N. T. HARRINGTON.

VALVE GEAR FOR EXPLOSION ENGINES.

APPLICATION FILED JAN. 20, 1908.

951,910. Patented Mar. 15, 1910.

2 SHEETS—SHEET 1.

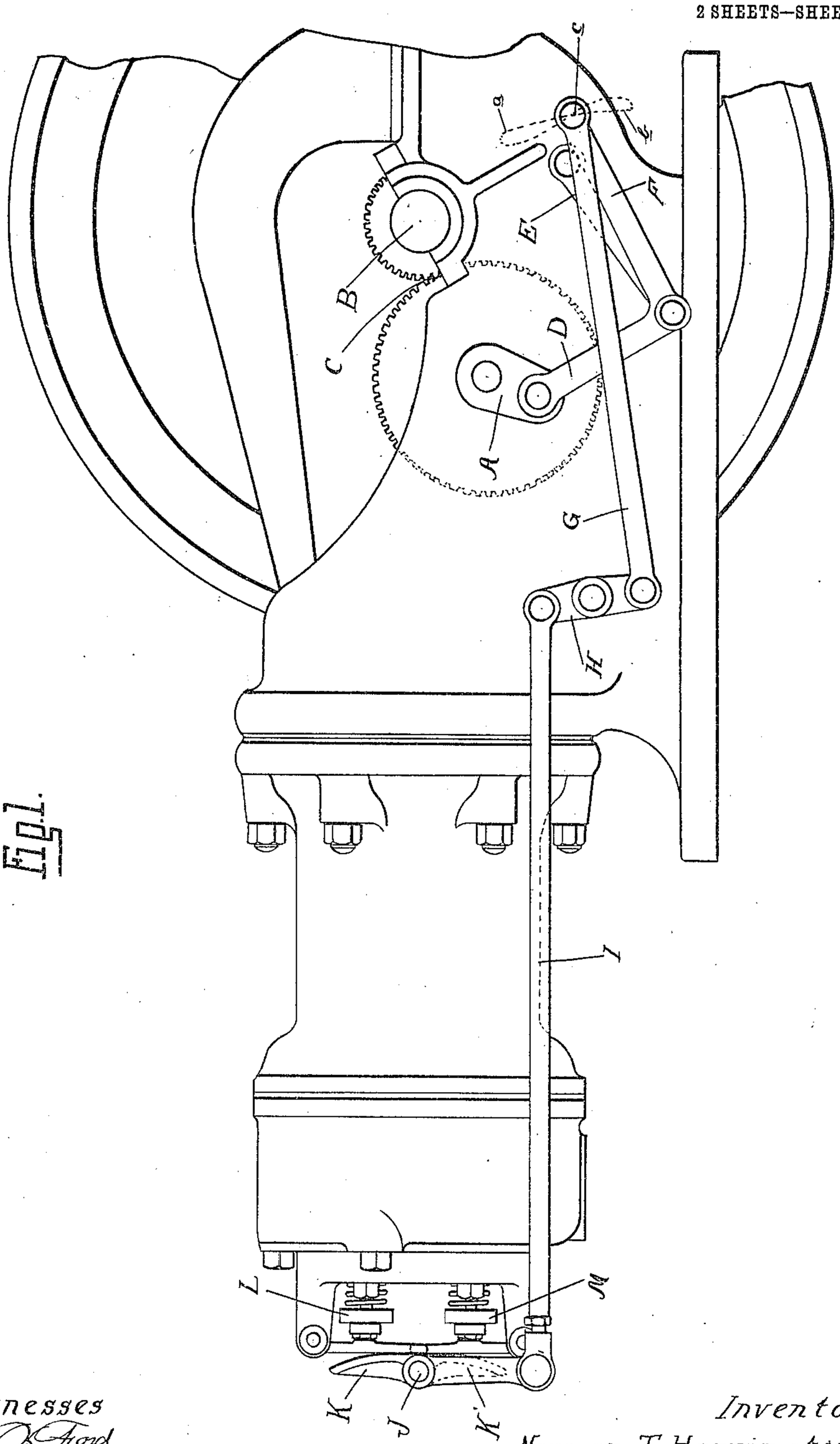

Fig. 1.

