to actuate said valves.

10. In an internal combustion engine the combination according to claim 9, wherein said convex faces have a different radii of curvature.

11. In an internal combustion engine, the combination comprising at least a pair of spring-controlled valves each having a stem, at least a pair of levers overlying said stems and being individually co-ordinated thereto for actuation thereof, the first one of said stems being located between the pivotal axes of said levers and the second one of said stems, a cam shaft extending substantially transversely of said levers and having cams for actuating the same, said levers being provided with convex faces of different curvature for engagement of said cams, the convex face of the lever co-ordinated with said first one of said stems having larger radius of curvature than the convex face co-ordinated with said second one of said stems.

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