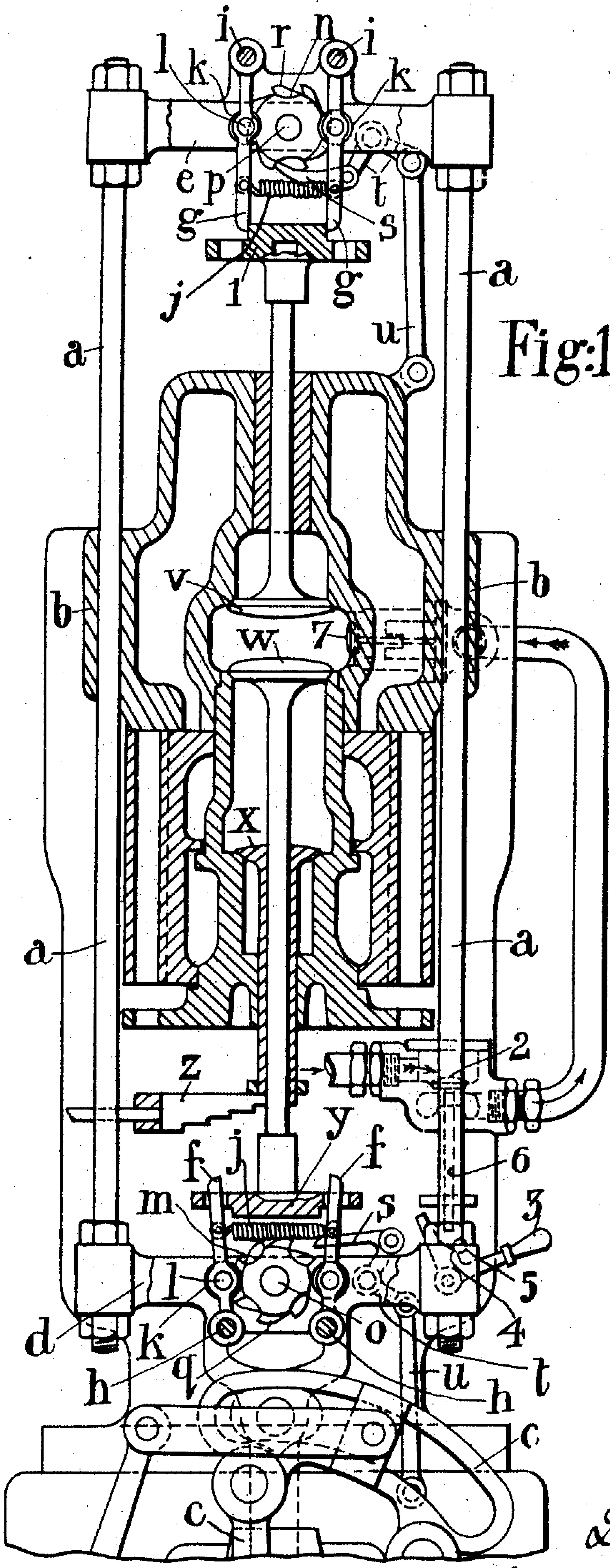
M. BRIGGS.

VALVE GEAR AND IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED AUG. 14, 1908.

927,484. Patented July 13, 1909.

5 SHEETS—SHEET 1



Witnesses:
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5 SHEETS—SHEET 2.

