J. PIERCE.

VARIABLE STROKE MECHANISM.

APPLICATION FILED APR. 23, 1913.

1,112,832.

Patented Oct. 6, 1914.

2 SHEETS—SHEET 1.

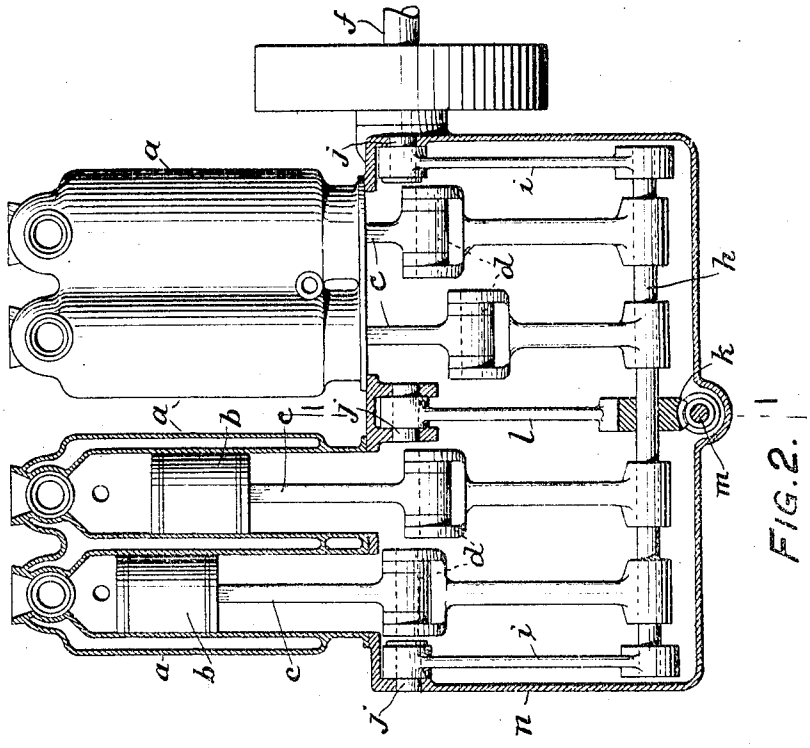



FIG. 2.

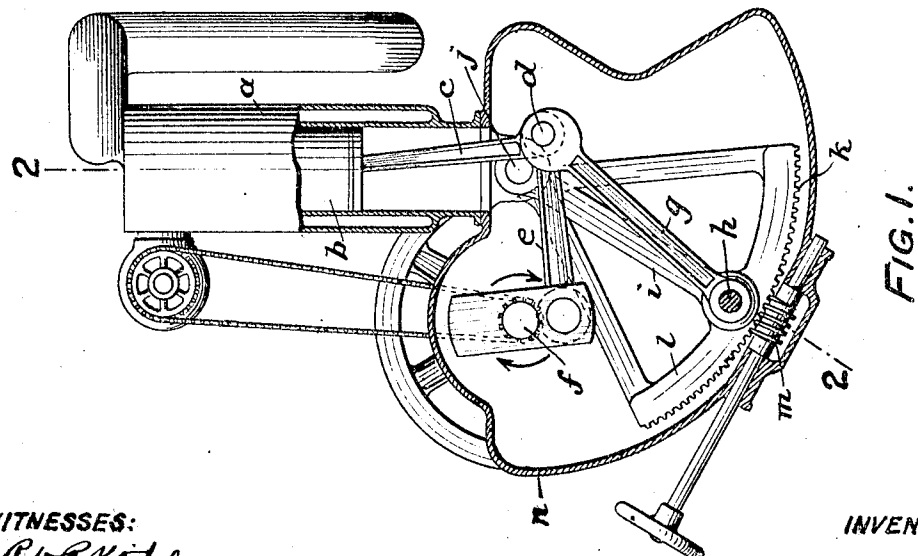



FIG. 1.

WITNESSES:

Robt. W. Mitchell.

E. E. Hall

INVENTOR

Joseph Pierce

BY Frank L. Busser

ATTORNEY

J. PIERCE.

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2 SHEETS—SHEET 2.

FIG. 3.

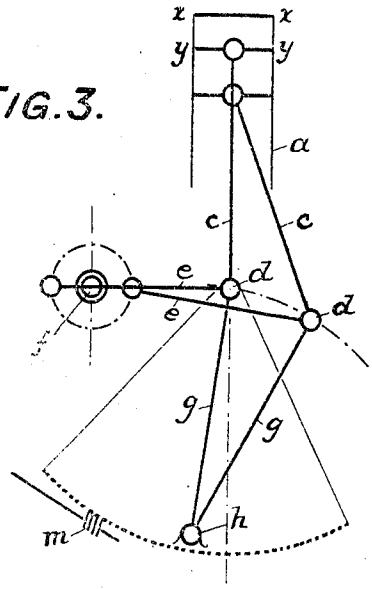



FIG. 4.

