

PATENT SPECIFICATION



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PROVISIONAL SPECIFICATION.

Improvements in or relating to Valve Actuating Gear.

We, RUDGE-WHITWORTH, LIMITED, a company registered under the laws of Great Britain, and JOHN VERNON PUGH, a British subject, both of Rudge Works, 5 Crow Lane, Coventry, in the County of Warwick, do hereby declare the nature of this invention to be as follows:—

This invention relates to the actuation of valves such, for example, as are positioned in the domed or like heads of internal combustion engine cylinders and are opened by pressure on the end of the spindle from a rocking lever controlled by a tappet rod positioned more or less parallel with the centre line of the cylinder.

In the usual construction employed for this purpose a ball end on the tappet rod contacts with a complementary inverted cup formed in the end of the rocking lever or, alternatively, a pin joint may be used in which the axis of the pin is parallel to the axis about which the rocker turns. Both of these constructions cause an appreciable amount of sliding to take place on the spherical or cylindrical surfaces employed and this amount of sliding coupled with the load between the surfaces is sufficient to cause serious wear which may be contributed to by inefficient lubrication at this point.

The object of the present invention is to overcome the foregoing disadvantages.

The invention consists in a valve actuating gear of the type indicated in which the junction of the tappet rod with the rocking lever and/or the pivotal mounting of the lever provides for a more or less rolling motion and also line contact of the parts on one another during the rocking movement.

The invention further consists in a
[Price 1/-]

valve actuating gear of the type indicated in which a tappet rod is provided at one end with a flat surface lying in a plane at right angles to its axis and which engages the rocking lever by entering a cavity having at the bottom thereof a convex surface representing a portion of a cylinder with its axis disposed parallel to the axis upon which the lever rocks, which convex surface executes substantially a rolling motion on the flat surface of the tappet rod end.

The invention further consists in a gear in accordance with the preceding paragraph, in which the cavity in the rocking lever has a cylindrical wall and the end portion of the tappet rod entering the said cavity is enlarged into a frusto-conical form, the larger diameter flat surfaced end of which coacts with the convex bottom of the cavity.

The invention further consists in a gear in accordance with either of the preceding paragraphs in which a convex surface is formed at the bottom of the cavity in a rocking lever by a pressing or like operation.

The invention also consists in improvements in or relating to valve actuating gear as hereinafter indicated.

In carrying the invention into effect in a convenient form as applied by way of example to an internal combustion engine, rocking levers are suitably mounted above the head of the cylinder and provided with arms adapted to cooperate with the ends of the valve spindles for opening the valves.

The rocking levers may be mounted by means of roller bearings on pivotal axes or may be mounted so that the pivot executes a rolling motion upon a suitable flat or curved surface.

The central boss of a rocking lever is provided at one end with an arm projecting towards the centre line of the engine to engage a tappet rod disposed more or less parallel with the cylinder axis and the end of this arm is formed with a cylindrical boss the axis of which lies in a plane which is at right angles to the axis about which the rocking lever turns and is tangential to a circle struck from this axis.

The tappet rod, which is disposed more or less parallel to the axis of the cylinder and in a vertical engine will occupy a substantially vertical position, is formed with a frusto-conical enlargement at its upper end, the larger end of the frustum being at the extremity of the rod and providing a flat enlarged surface which may be ground to provide a flat plane at right angles to the axis of the rod.

Formed in the boss at the end of the rocking lever arm and upon the underside thereof is a cylindrical recess of a diameter slightly larger than the biggest end of the frusto-conical enlargement on the tappet rod and of a depth adapted to accommodate the frusto-conical portion, the taper of the cone being such that in the extreme positions of its oscillation the cylindrical sides of the cavity lie parallel to the adjacent surface of the frusto-conical enlargement with a suitable working clearance.

The bottom of the cylindrical recess is a convex surface representing a portion of the surface of a cylinder having its axis parallel to the axis about which the rocking lever moves, the contacting surfaces of the end of the tappet and the bottom of the cavity being conveniently prepared as by case-hardening or any other processes adapted to provide a suitable surface and as the movement between them is very nearly a pure rocking or rolling motion with line contact the wear will be very slight.

The enlargement of the end of the tappet rod may conveniently be effected by a "heading" such, for example, as is employed in the formation of wheel spoke heads and the flat end of the extremity is conveniently formed by grinding or other suitable processes.

