No. 735,742. PATENTED AUG. 11, 1903.

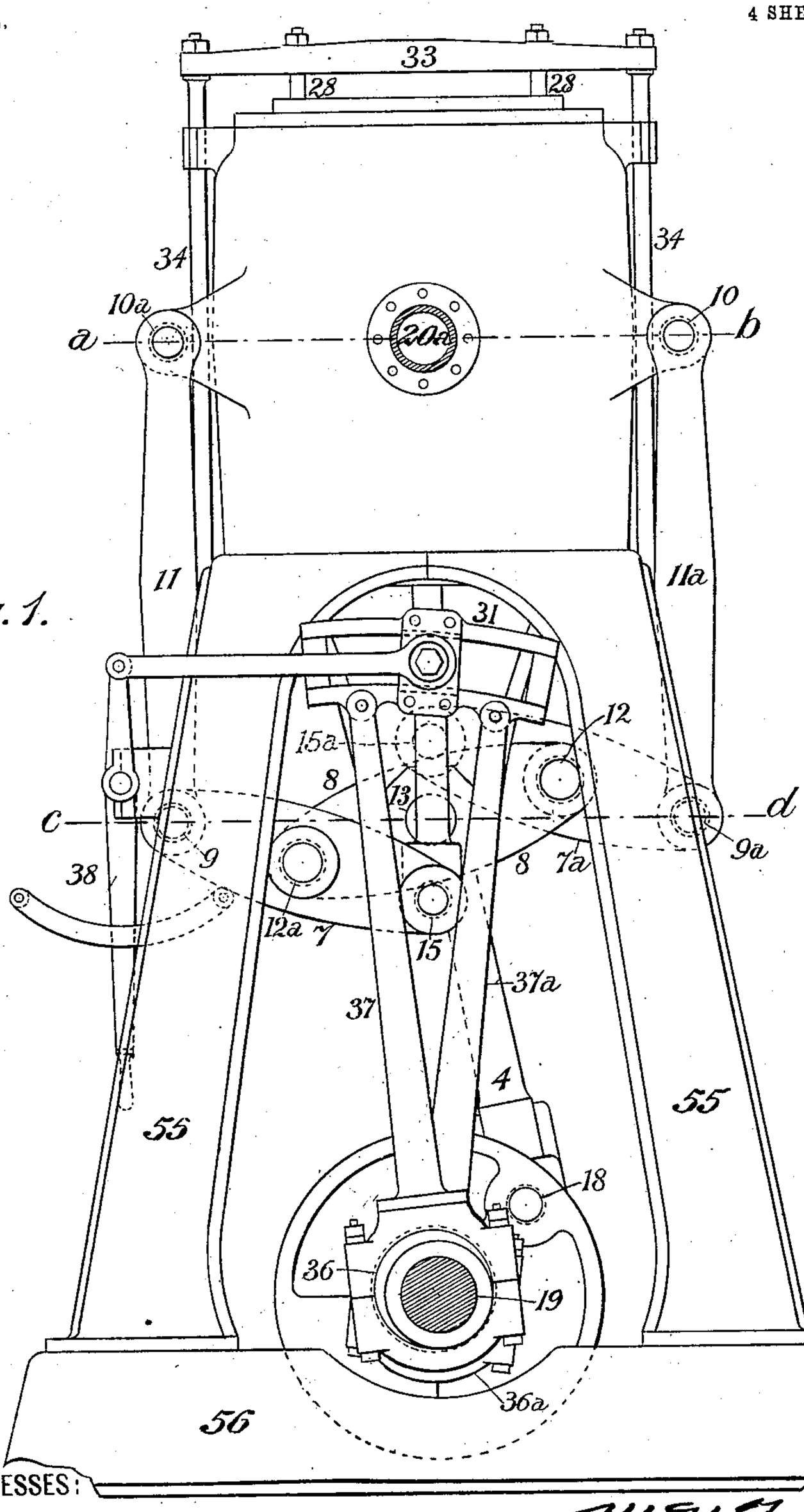
M. N. FORNEY.

VALVE MECHANISM FOR FLUID PRESSURE ENGINES.

APPLICATION FILED AUG. 8, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

James C. Herron.

S. R. Bell.

INVENTOR

M. N. Forney.

by J. Howden Bell.