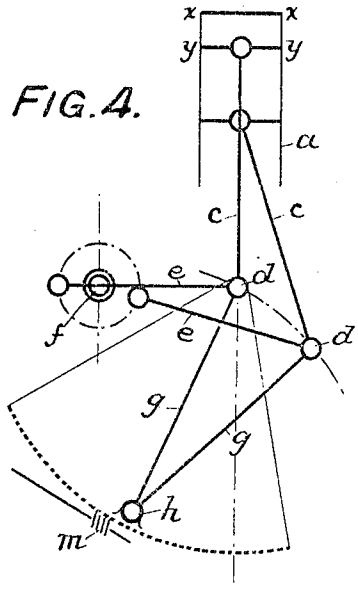



FIG. 5.

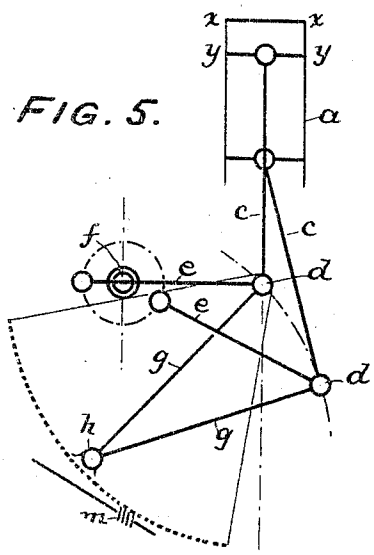
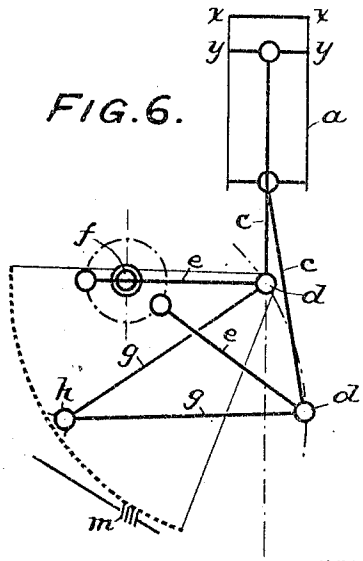



FIG. 6.




WITNESSES:

Robt. P. Ritchel

E. E. Wall

INVENTOR

Joseph Pierce

BY Frank A. Brasser

ATTORNEY

# UNITED STATES PATENT OFFICE.

JOSEPH PIERCE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO JOHN STUART WESTNEY, FREDERICK W. LAWRENCE, ADOLPH SCHWARTZ, AND HENRY C. GEORGE, ALL OF PHILADELPHIA, PENNSYLVANIA.

## VARIABLE-STROKE MECHANISM.

1,112,892. Specification of Letters Patent. Patented Oct. 6, 1914.

Application filed April 23, 1913. Serial No. 763,003.

*To all whom it may concern:*

Be it known that I, JOSEPH PIERCE, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Variable-Stroke Mechanism, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

The object of my invention is to provide an improved variable stroke mechanism, which is capable of general application, but which is particularly adapted to the purpose of varying the stroke of the piston of an engine, for example, of an internal combustion engine, in such a manner that the clearance at the end of the compression stroke will be uniform at all adjustments.

I have shown the invention as applied to a set of four cylinders, although it will be understood that the invention, when applied to internal combustion engines, is capable of embodiment in a single cylinder or in any number of cylinders.

In the drawings: Figure 1 is an end view, principally in vertical section on the line 1—1 of Fig. 2, of an engine showing my improved variable stroke mechanism arranged to vary the stroke of the pistons. Fig. 2 is a front view, principally in vertical section on the line 2—2 of Fig. 1. Figs. 3, 4, 5 and 6 are diagrammatic views showing different adjustments of the mechanism for varying the stroke of the piston.

The four cylinders *a*, *a*, etc., are shown arranged in pairs, each having a piston *b* to which is pivoted a piston rod *c*. To the wrist pin *d* of each piston rod is pivoted a connecting rod *e* and a stroke-regulating arm *y*. The connecting rod is connected to a crank on the crank-shaft *f*, while the arms *g* connected to the several wrist pins are pivoted on the stroke-regulating rod *h*.

Between the pairs of cylinders and on the outside of each pair are studs or pins *j*, from which are hung arms or hangers *i*, *i*, and a quadrant or hanger *l*, carrying the rod *h*. The quadrant *l* carries a rack *k*, which is engaged by a hand-operated worm *m*. A casing *n* secured to the cylinders carries the studs *j* and the bearings for the crank shaft, and incloses the crank-shaft, the connecting rods, the stroke-regulating arms, the quadrants and the stroke-regulating rod.

The valve mechanism is not shown, the same forming no part of my invention.