For the formation of the convex cylindrical surface at the bottom of the cavity in the end of the rocking lever arm a previously prepared separate piece may be inserted and held in position, say by a projection through a small aperture in the end of the cavity which may be riveted over or retained by a nut,

but as the position of the axis of the cylinder, of which this surface forms a portion, in relation to the axis about which the lever rocks is of great importance, the bottom is preferably formed from the material of the lever and this is conveniently done by providing first a flat bottom to the cylindrical recess and a flat end on the exterior of the boss of the lever arm parallel with the flat bottom of the cavity. The convex cylindrical surface is then formed by a pressing operation by means of a punch or die which may be an easy fit in the cylindrical recess and have a concave cylindrical end of the desired form, the flat exterior end of the boss forming an adequate support for the lever during the pressing operation and the surface produced being quite satisfactory for the purpose as regards finish, without requiring further machining or other operations.

Such a method of production ensures that the axis of the cylindrical surface remains always parallel with the axis of rocking and that consequently a true rocking or rolling contact is provided. The flat end of the tappet rod at right angles to the axis thereof allows free turning of this rod during working and consequent even distribution of the wear and maintenance of the parts in the best possible condition.

Instead of forming the tappet rod with an enlarged end the rod may be left parallel up to its extremity on which the flat wearing surface is formed or, if desirable, the end of the rod could even be of reduced diameter or the rod necked down at the region of the mouth of the cylindrical recess to form a frusto-conical end adapted to co-operate with a cylindrical recess in the rocking lever. In any case it is essential that clearance be provided between the wall of the recess and the circumferential wall of that portion of the rod which enters the recess for all relative positions of the tappet rod and rocking lever and in the event of the rod being cylindrical at this portion the cavity in the lever may be formed conical with the larger diameter at the mouth.

Rocking surfaces may be employed for the pivotal support or fulcrum of the lever if desired and other modifications and additions may be introduced without in any way departing from the spirit of this invention.

Dated this 17th day of January, 1924.

MARKS & CLERK. 125

COMPLETE SPECIFICATION.

Improvements in or relating to Valve-actuating Gear.

- We, RUDGE-WHITWORTH, LIMITED, a company registered under the laws of Great Britain, and JOHN VERNON PUGH, a British subject, both of Rudge Works, 5 Crow Lane, Coventry, in the County of Warwick, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—
- 10 This invention relates to the actuation of valves which are opened by pressure on the end of the spindle from a rocking lever controlled by a tappet rod positioned more or less in the direction of the centre line of the engine and adapted to provide for rolling movement of a cylindrical or equivalent curved surface upon a flat surface at the force-transmitting contact regions of the working joints of the actuating gear.
- The object of the present invention is to provide an improved construction of such actuating gears.
- 25 The invention consists in a valve-actuating gear adapted to provide for rolling movement to all intents without sliding of a cylindrical or equivalent curved surface upon a flat surface at the force-transmitting contact regions of the working joints in which a large radius or gradual curvature is given to the curved surface to distribute the moving pressure zone over the greatest available area.
- 35 The invention further consists in a gear in accordance with the preceding paragraph, in which the cavity in the rocking lever has a cylindrical wall and the end portion of the tappet rod entering the said cavity is enlarged into a frusto-conical form, the larger diameter flat surfaced end of which coacts with the convex bottom of the cavity.
- 45 The invention further consists in a gear in accordance with either of the preceding paragraphs in which a convex surface is formed at the bottom of the cavity in a rocking lever by a pressing or like operation.
- 50 The invention also consists in improvements in or relating to valve-actuating gear as hereinafter described.
- Referring now to the accompanying drawings:—
- 55 Figure 1 is a side view, partly in section, of a portion of an internal combustion engine to which the invention is applied;
- Figure 2 is a plan view of the same, also partly in section; 60
- Figure 3 is a detail of the lever end showing a section through the cavity with the tappet rod end in the position it occupies when the valve is closed; 65
- Figure 4 is a view similar to the last but indicating the position occupied when the valve is open;
- Figure 5 is a section of the lever end cavity on the line A—A of Figure 4. 70
- In carrying the invention into effect in the convenient form shown as applied by way of example to an internal combustion engine, rocking levers *a*, *b*, are suitably mounted above the head of the cylinder *c* and provided with arms *a*¹, *a*², *b*¹, *b*², adapted to co-operate with the ends of the valve spindles *a*³, *a*⁴, *b*³, *b*⁴, for opening the valves. 75
- In the drawings the rocking levers *a* and *b* are shown as mounted by means of bearing rollers *d* on the pivotal axes *e*. Alternatively, the rocking levers may be mounted in any other suitable manner. 80
- At one end of the central boss of each rocking lever there is provided an arm, such as *f* or *g*, projecting at an angle towards the centre line of the engine to engage a tappet rod *h* or *i* disposed in a plane parallel with the cylinder axis and at right angles to the engine crank shaft. The ends of these arms are formed with a cylindrical boss *f*¹ or *g*¹ the axes of which lie in a plane which is at right angles to the axes about which the rocking levers *a*, *b* turn. The axes of said bosses are also tangential to circles struck from the axes of the lever fulcrum pins. 85
- The two tappet rods *h* and *i* are each formed with a frusto-conical enlargement *j* at the upper end, the larger end of the frustum being at the extremity of the rod and providing a flat enlarged surface *j*¹ which may be formed to provide a flat plane at right angles to the axis of the rod, say for example by grinding or any other processes. 90
- The ends of the levers *f* and *g* are similar and formed in the boss *g*¹ at the end of the lever *g* and upon the underside thereof is a cylindrical recess *g*² of a diameter slightly larger than the 95
- 100
- 105
- 110