ATTORNEY

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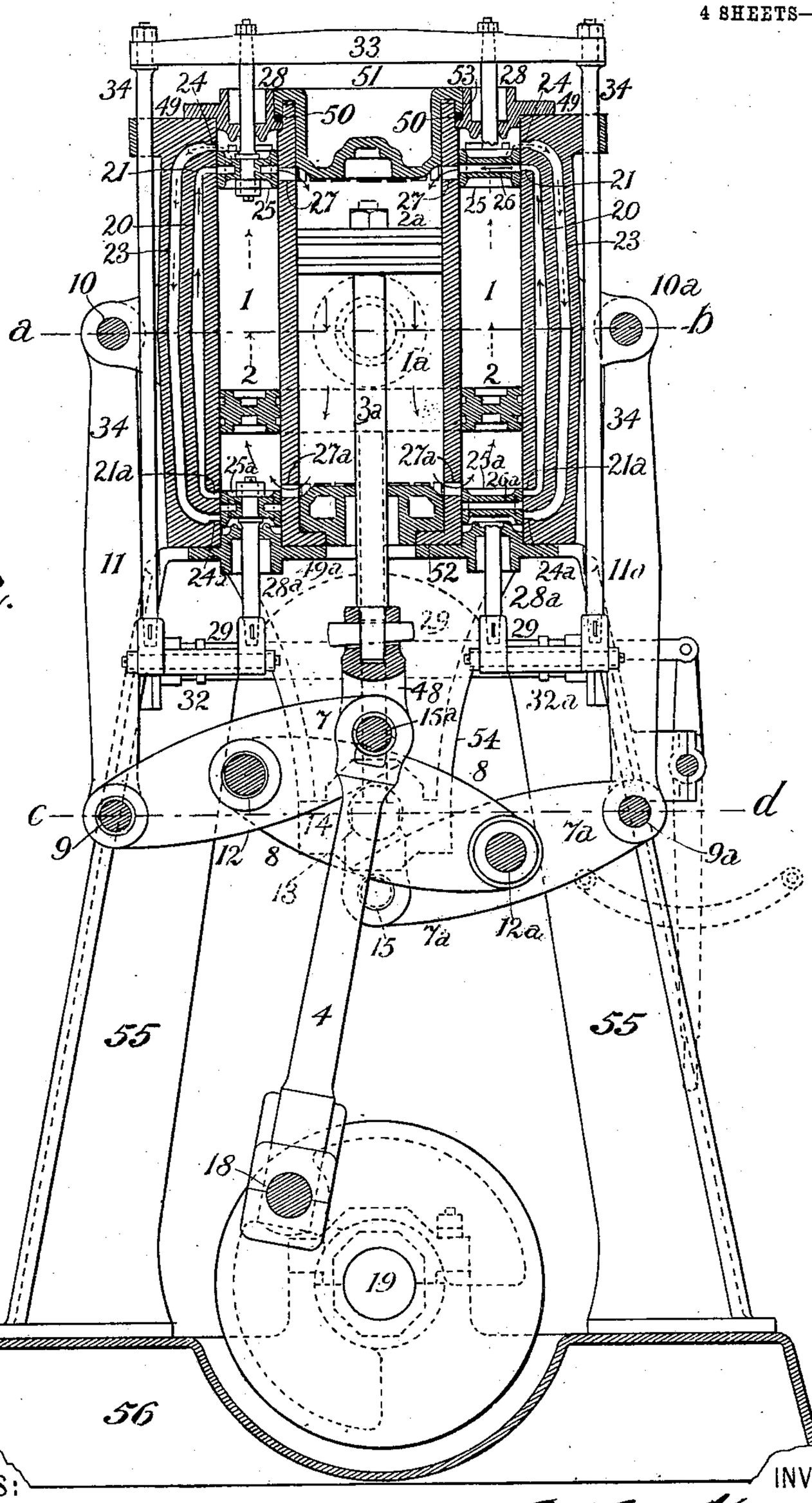

Fig. 2.

WITNESSES:

James C. Herron.

S. R. Bell.

INVENTOR

M. N. Forney.

by Johnson & Dell,

ATTORNEY

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NO MODEL. 4 SHEETS—SHEET 3.