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Fig. 4.

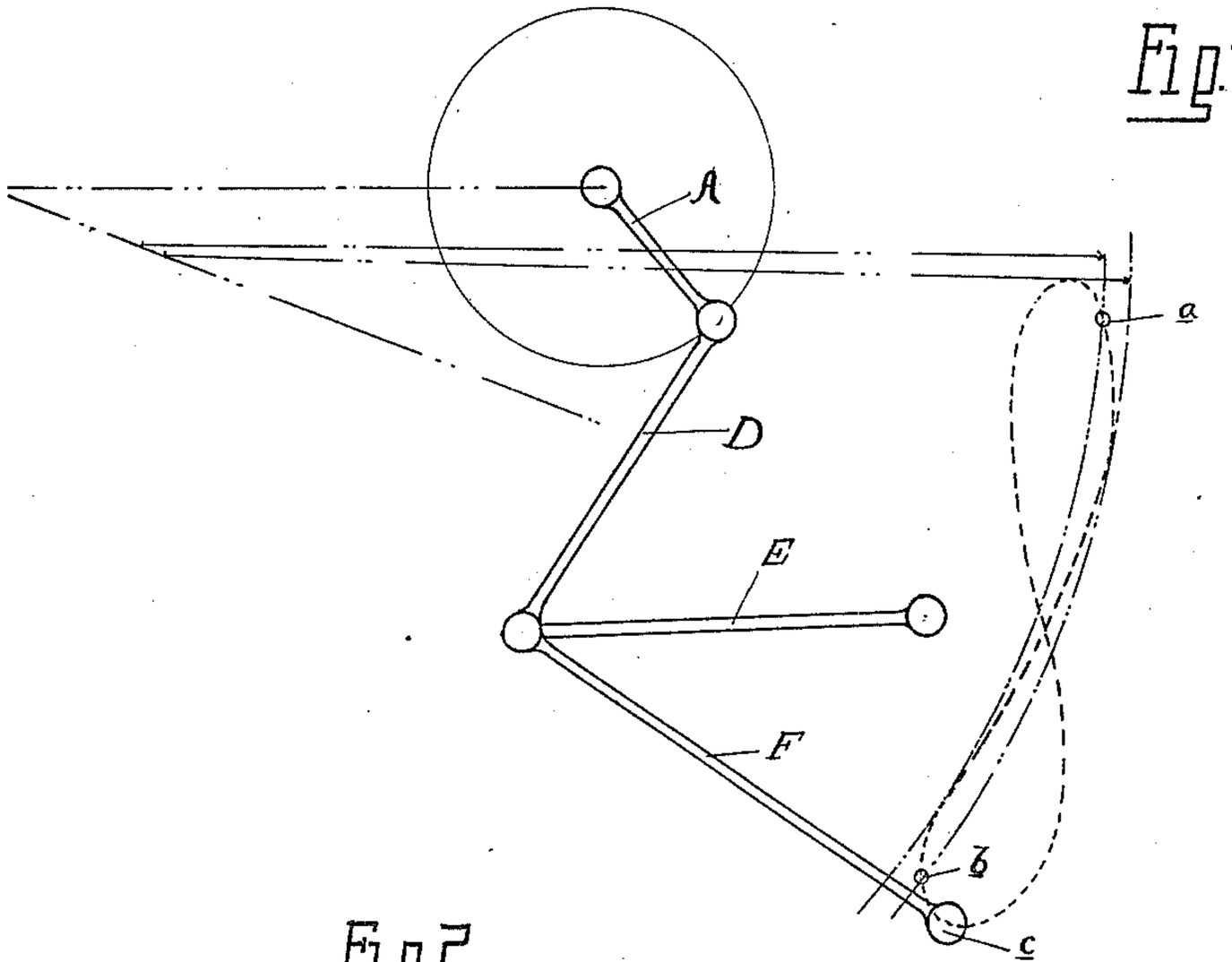
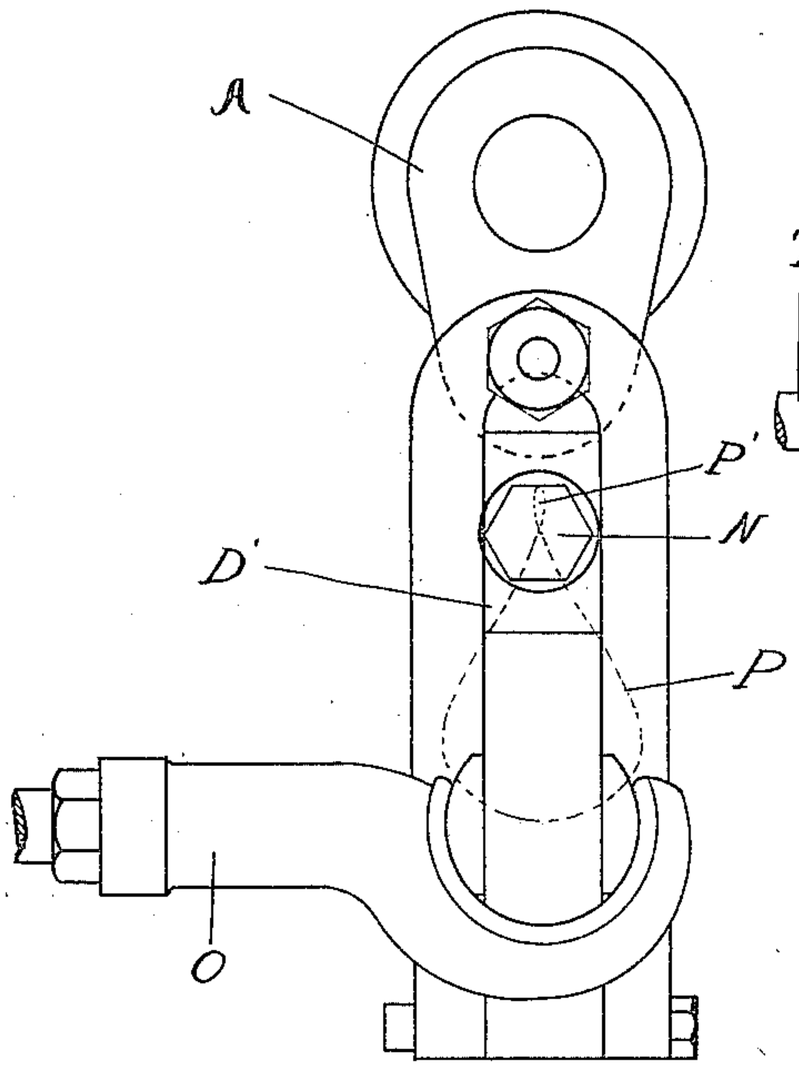
