

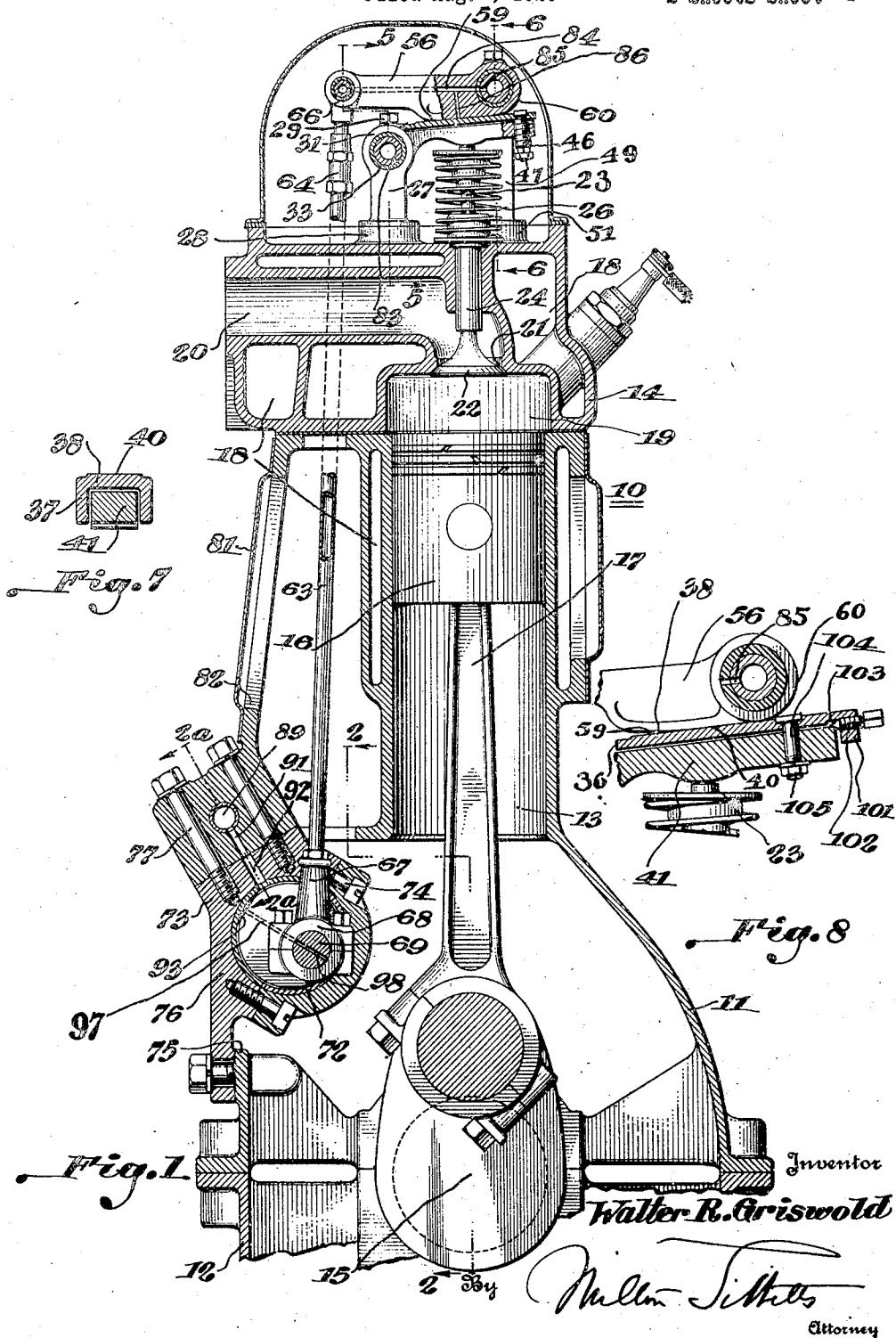
Feb. 12, 1929.