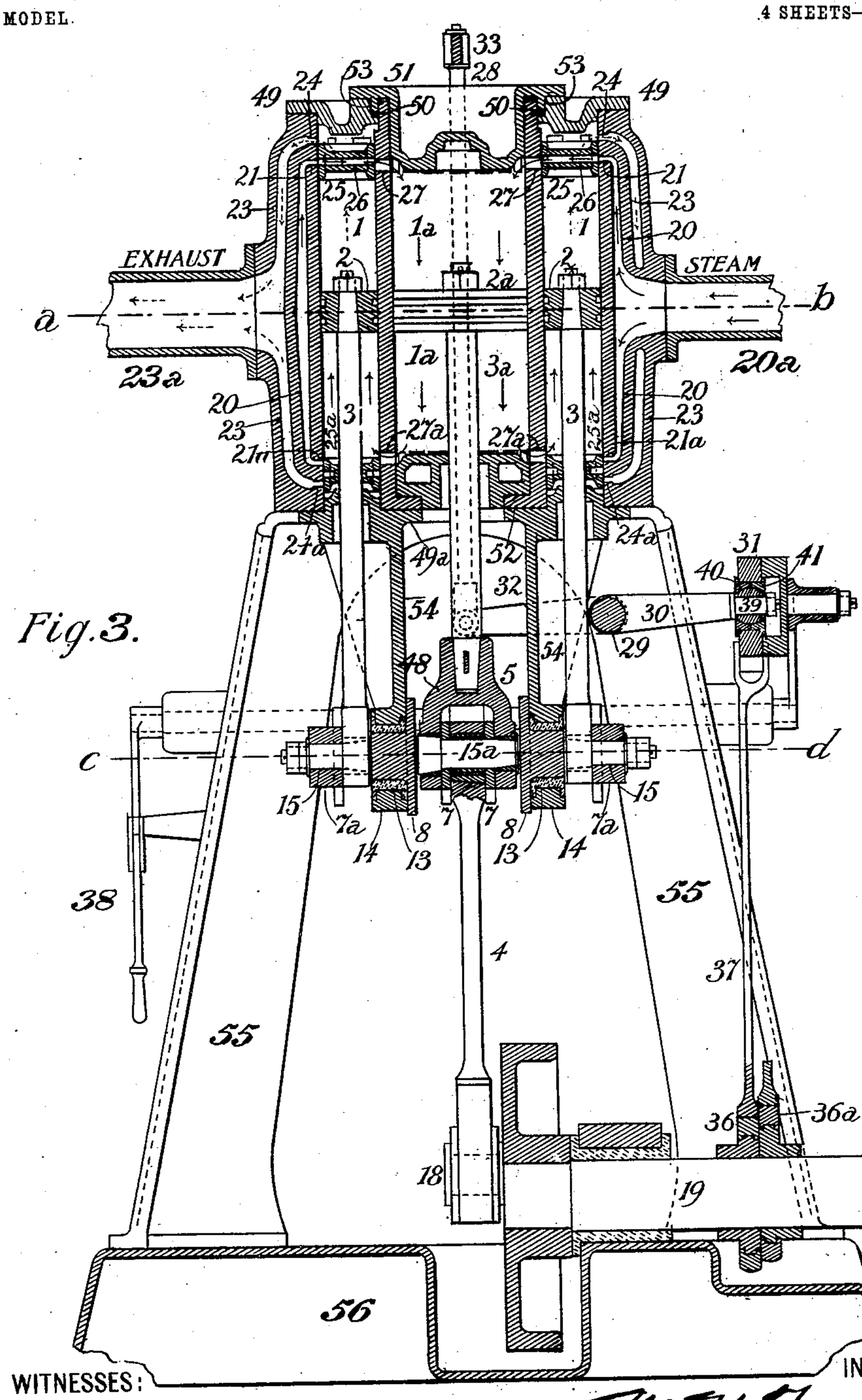

Fig. 3.

WITNESSES:

James C. Herron.

S. R. Bell.

INVENTOR

M. N. Forney.

by Andrew Pell,

ATTORNEY

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M. N. FORNEY.

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APPLICATION FILED AUG. 8, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 4.