biggest end of the frusto-conical enlargement j on the tappet rod i and of a depth adapted to accommodate the frusto-conical portion. The taper of the cone of the enlargement j is such that in the extreme positions of its oscillation the opposite sides of the cylindrical cavity lie substantially parallel, with a suitable working clearance, to the adjacent piece of surface of the frusto-conical enlargement.

At the end g^3 of the cylindrical recess g^2 is a convex surface representing a portion of the surface of a cylinder of large radius having its axis parallel to the axis about which the rocking lever b moves, the contacting surfaces of the end of the tappet and the end of the cavity being conveniently prepared as by case-hardening or any other processes adapted to provide a suitable surface and the wear will be very slight as the movement between them is very nearly a pure rocking or rolling motion with line contact.

The end of the tappet rod may conveniently be enlarged by a "heading" process such, for example, as is employed in the formation of wire wheel spoke heads and the flat end of the extremity is conveniently formed by grinding or other suitable processes.

The convex cylindrical surface g^3 at the bottom of the cavity g^2 in the end of the rocking lever arm g may be formed by a previously prepared separate piece inserted and held in position, say by a projection taken through a small aperture in the end of the cavity and riveted over or retained by a nut, but as the position of the axis of the cylinder of which this surface forms a portion in relation to the axis about which the lever rocks is of great importance, the bottom is preferably formed from the material of the lever and this is conveniently done by providing first a flat bottom to the cylindrical recess g^2 and a flat end on the exterior of the boss g^1 of the lever arm parallel with the flat bottom of the cavity. The convex cylindrical surface g^3 is then formed by a pressing operation by means of a punch or die which may be an easy fit in the cylindrical recess and have a concave cylindrical end of the desired large radius, the flat exterior end of the boss forming an adequate support for the lever during the pressing operation and the surface produced in this way being without further machining or other operations quite satisfactory for the purpose.

The foregoing method of production ensures that the axis of the cylindrical

surface g^3 remains always parallel with the axis of the rocking and that consequently a true rocking or rolling contact is provided. The flat end j^1 of the tappet rod at right angles to the axis thereof allows free turning of this rod during working and consequent even distribution of the wear so that the best possible conditions for satisfactory working are ensured.

The end of the tappet rod instead of being enlarged may be left parallel up to its extremity on which the flat wearing surface is formed or, if desirable, the end of the rod could even be of reduced diameter or the rod necked down at the region of the mouth of the cylindrical recess to form a frusto-conical end adapted to co-operate with a cylindrical recess in the rocking lever. In any case it is essential that clearance be provided between the wall of the recess and the circumferential wall of that portion of the rod which enters the recess for all relative positions of the tappet rod and rocking lever and in the event of the rod being cylindrical at this portion the cavity in the lever may be formed conical with the larger diameter at the mouth.

