

No. 748,083.

PATENTED DEC. 29, 1903.

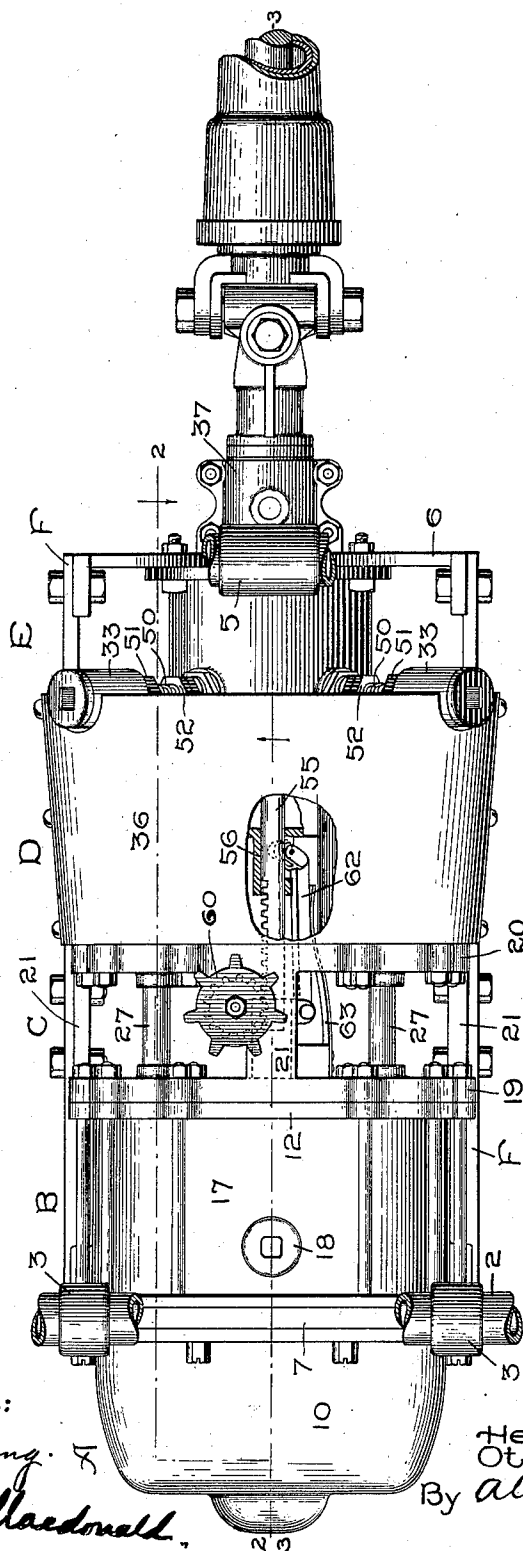
H. LEMP & O. F. PERSSON.
MULTIPLE CYLINDER STEAM ENGINE.

APPLICATION FILED JAN. 12, 1903.

NO MODEL.

6 SHEETS—SHEET 1.

Fig. 1.