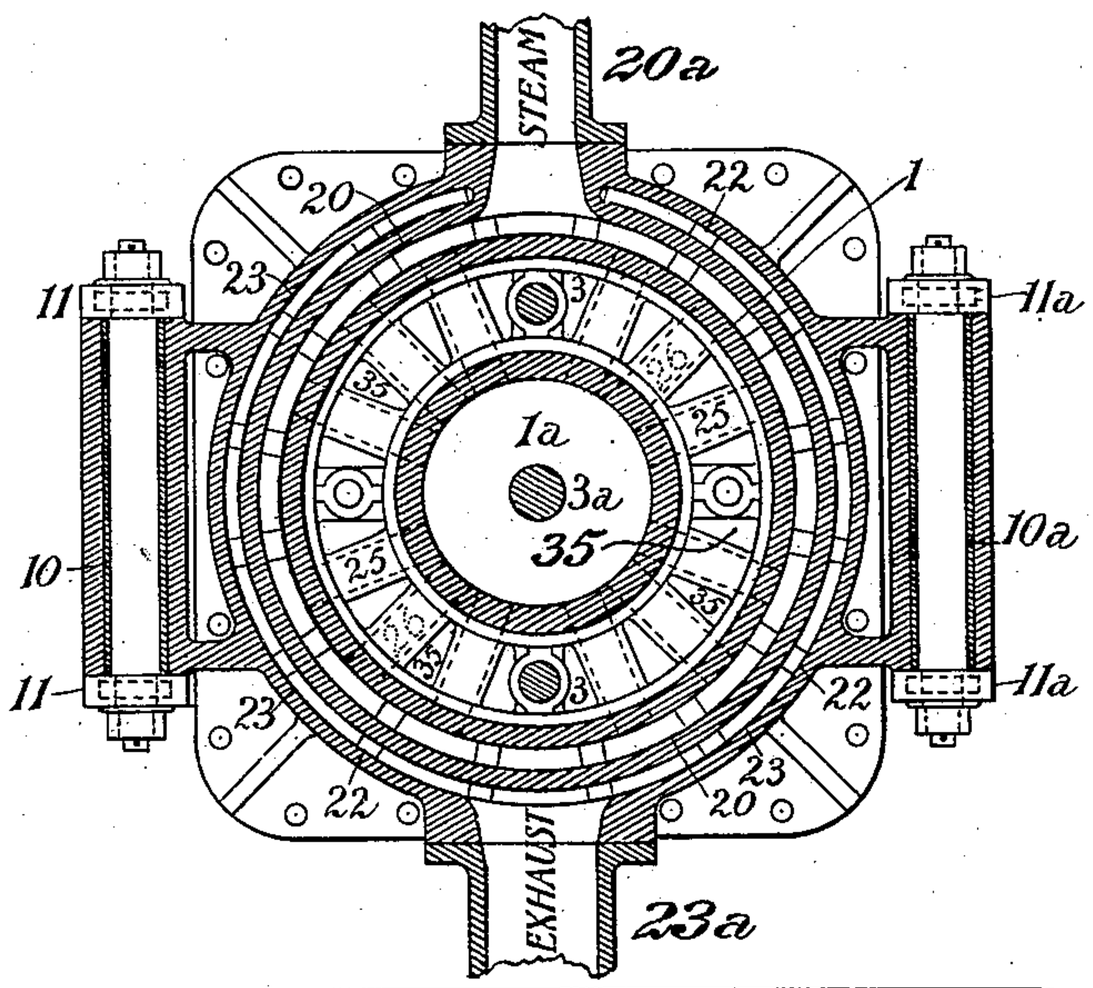
