No. 669,416. Patented Mar. 5, 1901.

O. B. JOHNSON.

EXPLOSIVE ENGINE.

(Application filed Sept. 24, 1900.)

(No Model.) 2 Sheets—Sheet 1.

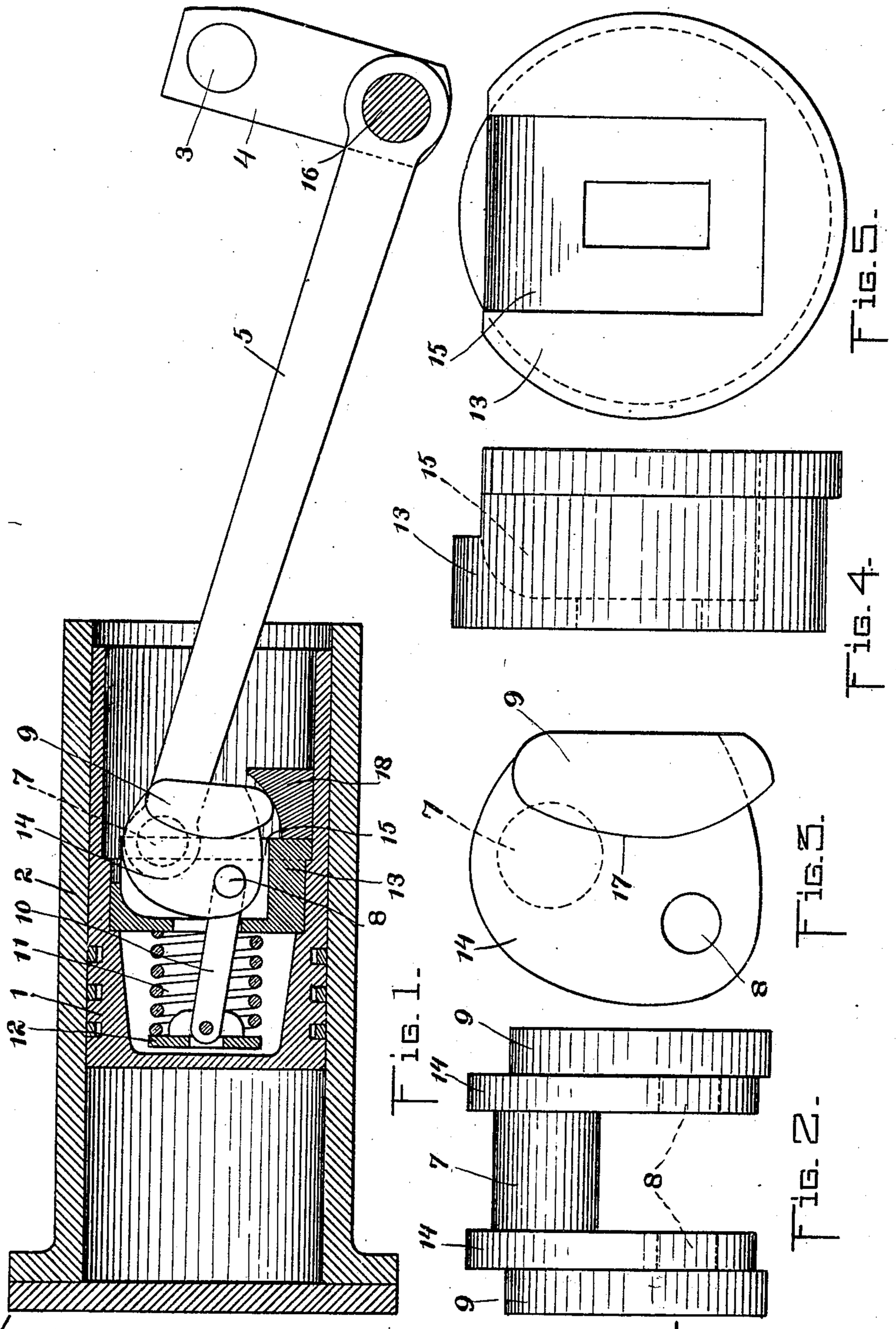

Fig. 1.

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 2.