Fig:2

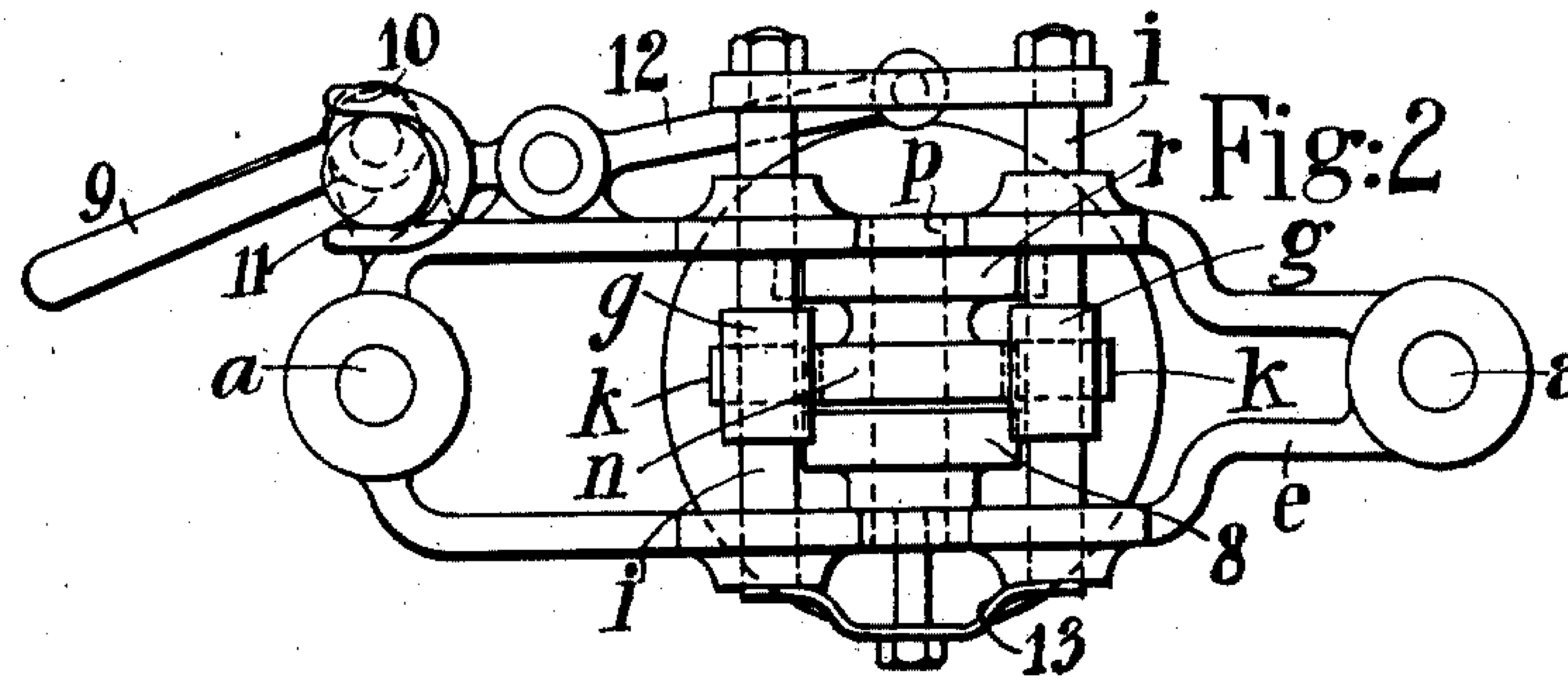


Fig:3

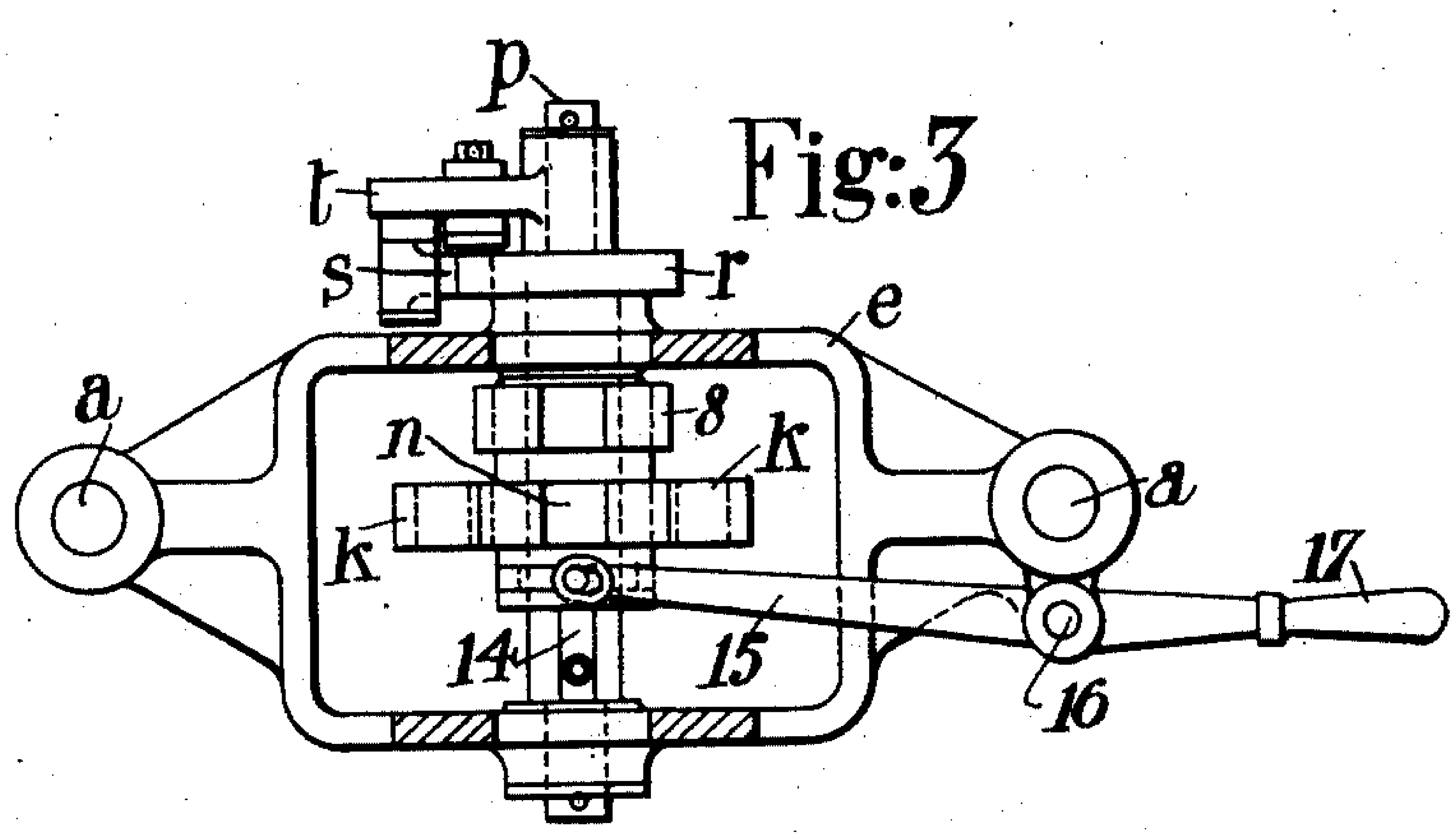
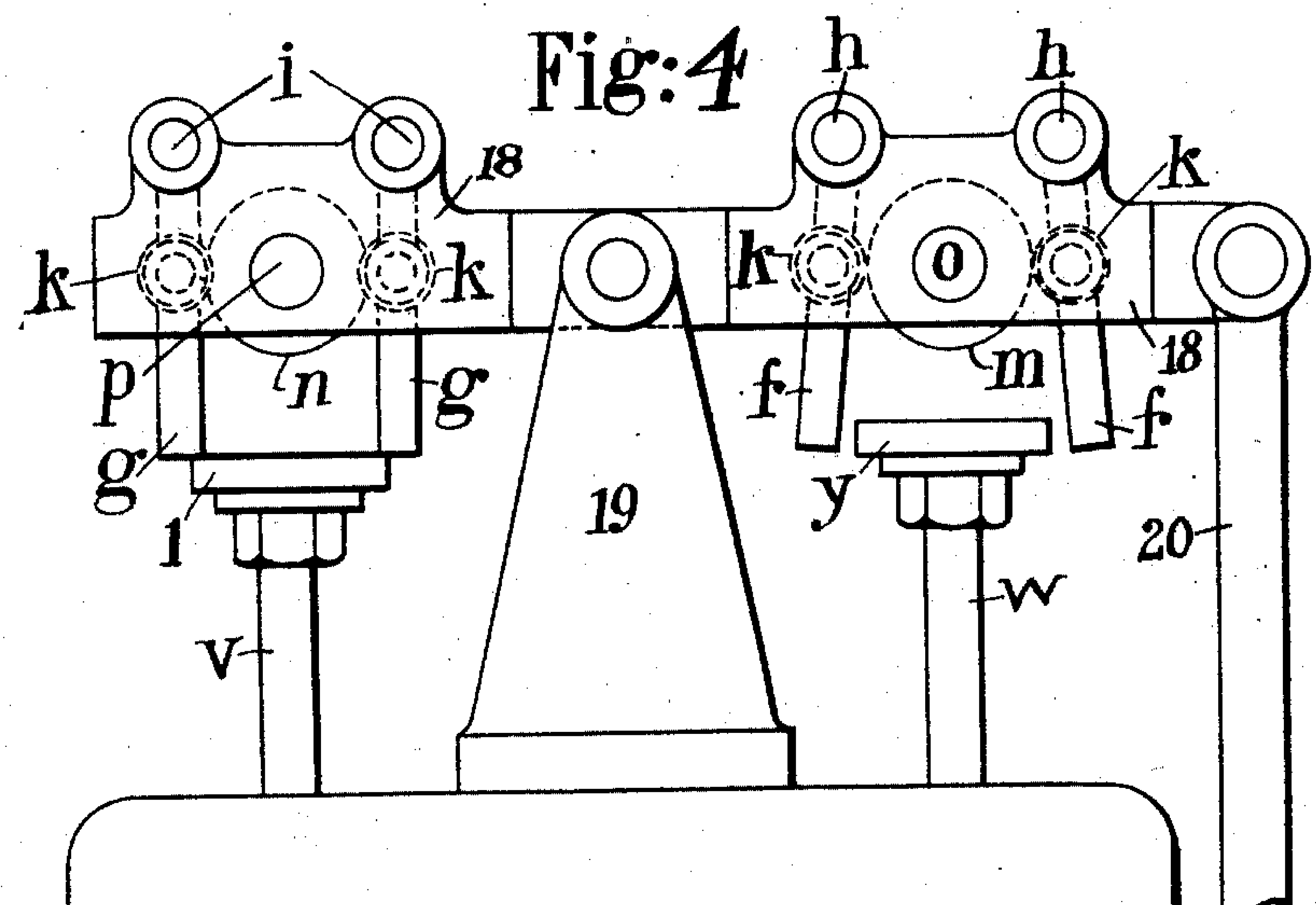


