Jan. 10, 1928. 1,656,065

J. P. HEINEMANN

VALVE MECHANISM FOR ENGINES

Filed March 31, 1926 3 Sheets-Sheet 1

Fig. 1.

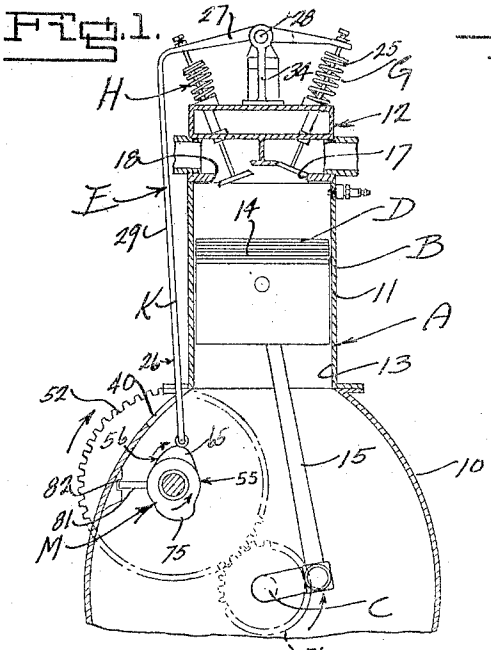


Fig. 2.

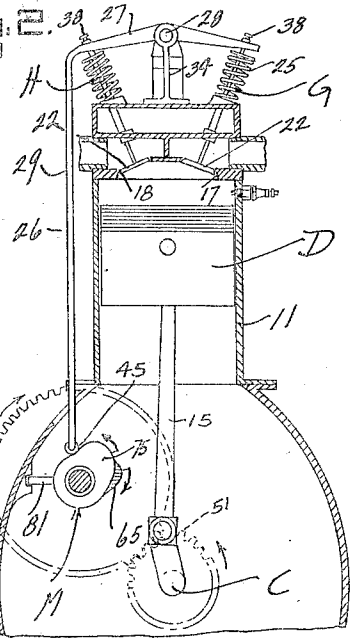


Fig. 3.

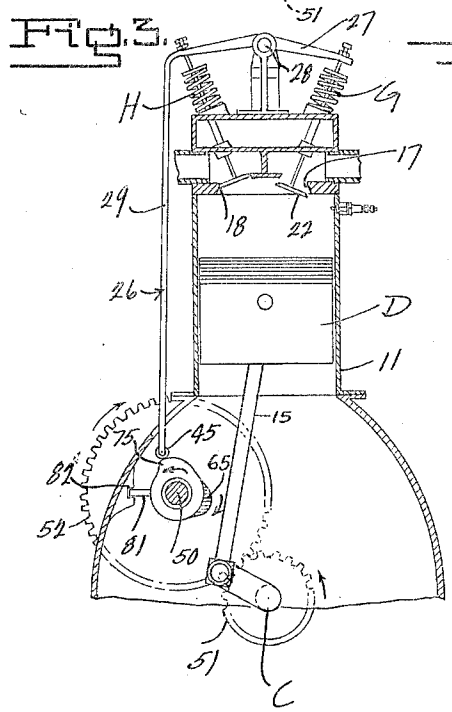
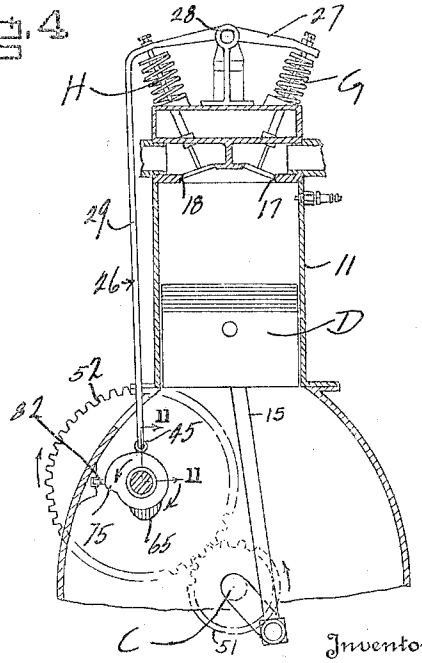


Fig. 4



Inventor

John P Heinemann

By Lancaster and Allwine

Attorneys

Jan. 10, 1928. 1,656,065

J. P. HEINEMANN

VALVE MECHANISM FOR ENGINES

Filed March 31, 1926 3 Sheets-Sheet 2

Fig. 5.