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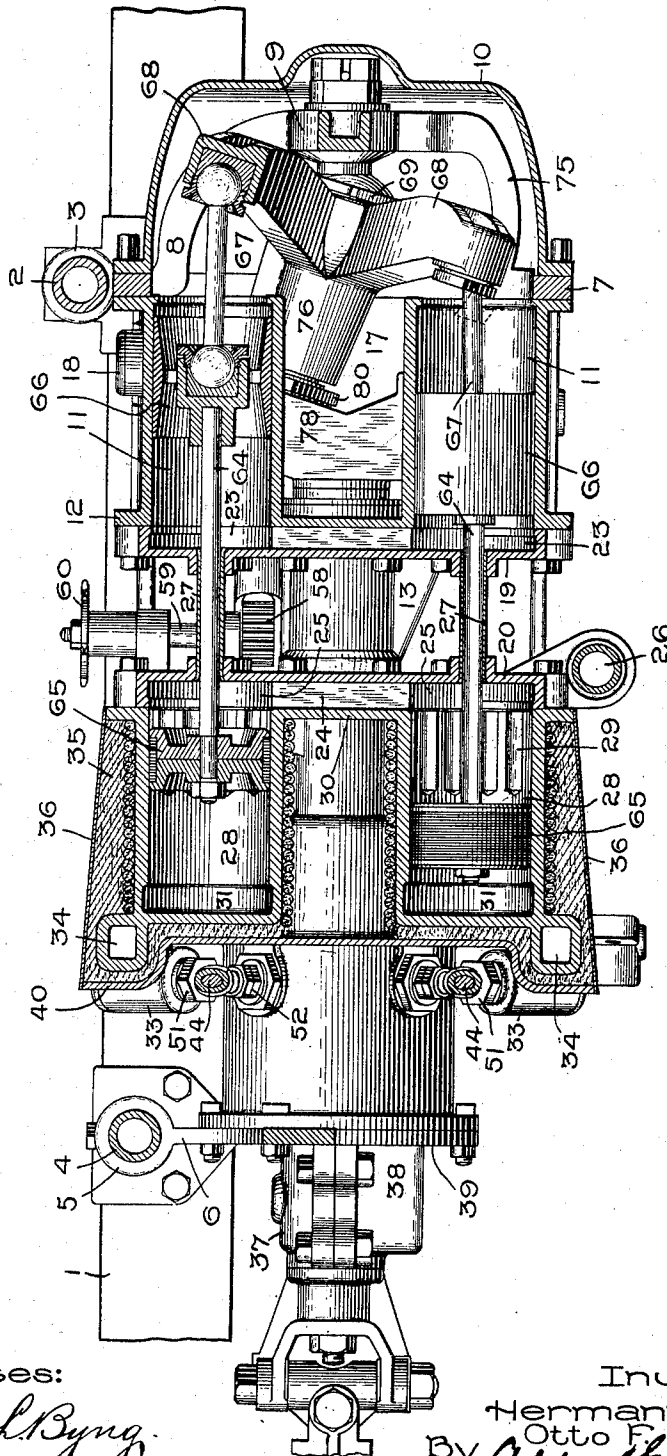
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6 SHEETS—SHEET 2.

Fig. 2.