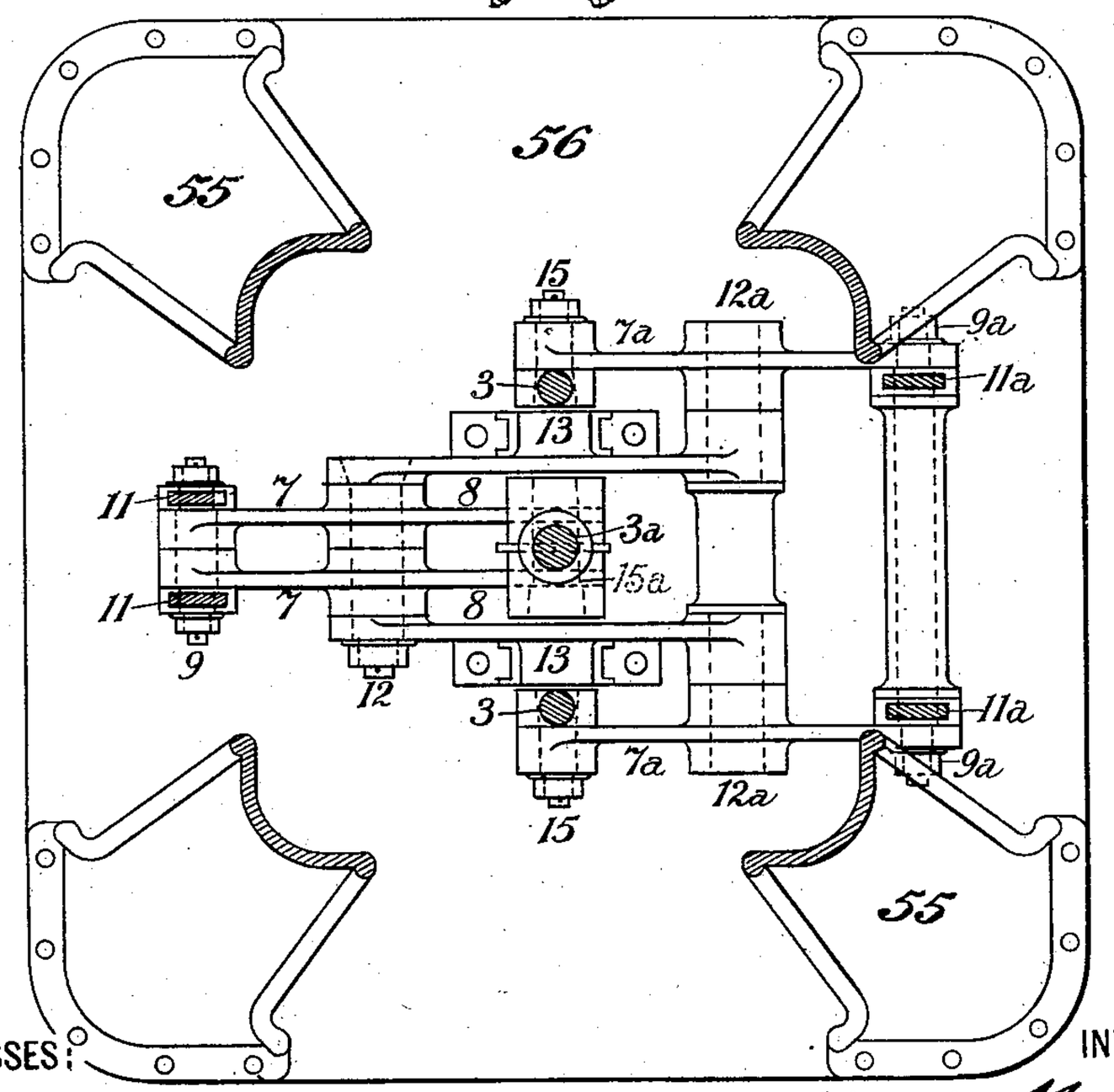