The radius of the curved surface is made sufficiently large or in other words the curvature is sufficiently gradual for the line of contact between the flat surface on the end of the tappet rod and the curved surface at the bottom of the cavity in the end of the lever to travel from one side to the other side of the total available area during the movement of the lever from one extreme to the other of its rocking movement. By this means the moving pressure zone is distributed over the greatest available area and the amount of wear resulting from the pressure is consequently decreased.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A valve-actuating gear adapted to provide for rolling movement to all intents without sliding of a cylindrical or equivalent curved surface upon a flat surface at the force-transmitting contact regions of the working joints, in which a large radius or gradual curvature is given to the curved surface to distribute the moving pressure zone over the greatest available area, substantially as described.

2. A gear in accordance with Claim 1, in which the cavity in the rocking lever has a cylindrical wall and the end portion of the tappet rod entering the said

cavity is enlarged into a frusto-conical form, the larger diameter flat surfaced end of which coacts with the convex bottom of the cavity.

5 3. A gear in accordance with Claim 1 or 2, in which a convex surface is formed at the bottom of the cavity in a rocking lever by a pressing or like operation, substantially as described.

10 4. A method of forming a curved contact surface for a rolling motion in a rocking lever of a valve-actuating gear

comprising forming a flat surface at the end of a positioning cavity and transforming said flat surface into a curved surface by means of a die or like pressure appliances. 15

5. Improvements in or relating to valve-actuating gear, substantially as described with reference to the accompanying drawings. 20

Dated this 6th day of November, 1924.

MARKS & CLERK.

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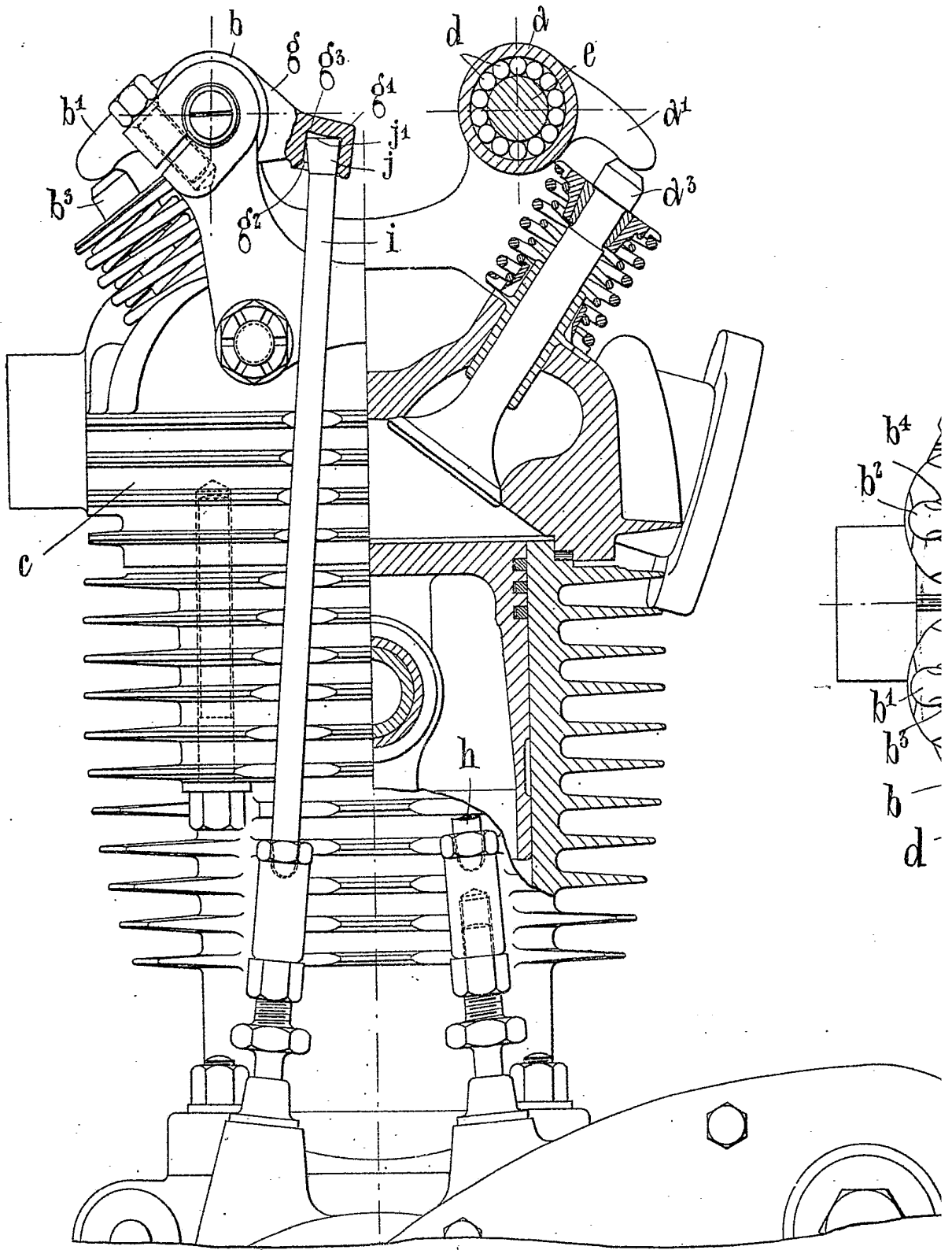