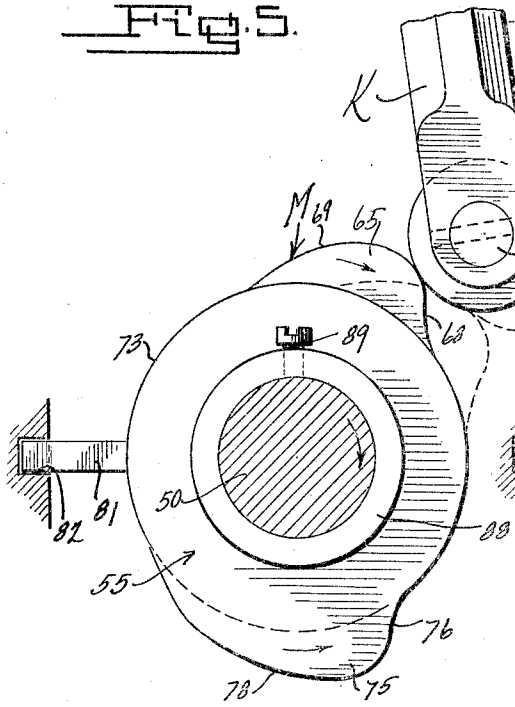


Fig. 6.

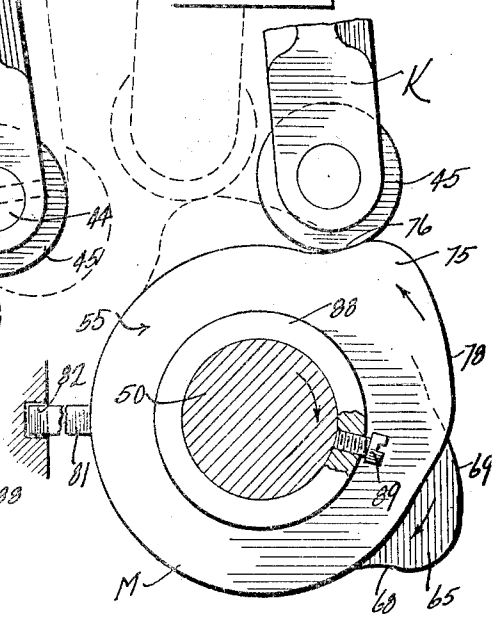


Fig. 11.

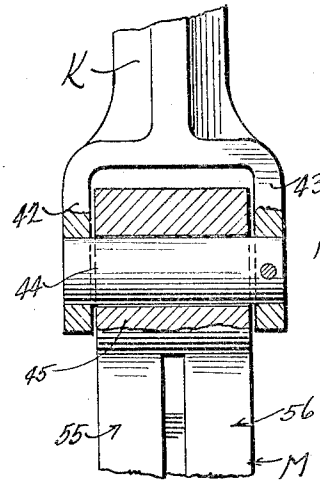


Fig. 12.

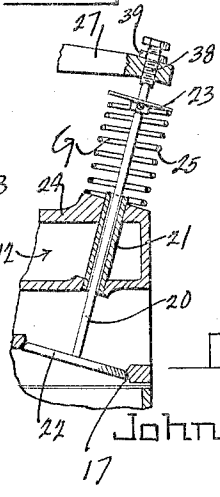
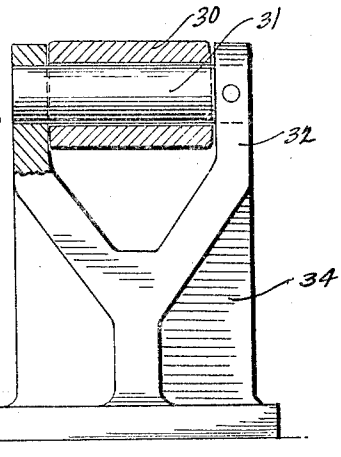


Fig. 13.



John P. Heinemann
Inventor

By Lancaster and Allwine
Attorneys

Jan. 10, 1928. 1,656,065

J. P. HEINEMANN

VALVE MECHANISM FOR ENGINES

Filed March 31, 1926 3 Sheets-Sheet 3

Fig. 7.