Fig. 5.



WITNESSES:

James C. Herron.

S. R. Bell.

INVENTOR

M. N. Forney,

by J. Hinsdale Bell,

ATTORNEY

No. 735,742. Patented August 11, 1903.

UNITED STATES PATENT OFFICE.

MATTHIAS N. FORNEY, OF NEW YORK, N. Y.

VALVE MECHANISM FOR FLUID-PRESSURE ENGINES.

SPECIFICATION forming part of Letters Patent No. 735,742, dated August 11, 1903.

Application filed August 8, 1902. Serial No. 118,970. (No model.)

To all whom it may concern:

Be it known that I, MATTHIAS N. FORNEY, of the borough of Manhattan, in the city and State of New York, have invented a certain new and useful Improvement in Valve Mechanism for Fluid-Pressure Engines, of which improvement the following is a specification.

In a separate application filed by me of even date herewith, Serial No. 118,969, there is set forth a two-cylinder fluid-pressure engine which is an improvement on that of Letters Patent of the United States No. 489,648, granted and issued to me under date of January 10, 1893, the characteristic features of which improvement may be generally stated as follows: The axes of the two cylinders are made coincident with each other by locating one cylinder within the other, the outer one surrounding the inner. The piston-rods of each cylinder are connected to separate primary levers, which are articulated to opposite ends of a pair of primary levers, so that the pistons of the inner and outer cylinders are constrained to move in opposite directions, respectively, and all the piston-rods to move in straight lines. By this means the guides, cross-head, and short connecting-links of Patent No. 489,648 are wholly dispensed with, and as the centers of gravity of the two pistons move in the same line no turning action or consequent disturbance is exerted. Inasmuch as the two pistons work in relatively opposite directions the movement of one piston and its rod will exactly balance that of the other piston and its rods if they are of equal weight.

The object of my present invention is to provide a valve mechanism which will be conveniently and desirably adaptable to use in controlling the supply and exhaust of motive fluid to and from the cylinders of an engine of the construction above referred to.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a view in elevation and as seen from the rear of a vertical two-cylinder compound engine of the overhead marine type, illustrating an embodiment of my invention; Fig. 2, a vertical transverse central section through the same looking toward the back of the engine; Fig. 3, a vertical longitudinal central section through the same; and Figs. 4 and 5, horizontal sections on the lines *a b* and *c d*, respectively, of Fig. 3, the low-pressure piston being omitted in Fig. 4 in order to show the lower valve clearly, and the oscillating levers being shown in a horizontal position and in elevation in Fig. 5.

The high-pressure cylinder 1^a and the low-pressure cylinder 1, which surrounds and axially coincides with the high-pressure cylinder, are secured to housings or standards 55, fixed upon a bed-plate 56, which supports the main bearing of the crank-shaft 19 of the engine. The high-pressure cylinder is fitted with a piston 2^a of the usual form, which is fixed upon a piston-rod 3^a, to the outer end of which is secured a forked head 48, which is coupled by a pin 15^a to the inner arms of a pair of primary levers 7 7, these being two parallel lever-bars. The outer arms of the primary levers 7 7 are coupled by a pin 9 to a pair of radius-links 11 11, the opposite ends of which are coupled to a pin 10, fixed to the low-pressure cylinder. The low-pressure cylinder 1 is fitted with an annular piston 2, which is fixed upon two piston-rods 3 3, projecting through suitable stuffing-boxes and having their outer ends coupled by pins 15 15 to the inner arms of a pair of second primary levers 7^a 7^a. The outer arms of the second primary levers 7^a are, similarly to those of the primary levers 7, coupled by a pin 9^a to a pair of radius-links 11^a 11^a, the opposite ends of which are coupled to a pin 10^a, fixed to the low-pressure cylinder. The primary levers 7 and second primary levers 7^a are coupled intermediately of their ends to a pair of secondary levers 8 8, which are parallel lever-bars having central journals 13 fitting in fixed bearings 14, the swiveling connection of the secondary levers to the primary levers 7 being effected by a pin 12 and that to the second primary levers by a pin 12^a. The main connecting-rod 4 is coupled at its upper end to the forked head 48 of the high-pressure piston-rod and to the primary levers 7 by the pin 15^a, and its lower end is coupled to the crank-pin 18 of the crank-shaft 19.

The operation of the high-pressure piston, piston-rod, and connecting-rod is similar to that of the corresponding parts in engines of the ordinary construction; but the piston-rods are constrained to move in straight lines by the system of oscillating levers which con-

stitutes a "parallel motion." The low-pressure piston being connected by its two piston-rods to the second primary levers 7^a, the pressure exerted upon it is transmitted by said levers to the secondary levers 8 8 and by them to the primary levers 7 7, and thence to the forked head 48, connecting-rod 4, and crank-pin 18. The levers are so proportioned that the inner ends of the primary levers and second primary levers move in substantially straight lines, and these levers serve as guides for the piston-rods of both the high and the low pressure cylinders.

The inner high-pressure cylinder 1^a is made separate from the outer low-pressure cylinder 1 and is attached to the lower cylinder-head 49^a by a flange 52. In order to allow for expansion and contraction and any unequal length of the two cylinders, the inner cylinder is attached to the upper cylinder-head 49 by a joint provided with packing 50, which allows the inner cylinder to move lengthwise independent of the outer cylinder and its head. The head 51 of the inner cylinder has a ring 53, formed on its under side, which acts as a gland to compress the packing 50, and thus make a steam-tight joint between the inside cylinder and the cylinder-head 49.