Fig.1.

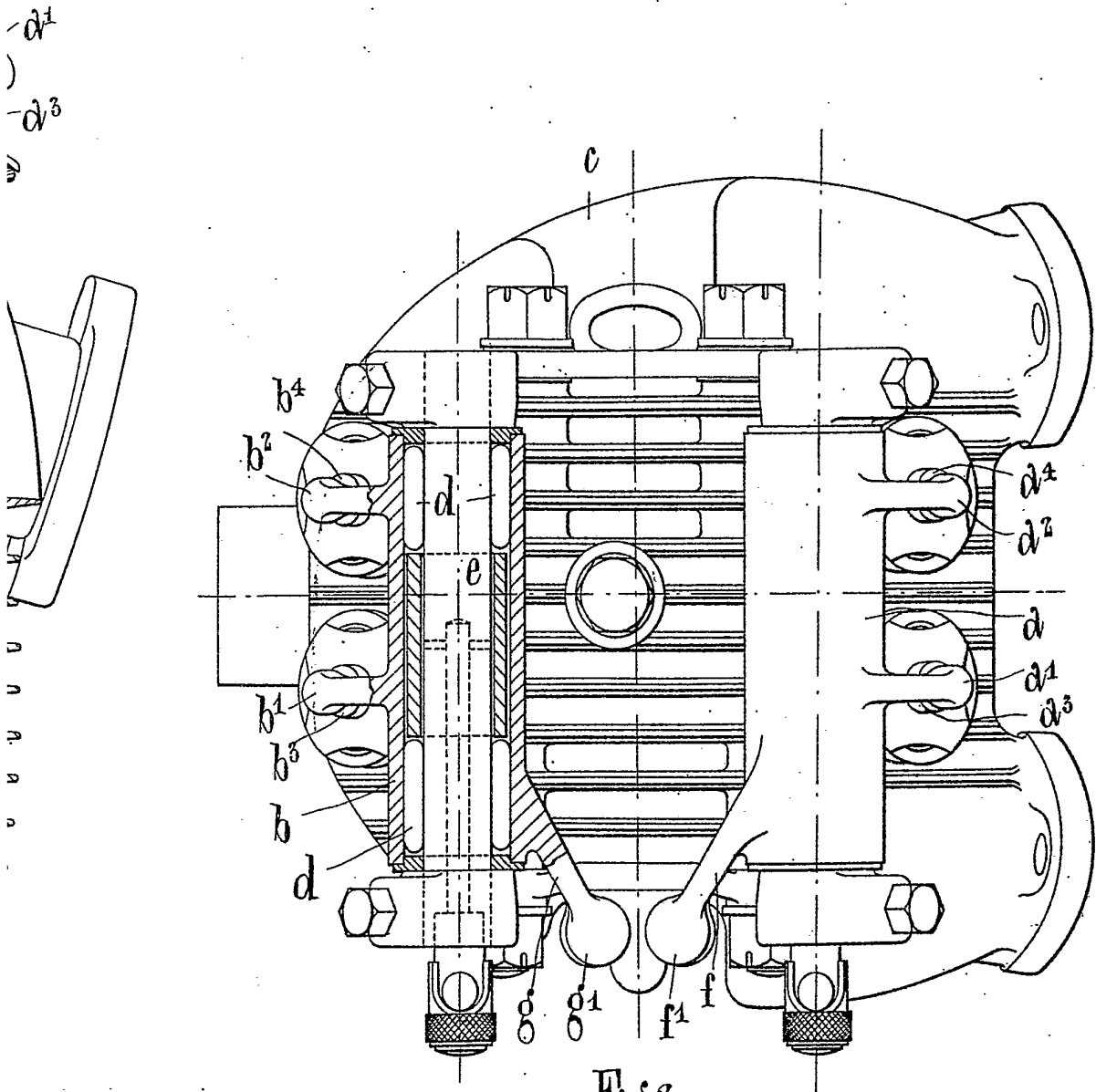
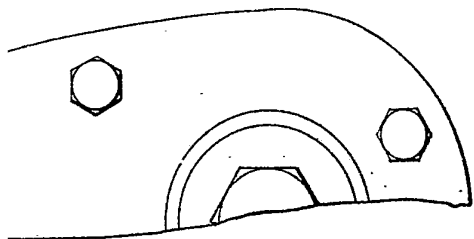