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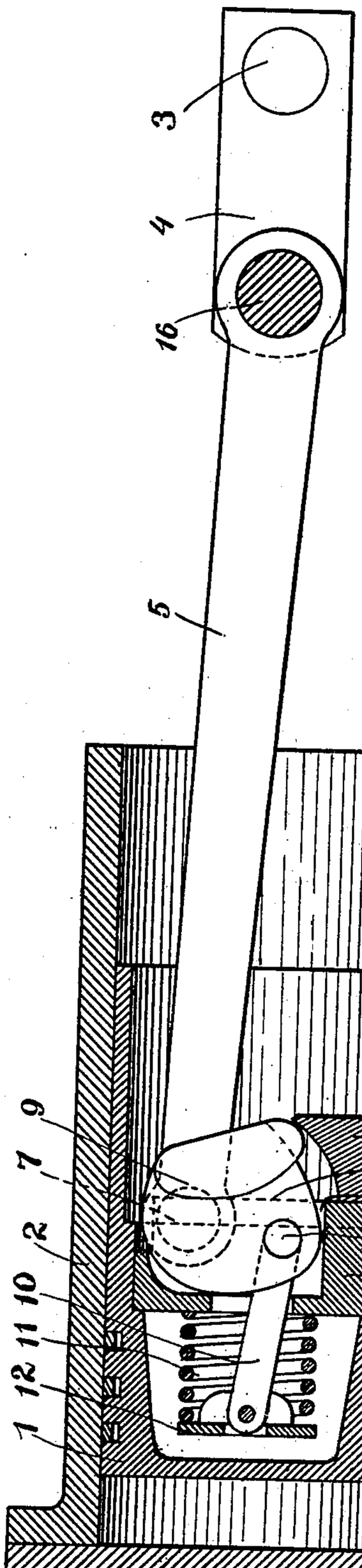

Fig. 6.

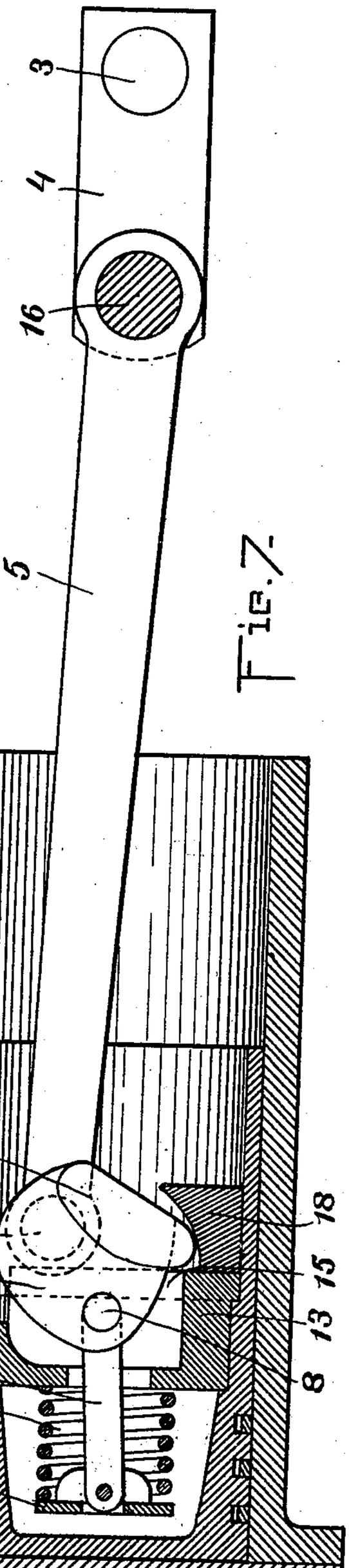

Fig. 7.

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UNITED STATES PATENT OFFICE.

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EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 669,416, dated March 5, 1901.

Application filed September 24, 1900. Serial No. 30,949. (No model.)

To all whom it may concern:

Be it known that I, ORVILLE B. JOHNSON, of Tyngsboro, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

This invention relates to engines driven by the heat produced by the explosion of a mixture of gas or hydrocarbon vapor with air. Such engines often give trouble in running, owing to the difficulty or practically the impossibility of completely expelling the waste gases formed by the combustion of the mixture in the cylinder. These waste gases remain in the clearance-space of the cylinder, mixing with and thus vitiating each fresh charge of gas and air and sometimes enveloping the ignition device so thickly that the charge fails to ignite properly and the engine is caused to run unevenly.

The object of my invention is to provide a means capable of application to any explosion-engine making four strokes of the piston in each cycle, whereby the piston may be forced quite to the head end of the cylinder during the exhaust-stroke, thus completely expelling the products of combustion, while on the compression-stroke the piston stops short of the end of the cylinder, leaving a clearance-space, in which is contained the compressed charge.

The invention consists in means hereinafter described by which the travel of the piston may be varied on different strokes, the wrist-pin being meanwhile always distant from the crank-pin by the same amount.