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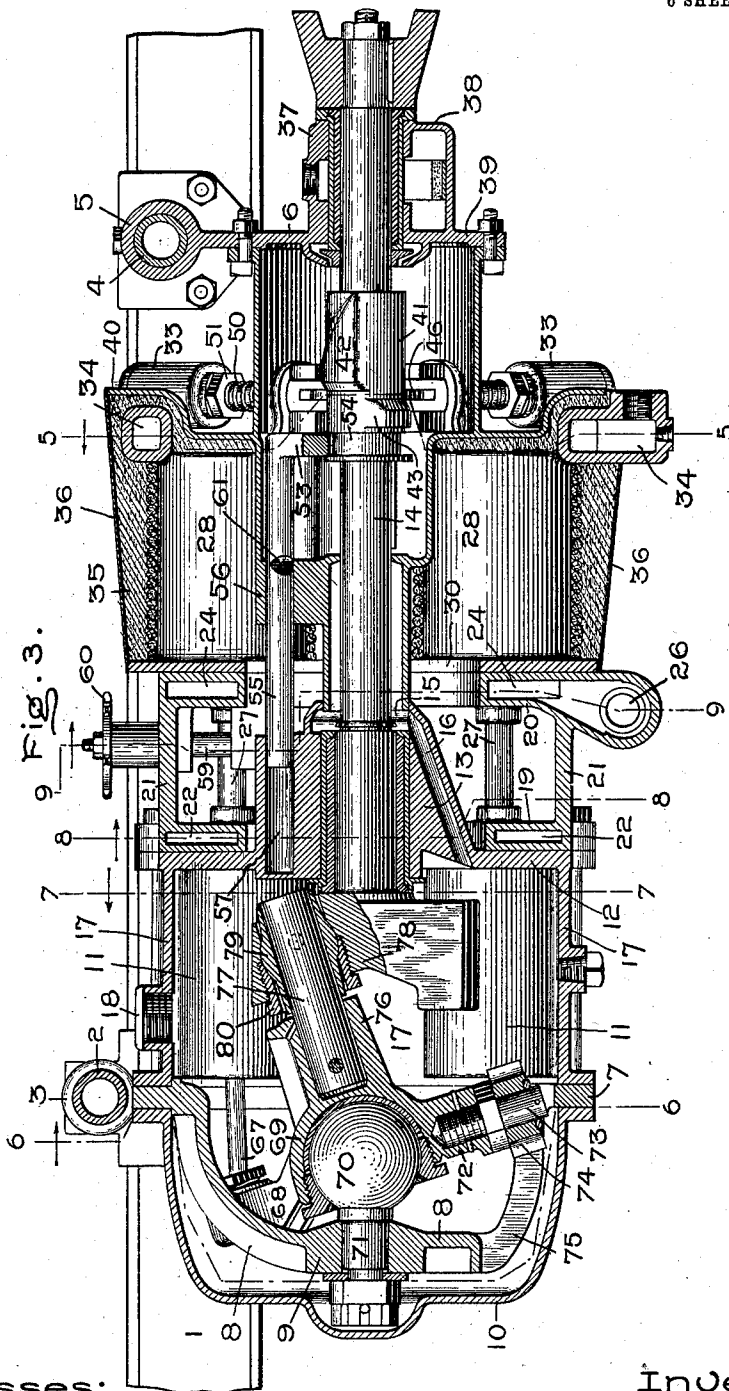
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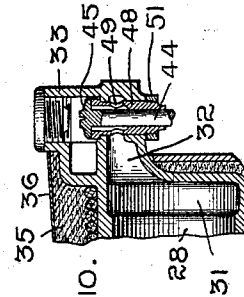
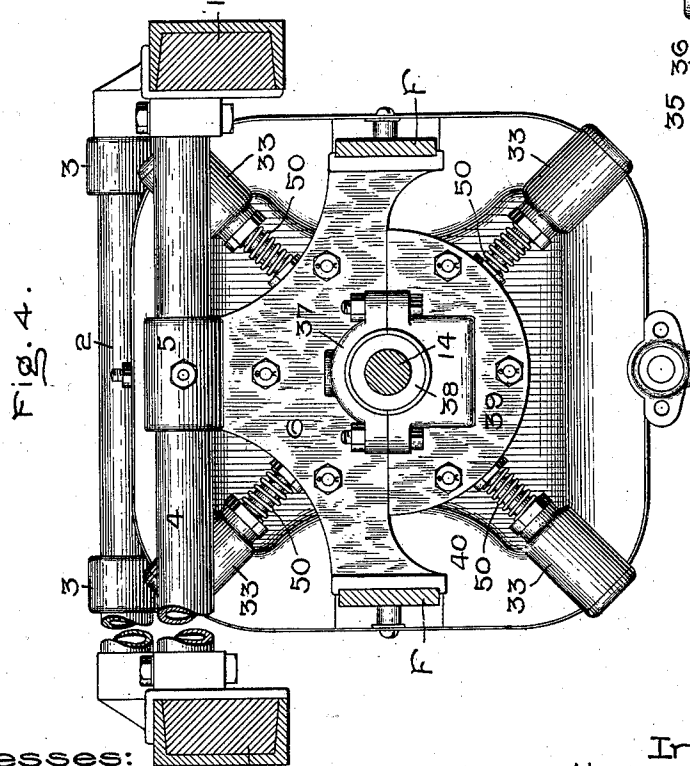