Fig:4



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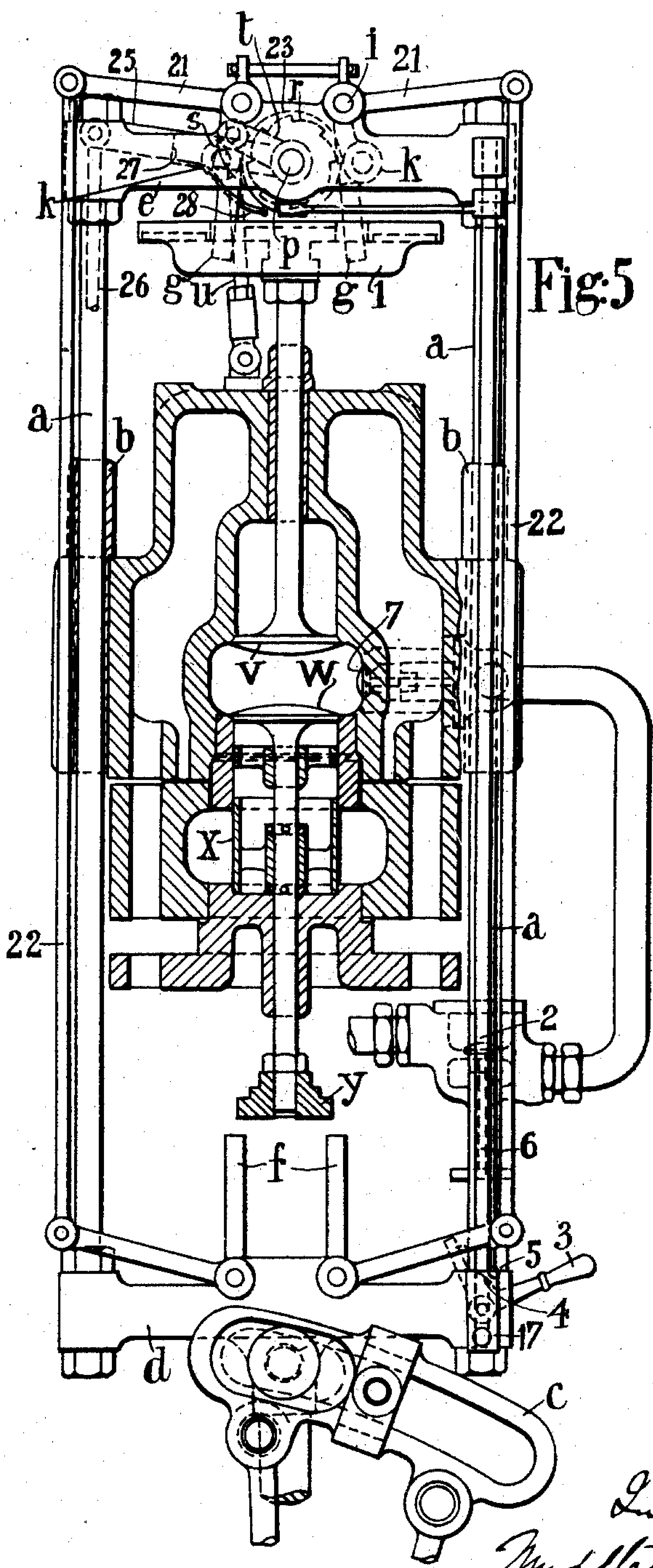
5 SHEETS—SHEET 3.