In the accompanying drawings, Figure 1 represents a longitudinal section of an explosion-engine, showing the device embodying my invention, the piston being in mid-stroke while moving toward the head end of the cylinder. Figs. 2 and 3 represent two elevations of the coupling member which connects the piston with the connecting-rod and which constitutes a part of the means for varying the position of the piston relatively to the connecting-rod. Figs. 4 and 5 represent two elevations of a disk or fitting which is secured in the piston and against the flat bearing-face of which the curved bearing-face of the coupling member rests. Fig. 6 represents a view similar to Fig. 1, showing the piston at the end of the compression-stroke ready to be impelled forward by the explosion of the charge. Fig. 7 represents a similar view showing the piston at the end of the stroke during which the waste gases are expelled.

The same reference characters designate the same parts in all the figures.

Referring to the drawings, the trunk-piston 1, reciprocating in the cylinder 2, drives the shaft 3 through the crank 4 and connecting-rod 5. The connecting-rod is yieldingly secured to the piston in such manner that the distance between the piston and the crank-pin 16 may be variable by a coupling member next described and a spring coöperating therewith. The said coupling member, as here shown, consists of two web-pieces 14, connected by a cylindrical piece 7, to which the connecting-rod is jointed and which takes the place of the wrist-pin in the ordinary form of engine. On the outer surface of the webs 14 are formed rocker members 9, the curved faces 17 of which bear against the flat outer face of a thick disk or fitting 13, while the webs 14 project into a depression 15, formed in the said fitting. The fitting is firmly fixed by suitable means within a cavity or recess in the piston 2, or if the connecting-rod is held by a cross-head the fitting may be fastened to the cross-head. The coupling member is held in operative position by a rod 10, one end of which is secured to the outer portion of the coupling member by a pin or by trunnions projecting through holes 8 in the webs of the coupling member, while the other end is attached to a head or bearing 12, which is forced away from the fitting 13 by a spiral spring 11, which abuts against the inner surface of the fitting 13. The curved bearing-face of the coupling member is thus pressed against the flat bearing-face of the piston by a force equal to the power of the spring, which may be any desired amount. The coupling member is held in place vertically by a retainer 18, secured to the disk 13 or to the trunk of the piston by suitable means, the upper surface of the retainer 18 having the shape of the curve traversed by the lower ends of the rocker members 9, so that the

ends of the members 9 are always in contact with the piece 18 and the coupling member is prevented from slipping down out of place.

When the piston is acted on by no external force greater than that of friction with the cylinder-walls, the spring 11 expands until the parts are in equilibrium, as is shown in Fig. 1, the most prominent portion of the curved bearing-face 17 being then in contact with the flat bearing-face of the fitting 13. Suppose that the piston moves from the position shown in Fig. 1, so as to compress the mixture of gas and air in the cylinder. As the piston moves toward the end of the cylinder the pressure constantly increases until it becomes so great that the spring is no longer able to maintain the parts in the position shown in Fig. 1. When this point is reached, the force acting along the connecting-rod inclines the coupling member, so that the line of contact between the curved and flat bearing-face advances upward. This motion of the coupling member pulls the rod 10 and head 12 attached to it against the pressure of the spring, compressing the latter. This action continues until the crank reaches the dead-point, when the compression is at the maximum and the parts are in the position shown in Fig. 6. The point of contact between the curved and flat bearing-faces is then approximately on the line of thrust exerted by the connecting-rod, the exact position of the point of contact depending on the amount of the mixture in the cylinder, for if the gas and air had been admitted during a portion only of the filling stroke of the engine the space at the end of the cylinder required by the mixture at the same pressure of compression would be less than that required by the amount of the mixture drawn in throughout the entire stroke. The force of the spring would then move the piston farther into the cylinder and the point of contact would be somewhat lower than as shown. When the explosion occurs, if the point of contact between the curved and flat bearing-faces is exactly on the line of thrust of the connecting-rod the piston and connecting-rod move as a unit and there is no relative motion between them; but if the point of contact is not on the line of thrust the piston moves toward the connecting-rod before the latter starts until the coupling member is inclined, so that the position of the point of contact is as specified, when the piston and connecting-rod move onward as though rigidly connected in the ordinary way. There is no tendency, except inertia of the coupling member, to cause the point of contact to move beyond the position specified, for that is the position of equilibrium of the piston and coupling member when under pressure, and the same force which moves the coupling member into that position causes it to return when the point of contact has advanced beyond the line of thrust of the connecting-rod, and, in addition, the farther the point of contact advances the greater is the leverage on which the spring acts to bring it back.

