

Jan. 22, 1929.

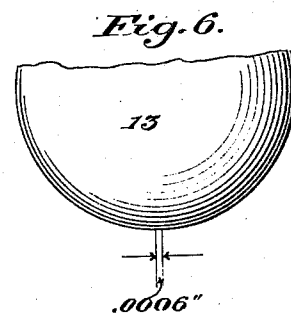
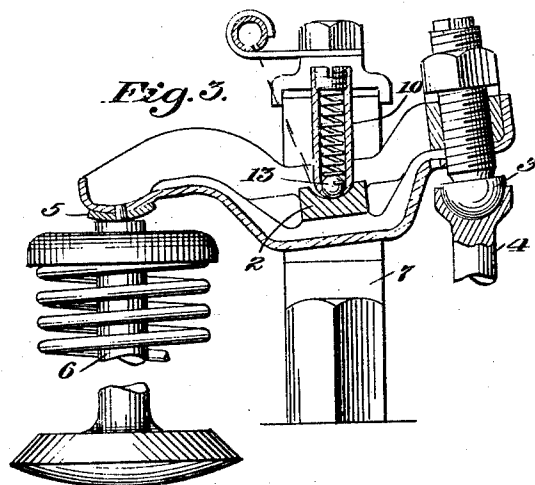
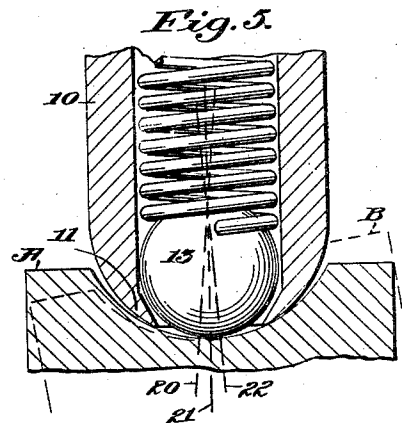
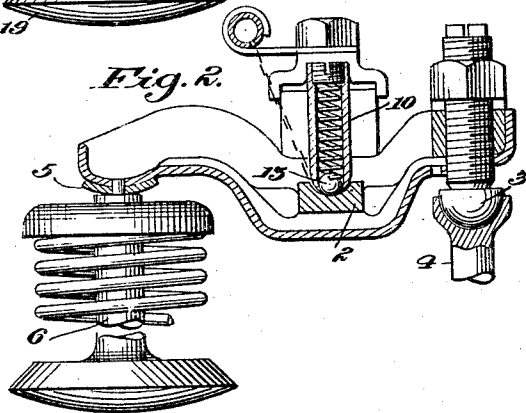
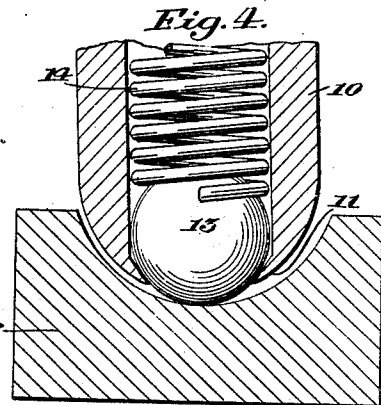
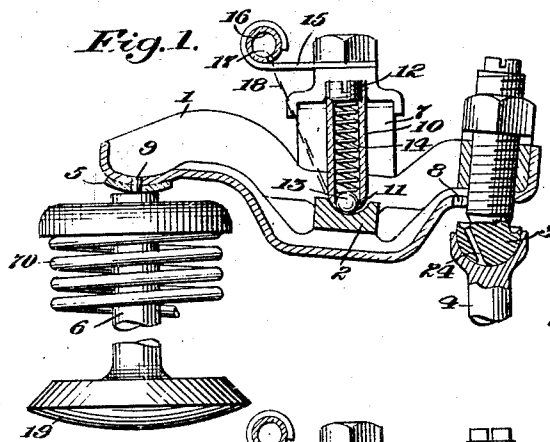
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1,699,657

ROCKER ARM AND ROCKER ARM ASSEMBLY

Filed July 30, 1926

4 Sheets-Sheet 1



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ROCKER ARM AND ROCKER ARM ASSEMBLY

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4 Sheets-Sheet 2

Fig. 9.