Fig:5



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5 SHEETS—SHEET 4.

Fig:6

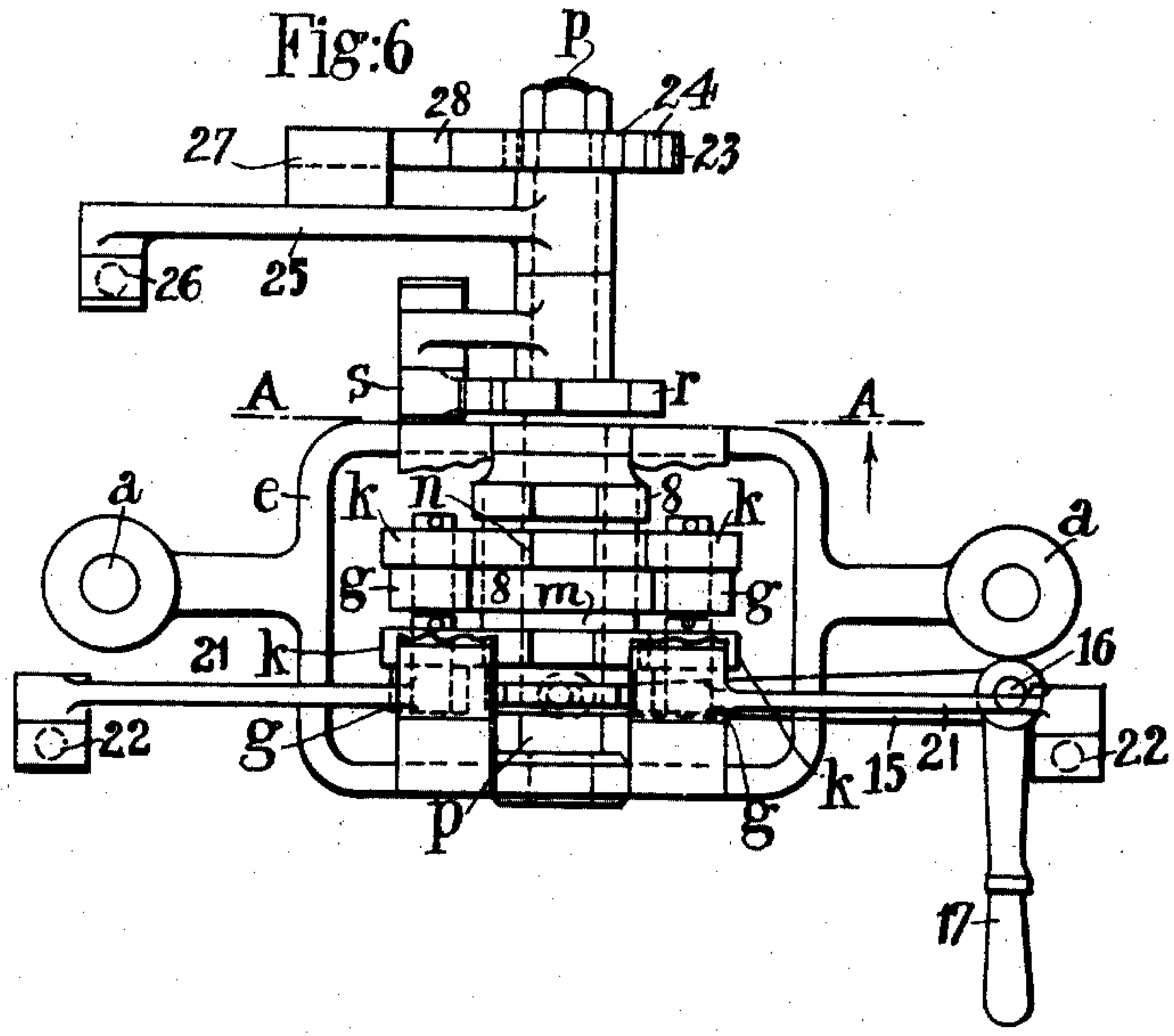
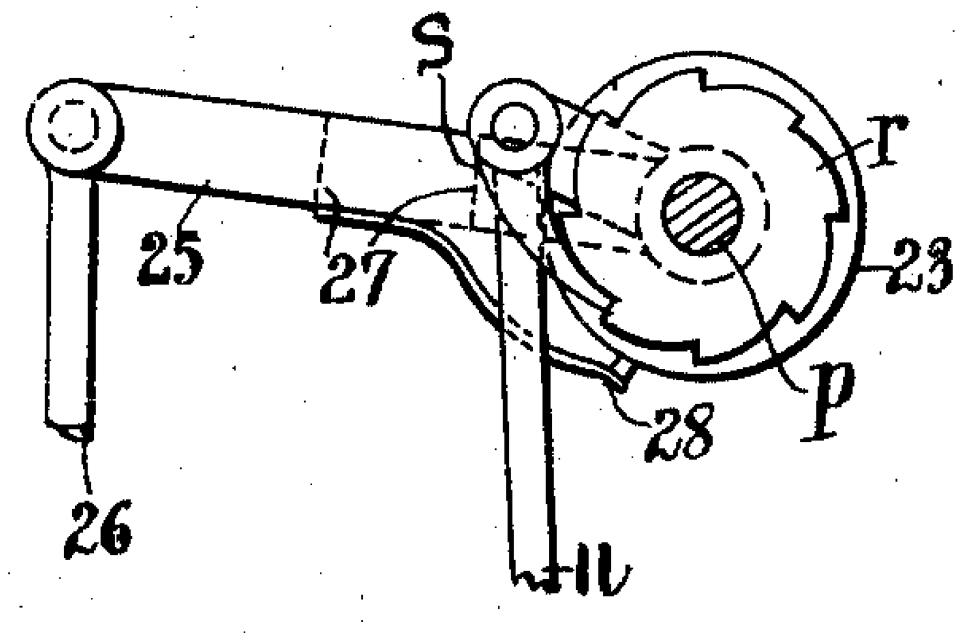