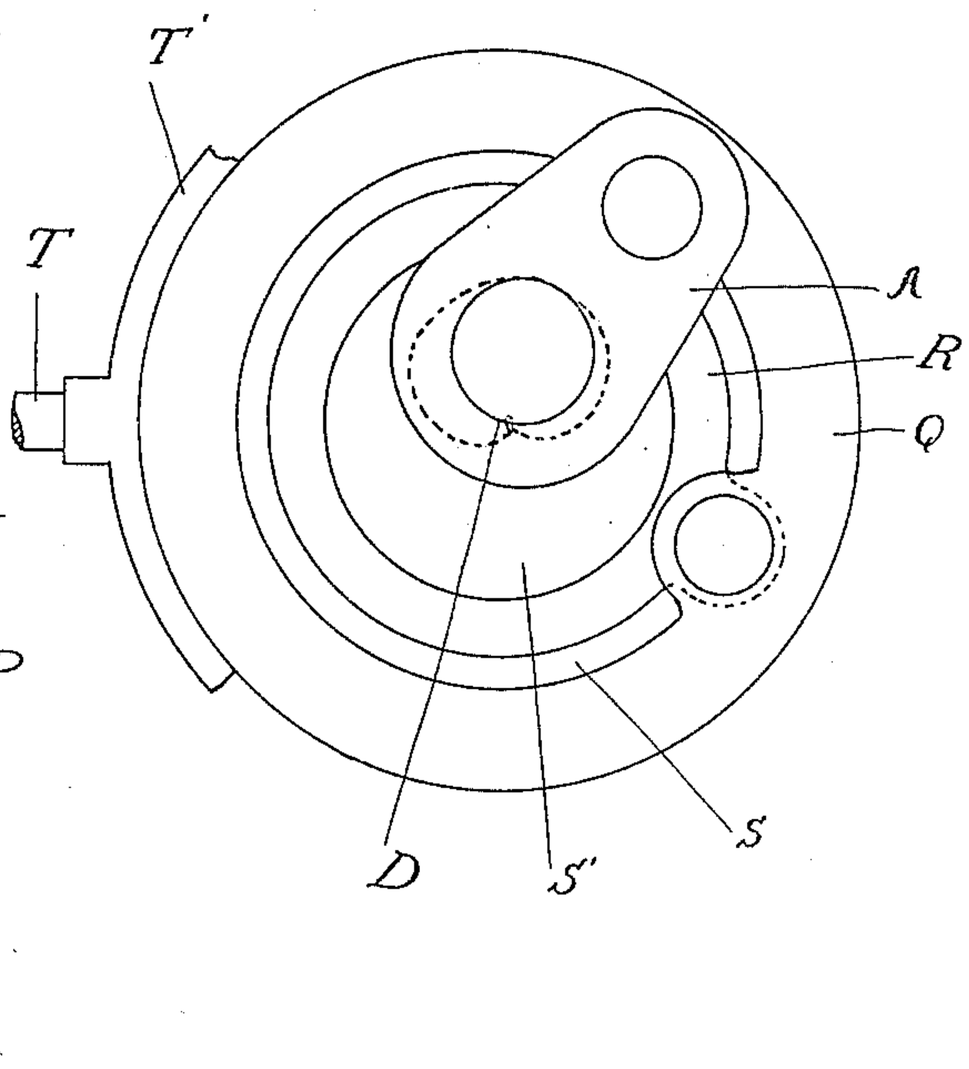