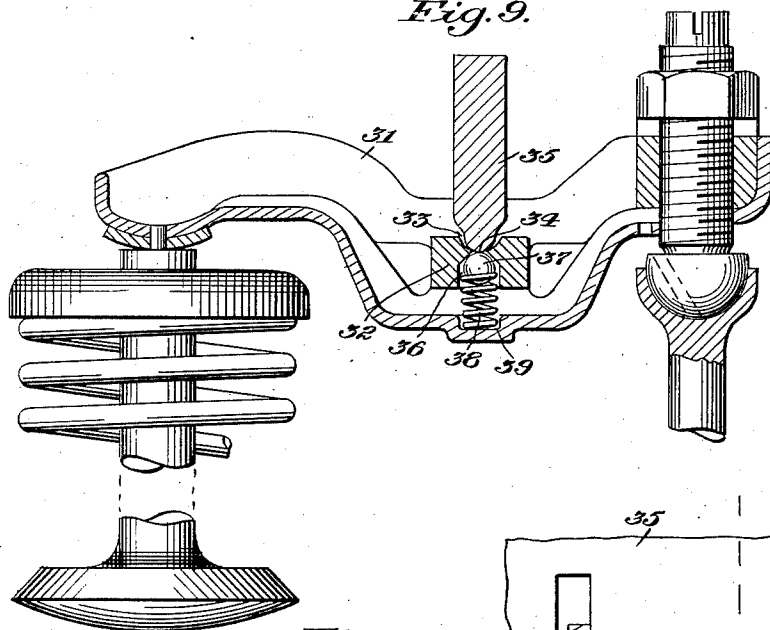


Fig. 10.

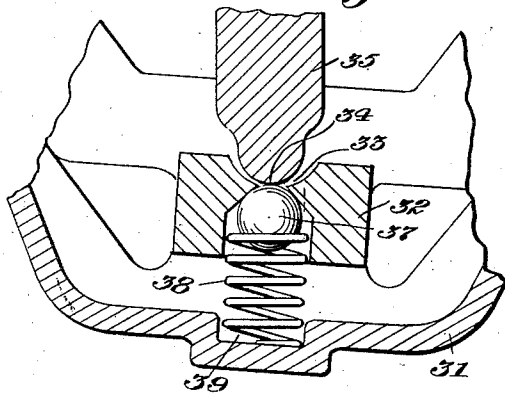


Fig. 12.

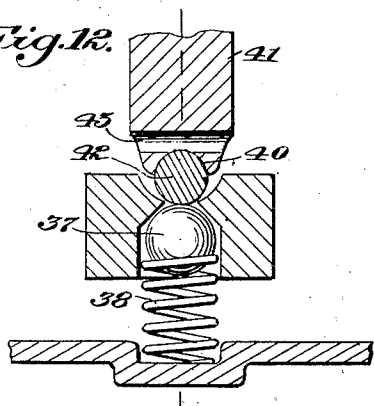


Fig. 11.

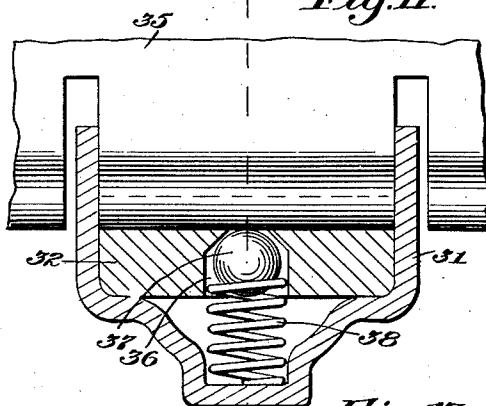
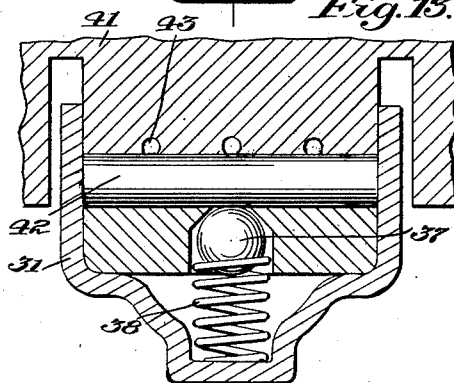


Fig. 13.