By reference to the diagrams, Figs. 3, 4, 5 and 6, the operation of the stroke-varying devices will be understood. The space between the two lines *x*—*x* and *y*—*y* at the top of each figure indicates the clearance between the head of the cylinder and the piston at the end of each compression stroke. In Fig. 3, the rod *h* has been adjusted to such position that the piston will have its minimum stroke, say about two and one half inches, the piston being shown as at the limits of its stroke. In Fig. 4, the rod *h* has been adjusted to such position that the piston will have a stroke of medium length, say about four inches. In Fig. 5, the rod *h* has been adjusted to such position that the piston will have a stroke of about six and a half inches. In Fig. 6, the rod *h* has been adjusted to such position that the piston will have its maximum stroke, say about eight and a quarter inches. Thus, by the simple rotation of a worm shaft, the stroke of all the pistons may be fixed at any predetermined length, but without affecting the clearance between the head of the cylinder and the piston at the end of the compression stroke, which is a constant factor.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. The combination, with a reciprocating element and a crank shaft, of a stroke-regulating rod, a connecting rod connected with the crank shaft, an arm pivoted on the stroke-regulating rod, said connecting rod and arm pivoted at a common point on the reciprocating element, and means to adjust the stroke-regulating rod to different positions, thereby varying the stroke of the reciprocating element.

2. The combination, with a reciprocating element and a crank shaft, of a stroke-regulating rod, a connecting rod connected with the crank shaft, an arm pivoted on the stroke-regulating rod, said connecting rod and arm pivoted at a common point on the reciprocating element, a quadrant suspending the stroke-regulating rod and turnable on an axis coincident with the point of con-

nection between said reciprocating and connecting rod and arm when the reciprocating element is at one limit of its stroke, and means to adjust said quadrant on its axis, thereby varying the stroke of the reciprocating element.

3. The combination, with a reciprocating element and a crank shaft, of a wrist pin on the reciprocating element, a relatively fixed stud whose axis is coincident with that of the wrist pin when the reciprocating element is at one limit of its stroke, a quadrant pivoted on said stud, a stroke-regulating rod carried by the quadrant, a connecting rod connecting the wrist pin and crank shaft, an arm connecting the wrist pin and stroke-regulating rod, and means to adjust the quadrant on its pivot, thereby varying the stroke of the reciprocating element.

4. The combination with a crank shaft and a reciprocating element including a pivoted rod, of a relatively fixed stud, a quadrant pivoted on said stud, two connecting rods each pivoted at one end on a common axis on said pivoted rod, the other end of one connecting rod being connected to the crank-shaft and the other end of the other connecting rod being pivotally connected to said quadrant, a rack on the quadrant and a worm engaging said rack, whereby the quadrant may be adjusted to vary the distance between said stud and said common axis when the reciprocating element is at one limit of its stroke.

5. The combination with a crank shaft and a reciprocating element including a pivoted rod, of a pivoted quadrant, two connecting rods each pivoted at one end on a common axis on said pivoted rod, the other end of one connecting rod being connected to the crank shaft and the other end of the other connecting rod being pivotally connected to said quadrant, said axis and the pivot of the quadrant being so relatively positioned that they coincide when the reciprocating element is at one limit of its stroke, and means to adjust the quadrant on its pivot, thereby varying the distance between said axis and the pivot of the quadrant when the reciprocating element is at the other limit of its stroke, whereby the stroke of the reciprocating element may be varied.

6. The combination of a crank shaft and a plurality of reciprocating elements, of a plurality of hangers pivoted on a common axis, a stroke regulating rod carried by the hangers, connecting rods connecting the several reciprocating elements and the crank shaft, arms connecting the several reciprocating elements and the stroke-regulating rod, and means to adjust the hangers to vary the position of the stroke-regulating rod, thereby varying the stroke of the several reciprocating elements.

7. The combination with a crank casing, a crank shaft, and a plurality of reciprocating elements each including a pivoted rod, a wrist pin on each rod, studs carried by the casing, the axis of said studs being coincident with the axis of the several wrist pins when the reciprocating elements are at one limit of their strokes, hangers suspended from the several studs, a stroke-regulating rod carried by the hanger, arms connecting the several wrist pins with the stroke-regulating rod, connecting rods connecting the several wrist pins with the crank-shaft, a rack on one of the hangers, and a worm engaging said rack and by means of which the position of the stroke-regulating rod may be varied to vary the stroke of the reciprocating element.

8. The combination of a crank shaft, a connecting rod connected with the crank shaft, a reciprocating element and a stroke-regulating arm, said rod, arm and reciprocating element having a common pivotal connection, means by which said arm is pivotally supported at a point distant from said common pivotal connection, and means to adjust the position of said pivotal support, thereby varying the stroke of the reciprocating element.

In testimony of which invention, I have hereunto set my hand, at Phila., Pa., on this 8th day of April, 1913.

JOSEPH PIERCE.

Witnesses:
MARY E. HAMER,
MARY PHILLIPS.