Fig: 8



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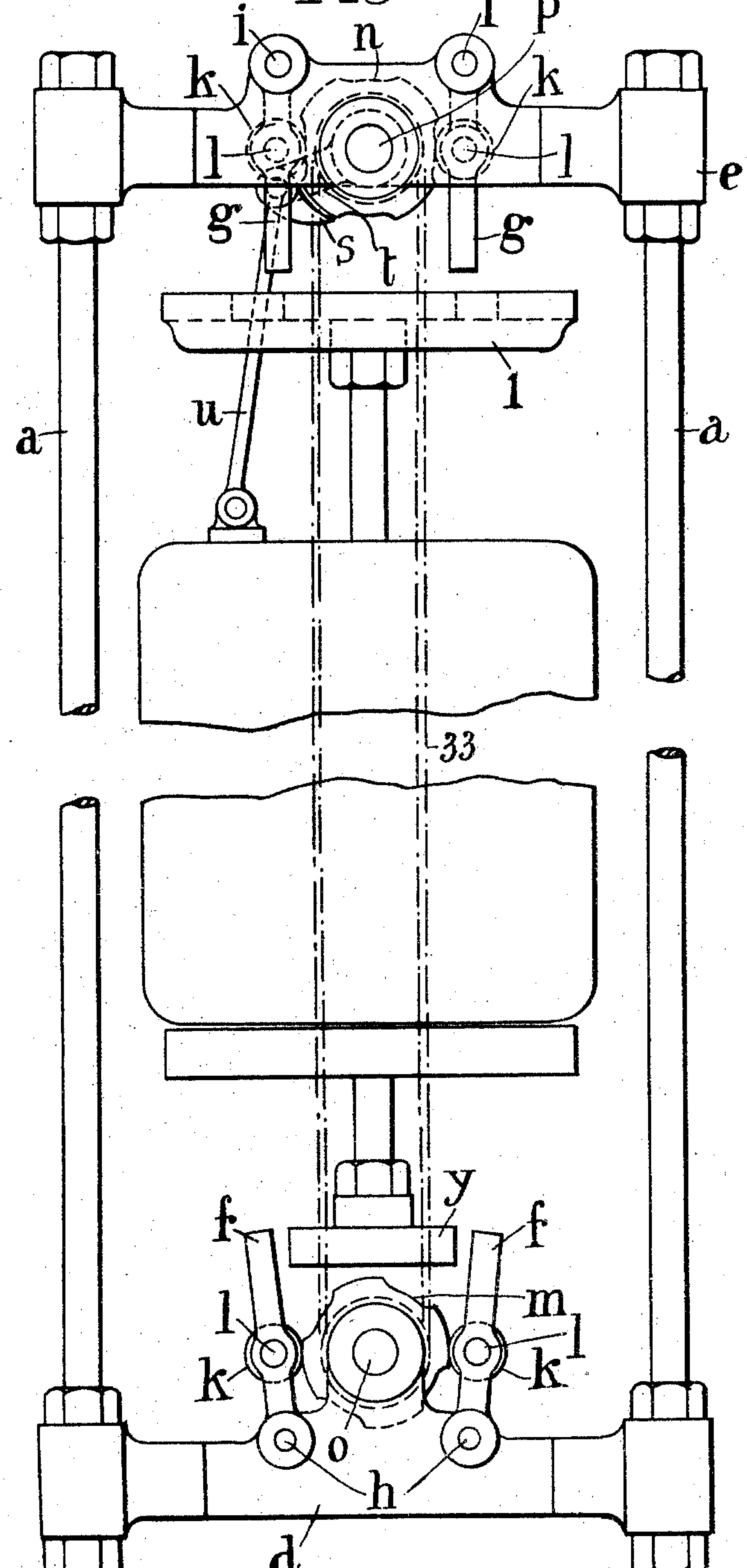
5 SHEETS—SHEET 5.

Fig: 7



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UNITED STATES PATENT OFFICE.

MYDDLETON BRIGGS, OF LLANELLY, ENGLAND.

VALVE-GEAR AND IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

No. 927,484. Specification of Letters Patent. Patented July 13, 1909.

Application filed August 14, 1908. Serial No. 448,633.