The means for admitting motive fluid to the central high-pressure cylinder and conducting it thence to the low-pressure cylinder after it has exerted its pressure on the high-pressure piston and finally exhausting it from the low-pressure cylinder after it has been expanded and done its work therein, which means constitute my present invention, consists in valves and ports and passages of special construction, which will now be described.

An annular supply-passage 20 is formed around the outside of the low-pressure cylinder 1, said passage communicating directly and continuously with the supply-pipe 20^a, leading from the source of fluid-pressure and having at its ends supply-ports 21 21^a, which open into the low-pressure cylinder, but which, as will be seen hereinafter, are continuously cut off from communication therewith by valves. The supply-passage entirely surrounds the low-pressure cylinder; but the ports where they enter the cylinder have bridges (not shown in the drawings) uniting their two sides. The inner and outer walls of the supply-passage are united by connecting-pieces 22 (shown in Fig. 4) cast therein. An annular exhaust-passage 23 is formed around the outside of the supply-passage 20, said passage communicating directly and continuously with the exhaust-pipe 23^a and, subject to the control of valves, communicating with the low-pressure cylinder by ports 24 24^a at the ends of said cylinder. Communication between the supply-passage 20 and the high-pressure cylinder 1^a and between the high-pressure and low-pressure cylinders is effected in proper sequence through valve-controlled ports 27 27^a, formed in the wall of the high-pressure cylinder at its upper and its lower ends, respectively. These ports extend completely around the cylinder, but are divided into sections by bridges.

The admission and exhaust of motive fluid to and from the cylinders 1^a 1 are effected and controlled by two annular piston-valves 25 25^a, which are fitted to reciprocate in the low-pressure cylinder adjacent to its ends and are properly packed on their inner and outer rims in order that they may work fluid-tight between the inner and outer cylinders. The inner and outer rims of the valves are connected by a plurality of tubular radial arms separated by intervening triangular open spaces 35, as shown in Fig. 4, and the passages through the radial arms constitute ports 26 26^a, which are shown in full lines in Figs. 2 and 3 and in dotted lines in Fig. 4. These ports are adapted to register at their inner ends with the ports 27 27^a of the high-pressure cylinder and at their outer ends with the ports 21 21^a, which lead from the supply-passage 20 into the low-pressure cylinder.

Reciprocating movement is imparted to the upper valve 25 through a pair of valve-stems 28 28 and to the lower valve 25^a through a pair of valve-stems 28^a 28^a, each valve-stem passing through a properly-packed stuffing-box in the adjacent cylinder-head. In Fig. 2 the upper and lower valve-stems on the right-hand side are represented as broken away, and their attachments to the valve are not shown in order that the valve-ports 26 26^a may be clearly represented. The connections of the valve-stems to the valves are shown on the left-hand side. The valves may be actuated by a single eccentric, either fixed or adjustable, or, as shown, by a pair of eccentrics and a link, or any other known and preferred form of valve-operating mechanism may be employed in the discretion of the constructor.

In the instance herein exemplified movement is imparted to a shifting link 31 by eccentrics 36 36^a, fixed upon the crank-shaft 19 at proper angles to the crank, their straps being connected by eccentric-rods 37 37^a to the link, which is shifted in position so as to reverse the direction of motion of the shaft or vary the point of cut-off as from time to time desired by a reverse-lever 38, as in engines of the ordinary construction. The stems 28 of the upper valve 25 are connected to a cross-bar 33, which is coupled at its outer ends by rods 34 to arms 32 32^a on a horizontal rock-shaft 29, journaled in bearings on the housings 55 55. The stems 28^a of the lower valve 25^a are coupled directly to the arms 32 32^a of the rock-shaft, and the two valves are thus moved coincidently by said shaft. An arm 30, which projects from the rock-shaft 29 in opposite direction to the arms 32 32^a, is coupled at its outer end to the link 31, and as said arm moves in a plane at right angles to the plane of movement of the link

the connection between the rocker-arm and the link is made, so as to compensate for the resultant inequality of movement. To this end a cylindrical bearing 39 is formed on the end of the arm 30, and a ring 40, having an outer spherical surface, is fitted thereon. The link block or die 41 is made in two sections, which fit over and conform to the spherical surface of the ring, and a universal joint is thus provided, which permits the inherent divergence resulting from the movement of the coupled parts in two different planes.