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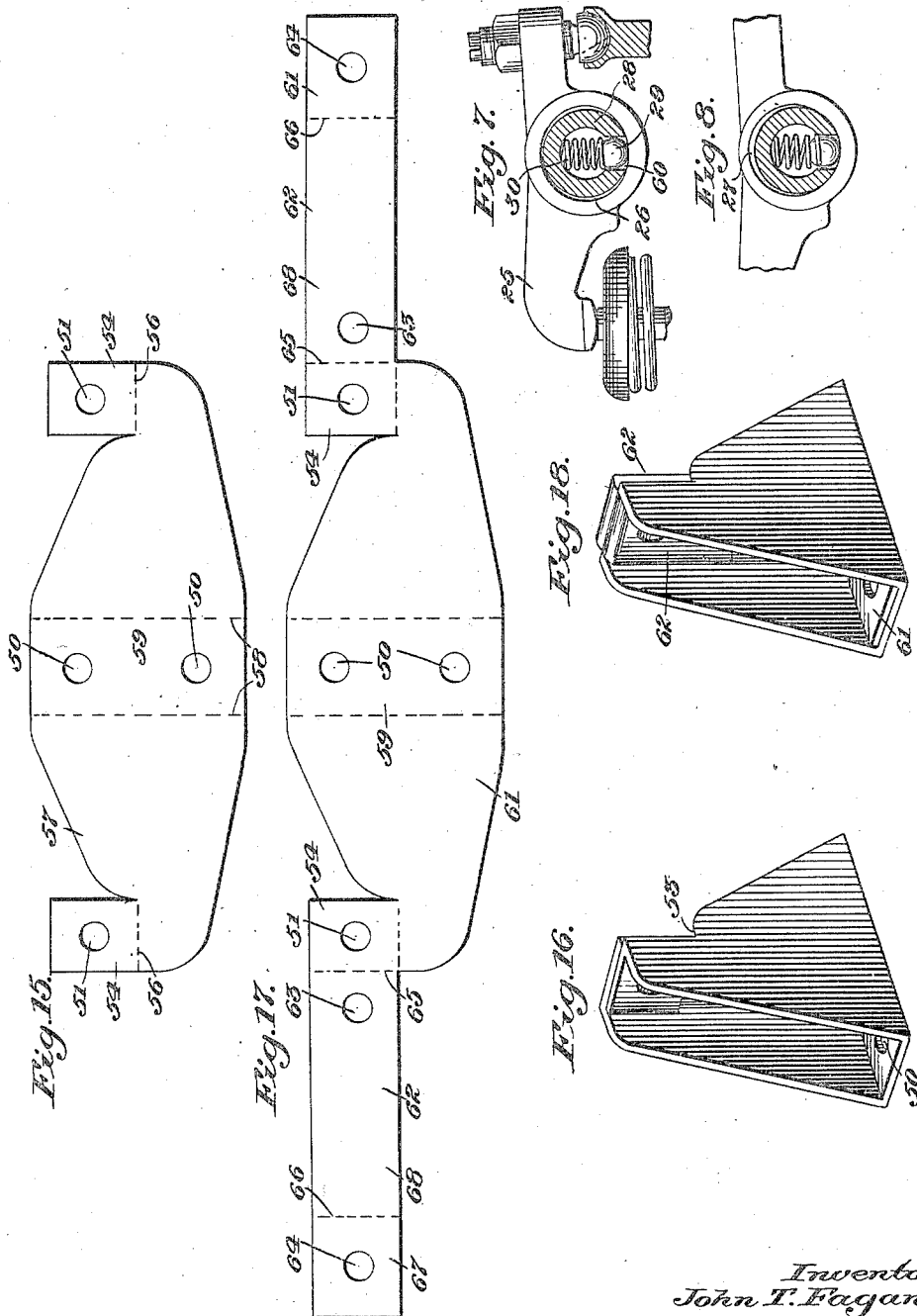
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ROCKER ARM AND ROCKER ARM ASSEMBLY