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INTERNAL COMBUSTION ENGINE

Filed Aug. 2, 1926

2 Sheets-Sheet 1



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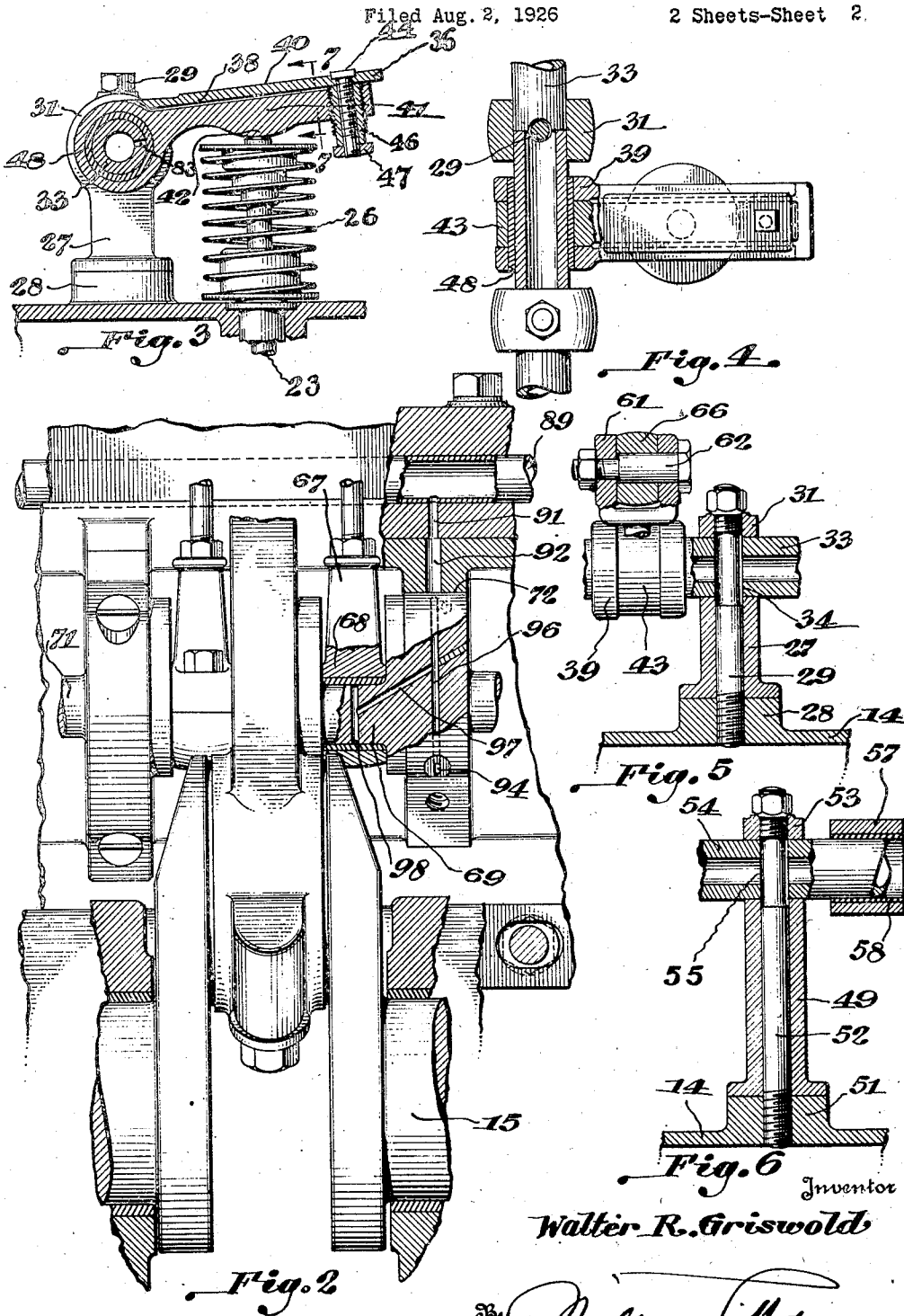
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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

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This invention relates to internal combustion engines, more particularly to the valve operating mechanism of such engines, and it has for one of its objects to provide a valve gearing for such an engine which shall be substantially silent in operation.

Another object of the invention is to provide such an engine valve operating mechanism in which the clearance between the valve and its operating member shall be a minimum and in which adjustments of the clearance may be readily made.

Another object of the invention is to provide driving mechanism for the valve operating mechanism of an internal combustion engine which shall be quiet and efficient, and which shall not require provision for the relief of shock as the valve starts to open.