The operation of the valves may be understood from the following explanation of the movement of the motive fluid, which is indicated by arrows, that of the supply fluid being indicated by arrows in full lines and that of the exhaust fluid, which has performed all its work, by dotted arrows. The motive fluid enters from the source of supply by the pipe 20^a, and thence flows through the passage 20 and ports 21 to the valve 25 and through the valve-ports 26 to the port 27, and thence to the upper end of the high-pressure cylinder 1^a, moving the piston 2^a of said cylinder downward by its pressure upon it. The lower valve 25^a has simultaneously uncovered the ports 27^a, and the motive fluid below the piston 2^a, which was admitted to the high-pressure cylinder during the preceding upward stroke, passes through the ports 27^a to the lower end of the low-pressure cylinder 1, in which it acts to move the piston 2 thereof upward. At the same time, as shown by the dotted arrows, the motive fluid above the piston 2, which acted on said piston during its preceding downward stroke, passes out of the low-pressure cylinder through the triangular open spaces 35 in the upper valve 25 and through the exhaust-ports 24 into the annular exhaust-passages 23, and thence to the exhaust-pipe 23^a. The reverse action takes place during the upward stroke of the high-pressure piston and the downward stroke of the low-pressure piston, the valves being moved by their operating-gear to open and close the upper and lower ports at the proper time.

The form of engine illustrated, while more particularly designed for marine or stationary purposes, may obviously be applied to use in locomotive-engines or automobiles without variation of its operative principle.

I claim as my invention and desire to secure by Letters Patent—

1. In a fluid-pressure engine, the combination of a pair of cylinders located one within the other, a piston and piston-rod in the inner cylinder, an annular piston and a pair of piston-rods in the outer cylinder, an annular supply-passage on the outside of the outer cylinder and having end ports opening thereinto, an annular exhaust-passage on the outside of the outer cylinder and having end ports opening thereinto, supply and exhaust pipes leading into and out of the supply and exhaust passages, respectively, ports establishing communication between the inner and outer cylinders, annular valves fitting in the ends of the outer cylinder and controlling the ports so as to admit motive fluid direct from the ports of the supply-passages to the inner cylinder, thence to the outer cylinder, and thence to the exhaust passage and pipe, a driving-shaft, means for reciprocating the valves, and connections from said shaft to the piston-rods.

2. In a fluid-pressure engine, the combination of a pair of cylinders located one within the other, a piston and piston-rod in the inner cylinder, an annular piston and a pair of piston-rods in the outer cylinder, an annular supply-passage on the outside of the outer cylinder and having end ports opening thereinto, an annular exhaust-passage on the outside of the outer cylinder and having end ports opening thereinto, supply and exhaust pipes leading into and out of the supply and exhaust passages, respectively, ports establishing communication between the inner and outer cylinders, annular valves fitting in the ends of the outer cylinder and having diametric passages establishing communication between the inlet-passage and the inner cylinder and openings establishing communication from one to the other side of the valves and thence to the exhaust-passages, a driving-shaft, means for reciprocating the valves, and connections from said shaft to the piston-rods.

3. In a fluid-pressure engine, the combination of a pair of cylinders located one within the other, a piston and piston-rod in the inner cylinder, an annular piston and a pair of piston-rods in the outer cylinder, an annular supply-passage on the outside of the outer cylinder and having end ports opening thereinto, an annular exhaust-passage on the outside of the outer cylinder and having end ports opening thereinto, supply and exhaust pipes leading into and out of the supply and exhaust passages respectively, ports establishing communication between the inner and outer cylinders, annular valves fitting in the ends of the outer cylinder and controlling the ports so as to admit motive fluid direct from the ports of the supply-passage to the inner cylinder, thence to the outer cylinder, and thence to the exhaust passage and pipe, a pair of valve-stems fixed to each valve and extending through the adjacent cylinder-head, a yoke secured to one pair of the valve-stems, a double-armed rocker-shaft having arms connected directly to one pair of the valve-stems, rods connecting the yoke with arms on the rocker-shaft, a driving-shaft, means for oscillating the rocker-shaft by the rotation of the driving-shaft, and connections from the driving-shaft to the piston-rods.

MATTHIAS N. FORNEY.

Witnesses:
LUDWIG CHARR,
M. T. CONROY.