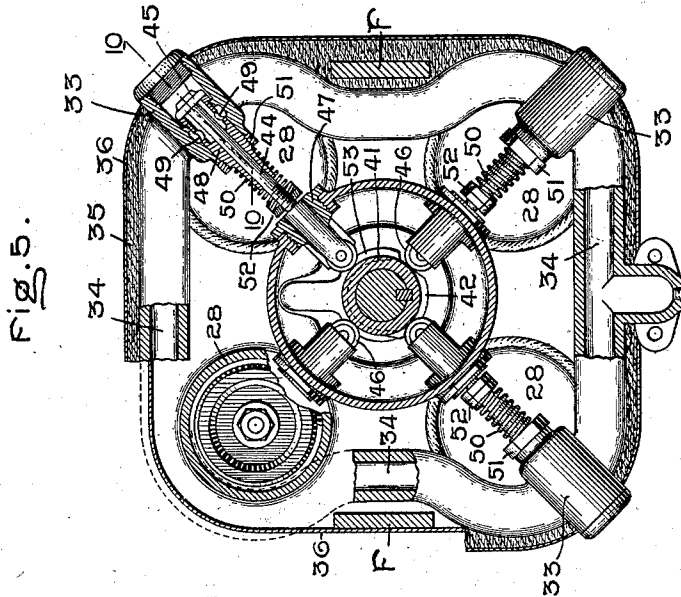
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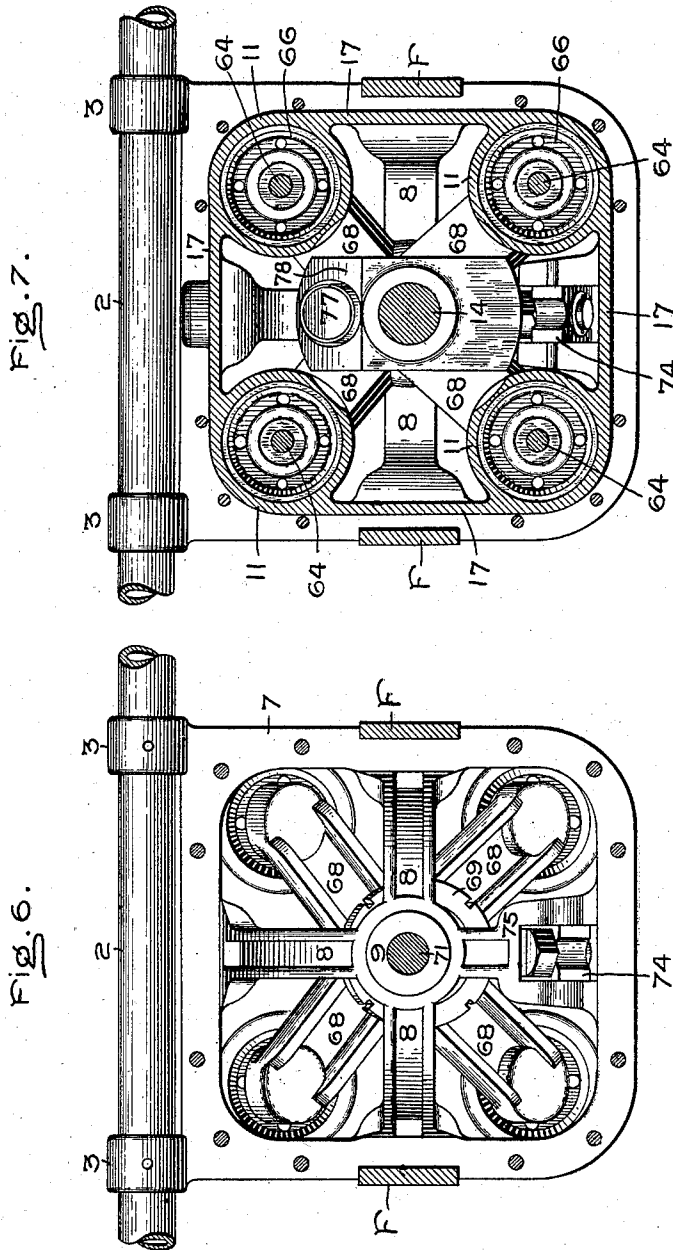
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6 SHEETS—SHEET 5.