Another object of the invention is to provide an engine having adequate lubrication of all parts of the valve operating mechanism which are subjected to wear, and in which the mechanism of any particular valve may be disassembled or adjusted without disturbing the adjustment or setting of any of the other valves.

Other objects of the invention will appear from the following description taken in connection with the drawing, which forms a part of this specification, and in which:

Fig. 1 is a view, partially broken away and partially in transverse vertical section, of an internal combustion engine constructed in accordance with the invention;

Fig. 2 is an enlarged detail view, partially in elevation, and partially in section substantially on the lines 2—2 and 2^a—2^a of Fig. 1;

Fig. 3 is an enlarged detail view, partially in elevation and partially in vertical section thru one of the valve operating rocker arms and its support;

Fig. 4 is a view, partially in plan and partially in horizontal section thru the rocker arm shown in Fig. 3;

Figs. 5 and 6 are enlarged detail sections substantially on the lines 5—5 and 6—6 of Fig. 1;

Fig. 7 is a detail section substantially on the line 7—7 of Fig. 3, and

Fig. 8 is a fragmentary vertical section thru a pair of rocker arms showing a modified form of the clearance adjusting mechanism.

The present invention, while it may be applied to the valve operating mechanism of all types of engines having reciprocating

valves, is particularly adaptable to engines in which valves of the poppet type are mounted in the cylinder head with the valve stems disposed upwardly, and in which the valves are actuated by rocker arms mounted in the head and connected by push rods to a timing shaft located at the side of the engine. Such valve-in-the-head engines are recognized as a type having numerous advantages of accessibility and simplicity, but these engines have heretofore presented certain difficulties in operation, one of which is excessive noise of the valve operating mechanism. This is caused in part by the unavoidable clearances in the train of actuating mechanism, but the necessity of allowing a considerable clearance between the valve stem and its actuating member, to compensate for temperature changes in the mechanism, is more largely responsible for such noise.

Other difficulties presented by this type of valve mechanism are the necessity of frequent adjustment of the actuating rockers, the inconvenience and difficulty of making such adjustments easily and accurately, and inadequate lubrication of the moving parts and the excessive wear attendant thereon. Such engine valve gear is also usually actuated from a cam shaft arranged to drive the lower ends of the push rods through suitable cam followers. The cams in such shafts are usually designed with long easement curves in order to diminish the shock and noise caused by a too abrupt engagement of the lift portion of the cam with its follower, and this frequently requires a compromise modification of that valve operation which would be dictated by purely theoretical considerations.

In the present invention is provided an engine having valve mechanism of the overhead type in which the shortcomings of previous valve mechanisms of the type referred to, are obviated.

Referring to the drawing, at 10 is shown an internal combustion engine, preferably of the well known valve-in-the-head type, having a crank case 11 provided with a detachable oil pan or sump 12, and surmounted by a row of cylinders 13 which may be in an integral block. The cylinder block 13 is provided with a detachable head 14, which in the present embodiment of the invention is adapted to support the engine valves and their operating mechanism. Within the

crank case 11 is journaled the usual engine crank shaft 15, the cranks of which are connected to pistons 16 slidably mounted in the cylinders 13, by connecting rods 17 of any suitable construction.

The engine cylinders 13 and head 14 are provided with suitable passages 18 for cooling fluid, and the head is provided with a combustion chamber 19 for each of the cylinders 13, each of these combustion chambers communicating with exhaust and intake passages, one of which is shown at 20. The passage 20 communicates through a port 21 with the combustion chamber 19, and this port 21 is controlled by a suitable valve 22, preferably of the well known poppet type, having a stem 23 which is slidably mounted in a guide 24 in the engine head 14. The valve 22 is also provided with a suitable spring 26, connected in any well known manner to the valve stem 23 and adapted to urge the valve toward closed position.