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4 Sheets-Sheet 3



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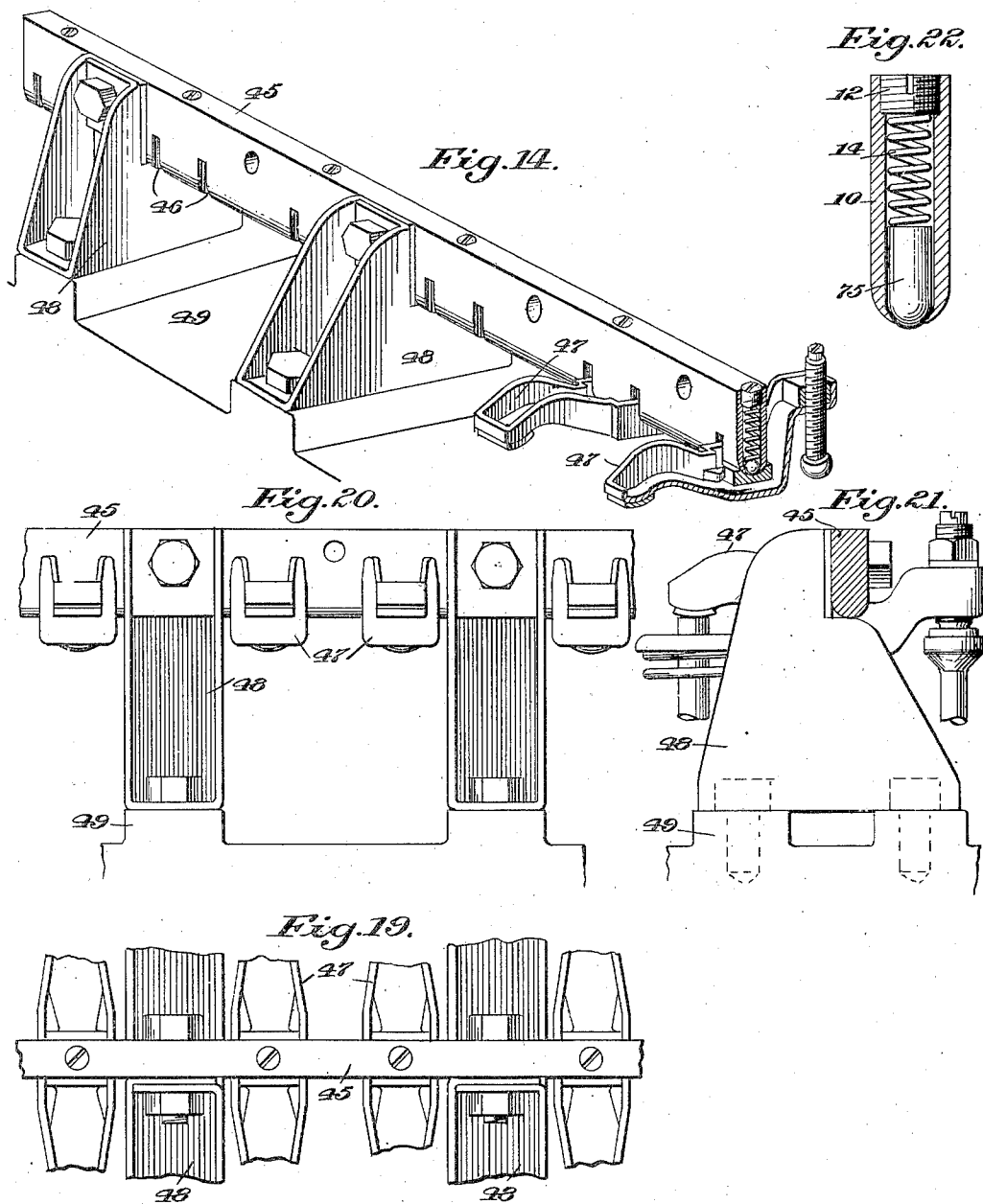
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ROCKER ARM AND ROCKER ARM ASSEMBLY

Filed July 30, 1926

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE.

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ROCKER ARM AND ROCKER-ARM ASSEMBLY.

Application filed July 30, 1926. Serial No. 125,950.