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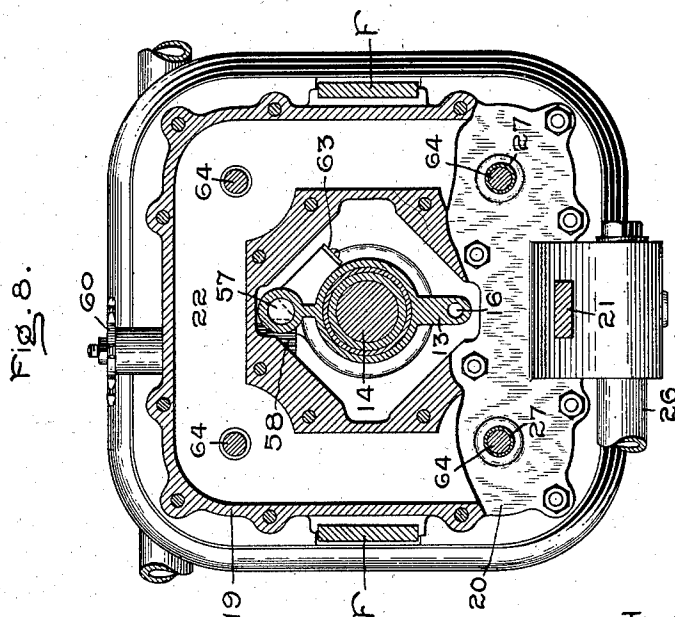
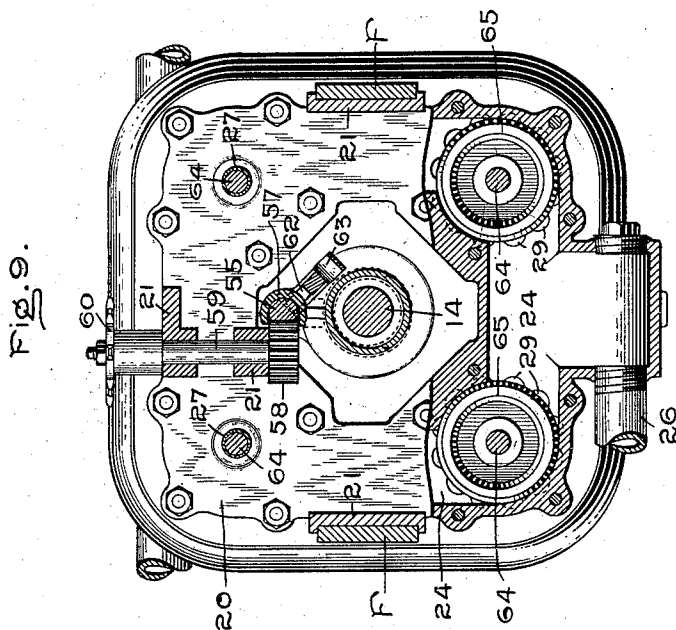
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NO MODEL.