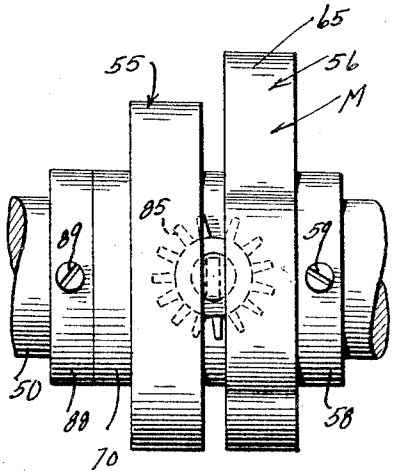


Fig. 8.

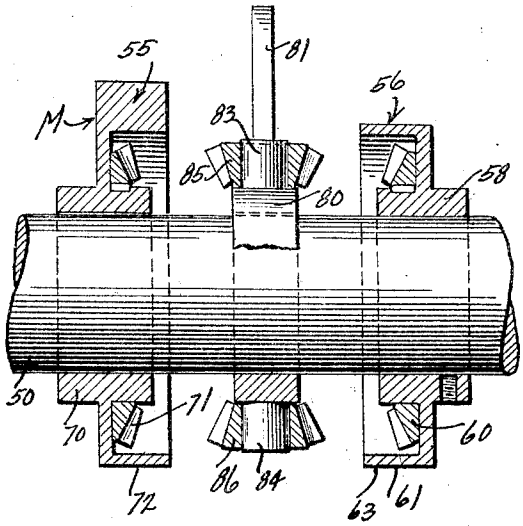


Fig. 9.

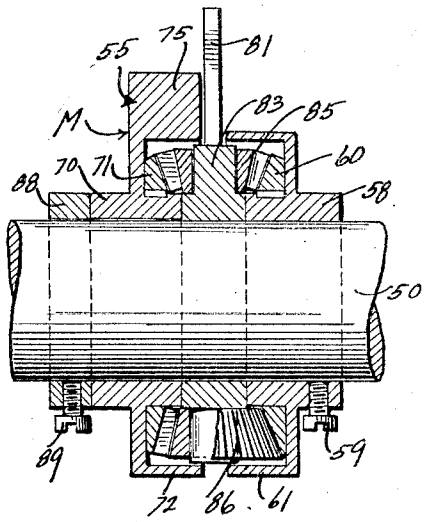
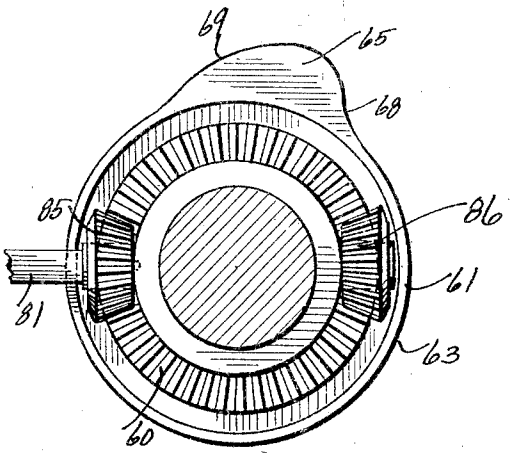


Fig. 10.



John P. Heinemann
Inventor

By Lancaster and Allwine
Attorneys

Patented Jan. 10, 1928. 1,656,065

UNITED STATES PATENT OFFICE.

JOHN P. HEINEMANN, OF PROVIDENCE, RHODE ISLAND.

VALVE MECHANISM FOR ENGINES.

Application filed March 31, 1926. Serial No. 98,807.

This invention relates to improvements in valve mechanisms for internal combustion engines.

The primary object of this invention is the provision of a simplified valve gear for internal combustion engines, embodying a compact operating mechanism for operating the intake and exhaust valves of the engine, with materially fewer operating parts than are used for conventional valve mechanisms; and which will do away with many pivot connections and wear parts of the valve gear as conventionally used for internal combustion engines.

A further object of this invention is the provision of an improved and simplified valve mechanism for four cycle internal combustion engines, embodying means to operate both intake and exhaust valves of a cylinder from a single operating mechanism.