Fig. 2.

Fig. 3.





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VALVE-GEAR FOR EXPLOSION-ENGINES.

951,910. Specification of Letters Patent. Patented Mar. 15, 1910.

Application filed January 20, 1908. Serial No. 411,736.

To all whom it may concern:

Be it known that I, NORMAN T. HARRINGTON, a citizen of the United States of America, residing at Lansing, in the county of Ingham and State of Michigan, have invented certain new and useful Improvements in Valve-Gear for Explosion-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

It is the object of the invention to obtain a simple construction of valve operating mechanism adapted for controlling and properly timing the operation of the valves of an explosion engine of the four cycle type and avoiding the use of cams.

To this end the invention consists in the peculiar construction and organization of a system of pivotally connected levers as hereinafter set forth.

In the drawings—Figure 1 is a side elevation of an engine to which one form of my improved valve operating mechanism is applied; Figs. 2 and 3 are diagrammatic views illustrating modified forms of the construction; and Fig. 4 is a diagram illustrating the operation of the mechanism shown in Fig. 1.

The operation of a valve actuating mechanism for an explosion engine of the four cycle type is complicated by reason of the fact that the valves must both remain closed during one portion of the cycle (the greater part of compression stroke) while during the remaining portions of the cycle they are in operation. Thus a gearing such as might be employed for operating the valves of a steam engine cannot be used to produce this peculiar timing effect. On the other hand, there are many objections to the use of cams which are ordinarily employed for producing the proper timed operation of the valves.

My improved construction is based on the principle that any point in the length of a pitman, which is connected at one end to a rotating crank and at its opposite end, or at some point in its length, is guided to reciprocate in a fixed path, will trace a loop, the width of which is greater at one end than at the other. If the tracing point is located at one side of the axis of the pitman or in various other relations thereto a double loop or eight-shaped figure will be traced, and by properly selecting the point the relative sizes and positions of the two portions of the loop may be variously modified. In my improved valve gearing I make use of this principle to translate the continuous rotary movement of the crank into an intermittent reciprocatory movement of the valve actuating mechanism. The interval or period of rest is not one in which the reciprocatory movement is absolutely stationary, but one in which the amount of movement is so small as to be negligible.

My invention may be embodied in several types of construction, some of which are illustrated in the drawings.

As shown in Fig. 1, A is the rotary crank, which is preferably driven from the main crank shaft B of the engine through the medium of a 2 to 1 gearing C, so as to make one complete rotation for each cycle of the engine.

D is the rod or pitman, one end of which is connected to the crank, and E is a swinging link or rock arm connected to the opposite end of the pitman, and compelling it to reciprocate through the arc of a circle. Extending at one side of the pitman is an arm F preferably integral therewith, the free end of which is pivotally connected with a rod or link G. The point of the pivotal connection between these two members will trace a double loop, the two portions of which are of substantially equal length, but which are unsymmetrical with respect to the longitudinal axis, forming a warped eight-shaped figure. In this figure the portion between the points *a* and *b* closely approximates an arc, having a radius equal to the length of the rod G, and thus this rod will be moved angularly, but not longitudinally. On the other hand, during all of the movement of the pivot *c*, which connects the arm F and rod G, with the exception of that portion of its orbit which lies between the point *a* and *b*, will cause a longitudinal reciprocation of the rod G first on one side and then upon the other side of its neutral position.

To actuate the valves by the mechanism just described, any suitable means may be employed which provides the slight lost motion required to compensate for the deviation of the curve *a b* from a true arc. As shown the link G is connected to a rocker H which changes the direction of reciprocation and transmits it to a rod I connected to a valve actuating rocker J, and the compound levers K K′ are arranged to coöperate with

the rocker J and actuate respectively the valve stems L and M of the inlet and exhaust valves.

In Fig. 2 a modified construction is diagrammatically illustrated in which the crank A which may be driven by a two-to-one gearing (not shown) is connected to a pitman D′ slidably engaging a stationary pivot bearing N.

O is the reciprocatory valve actuating rod, which is pivotally attached to the pitman D′, the arrangement being such that during the rotation of the crank the pivot of the rod O will be moved upon opposite sides of the stationary pivot N. This will cause it to trace the double loop figure indicated in dotted lines at P, and in which the width of one of the loops P′ is so slight as to impart very little reciprocatory movement to the rod O. With this construction the interval of delay is that in which the small loop P′ is being traced, while during movement through the big loop the rod is reciprocated to actuate the valves.

In Fig. 3 still another modification is illustrated, in which the crank A is pivotally connected to a member Q, this member being also pivotally connected to a second crank R, which is eccentric to the first crank. The result is that the center *d* of the member R will trace a double looped figure indicated by dotted lines in which the large loop S contains within it a smaller loop S′, the latter being of very slight width. It is therefore only necessary to revolubly connect the member Q to the valve actuating rod T, as by means of the encircling strap T′, in order to communicate a properly timed reciprocation to the valve actuating member.