6 SHEETS—SHEET 6.



Witnesses:

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UNITED STATES PATENT OFFICE.

HERMANN LEMP AND OTTO F. PERSSON, OF LYNN, MASSACHUSETTS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MULTIPLE-CYLINDER STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 748,083, dated December 29, 1903.

Application filed January 12, 1903. Serial No. 138,616. (No model.)

To all whom it may concern:

Be it known that we, HERMANN LEMP and OTTO F. PERSSON, citizens of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Multiple-Cylinder Steam-Engines, of which the following is a specification.

This invention relates to that class of steam-engines of the single-acting multiple-cylinder type in which the thrust of the piston-rods is transmitted to the crank-pin by means of a wabblor mounted on a universal joint in line with the axis of the shaft.

The invention consists in certain details of construction which will appear in the following specification and are particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a top plan view of our improved engine, partly broken away. Fig. 2 is a sectional side elevation on the line 2 2 of Fig. 1. Fig. 3 is a longitudinal section on the line 3 3 of Fig. 1. Fig. 4 is an end view. Figs. 5, 6, 7, 8, and 9 are cross-sections on the lines correspondingly numbered on Fig. 3, and Fig. 10 is a cross-section on the line 10 10 of Fig. 5.

While the engine is adapted to run in any position, we have chosen to illustrate it as placed horizontally, that being the position in which it would ordinarily be used in an automobile, for which it has been especially designed. The engine is in this case suspended between beams 1 by means of cross-bars, preferably tubular, which are suitably secured to the engine-frame in the manner shown, one bar 2 passing through eyes 3 on a basket or cage which incloses the wabblor and the other bar 4 passing through an eye 5 on a plate 6, forming the upper half of the head of the chamber, inclosing the cam for actuating the valves. The details of the support can be modified without departing from the spirit of our invention.

The frame of the engine comprises five sections—to wit, the wabblor-section A, the cross-head or guide-section B, the middle section C, the cylinder-section D, and the cam sec-

tion or chamber E for the valve-actuating cam, all united in the order named and supported by side bars F, extending from the wabblor-section to the plate 6.

The wabblor-section A comprises a skeleton plate 7 and curved ribs 8, which form a cage inclosing the wabblor, which will be described later. The ribs unite at the center in a hub 9, in which the wabblor-bearing is mounted. The section has a thin metal casing 10, bolted to the flange of the plate 7, and the casing normally contains oil for lubricating purposes.

The cross-head section B is a single casting comprising tubular guides 11, which are preferably cylinders open at each end and integral with a plate 12, which has at its center between the guides a solid bearing 13 for the main shaft 14. When the section B is made of aluminium, the bearing 13 can with advantage be carried by the section C, which would be made of a metal having a greater strength, such as cast-iron. At the front end of the bearing is a circumferential groove 15 for waste oil and a duct 16 to carry such oil away. The guides are connected by top, bottom, and side webs 17, so that the wabblor is completely housed. In the top web is an oiling-hole closed by a screw-plug 18.

The skeleton-like middle section is a casting comprising two parallel plates 19 20, connected by top, bottom, side, and middle bridge-pieces 21, the side bridges having flanges to engage with the side bars F. The plate 19 has a passage 22 cored out in it communicating with recesses 23, which register with the open ends of the tubular guides 11. The plate 20 also has a cored passage 24, connecting recesses 25, which are in line with the recesses 23 and communicating with the exhaust-pipe 26. Corresponding recesses are connected by sleeves 27, received in bosses 28 at the centers of said recesses for a purpose hereinafter set forth.

The cylinder-section D is also an integral casting, comprising the cylinders 28, preferably four in number and grouped symmetrically around the shaft 14, with their axes par-

allel with that of the shaft. At the exhaust end of the cylinders are internal longitudinal grooves 29, whose rear ends open into the recesses 25 in the plate 20, which fits flat against the plate 30, uniting these ends of the cylinders. The other ends of the cylinders are closed, but are provided with a large clearance-space 31, communicating by a passage 32 with a valve-chest 33, which in turn is in constant communication with a live-steam pipe or passage 34, preferably cast integral with the cylinders. To prevent radiation losses, the cylinder-section is wrapped with non-conducting material 35, such as asbestos or mineral wool, and is jacketed with sheet metal 36.

The cam-section E is preferably cylindrical, concentric with the shaft 14. As already stated, the upper half of its head is formed by the plate 6, which carries the upper half 37 of a front bearing for the shaft. The lower half 38 is carried by a plate 39, which forms the lower half of the chamber-head. The cam-section is preferably provided with an integral flange 40, which serves as a front for the jacket of the cylinder-section. In the rear of this flange the cam-section is reduced in diameter and extends between the steam-cylinders, its rear end entering the groove 15 in the cross-head section around the shaft which is thus entirely inclosed between the front and rear bearings. The cam-section incloses the cam which actuates the steam-admission valves. It consists of a sleeve 41, splined on the shaft 14, so as to be longitudinally movable thereon and provided with cam-surfaces 42 43, with a cylindrical interval between them. The stems 44 of the puppet-valves 45 rest on the sleeve 41, being preferably provided with antifriction-rollers 46, bearing on the sleeve and sliding through bushings 47 in the walls of the chamber. The outwardly-opening puppet-valves are located in the valve-chests 33 and control the admission of steam into the passages 32. Each valve seats on the end of a sleeve 48, which is counterbored around the valve-stem just below the valve and has ports 49 to permit the steam passing down into the sleeve to enter the passage 32. The valve is normally held to its seat by a helical spring 50, surrounding the stem and abutting at one end against a nut 51 on said sleeve, by means of which its position can be adjusted, and at the other end against a collar 52, adjustable on the stem. As the shaft 14 rotates the valves open in succession, the cam 42 being for the forward rotation of the engine and the cam 43 for the reverse. When the intervening cylindrical portion of the sleeve 41 is used, the valves are not actuated, and the engine stops. To vary the point of cut-off when running forward, the cam 42 is made tapering, and the sleeve can be moved lengthwise on the shaft to bring any portion of the cam into play. The movement of the sleeve is accom-