This invention relates to rocker arms and rocker arm assemblies, including their lubrication, mountings, shafts, and shaft supports therefor; for use in connection with internal combustion engines for automobiles, motor boats, etc.

An object of the invention is to make a rocker arm assembly that will be practically free from noise, and also be practically frictionless;

A further object is to provide a rocker arm assembly in which a "floating" fulcrum is provided for said rocker arm;

A further object is to provide a rocker arm assembly in which a "floating" fulcrum and a cooperating fixed fulcrum are provided for said rocker arm;

A further object is to provide a rocker arm in which there is a minimum of angular displacement at the fulcrum;

A further object is to provide a rocker arm assembly in which the ends of the rocker arm are in constant contact with the push rod and the valve stem;

A further object is to provide a rocker arm which serves as an oil reservoir, and which provides for maintaining oiled contact surfaces at the fulcrum, and between the rocker arm and the push rod, and the rocker arm and the valve stem;

A further object is to provide a shaft upon which is mounted a resilient ball bearing to serve as a "floating" fulcrum;

A further object is to provide a support for a shaft, the support being a metal stamping and folded to constitute a rigid stiff structure;

Other objects will appear upon reading the specification.

In the accompanying drawings,

Figure 1 illustrates a sectional view of one form of the improved rocker arm, with the valve in the closed position;

Figures 2 and 3 are otherwise duplicates of Figure 1, with the valves at the middle of the stroke, and full open, respectively;

Figures 4 and 5 are enlarged sectional views of the ball and bearing assembly, showing the clearance between the bearing block and the section of the shaft retaining the ball at different positions; and the angular displacement;

Figure 6 is an enlarged illustration of a ball bearing with two projected axes, indicating the extent of displacement at the surface of the ball bearing, which in practice

with a $\frac{3}{16}$ th inch diameter ball bearing is about 0.0006 inch.

Figures 7 and 8 are views, partly in section, of a different form of rocker arm and supporting shaft, and ball bearing mounting;

Figure 9 is a sectional view of a rocker arm in the partly open position, showing the spring pressed ball mounted in the lower bearing;

Figure 10 illustrates a detail of Figure 9, with the rocker arm in the closed position, showing the increased clearance between the end of the blade and the bearing block;

Figure 11 is a transverse sectional view of Figure 9, on the line 11—11;

Figures 12 and 13 are longitudinal and transverse sectional views, respectively, of a further modification, showing a lower mounted ball pressing against a cylinder mounted in the edge of the blade;

Figure 14 is a view in perspective of the shaft and its support stamping;

Figures 15, 16, 17 and 18 are illustrations of a metal stamping to constitute a support for the shaft;

Figures 19 and 20 are top and side views, respectively of a portion of the shaft with the supports and rocker arms;

Figure 21 is an end view of the shaft, with a side view of the support and rocker arm; and

Figure 22 is a view of a section of a resiliently mounted plug bearing.

In Figure 1, an oil holding rocker arm 1, of the reservoir type, shown as a stamping is provided with a detachable hardened steel bearing block 2, an adjustable hardened hemispherical head 3 supported in the socket of the push rod 4, and the hardened valve shoe 5 to operate the valve stem 6, mounted in operative relation on the shaft 10, also shown in detail in Fig. 14, and indicated therein by reference number 45, which is mounted in end-supports 7. The rocker arm 1 is provided with oil holes 8 and 9, which feed oil to the push rod socket and the valve stem end under the hardened shoe 5. Oil hole 24 supplies oil to the bottom surface of the head 3. The shaft 10 is provided with recesses in which are placed the ball bearings 13, see also the broken end of the shaft in Fig. 14, resiliently mounted, as for example by the compression spring 14, see Fig. 1, and the view of the end of the shaft in Fig. 14. The recesses are tapped at their

upper ends to receive the plugs 12. The lower edge of the shaft 10 is rounded, as shown in Fig. 5 to function as the bearing when the valve is open, as shown in Fig. 3.