Mounted on the engine head 14 is a row of pedestals or other suitable supports 27 which are secured to lugs 28, integral with the head 14, in any convenient manner as by bolts or studs 29. These pedestals 27 are provided at their upper ends with eyes 31, in which are secured tubular pivotal supports, such as the arbors 33, disposed longitudinally of the head 14. The arbors 33 are provided with suitable holes 34 for the passage of the bolts 29, which may be of reduced section to provide clearance for easy removal of the arbor. Mounted on the arbors 33 are rocker levers or arms 36, preferably of channel section as shown in Fig. 7, having downwardly disposed flanges 37 connected by a web 38, which has a plane upper face 40. This web is cut away at the fulcrum end of the lever, and the flanges are provided with suitable eyes 39 by means of which they are pivotally mounted on the arbor. Pivotaly mounted on the arbor 33 between the flanges 37 of the rocker lever 36 is a companion rocker lever 41 having a tappet portion 42 on its lower face adapted to contact and operate the upper end of the valve stem 23 and having at its fulcrum end an eye 43, disposed between the eyes 39, surrounding the arbor 33.

The levers 36 and 41 are adapted to be adjustably connected at their outer ends in any suitable manner as by means of a bolt 44, fixed in the web 38 and projecting downwardly thru the lever 41. Co-operating with the bolt 44 is a tubular nut 46, through which the bolt 44 passes freely, and which is threaded externally in the arm 41, and a nut 47 is threaded on the lower end of the bolt 44 so that it may be screwed into engagement with the end of the tubular nut 46. A bushing 48 may be placed on the arbor 33 to support the eyes 39 and 43 if desired. These levers 36 and 41 are thus rigidly connected and oscillate together as a single arm about the arbor

33, and angular relation between them about the axis of this arbor being, however, readily adjustable.

Disposed on the engine head 14 on the opposite side of the valve stems 23 is a row of pedestals or supports 49, similar to the pedestals 27, each of which is mounted on a lug 51 and connected thereto by bolts 52, and which have at their upper end eyes 53 in which a tubular arbor 54 is mounted. This arbor may be continuous, having holes 55 for the passage of the bolts 52, or it may be made in abutting sections, the ends of which have semi-cylindrical recesses to entertain the bolts. The arbor 54 is adapted to support spaced rocker arms 56 provided at their ends with eyes 57 and bushings 58 by means of which they are pivotally mounted on the arbor 54. The lower face of the arms 56 has a surface 59 curved longitudinally of the rocker lever which curve is conjugate to the upper face 40 of the rocker lever 36. These curves may be of any desired form to give the desired valve travel but they are preferably of a nature adapted to roll one upon the other with a minimum of sliding movement. The portion of the curved surface 59 toward the fulcrum end of the lever 56 is preferably tangent to the circular portion 60 of this lever which forms the eye 57 by which it is mounted on the arbor 58. The other end of the lever 56 is preferably forked as indicated at 61 in Fig. 5 and the branches of this fork are drilled to provide a clevis, adapted for co-operation with a pin 62 by means of which the lever 56 is oscillated in a manner presently to be described.

It will be evident from the above description that as the forked end of the lever 56 is moved downwardly its curved surface 59 will roll upon the plane surface 40 of the lever 36 and depress the latter thus also depressing the lever 41 and opening the valve 22 against its spring 26. The point of contact between the surfaces 59 and 40 moves along the curves of these surfaces during opening and closing of the valve, and these surfaces are preferably so related that during the dwell portion of the valve cycle, when the valve is closed, the circular portion 60 of the curve of the arm 56 is in contact with the surface 40, so that motion of the arm 56 during this period does not produce any corresponding motion of the arm 36 or of the valve 22.

The upper rocker lever 56 is adapted to be oscillated by suitable rods 63, which are preferably tubular in construction as shown in Fig. 1, and each of which is connected at its upper end by a turn-buckle 64 to an eye 66 adapted to cooperate with the pin 62 of the clevis 61 previously described. The lower end of the rod 63 is preferably threaded into an extension 67 integral with one portion of a two part bearing member 68, disposed within the crank case 11. These connecting bear-

ings 68 are mounted on and adapted for actuation by the cranks 69 of a crank shaft 71, which is mounted in the crank case 11 parallel to the engine crank shaft 15. The crank shaft 71 is preferably journaled in suitable bearings 72 supported by brackets 73, which may be made in two parts and connected by the bolts 74 if desired. These brackets are mounted in a longitudinal opening 75 in the crank case 11, and form a cover plate 76 therefor, which cover plate is removably secured to the crank case 11 in any convenient manner as by bolts 77, so that the entire timing shaft assembly comprising the brackets 73, bearings 72, shaft 71 and crank bearings 68 may be removed as a unit from the crank case 11.