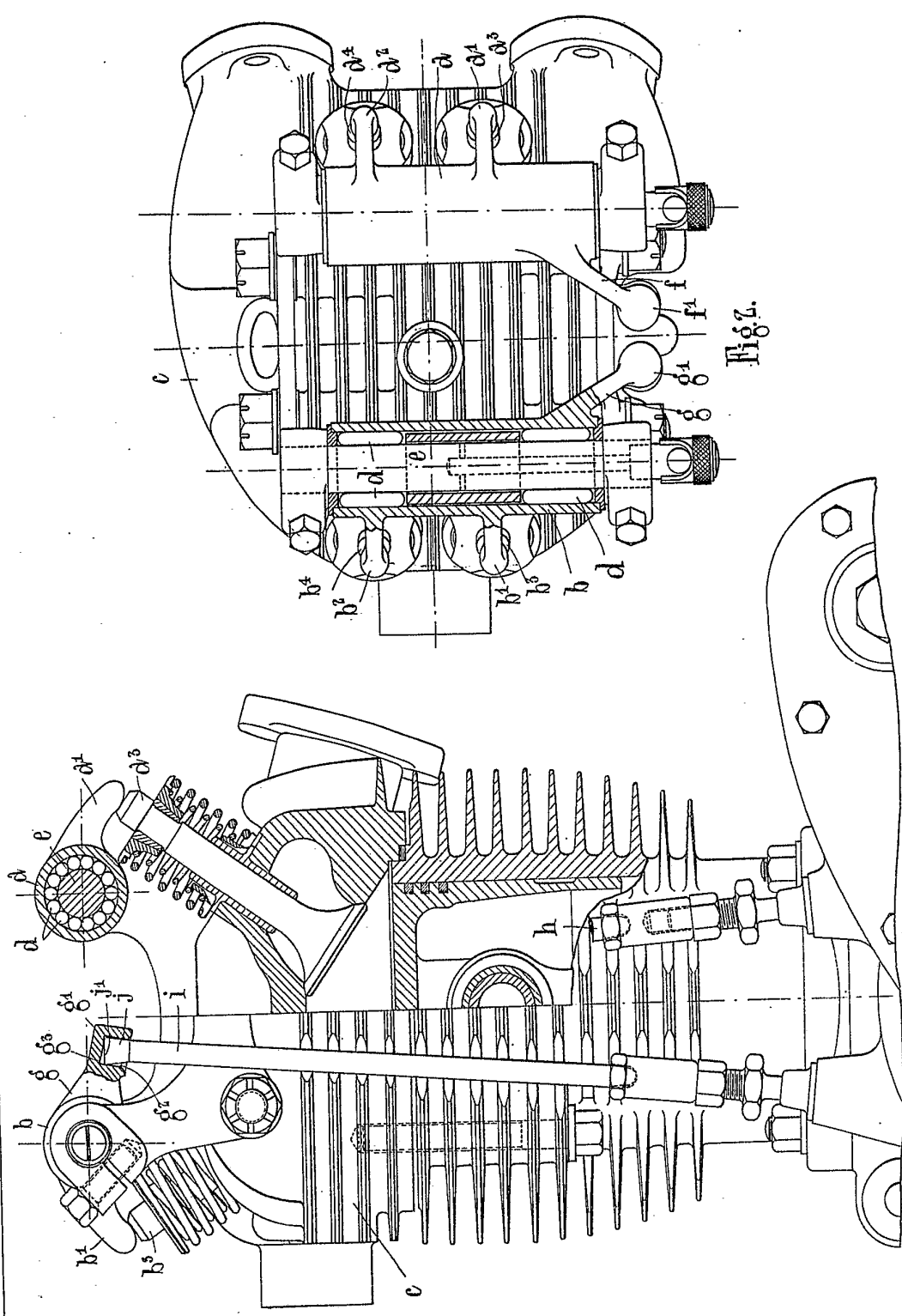


Fig. 2.