A further object of this invention is the provision of novel cam means for operating intake and exhaust valves of engines.

A further object of this invention is the provision of a novel one-piece rocker arm for operating both intake and exhaust valves of a cylinder of an internal combustion engine.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawings, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views.

Figures 1 to 4 inclusive are diagrammatic views illustrating the cooperative relation of the simplified valve gear as used in connection with intake and exhaust valves of an internal combustion engine; the different views illustrating different operating positions of the intake and exhaust valves and different positions of the cam means for operating the same.

Figure 5 is an enlarged fragmentary view, partly in section, showing the novel cooperation of cam means with a valve operating lever, showing the cam means about to operate on the valve lever to cause an opening of the exhaust valve.

Figure 6 is a view of the details similar to that shown in Figure 5, but with the cam mechanism and valve lever in position denoting the start of the intake valve opening movement.

Figure 7 is an elevation of the cam means as mounted upon a cam shaft.

Figure 8 is a view of the cam details in a non-assembled relation upon a cam shaft, showing the cooperative features thereof in section.

Figure 9 is a sectional view taken longitudinally of the cam shaft, showing the parts of the cam mechanism assembled upon the cam shaft.

Figure 10 is a sectional view taken at right angles to the cam shaft, through the cam mechanism, showing novel features thereof.

Figure 11 is an enlarged fragmentary sectional view taken substantially on the line 11—11 of Figure 4.

Figure 12 is a fragmentary sectional view taken through the intake valve of an engine cylinder and adjacent cooperating parts of the rocker arm.

Figure 13 is an enlarged sectional view taken through the rocker arm bearing bracket.

In the drawings, wherein for the purpose of illustration is shown only a preferred embodiment of this invention, the letter A may generally designate an internal combustion engine, of any approved type, which may comprise a housing B of any approved formation, including a crank shaft C and piston means D operating in the cylinders thereof. Valve gear E is provided which may comprise intake and exhaust valve mechanisms G and H for each cylinder, with a rocker lever and arm construction K operatively connected with said valves G and H, and cooperating with novel cam means M operated from the crank shaft C.

The housing B as above mentioned is of any approved formation and includes the crank case 10 upon which a cylinder block 11 is mounted, and over which block 11 is positioned a valve supporting head 12 either removable or non-removable, as preferred.

In each cylinder chamber 13 of the housing B is positioned a piston 14, connected by connecting rod means 15, which engages a throw of the crank shaft C, as in conventional construction.

The housing B may incude intake and exhaust ports 17 and 18, for each cylinder 13,

suitably connected in any approved manner with intake and exhaust manifolds which may be located at opposite sides or at the same side of the housing, as preferred.

The intake and exhaust valves G and H are of similar construction, and cooperate over their ports 17 and 18 at opposite sides of the pivot action of the rocker arm which operates the same. Each of these valves G and H includes a valve stem 20 slidable in a suitable sleeve bearing 21 provided in the head of the housing B, as illustrated in Figure 12; the stems 20 at their lower ends having valve heads 22 cooperating over the respective ports which they control. Disc-shaped spring retainers 23 are fixed on the stems 20 exteriorly and spaced above the top wall 24 of the head 12 of the engine; compression springs 25 of the spiral type being positioned between the disc spring retainers 23 and suitable seats provided on the wall 24, in order to normally maintain the tapered valve heads 22 closed in their respective ports.

Referring to the novel valve operating means K, the same preferably includes a substantially L-shaped operating member 26, which includes a rocker lever 27 pivoted at 28 between the ends thereof, and at the outer end of which is integrally connected with a depending cam operating lever 29. The valve rocker lever 27 substantially midway between the ends thereof is provided with a sleeve like portion 30 which oscillatively bears upon a suitable bearing shaft 31 which is supported in the yoke 32 of a suitable bracket 34 mounted upon the head of the engine A, as illustrated in Figures 1 and 13 of the drawings. The rocker lever 27 has arm portions at opposite sides of its pivot axis, for operating the intake and exhaust valves; the said arm portions at their outer ends being provided with adjustable "take up" bolts or screws 38 having a screw threaded adjusting engagement in said arm portions of the rocker lever 27, as illustrated in Figure 12 of the drawings; the same being secured in definite relation by means of a lock nuts 39. These adjustable members 38 at their lower ends are provided with suitable sockets for tappet engagement against the tops of the valve stems 20.