The crank shaft 71 is adapted to be driven at one end thereof from the engine crank shaft 15 in any convenient manner, but in timed relation thereto, as by means of gears or a chain and sprocket (not shown); this drive being in all respects similar to the drive in common use for the cam shafts usually employed as timing shafts in internal combustion engines. It will be apparent that as the crank shaft 71 is rotated, its motion will be transferred through the cranks 69, bearings 68, extensions 67 and rods 63, to the outer end of the upper rocker levers 56, which will be oscillated in the manner previously described to operate the engine valves.

The rods 63 are adapted to pass through a suitable opening formed between the block of cylinders 13 and a cover plate 81, which cover plate is removably secured over an opening 82 in the casting of block 13 in any well known manner. It will be seen that with the cover plate 81 removed, the lower ends of the rods 63 may be readily disconnected from the members 67 after the upper ends of the rods have been disconnected from the rocker levers 56 by removal of the clevis pins 62. After removal of the rods 63 thru the opening 82, the timing shaft assembly may be removed as previously described by taking off the cover plate 76. In this way access to the drive for the valve gearing, for purposes of adjustment, inspection or repair is readily effected.

Adequate lubrication is provided for the rocker arms 36 and 56 by connecting the tubular arbors 33 and 54 to any suitable source of lubricant under pressure, as for example the engine oiling system (not shown). The rocker levers 36 and 41 are each provided at their hub portions with a radial oil passage 83, by means of which lubricant is conducted from the hollow arbor 33 to the bearing hubs of these rocker levers, thus providing adequate lubrication at this point. The upper rocker lever 56 is provided with a longitudinal passage 84 connecting through a radial duct 85 with the interior of the tubular arbor 53, by means of which oil is conducted from this tubular arbor to lubricate the clevis pin 62 and the bearings of the clevis 61 and the rod connection 66 therewith. This passage 84 may be provided with a branch passage 86 by means of which lubricant is also conducted between the contacting surfaces 59 and 40 of the rocker lever assembly.

The timing shaft assembly is also lubricated from the engine system through a conduit 89 formed in the crank case 11 and extending longitudinally of the engine. Suitable ducts 91 communicate with the conduit 89, and also register with ducts 92 formed in the brackets 73, which conduct lubricant to the timing shaft bearings 72. Each of these bearings has a metering slot 93, adapted to communicate once in each revolution of the shaft 71 with a metering orifice 94 formed in the bearing 72, and the slot 93 is connected by a diametrically disposed passage 96 and a communicating inclined passage 97 with a duct 98 in the crank pin 69. In this way, oil is delivered from the supply at the bearings 72 to the crank pin bearings of the timing shaft so as to insure the adequate lubrication thereof.

In Fig. 8 is shown a modification of the rocker clearance adjustment mechanism in which the end of the web portion 38 of the rocker arm 36 has a downwardly disposed portion 101 in which is threaded a set screw 102 having a conical point 103 adapted to enter between the web 38 and the lever 41 to regulate the angular relation of these members about the axis of the arbor 33. These members are urged together by a bolt 104, the head of which is secured from turning with respect to the web 38 and which has a nut 105 contacting the lower surface of the lever arm 41. It will be evident that by slacking off the nut 105, the parts 38 and 41 may be separated to any desired degree by screwing in the set screw 102 to take up the clearance between the rocker assembly and the valve stem, after which the parts may be clamped in adjusted position by tightening up the nut 105. This adjustment may be readily performed while the engine is running slowly, so that a fine adjustment of the clearance can be effected.

It will be evident that in the mechanism of the present invention is provided valve actuating gearing in which the clearance between the valve stem and its actuating member may be maintained a minimum, as low as .0015 inch, since any variations in the length of the valve stem or of the push rods 63, tending to decrease this clearance, will simply result in a shifting of the point of contact between the lower surface 59 of the rocker arm 56 and the upper surface 40 of the rocker arm 36.