To all whom it may concern:

Be it known that I, MYDDLETON BRIGGS, a subject of the King of Great Britain, residing at Llanelly, in the county of Carmarthen, England, have invented new and useful Improvements in Valve-Gear and Ignition Apparatus for Internal-Combustion Engines, of which the following is a specification.

The invention has for its objects an improved valve gear and ignition device which may be made reversible for internal combustion engines working on the four or more cycle principle and especially adapted for marine work.

The invention relates to that type of internal combustion engine in which the valves are operated directly from the crank shaft.

I will describe my invention by the aid of the accompanying drawings, in which—

Figure 1 is an elevation partly in section of my improved valve gear. Fig. 2 is a plan of parts required to enable the engine to be put on either half compression or on full compression, and Fig. 3 is a sectional plan showing a modified arrangement for the same purpose. Fig. 4 is an elevation of parts indicating a modified method of mounting the trip levers, cam wheels and other parts. Fig. 5 is an elevation partly in section showing a simplified form of apparatus for operating the inlet valve. This figure also shows the improved ignition apparatus. Fig. 6 is a plan of parts of Fig. 5. Fig. 7 is an elevation showing a further modification in the valve gear. Fig. 8 is a vertical section on line A—A of Fig. 6.

Referring to Fig. 1, *a, a* are a pair of vertical rods which are mounted in suitable guides *b* and have a regular up and down motion imparted to them by a single eccentric, when the gear is not used for reversing, or when capable of reversing by two eccentrics mounted on the crank shaft and combined with any suitable reversing gear, such for instance as the ordinary Stephenson link motion, parts of which are shown at *c, c*. To the ends of these vertical rods *a, a*, are fixed carriers or crossheads *d, e*, which crossheads are capable of adjustment on said rods. The rods *a* and crossheads *d, e*, thus form a movable frame which, as hereinafter described, carries the gear for raising the valves from their seats. These crossheads are each provided with a pair of trip levers *f, f*, or *g, g*, which are mounted on pins *h, h*, or *i, i*, and are pulled toward each other by springs *j*. These trip levers have each, near the center of their length, a hardened roller *k*, mounted on a pin *l*. Under normal conditions these rollers engage with the full compression cams *m, n*, which have a suitable number of indentations on their peripheries. These full compression cams are respectively fixed on spindles *o, p*, and they are automatically operated by means of ratchet wheels *q, r*, also respectively fixed on said spindles and acted upon by pawls *s* which may be carried by some fixed point, or as shown in Fig. 1, by crank levers *t* connected to links *u*, pivoted to stationary parts of the engine or framing. The exhaust valve *v* and the inlet valve *w*, are very similar to those in use on ordinary gas engines, and the gas valve *x* is preferably arranged concentrically with the inlet valve *w*. All the valves are held to their seats by the usual springs, which are not shown.

The action of the gear is as follows:—Supposing the engine crank shaft to be revolving on the out stroke or suction stroke of the engine, and the hardened rollers *k*, of the lower trip levers *f* in the indentations of the lower full compression cam *m*, then such trip levers *f* approach underneath a plate *y* connected to the stem of the inlet valve *w*, which plate is thereby raised at the same speed as the vertical rods *a*; the air inlet valve *w* is thus opened and, if the governor die *z* (a stepped plate moved by the governor) is in a suitable position, the gas valve *x* is also raised and the rising is greater or less according to the position of the governor die *z*. If a governor is not used the gas valve *x*, is connected to the inlet valve *w*, and moves therewith. The gas valve *x*, when not concentric with the air inlet valve *w*, may be operated by a tappet or projection on the stem of said valve *w*, as will be readily understood. The vertical rods *a* now descend carrying with them both pairs of trip levers *f, g*, during which motion, after a certain portion of the stroke, the lower trip levers f free themselves from the plate y connected to the stem of the inlet valve w and both the inlet valve w and gas valve x are closed. The ratchet wheel q connected with the lower full compression cam m, now causes said cam to revolve through a sufficient number of degrees to cause the lower trip levers f to move apart, and on the next upstroke of the vertical rods a, the first part of which corresponds to the latter portion of the compression stroke, and the last part to the first half or thereabout of the explosion stroke of the engine, said lower trip levers f pass through holes in the plate y and thereby fail to raise the inlet valve w and gas valve x.

The action of the exhaust valve v is very similar to that above described for the inlet valve w with the exception, that when said valve v is nearing its seat, the upper trip levers g are caused to move apart by the rotation of the cam n, thus passing through the plate 1 attached to the stem of the exhaust valve v and thereby allowing said valve to close immediately by the action of the exhaust valve closing spring, although the vertical rods a have not actually attained a similar relative position. The reason for this is due partly to the fact that, taking into consideration the ordinary valve settings, it is necessary to have both the inlet valve w and exhaust valve v open together for a period of about 20 degrees at the end of the exhausting stroke.

In order to prevent undue shock and wear taking place when the exhaust valve v comes onto its seating, a suitable dash-pot is preferably arranged in connection with said exhaust valve, as will be readily understood.

The plates y and 1 connected respectively to the inlet valve w and exhaust valve v and their co-acting trip levers f and g, may be so arranged that the said trip levers may, when required, be caused to pass outside the edges of said plates instead of through holes therein.

The engine may be started in the usual way by compressed air which is admitted into the cylinder at every outstroke of the piston by a valve 2 operated by a lever 3 carried by the cross head d and having an inclined plane 4 thereon. A stud 5 to act on the said inclined plane 4 is fixed to a stationary part of the engine or frame. Immediately the inclined plane 4 of the lever 3 comes in contact with the stud 5 the lever 3 is tripped off the valve rod 6, thus allowing the valve 2 to shut. When the engine is not running on compressed air the said lever 3 may be thrown out of action. A suitable non-return valve 7 is fixed in the combustion chamber in connection with the compressed air supply.