From this description of the rocker lever 27 of the valve member 26 it is obvious that upon oscillation of the same the valves G and H will be alternately opened and closed; the lever 27 being held in a definite relation by means of the closing springs for the valves G and H.

At the outer end of the lever portion of the valve lever 27 which operates the exhaust port H, the said valve operating lever 27 is provided with the depending cam lever 29, which extends downwardly along a side of the engine, and may enter a suitable opening 40 in the crank case or other part of the engine housing, for cooperation with the cam mechanism M in order that the cam lever 29 may be swung back and forth for rocking the valve operating lever 27.

The cam operated lever 29 of the member 26, at the lower end thereof is preferably bifurcated, or provided with depending spaced arms 42 and 43, apertured for receiving therein the ends of a supporting shaft 44 upon which a suitable cam roller 45 is rotatably mounted for roller cooperation upon the cam mechanism M, as will be subsequently described.

Referring to the cam mechanism M, the same includes a cam shaft 50 rotatably supported by the housing B of the internal combustion engine A, preferably in the crank case compartment thereof; the same being connected to the crank shaft C by means of gears 51 and 52 respectively keyed with the shafts C and 50, so that the cam shaft 50 rotates at one-half crank shaft speed.

The cam means M also includes suitable intake and exhaust valve operating cams 55 and 56 respectively, which are adapted to be mounted on the cam shaft 50 for rotation in opposite directions; both of the same operating upon the single valve lever roller 45 in order to effect the operation of the exhaust and intake valves thereof. For each of the cam mechanisms M, the exhaust valve cam 56 is provided with a hub portion 58 which may be keyed by means of a set screw 59 or by other means for rotation with the cam shaft 50. Upon this hub or sleeve portion 58 is annularly mounted a bevel gear 60 the teeth of which face towards the other cam 55. An annular flange 61 is provided peripherally in overlying relation with the bevel gear 60, providing a pocket, so to speak, within which the bevel gear 60 is disposed; the annular flange 61 being provided at its outer periphery with a surface 63 upon which the roller 45 operates, and having on said surface 63 a cam throw or extension 65 which is adapted to engage the roller 45 to throw the valve lever 26, and particularly the cam lever portion 29 thereof inwardly towards the housing of the engine, upon rotation of the same; the cam throw 65 being particularly designed so that the forward surface 68 thereof which first engages the roller 45 will effect a quick opening of the exhaust valve and as the same continues to rotate so that the roller 48 will pass over the peak thereof, and then over the rearwardly gradually sloping surface 69 so that the exhaust valve will be slowly closed. It is of course understood that during rolling of the roller 45 over the surface 63, the exhaust valve will be closed, since this surface 63 is concentric with the cam shaft axis.

The intake valve cam 55 is independently rotatable upon the cam shaft 50, and it com-

prises the hub sleeve 70 provided with an opening therethrough for receiving the cam shaft 50. Exteriorly upon the hub is formed a bevel gear 71, the teeth of which face the direction of the bevel gear 60 of the exhaust valve cam 56. An annular flange 72 is integral with the hub portion 70, providing a pocket in which the gear portion 71 is received; the exterior surface 73 of the annular flange 72 being concentric with the cam shaft axis, and said exterior surface 73 having thereon an integral cam throw 75, the forward end 76 of which provides a surface adapted to engage the roller 45 to effect a quick opening of the intake valve; the said throw 75 from the peak thereof in the opposite direction providing a gradually sloping surface 78 which converges into the surface 73, so that the intake valve will be gradually closed after it has been opened.

For operating the cams 55 and 56 in opposite directions of rotation, novel means is provided consisting of a stationary sleeve 80 disposed upon the cam shaft 50 between the cams 55 and 56; the same having a preferably integral projection 81 which is suitably keyed in a socket 82 or the like, of the engine housing or casing, to hold the sleeve 80 stationary. Radially projecting at diametrically opposed points from the stationary sleeve 80 are spider projections or spindles 83 and 84, rotatably receiving thereon bevel pinions 85 and 86, the teeth of which are adapted to mesh with the bevel gears 60 and 71 of the cams 56 and 55 respectively.