It will also be evident that this invention provides a mechanism in which the wear of

the parts is a minimum, since the rocker levers roll together on their conjugate faces with a minimum of friction. Furthermore, these surfaces, as well as all wearing parts of the mechanism are adequately lubricated under pressure from the engine oiling system.

In the event that it becomes necessary to make a replacement of a valve or its spring, or an adjustment of any particular valve, it is only necessary to disconnect the push rods of the valves in that cylinder to which the adjustment appertains, by removing the clevis pin 62, dismount the arbor 54 by removal of the stud bolts 52, and turn back the rocker levers 36 on their pivotal mountings at 58. In this way the valves requiring attention are readily exposed without the necessity of dismantling the entire valve mechanism.

It will also be observed that no provision is necessary to lessen the shock of engagement of the parts as any given valve starts to open, since the movement of the timing shaft 71 is uniform; there being no sudden engagement as in the case of a cam operated device. In this way the practical cycle of operation of a valve can be made to much more nearly agree with the theoretical cycle thereof.

It will be understood that various forms of the invention other than those described above may be used without departing from the spirit or scope of the invention.

I claim:

1. The combination in an internal combustion engine having a poppet valve of valve operating mechanism comprising a two part rocker arm having a common fulcrum for the parts, a second rocker arm adapted to contact one part of the first named arm and having a conjugate contact surface, means on the other part of the two part arm to operate the valve, means to adjust the angle between the parts of said arm, and means to operate the second named arm in timed relation to the engine.

2. The combination in an internal combustion engine having a poppet valve of valve operating mechanism comprising contacting rocker arms fulcrumed at opposite sides of said valve, one of said arms having two parts, valve contacting means on one of said parts, screw means to adjust the angle between the parts, and means to operate the other arm in timed relation to the engine.

3. In combination in an internal combustion engine having a poppet valve, a valve mechanism comprising parallel pins on opposite sides of the valve, a forked lever fulcrumed on one said pin, a lever fulcrumed on said pin between the branches of the forked lever and having a plane upper surface, a lever fulcrumed on the other pin having a lower surface conjugate to and adapted to roll on the said plane surface, means adjustably connecting the ends of the two first named le-

vers and means to operate the last named lever in timed relation to the engine.

4. In combination in an internal combustion engine having a poppet valve, a valve mechanism comprising parallel pins on opposite sides of the valve, a forked lever fulcrumed on one of the said pins and adapted to operate the valve, a lever fulcrumed on said pin between the branches of the forked lever and having a plane upper surface, a lever fulcrumed on the other pin having a surface adapted to roll on the said plane surface to provide the lift and dwell of the valve, and means to adjust the plane surface lever about its fulcrum relative to the forked lever to vary the clearance between said levers and the valves.

5. A valve actuating mechanism for an internal combustion engine having a lubricating system, comprising a pair of superimposed levers having conjugate contact surfaces and fulcrumed at opposite ends, and means connected to the engine lubricating system to meter lubricant to the fulcrums of levers and to said surfaces.

6. A valve actuating mechanism for internal combustion engines comprising a lever to operate the valve and having a plane surface, a lever having a conjugate surface adapted to roll on said plane surface and having a cylindrical surface tangent to the conjugate surface, and means to oscillate the second lever in such timed relation to the engine that the conjugate and the cylindrical surfaces cooperate with the plane surface during the lift and the dwell of the valve respectively.

7. A valve actuating mechanism for internal combustion engines comprising a valve operating lever having a plane surface, and a second lever to actuate the first lever having a surface including two curved portions, one of said portions cooperating with the plane surface during valve lift, and the other portion cooperating with the plane surface during valve dwell.

8. A valve actuating mechanism for internal combustion engines comprising a valve operating lever, and a lever having contiguous curved surfaces adapted to make rolling contact with the operating lever, one of said curved surfaces oscillating the operating lever during valve lift, and the other curved surface contacting the operating lever during valve dwell.

9. A valve actuating mechanism for internal combustion engines comprising two levers one of which is adapted to operate the valve, a common fulcrum for said levers, means adjustably connecting said levers, a third lever having a separate fulcrum and adapted to operate the other of the first mentioned levers, and means actuating said third lever in timed relation to the engine.

In testimony whereof I affix my signature.
WALTER R. GRISWOLD.