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[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 2.

Fig. 1.

[This Drawing is a reproduction of the Original on a reduced scale]

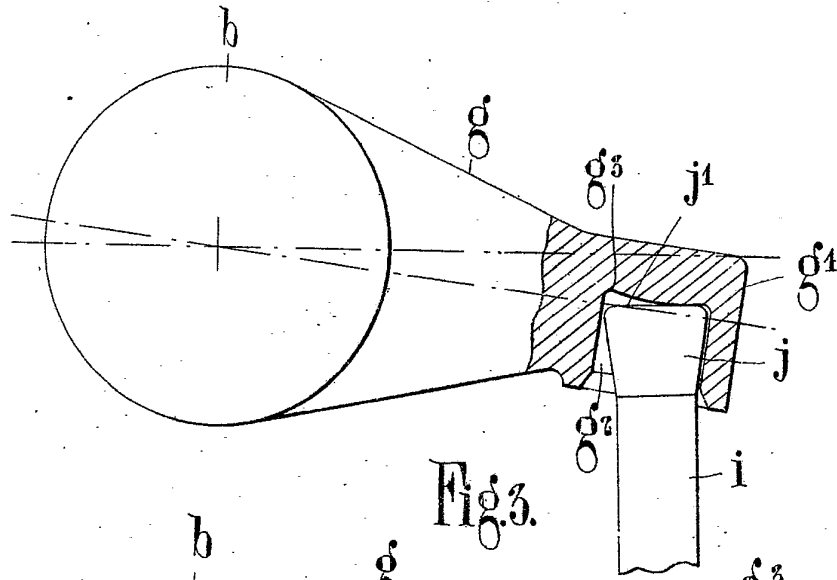


Fig. 3.

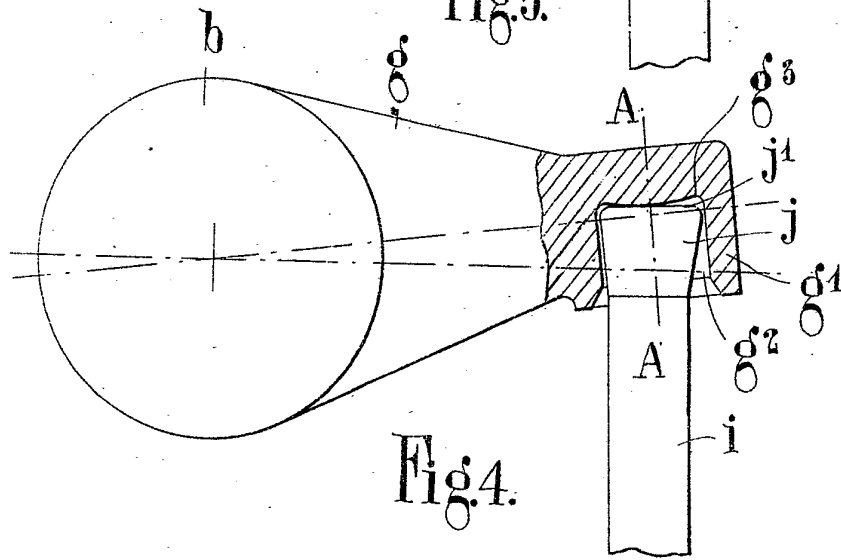


Fig. 4.

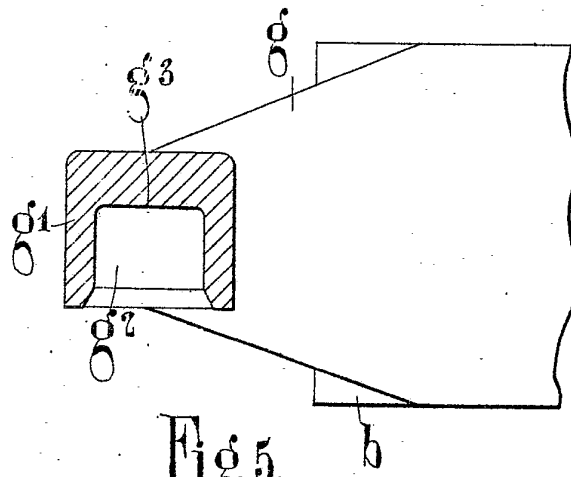


Fig. 5.