In order to hold the cams 55 and 56 assembled in their gear meshing relation with the gears 85 and 86, it is to be noted that the cam 56 is keyed upon the cam shaft 50 against longitudinal or rotational movement with respect thereto. To hold the cam 55 upon the cam shaft 50, a thrust sleeve 88 is preferably keyed at 89 upon the cam shaft 50, and the end of the hub of the cam shaft 55 bears against this thrust sleeve in order to hold the bevel gears of the intake and exhaust valve cams in meshing relation with the gears 85 and 86. Thus, it can be seen that upon rotation of the shaft 50 the cams 55 and 56 will be rotated in opposite directions about the axis of the cam shaft 50, at one half crank shaft speed each.

As to the operation of the intake and exhaust valves for each cylinder, referring to Figure 1 of the drawings, the same shows the throw 65 of the exhaust cam 56 in engagement at its peak with the roller 45 of the valve operating lever 26. The exhaust valve cam 56 is rotating in the direction shown, and has swung the lever portion 29 inwardly, rocking the lever member 26 upon its pivot 28, to move the exhaust valve H to open the port 18, and of course this action has no effect upon operation of the intake valve G. From the position illustrated in Figure 1 the cams 55 and 56 continue to rotate in the directions shown, and as soon as the roller 45 rides off of the throw 65 of the cam 56 the springs 25 of the valves will force the operating lever 25 into the return position, and both of the valves will be closed, and the roller 45 will ride upon the concentric surfaces 63 and 73 of the valves 56 and 55 respectively. As the cam 55 continues to rotate, the throw portion 75 thereof will come into contact at its abrupt end surface 76 with the roller 45, and will swing the lever portions 29 outwardly, from the position illustrated in Figure 2, to the position illustrated in Figure 3, and this movement will cause the valve lever arm 27 to depress the intake valve G and open the port 17 for admission of fuel to the engine; the roller 45 then riding down over the gradually sloping surface 78 of the intake valve cam 55, to cause a gradual closing of the intake port. The position illustrated in Figure 4 shows the intake and exhaust valves closed immediately after the intake valve has closed and just before the compression stroke has started.

In the relation of parts shown the inlet valve is adapted to open when the crank shaft throw of the respective cylinder is approximately 10° past dead center; the inlet valve is adapted to close when the crank shaft throw of the respective cylinder is approximately 35° past the bottom dead center; the exhaust valve is adapted to open when the throw of the crank shaft is approximately 45° ahead of the bottom dead center; and the exhaust valve of the respective cylinder is adapted to close when the throw of the crank shaft of the respective cylinder is approximately 8° past top dead center.

From the foregoing description of this invention it is apparent that a novel and compact valve operating mechanism for intake and exhaust valves of internal combustion engines has been shown, which embodies a novel valve operating lever of one piece, which extends directly from the valves to the cam operating mechanism; the cam operating mechanism embodying a novel assemblage of oppositely rotating cams which effect respectively the operating of the intake and exhaust valves thru the one-piece valve operating lever.

Various changes in the shape, size, and arrangement of parts may be made to the form of invention herein shown and described, without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In a valve construction for engines the combination of an inlet valve and exhaust valve, a single operating lever for said valves, and valve actuating means operating on said lever including oppositely rotating

inlet valve and exhaust valve operating cams.

2. In a valve actuating mechanism for engines the combination of an inlet valve, an exhaust valve, a rocker lever pivoted intermediate its ends and adjacent the ends thereof operating upon said inlet and exhaust valves at opposite sides of the pivot axis of said rocker lever, and a pair of cams operating said lever, one of the same including a throw portion for operating the inlet valve and the other including a throw portion for operating the exhaust valve.

3. As an article of manufacture an internal combustion engine valve gear lever of substantially L-shaped formation including a rocker lever portion having a pivot bearing intermediate the ends thereof and including a substantially right angled cam operating lever portion rigidly extending in substantially right angled relation from an end of said rocker lever portion.

4. In an internal combustion engine the combination of a cylinder including intake and exhaust ports, intake and exhaust valves for the ports, a rocker lever pivoted between its ends and adjacent one end operably associated with the intake valve and at the opposite end operably associated with the exhaust valve, cam means, and a lever rigid with said rocker lever operating on said cam means.