The engine is put on half compression by causing the half compression cams 8 to act on the upper and lower pairs of trip levers f, g. This may be effected in the manner shown at Fig. 2 by sliding the rollers k of both the upper and lower pairs of trip levers f, g, on to the half compression cams 8 which may be effected by means of a lever 9 giving motion to a shaft 10 on which eccentrics 11 are fixed. These latter give motion to levers 12 connected with the pins h, i, to which the trip levers f, g, are fixed, or by other suitable means. Suitable springs 13 are provided to keep all the hardened rollers k normally in their full compression positions. Or the arrangement shown at Fig. 3 may be adopted in lieu of that shown at Fig. 2. In this arrangement the full compression cams m, n, and the half compression cams 8 are arranged in such manner as to be capable of being slid upon the spindles o and p, which spindles are fitted with suitable feathers or keys 14. The cam n is shown engaging the trip lever rollers k, and the cam m will at the same time be in engagement with the trip levers f, which is the normal running position of the cams m, n. Half compression is obtained by sliding the half compression cams 8 into a similar relative position, that is to say, in engagement with the trip lever rollers k. This may be effected by means of levers 15 fixed on a vertical shaft 16 on which is also fixed an operating lever 17.

When the engine is started by external means, such as by giving motion to the fly wheel by hand et cetera, it is only necessary to move the upper half compression cam 8, in which case the lever for moving the lower cams is disconnected and the full compression cam remains in position all the time.

If so desired the main reversing lever (not shown), as also the air valve lever 3 and the half compression lever 9 or 17, may be linked together so as to be operated by one movement.

By the present invention I obviate the necessity of a two to one reduction gearing, cam shafts and their necessary bearings and other parts heretofore employed, and I obtain a means of easily and positively reversing an internal combustion engine. The invention is equally applicable to an engine running in one direction only, in which case the otherwise necessary reversing motion can be dispensed with, one eccentric only attached to the lower crosshead d being sufficient.

I would remark that the motion of the eccentrics is much more rapid than would be the case if the latter were mounted on a cam shaft running at half the speed of the crank shaft.

When the improved valve gear is used in connection with a double acting engine or with an engine having two single acting or double acting cylinders placed in tandem, that is, in one and the same center line and in which also the separate valve boxes of each cylinder or each end of a cylinder are placed directly over one another or thereabout, the vertical rods a may have attached to them and operate as many pairs of crossheads d, e, as may be required.

In the modified arrangement shown diagrammatically at Fig. 4, like parts are marked with similar characters of reference to those used in Fig. 1. In this case the cams, trip levers and other parts operating the inlet valve w, are mounted on one side of a frame 18, which is pivoted at its center to a standard 19, while the cams, trip levers and other parts operating the exhaust valve v are mounted on the opposite side of said frame 18. The valves w and v are correspondingly arranged on each side of the standard 19 so that their plates y and 1 can be acted upon by the respective trip levers f and g. The valves w and v are in this modification both arranged to be opened by the downward motion of their trip levers.

A rocking motion is imparted to the frame 18 by the actuating rod 20 which when a reversing action is required, is coupled up to the Stephenson or other reversing gear as before described. By this means an up and down motion is imparted to the trip levers, each pair of which is capable of acting to open its respective valve on its downward stroke and one set of trip levers moves in the direction of its relative valve during 180 degrees of rotation of the engine crank shaft, while the other set moves in the direction of its relative valve during the remaining 180 degrees of rotation of the crank shaft, as described with respect to Fig. 1. In this arrangement any suitable means may be applied to give parallel motion to the trip levers and their respective parts to obviate the angular motion which would otherwise occur when the trip levers approach the plates y and 1.

In the modification shown in Figs. 5 and 6 I use only one ratchet wheel r for giving motion to both pairs of cam wheels m, n, and I mount both the inlet and exhaust cam wheels m, n, 8, 8, on the same spindle p as that of the ratchet wheel r. The spindle p of the cams m, n, 8, 8, and ratchet wheel r is preferably mounted in the top or exhaust crosshead e, which crosshead is attached by vertical rods a, a, to the lower crosshead d. In normal running the exhaust cam n engages the rollers k of the exhaust trip levers g and the inlet cam m engages the rollers k of inlet crank trip levers g, 21, which latter by means of rods 22 impart motion to inlet trip crank levers f, f. The exhaust and inlet cam wheels m, n, are provided with the same number of indentations while the teeth of the ratchet wheel r are double the number of the indentations of one of said wheels m, n.

The electrical timing gear is arranged as follows:—On the spindle of the ratchet wheel r and cam wheels m, n, 8, 8 is keyed a fiber wheel 23 or a wheel of other suitable non-conducting material, this wheel is provided with contact pieces 24 equally spaced around its periphery to the same number as there are indentations in one cam wheel and these contact pieces 24 are in electrical connection with the aforesaid spindle p. A suitable rocking arm 25 is so arranged upon the said spindle p as to be capable of being rotated by a rod 26 through the requisite number of degrees to advance or retard the ignition as the case may be. An insulating block 27 is provided with a contact spring or brush 28. As the ratchet wheel r has twice as many teeth as there are contact pieces 24 in the fiber wheel 23 and as the latter is keyed in suitable relative position on the ratchet wheel spindle p the contact spring or brush 28 only comes in contact with the contact pieces 24 in the fiber wheel 23 on every alternate upstroke of the vertical rods a, a, connecting the cross heads d, e, the actual moment of contact being controlled by the position of the rod 26 connected to the rocking arm 25 carrying the contact spring or brush 28, which arm 25 may be held and regulated by any suitable device.