5 Upon the upward movement of the push rod 4, the rocker arm 1 tilts, and exerts pressure upon the valve stem 6, and upon spring 70, the pressure being distributed between spring 70 and spring 14, the latter also being compressed and the ball 13 being pressed back into the recess, the rounded edge 11 of the shaft cooperating with the ball to serve as the fulcrum on the bearing block 2. The positions of the bearing block with the valve in the closed position is shown at A in Fig. 5, and shown at an exaggerated inclination in dotted lines at B with the valve in the open position, as more fully described hereafter. The shaft 10 is also provided with a detachable bracket 15 which supports an oil conduit 16, the latter having a perforation 17 so located that a jet of oil 18, under pressure, supplies oil to the bearing 2 and ball bearing 13, the oil accumulating in the rocker arm 1 and flowing through the openings 8 and 9. The rocker arm 1 in Figure 1 is shown with the valve 19 in the closed position. In Figure 2 the rocker arm and valve are shown in the "half-way" position, while in Figure 3, they are shown in the "full open" position.

Instead of a ball bearing 13, or other type of rotatable bearing being resiliently mounted in the shaft 10, or other casing or support therefor, a plug, having a rounded end, either a hemispherical end, or an end shaped like half of a cylinder, may be resiliently mounted in the shaft 10. Such a construction is shown in section in Figure 22, in which the section of the plug is shown at 75. The "floating" operation of the bearing is otherwise the same. The plug 75 may also be mounted in the rocker arm in place of the ball bearing 37 as shown in Figures 9 to 13.

Figures 4, 5 and 6 are enlarged views showing the clearance, exaggerated, between the bearing 2, and the end 11 of the shaft 10, with the rocker arm in different positions. In Figure 4, it is in the closed position, and the clearance is at a maximum; as the push rod 4 in Figure 1 raises the end of the rocker arm the spring 14 is compressed, the compression increasing with the movement of the rocker arm from the "closed" to the "full open" position shown in Figure 3, in which the clearance is at a minimum. The movement of the bearing 2 under the ball 13 is a sliding movement and tends to rotate the ball, thereby continually presenting new contact surfaces. In Figure 5, the axial lines 20, 21, 22, with displacement exaggerated indicate respectively as follows—axial line 20 is parallel to the normal vertical axis through the bearing 2 when the valve

19 and rocker arm are in the closed position, as shown in Figure 1; line 21 is in the vertical axis of the bearing block when the valve and rocker arm are in the half-open position; as shown in Figure 2; and line 22 is parallel to the normal vertical axis of the bearing block when the valve and rocker arm are in the full open position. The angular displacement of the bearing 2 is about 0.0006 inch each side of the half-way position, or about 0.0012 inch displacement for the full swing of the rocker arm; the displacement for a half movement is illustrated in Figure 6. In the present standard practice, a clearance of from 0.008 to 0.010 inch is allowed between the end of the valve stem 6 and the hardened shoe 5 on the tappet end of the rocker arm in order to provide for the expansion of the valve stem when the engine is hot, otherwise the valves will not close completely, and there will be a loss of compression and power in the engine due to a leaking valve. With this clearance, there is considerable noise during the operation of the engine, and it is very objectionable. This spacing of about 0.010 inch is customary with an opening of five-sixteenths inch between the valve and valve seat.

In Figure 1, showing the rocker arm and valve in the closed position, the shoe 5 and the valve stem 6 are in contact, the ball 13 is in contact with the bearing block 2 and the spring 14 expanded. The clearance between the end 11 of the shaft 10 and the bearing block 2 in the closed position is about 0.003 inch, which is equivalent to about 0.010 inch between the end of the valve stem and the shoe 5; this spacing is the customary practice with the five-sixteenths inch opening above noted, but will vary with different openings between the valve and valve seat. When the rocker arm oscillates to the open position, the ball 13 and spring 14 are compressed, the compression increasing as the rocker arm presses the valve stem to open the valve; with the valve fully opened, the end 11 of the shaft 10 rests in the bearing block 2 and functions as the bearing. The clearance of about 0.003 inch between the end 11 of the shaft 10 and the bearing block 2 in Figure 1 is so small that the operation of the rocker arm is noiseless; the variable expansion of the valve stem 6, due to the changing temperature of the engine, against the rocker arm causes slight changes in the compression of the spring 14, but contact between the valve stem and shoe 5 is always maintained. This construction provides a "floating" support for the rocker arm. The presence of the film of oil which is maintained between the working surfaces of the valve stem and shoe 5, the ball 13 and bearing block 2 and the head 3 and push rod socket 4 further serve to cushion the impact

and reduce the noise. The surplus oil is collected in the oil pit and pumped back into the oil circulation system. Where oil circulation systems are not used, felt wicks may be inserted in the oil holes 8 and 9, which will maintain an oil film between the working surfaces.