5. Valve mechanism for engines comprising a cylinder having intake and exhaust ports, intake and exhaust valves for the ports, a rocker lever pivoted between the ends thereof and adjacent the ends thereof operably associated with said intake and exhaust valves, cam means including oppositely rotating intake valve and exhaust valve cams, and a single lever connected with the rocker lever and operably associated with said cams.

6. In a valve mechanism for internal combustion engines the combination with a cylinder including intake and exhaust ports, intake and exhaust valves therefor, a rocker arm pivoted between its ends and adjacent its ends operating on said intake and exhaust valves, spring means for normally maintaining both of said valves closed and the rocker lever in a predetermined position, cam mechanism, and lever means operably associated with the rocker lever and upon which the cam means operates to alternately open and close said valves.

7. In combination with an engine cylinder including intake and exhaust ports, intake and exhaust valves for the ports, a rocker lever pivoted between its ends and adjacent its ends operating upon said intake and exhaust valves, spring means normally maintaining the valves closed and the rocker lever in a predetermined position, a lever arm rigid with the rocker lever and depending alongside of the cylinder, and cam means operating on the lower end of said lever arm to swing the same back and forth and cause operation of the rocker lever upon its pivot to alternately operate said intake and exhaust valves.

8. In an engine valve mechanism the combination of a cylinder including intake and exhaust ports, intake and exhaust valves for said ports, a valve rocker lever pivoted between its ends and at opposite sides of its pivot operating on said intake and exhaust valves, spring means for maintaining the valves closed and the rocker lever in a predetermined position, cam means, and a cam operated lever connected with the rocker lever and mounted alongside of the cylinder for lateral swinging in order to operate said rocker lever.

9. In an engine valve mechanism the combination of a cylinder including intake and exhaust ports, intake and exhaust valves for said ports, a valve rocker lever pivoted between its ends and at opposite sides of its pivot operating on said intake and exhaust valves, spring means for maintaining the valves closed and the rocker lever in a predetermined position, cam means, and a cam operated lever connected with the rocker lever and mounted alongside of the cylinder for lateral swinging in order to operate said rocker lever, said cam means including oppositely rotatable intake valve and exhaust valve cams.

10. In an engine valve mechanism the combination of a cylinder including intake and exhaust ports, intake and exhaust valves for said ports, a valve rocker lever pivoted between its ends and at opposite sides of its pivot operating on said intake and exhaust valves, spring means for maintaining the valves closed and the rocker lever in a predetermined position, cam means, and a cam operated lever connected with the rocker lever and mounted alongside of the cylinder for lateral swinging in order to operate said rocker lever, said cam means including oppositely rotatable intake valve and exhaust valve cams, each having a single throw thereon with an abrupt pitch as it advances in engagement with the cam operated lever and a gradually sloping surface rearwardly thereof, whereby to cause abrupt opening of the valves and a gradual retarding closing thereof.

11. In an internal combustion engine the combination with a four cycle engine including cylinders having intake and exhaust valves, a single rocker lever for each intake and exhaust valve of a cylinder pivoted between its ends and at opposite sides of its pivot engaging the respective intake and exhaust valves for operation thereof, spring means normally maintaining each rocker lever in a predetermined position when its valves are closed, and cam means for operat-

ing each rocker lever to cause synchronised operation of the intake and exhaust valves according to four cycle engine operation.

12. In a valve mechanism for internal combustion engines the combination with an internal combustion engine including a crank shaft, and a cylinder having intake and exhaust ports, intake and exhaust valves for the ports, a rocker lever pivoted between its ends at opposite sides of its pivot being operably associated with said intake and exhaust valves, spring means for maintaining the valves closed and the rocker lever in a predetermined position, a lever rigid with the rocker lever and arranged substantially at right angled relation therewith in depending relation along the cylinder, a cam shaft, means connecting the cam shaft with the crank shaft for rotation at one half the speed of the crank shaft, a cam fixed on the cam shaft including a single throw portion, a second cam rotatable on the cam shaft, means for operating the second cam in opposite direction with respect to the first mentioned cam at the same speed of rotation, said second cam having a single throw portion thereon, said cams being associated in such relation as to both operate on said depending lever in order to cause the lateral swinging movement thereof for rocking the rocker lever on its pivot to cause actuation of the intake and exhaust valves.

JOHN P. HEINEMANN.