The above arrangements are equally applicable whether the cross heads are arranged one above another or whether they are arranged at or near opposite ends of a horizontal rocking bar or frame, as shown at Fig. 4, so that the cams m, n, 8, 8, and trip levers f, g, receive an up and down motion by an actuating rod or rods coupled up to a single eccentric or suitable reversing gear as above described.

By the herein described arrangement of parts shown at Figs. 5, 6 and 8 the exhaust and inlet cams, a single ratchet wheel and the electrical timing contact wheel are all fixed on the same spindle, thus dispensing with a second spindle having either the exhaust or inlet cams thereon and consequently with means for driving said second spindle.

In the modification shown in Fig. 7 I also dispense with one ratchet wheel and its operating parts giving motion to one of the pairs of cams n, 8, as described with respect to Figs. 5 and 6, and we give motion from the upper axle p to the axle o, of the other pair of cams m, 8, by means of a chain 33 as shown or by toothed gearing as will be understood.

The action of the trip levers f, g, in the apparatus shown in Figs. 5, 6 and 7 is similar to that described with respect to Figs. 1 to 4.

What I claim is:—

1. In a valve gear for internal combustion engines the combination with the crank shaft, of a reversing gear operated direct from said crank shaft, a frame receiving a reciprocating movement from said reversing gear and means carried by the frame for opening the inlet and gas valves when the frame is moving in one direction and for opening the

exhaust valve when the frame is moving in the opposite direction substantially as set forth.

2. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of a frame, means operated by the crank shaft for giving a reciprocating motion to said frame, two pairs of pivoted trip levers mounted on said frame, a spring acting to pull the levers of each pair of trip levers toward each other, means carried by said frame to cause the trip levers to move apart, and means operated by the trip levers for opening the inlet and gas valves when the frame is moving in one direction, and for opening the exhaust valve when the frame is moving in the opposite direction, substantially as set forth.

3. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of reversing gear, a frame receiving reciprocating motion from said reversing gear, two pairs of pivoted trip levers mounted on said frame, means acting to pull the levers of each pair of trip levers toward each other, means carried by said frame to cause the trip levers to move apart, and means operated by said trip levers for opening the inlet and gas valves when the frame is moving in one direction and for opening the exhaust when the frame is moving in the opposite direction, substantially as set forth.

4. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of a frame, means operated by said crank shaft for giving a reciprocating motion to said frame, trip levers mounted on said frame, means carried by the frame for positively moving said trip levers into operative and inoperative positions and means operated by the trip levers for opening the inlet and gas valves when the frame is moving in one direction and for opening the exhaust valve when the frame is moving in the opposite direction substantially as set forth.

5. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of a frame, reversing gear, operated by said crank shaft, for giving a reciprocating motion to said frame, trip levers mounted on said frame, means carried by the frame for positively moving said trip levers into operative and inoperative positions and means operated by the trip levers for opening the inlet and gas valves when the frame is moving in one direction and for opening the exhaust valve when the frame is moving in the opposite direction, substantially as set forth.

6. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of a frame, means operated by said crank shaft for giving a reciprocating motion to said frame, cams carried by said frame, means operated by a stationary part of the engine for intermittently rotating said cams and pivoted trip levers carried by said frame and actuated by said cams for opening the inlet, gas and exhaust valves, substantially as set forth.

7. In a valve gear for internal combustion engines, the combination with the crank shaft of the engine, of a frame, reversing gear operated by said crank shaft for giving a reciprocating motion to said frame, cams carried by said frame, means operated by a stationary part of the engine for intermittently rotating said cams and pivoted trip levers carried by said frame and actuated by said cams for opening the inlet, gas and exhaust valves, substantially as set forth.

8. In a valve gear for internal combustion engines, the combination with a frame, of means for giving a reciprocating motion to said frame, two full compression cams and two half compression cams carried by said frame, means for intermittently rotating said cams, rollers actuated by said cams, and pivoted trip levers actuated by said rollers for opening the inlet, gas and exhaust valves, substantially as set forth.

9. In a valve gear for internal combustion engines, the combination with a frame, of means for giving a reciprocating motion to said frame, two full compression cams and two half compression cams carried by said frame, ratchet mechanism for intermittently rotating said cams, rollers actuated by said cams, and pivoted trip levers actuated by said rollers for opening the inlet, gas and exhaust valves, substantially as set forth.

10. In a valve gear for internal combustion engines, the combination with a frame, of means for giving a reciprocating motion to said frame, two full compression cams and two half compression cams carried by said frame, means for intermittently rotating said cams, rollers actuated by said cams, pivoted trip levers actuated by said rollers, inlet, gas and exhaust valves operated by said trip levers, and means for causing the full compression cams or the half compression cams to act on said rollers, substantially as set forth.

11. In a valve gear for internal combustion engines, the combination with a frame, of means for giving a reciprocating motion to said frame, two full compression cams and two half compression cams carried by said frame, means for intermittently rotating said cams, rollers actuated by said cams, pivoted trip levers actuated by said rollers for opening the inlet, gas and exhaust valves, and means for operating the compressed air starting valve carried by said frame, substantially as set forth.

12. In a valve gear for internal combustion engines, the combination with a frame, of means for giving a reciprocating motion to

said frame, two full compression cams and two half compression cams carried by said frame, means for intermittently rotating said cams, rollers actuated by said cams, pivoted trip levers actuated by said rollers for opening the inlet, gas and exhaust valves, a wheel made of insulating material rotating with one of said cams, contact pieces on said wheel and a brush acting in conjunction with said contact pieces, substantially as set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

MYDDLETON BRIGGS.

Witnesses:

TREVOR THOMAS,
DAVID LEWIS.