In Figures 7 and 8, a type of rocker arm 25, of a standard design, and having a hole 26 therethrough, the wall of which is hardened, is shown mounted upon a hardened loose fitting hollow shaft 28, which allows for ample clearance. The shaft is drilled at 60, and carries the ball bearing 29 and a compression spring 30. The hole 26 in Figure 7 is slightly wider along the horizontal diameter than along the vertical diameter, while in Figure 8, the hole 27 has a greater vertical diameter than horizontal diameter. In Figures 7 and 8, the construction permits the rocker arm to be maintained in contact with the valve stem and the ball and socket joint at the push rod. In Figure 7, the movement of the rocker arm upon the ball bearing 29 is that of a rolling motion; while in Figure 8, the movement of the rocker arm is that of a sliding motion. The principles of noiseless operation are the same as in the modification shown in Figure 1.

In Figures 9, 10 and 11, a rocker arm 31 resembling that shown in Figure 1, but provided with a different shaft mounting is illustrated. The bearing block 32 is provided with a slotted recess 33 on its upper surface to provide a bearing for the curved bearing edge 34 of the rigid blade 35, the recess is shown of sufficient width to provide ample clearance space when the rocker arm is in either extreme position, for example the closed position, see Figure 10. In the lower side of the bearing block 32 is a recess 36, opening through a reduced hole into the slotted recess 33 on the upper side. Within the recess 36 is a ball bearing 37, a small surface of which projects through the reduced hole and contacts with the edge 34 of the blade 35, a spring 38 seated in the depression 39 in the rocker arm 31 enters the lower part of the recess 36 and maintains the ball 37 under compression. In operation, the contact between the ball 37 and the edge 34 of the blade is maintained under sufficient compression so that practically no pressure is exerted against the surfaces 33 of the bearing block 32, nor against the end of the recess 36 enclosing the ball 37, the bearing block 32 simply rests against one or the other of the surfaces of the edge 34 or ball 37 in its slight movement. When the valve is full open, the blade presses against the block 32. The principles of noiseless operation are the same as in the modification shown in Figure 1.

In Figures 12 and 13, the lower edge 40

of the blade 41 is grooved to receive the roller 42 which takes the place of the curved edge 34 of blade 35. Oil ducts 43 are provided to supply oil to the upper surfaces of the roller. This modification functions otherwise just as the construction shown in Figures 9, 10 and 11. The principles of noiseless operation are also the same as in the modification shown in Figure 1.

The shaft upon which the rocker arm 75 oscillates, as shown in Figures 1, 9 and 12 may be mounted as illustrated in Figures 14 to 21.

In Figure 14, the shaft 45 is shown as drilled to receive the ball bearings and springs 80 for use in the modification shown in Figure 1. The shaft is slotted at proper intervals, as at 46, 46 to receive the side walls of the rocker arm 47. A longitudinal cross section of a mounted rocker arm, and of the ball bearing and compression spring, constituting the "floating" fulcrum, are shown on the end of the shaft. The shaft is secured to supports 48, 48 which in turn are secured to the cylinder head 49. The supports illustrated are made of steel stampings, and may have the shape illustrated in Figure 15, which after folding, will appear as in Figure 16. A modified form of the stamping is shown in Figure 17 which after folding will appear as in Figure 18. The stamping in Figures 15 and 16 is punched as at 50, 51 to receive bolts, the extensions or ears 54, 54 are folded on the lines 56, 56, at right angles to the sides 57, 57, the sides being folded on the lines 58, 58, perpendicularly from the base 59; to a position substantially parallel with each other, and the ears 54, 54 engaging in overlapping relation so that holes 51, 51 register. The shaft 45, Figure 14, rests on the ledges 53, and is bolted to the support through holes 51. The support is secured to the engine with bolts passing through holes 50, 50.