plished, preferably, by means of a fork 53, engaging with a groove 54 in the sleeve and carried on one end of a rack-bar 55, sliding in guides 56 57 in the cam-section and the cross-head section, respectively. A pinion 58 meshes with the rack and is rotatable at will by the operator by means of a shaft 59, journaled in the top and middle bridge-pieces of the middle section and provided with a sprocket or other wheel 60. In order to hold the rack-bar from accidental movement when the engine is not running, a notch 61 is cut in the bar, and a detent 62, urged by a spring 63, is hinged to the guide 57 and engages with said notch when the valve-stems engage with the cylindrical interval on the sleeve 41.

The piston-rods 64 of the pistons 65 pass through the sleeves 27 and are attached to the cross-heads, which are preferably cylindrical trunks 66, having a sliding fit in the guides 11. In service the cross-heads slowly revolve under the action of the wabblers, and this prevents the parts from getting out of round. The pistons also revolve with the cross-heads, and in this manner the cylinders preserve their shape and reduce the leakage to a minimum. The connecting-rods 67 have a ball-and-socket-joint connection with the cross-heads and also with the arms 68 of the wabblers, said arms being four in number and all in the same plane. The hub 69, from which they radiate, has a ball-socket to fit upon a stationary ball-bearing 70, which has a stem 71, by means of which it is mounted rigidly in the hub 9 of the wabblers-section of the engine-frame. The hub 69 has a fifth arm 72, carrying a radial pin 73, on which is pivotally held a block 74, fitted to slide between guide-ways 75, formed in the cage or wabblers-section A. This construction allows the wabblers to have a universal movement on the ball 70, but prevents it from revolving thereon in unison with the shaft.

Projecting centrally from the wabblers in a plane at right angles with that of the arms 68 is a socket 76, in which is fastened a crank-pin 77, whose outer end has a ball-and-socket connection with a crank 78, preferably counterbalanced and secured on the rear end of the shaft 14. The ball portion of this joint is preferably formed on a sleeve 79, secured to the pin, and it is held in its socket in the crank by a screw-gland 80.

The operation of the engine is similar to that of all engines of this class. Steam is admitted to the cylinders in regular succession, and the thrusts of the pistons are imparted to the arms of the wabblers in succession, thus causing the crank-pin to revolve in a conical path, the apex of the cone being at the intersection of the axes of the crank-pin and the shaft at the center of the ball 70. The revolution of the pin rotates the shaft, which at the front end is provided with any suitable device for communicating its motion to the driven shaft, such as the axle of an automo-

bile. The steam exhausts from each cylinder as soon as the piston uncovers the front ends of the longitudinal grooves in said cylinders.

5 The engine runs smoothly at a high rate of speed and has no dead-centers. Its compact form and light weight make it especially suitable for automobile-work.

10 It is to be noted that the wabblor is situated at one end of the engine and that the main driving-shaft extends parallel with the cylinders and toward them. In this manner the total length of the engine is reduced to a minimum.

15 The crank is formed integral with the main shaft 14 in order to give the necessary strength, and the spherical bearing 79 between the crank and the crank-pin 77 is so arranged that it is removable from the side adjacent to the wabblor. It is also to be noted that no part of the bearing projects beyond the end of the crank. This is an important feature, as it enables us to reduce the cross-section of the engine to a minimum. With engines of the class described the length of piston-stroke increases as the cylinders are moved away from the center of the main shaft. Hence for this reason it is important to keep the cylinders as near together as possible.