The spring sustains no portion of the sudden pressure caused by the explosion, as the pressure is transmitted from the piston through the coupling member to the connecting-rod, and these parts are all in rigid connection when in the position they occupy at the time of explosion, except when the point of contact is not within the line of thrust, and then the spring undergoes but a slightly-increased degree of compression. Thus the spring is not subject to shock while under stress, and as it is never strained unduly there is nothing to cause it to lose its efficiency.

When the piston makes the return stroke after the explosion, it expels the products of combustion or waste gases. The piston keeps the same position relative to the connecting-rod as that shown in Fig. 1 until the crank approaches the dead-point, when the connecting-rod gradually comes to rest and starts in the opposite direction. The inertia of the piston, however, causes it to continue its motion after the connecting-rod has stopped, and the moving parts then assume the position shown in Fig. 7. Motion of the piston away from the connecting-rod causes the curved bearing-face of the coupling member to roll downward on the flat bearing-face of the piston in consequence of the pull of the connecting-rod on the pin 7 away from the piston. This motion of the coupling member, as well as the upward rolling movement, exerts a pull on the rod 10, compressing the spring and increasing the leverage with which the spring acts on the coupling member to return it to the position of equilibrium, since the point of contact between the curved and flat bearing-surfaces acts as the fulcrum. Thus the motion of the piston away from the connecting-rod, as well as motion toward it, is resisted by the spring. As soon as the force exerted by the spring becomes as great as the force due to the kinetic energy of the piston the piston is brought to rest and begins to follow the connecting-rod on the second outward stroke of the cycle, the stroke during which the cylinder is filled with a fresh mixture. The spring is designed of sufficient power to allow the piston to approach as near the head of the cylinder as possible without striking it.

It is evident that this invention provides a simple and efficient means for clearing the cylinder of waste gases after each explosion, and in addition it provides a variable clearance space which contains the compressed charge at substantially the same pressure, which can be regulated by the power of the spring whether the charge be the full one or reduced in quantity. To the best of my knowledge this result is not attained by any form of engine now in use.

Having thus explained the nature of my invention and described a way of construct-

ing and using the same, though without attempting to set forth all of the forms in which it may be made or all of the modes of its use, what I claim, and desire to secure by Letters Patent, is—

1. An explosive-engine comprising a reciprocating member, such as a piston, having a bearing-face, a coupling member jointed to the connecting-rod or part which receives motion from the piston and adapted to stand at different angles with the connecting-rod, said coupling member having a complemental bearing-face, and a yielding connection between the two members, whereby a yielding contact is maintained between the said bearing-faces, one of said faces being curved.

2. An explosive-engine comprising a reciprocating member, such as a piston, having a bearing-face, a coupling member jointed to the connecting-rod or part which receives motion from the piston and adapted to stand at different angles with the connecting-rod, said coupling member having a complemental bearing-face, a rod jointed to the outer portion of said coupling member, and a spring interposed between a bearing on said rod and a bearing on the piston, whereby a yielding contact is maintained between the said bearing-faces, one of said faces being curved.

3. An explosive-engine comprising a piston having a flat bearing-face, a coupling member jointed to the connecting-rod which receives motion from the piston and having a curved bearing-face resting against the flat bearing-face of the piston, a rod jointed to the outer portion of the coupling member, and a spring interposed between a bearing on the outer portion of the rod and a bearing on the piston, whereby a yielding contact is maintained between the said bearing-faces.

4. An explosive-engine comprising a recessed piston, a fitting seated in the recess of the piston and having a flat bearing-face, a coupling member jointed to the connecting-rod which receives motion from the piston and having a curved bearing-face resting against the said flat bearing-face, a rod jointed to the outer portion of the coupling member and extending through the said fitting into a cavity between the fitting and the head of the piston, a bearing-head jointed to the outer portion of the rod, and a spring interposed between the said bearing-head and the fitting.

5. An explosive-engine comprising a piston having a flat bearing-face, a coupling member jointed to the connecting-rod which receives motion from the piston and having a curved bearing-face resting against the flat bearing-face of the piston, a rod jointed to the outer portion of the coupling member, a spring interposed between a bearing on the outer portion of the rod and a bearing on the piston, whereby a yielding contact is maintained between the said bearing-faces, and a coupling-retainer on the piston having a segmental retaining-face engaging a portion of the coupling.

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

ORVILLE B. JOHNSON.

Witnesses:
C. F. BROWN,
A. D. HARRISON.