With each modification described, a positively connected system of levers is employed to translate the continuous rotary movement of the crank into intermittent reciprocatory movement of the valve actuating member. Furthermore in each the interval of delay is effected during the movement of the pivot through some portion of the double looped orbit.

What I claim as my invention is:

1. A valve-actuating mechanism for explosion engines of the four-cycle type, comprising a continuously rotating crank, a reciprocatory valve-actuating member having a period in its neutral position when it is substantially at rest, valves operated respectively by said member while upon opposite sides of its neutral position, and a plurality of positively connected members connecting said crank with the valve-actuating member and constructed to translate the movement of said crank into substantially intermittent movement of said valve-actuating member.

2. A valve-actuating mechanism for explosion engines of the four-cycle type, comprising a continuously rotating crank, a reciprocating valve-actuating member, inlet and exhaust valves operated respectively by said member while upon opposite sides of its neutral position, and a plurality of positively connected members connecting said crank with the valve-actuating member and constructed to translate the movement of said crank into reciprocatory movement of said valve-actuating member with a period including a portion of each of the compression and explosion strokes of the engine in which said valve-actuating member is substantially stationary.

3. A valve actuating mechanism for explosion engines of the four-cycle type, comprising a continuously rotating crank, a member pivotally connected to said crank, means determining the movement of said member whereby a point thereof will traverse a double looped orbit, a reciprocatory valve actuating member having a connection with said crank actuated member concentric to said point, whereby the movement of said crank is translated into reciprocatory movement of said valve actuating member, with a period including a portion of each of the compression and explosion strokes of the engine in which said valve actuating member is substantially at rest, and inlet and exhaust valves operated respectively by said last-mentioned member while upon opposite sides of its neutral position.

4. A valve actuating mechanism for explosion engines of the four-cycle type, comprising a continuously rotating crank, a member connected to and actuated by said crank, means for determining the movement of said member to cause a point therein to traverse an arc and other portions extending upon opposite sides of said arc portion, a reciprocatory valve actuating member, and a rod pivotally connected to said crank actuating member concentric with said point therein, the opposite end of said rod being connected to said valve actuating member at a point approximating the center of said arc during the tracing thereof by said point, whereby the movement of said crank is translated into reciprocatory movement of said valve actuating member with a period including a portion of each of the compression and explosion strokes of the engine in which said valve actuating mechanism is substantially at rest, and inlet and exhaust valves operated respectively by said last-mentioned member while upon opposite sides of its neutral position.

5. A valve actuating mechanism comprising a continuously rotating crank, a bell-crank lever having one arm pivotally connected to said crank, means engaging the fulcrum of said lever for determining the movement thereof in a fixed line, a reciprocatory valve actuating member and a radius

arm or link connecting said valve actuating member with the opposite arm of said bell-crank lever.

6. A valve operating mechanism comprising a continuously rotating crank, a bell-crank lever having one arm connected with said crank, a swinging fulcrumed link for said bell-crank lever, a reciprocatory valve actuating rod and a radius arm or link for connecting the opposite end of said bell-crank lever with said reciprocating rod.

7. A valve operating mechanism comprising a continuously rotating crank, a bell-crank lever having one arm attached to said crank, a swinging link to which said bell-crank lever is fulcrumed, a reciprocatory valve actuating rod, a radius arm or link connected to the opposite end of said bell-crank lever, and a rocker connection between said radius arm and valve actuating rod.

8. A valve operating mechanism for explosion engines of the four-cycle type comprising a member rockable in opposite directions from a neutral position to actuate the inlet and exhaust valves respectively, a continuously rotating crank, a member connected to and actuated by said crank, means for determining the movement of said member to cause a point thereof to traverse a double loop-shaped orbit, a radius arm connected to said member concentric with said point and a rod connecting said radius arm with said rockable valve actuating member.

In testimony whereof I affix my signature in presence of two witnesses.

NORMAN T. HARRINGTON.

Witnesses:

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