In Figures 17, and 18, a modified support stamping is illustrated. The stamping 61 resembles that in Figure 15, but has extensions 62, 62 from the ears 54, 54 of Figure 15. The stamping is folded as in Figure 16, the extensions are punched at 63, 63, 64, 64 and are folded on the lines 65, 65, 66, 66, the folds on the lines 65, 65 bring the holes 51, 63 on each side in register, and the folds on the line 66, 66, bring the holes 64, and 50 in register, the bent extremities 67, 67 constituting feet, which are secured by bolts to the base 59 and the engine with bolts. The structure illustrated in Figure 18 is unusually well braced and rigid, the central extensions or webs, 68, 68 cooperating with the sides and base to prevent collapse in any direction.

I claim:—

1. In a rocker arm, a bearing block, a resiliently mounted ball surface bearing cooperating with said bearing block, to function as

a floating fulcrum for said rocker arm and a curved bearing associated with said ball surface bearing to function as a fixed fulcrum.

2. The combination comprising a rocker arm, a bearing block, a resiliently mounted ball surface bearing, a retaining casing for said ball surface bearing, said retaining casing provided with a curved bearing edge, said bearing block provided with a grooved recess, said recess serving as the bearing surface for said ball surface bearing and curved edge of said retaining casing.

3. The combination comprising a rocker arm, a bearing block, a resiliently mounted revolvable bearing adapted to be maintained in contact with said bearing block, said resiliently mounted and revolvable bearing supported in a casing, said casing provided with a curved edge, said curved edge maintained out of contact with said bearing block when the rocker arm is at one extreme of an oscillation and to approach contact with said bearing block during the oscillation of the rocker arm to the other extreme.

4. The combination comprising a rocker arm, a bearing block, a resiliently mounted revolvable bearing adapted to be maintained in contact with said bearing block, said resiliently mounted and revolvable bearing supported in a casing, said casing provided with a curved edge, said curved edge adapted to cooperate with the revolvable bearing and function as a bearing block during a part of the oscillation of the rocker arm.

5. In a rocker arm, a shaft, a resiliently mounted ball bearing associated with said shaft, said resiliently mounted ball bearing cooperating with said bearing block to function as a floating fulcrum for said rocker arm and a surface connected with said shaft constructed to cooperated with said bearing block to function periodically as a fixed fulcrum for said rocker arm.

6. A rocker arm assembly comprising a trough like rocker arm with sides, a bearing block therein, a shaft provided with spaced transverse slits, said shaft comprising a bear-

ing surface between the slits, the sides of said rocker arm in said slits, a resiliently mounted ball bearing, said ball bearing adapted to function as a "floating" fulcrum for said rocker arm and shaft.

7. A rocker arm assembly comprising a trough-like rocker arm with sides, a bearing block therein, a shaft provided with spaced transverse slits, recesses in said shaft between said slit, resiliently mounted ball bearings mounted in said recesses, the sides of said rocker arm in said slits, one of said resiliently mounted ball bearings cooperating with said bearing block to function as a "floating" fulcrum for said rocker arm.

8. A shaft for rocker arms, comprising a bar provided with pairs of transverse slits, recesses associated with said bar between said slits, and resiliently mounted ball bearings in said recesses.

9. A shaft for rocker arms, comprising a bar provided with spaced transverse slits, recesses associated with said bar adjacent said slits, casings in said recesses, resiliently mounted ball bearings in said casings, and said casings provided with rounded lower ends.

10. A shaft assembly comprising a shaft and a resiliently mounted ball surface fulcrum associated therewith and carried thereby.

11. A shaft assembly comprising a shaft, recesses associated with said shaft, resiliently mounted bearings in the recesses, said bearings provided with a rounded end projecting beyond the surface of the shaft.

12. The combination of a rocker arm having parallel walls and a shaft therefor, said shaft provided with a portion having parallel edges, said edges in alinement with and co-operating with the walls of said rocker arm to maintain said rocker arm in alinement.

In testimony whereof I hereby affix my signature.

JOHN T. FAGAN.