20 In accordance with the patent statutes we have described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What we claim as new, and desire to secure by Letters Patent of the United States, is—

40 1. In a multiple-cylinder steam-engine, the combination with a central shaft, of a frame comprising end plates, side bars connecting said plates, and a cylinder-section surrounding said shaft and supported by said side bars.

45 2. In a multiple-cylinder steam-engine, the combination with a central shaft, of a frame comprising end plates, side bars connecting said plates, and a cylinder-section and a cross-head section surrounding said shaft and supported by said side bars.

50 3. In a multiple-cylinder steam-engine, the combination with a central shaft, of a frame comprising end plates, side bars connecting said plates, and a cylinder-section, a cross-head section and a middle section surrounding said shaft and supported by said side bars.

55 4. In a multiple-cylinder steam-engine, the combination with a central shaft, of a frame comprising end plates, side bars connecting said plates, and a cylinder-section, a cross-head section, a middle section and a cam-inclosing section, all united and supported by said side bars and surrounding said shaft.

60 5. In a multiple-cylinder steam-engine, the combination with a central shaft, of a cam-carrying sleeve mounted thereon, a cylinder-

section surrounding the shaft, a cam-inclosing section concentric with the shaft and extending into the cylinder-section, a means for moving the cam-sleeve which extends through 70 the cylinder-section, and an actuator for imparting motion to said means which is located at the end of the cylinder-section opposite the cam-section.

6. In a multiple-cylinder steam-engine, the combination with a cylinder-section, of a cross-head section, and a middle section comprising sleeves for the piston-rods.

7. In a multiple-cylinder steam-engine, the combination of a cylinder-section, a radially- 80 extending valve-chest formed integral with each cylinder, valves in said chests, a shaft passing centrally through said cylinder-section, a cam on said shaft for actuating said valves, and a cam-inclosing section concentric with said shaft. 85

8. In a multiple-cylinder steam-engine, the combination with a cylinder-section, of a middle section comprising parallel plates having cored-out passages and recesses communicating therewith, said recesses in one plate registering with the exhaust ends of the cylinders. 90

9. In a multiple-cylinder steam-engine, the combination with a cylinder-section, of a middle section comprising end plates and connecting bridge-pieces, and sleeves in line with the cylinders. 95

10. In a multiple-cylinder steam-engine, the combination with a cylinder-section and a middle section, of a cross-head section comprising a plate, tubular guides integral therewith, and webs connecting said guides at top, bottom and sides. 100

11. In a multiple-cylinder steam-engine, the combination with a central shaft, of a cross-head section comprising a plate, tubular guides integral therewith, and a central solid bearing for said shaft integral with said plates. 105

12. In a multiple-cylinder steam-engine, the combination with a central shaft, of a cross-head section comprising a plate, tubular guides and a central shaft-bearing integral with said plate, and a cam-section having a head carrying a bearing for said shaft. 115

13. In an engine, the combination of a wabblor, a driving-shaft extending away from the wabblor and driven thereby, cylinders which surround the shaft, and guides for the pistons which also surround the shaft and are situated between the wabblor and the cylinders and are in line with the cylinders. 120

14. In an engine, the combination of a wabblor-section, a wabblor therein, spaced and connected cross-head and cylinder sections, cross-heads for the cross-head section, pistons for the cylinder-section, a main crank-shaft, and a main bearing for the crank-shaft carried by the cross-head section and extending forwardly therefrom between the same and 130 the cylinder-section.

15. In an engine, the combination of a sec-

tion containing a wabblor, a section contain-
ing cross-heads, a skeleton-like middle sec-
tion, a section containing the pistons, a sec-
tion containing the cams for actuating the
5 valves, said sections being removably con-
nected in axial alinement, and side bars for
supporting the sections and serving to rein-
force the skeleton-like middle section.

In witness whereof we have hereunto set
our hands this 9th day of January, 1903.

HERMANN LEMP.
OTTO F. PERSSON.

Witnesses:

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