

J. E. J. GOODLETT.
COMPOUND ENGINE.

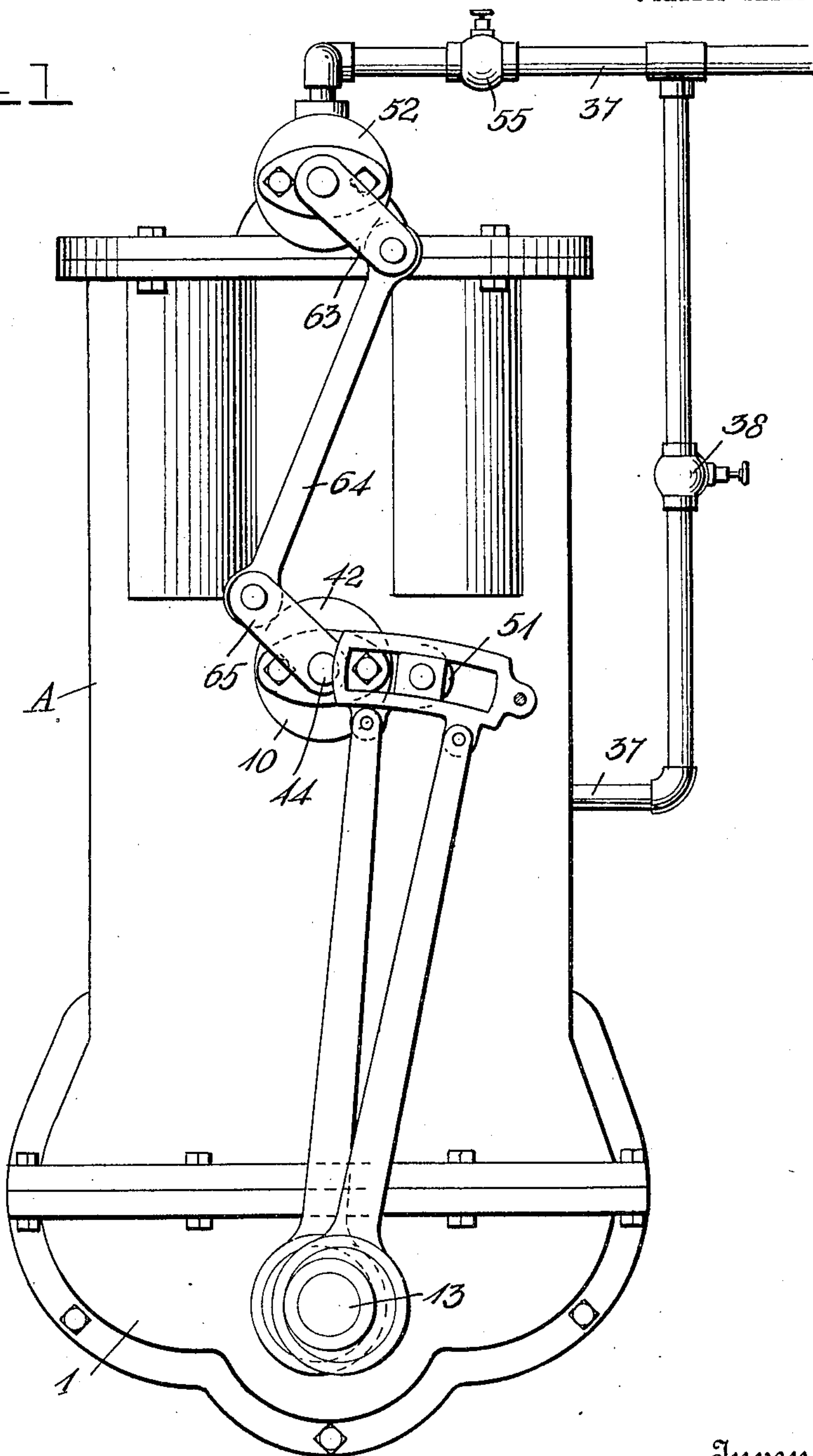
APPLICATION FILED JULY 11, 1907.

Patented Dec. 15, 1908.

5 SHEETS—SHEET 1.

906,703.

Fig. 1



Witnesses
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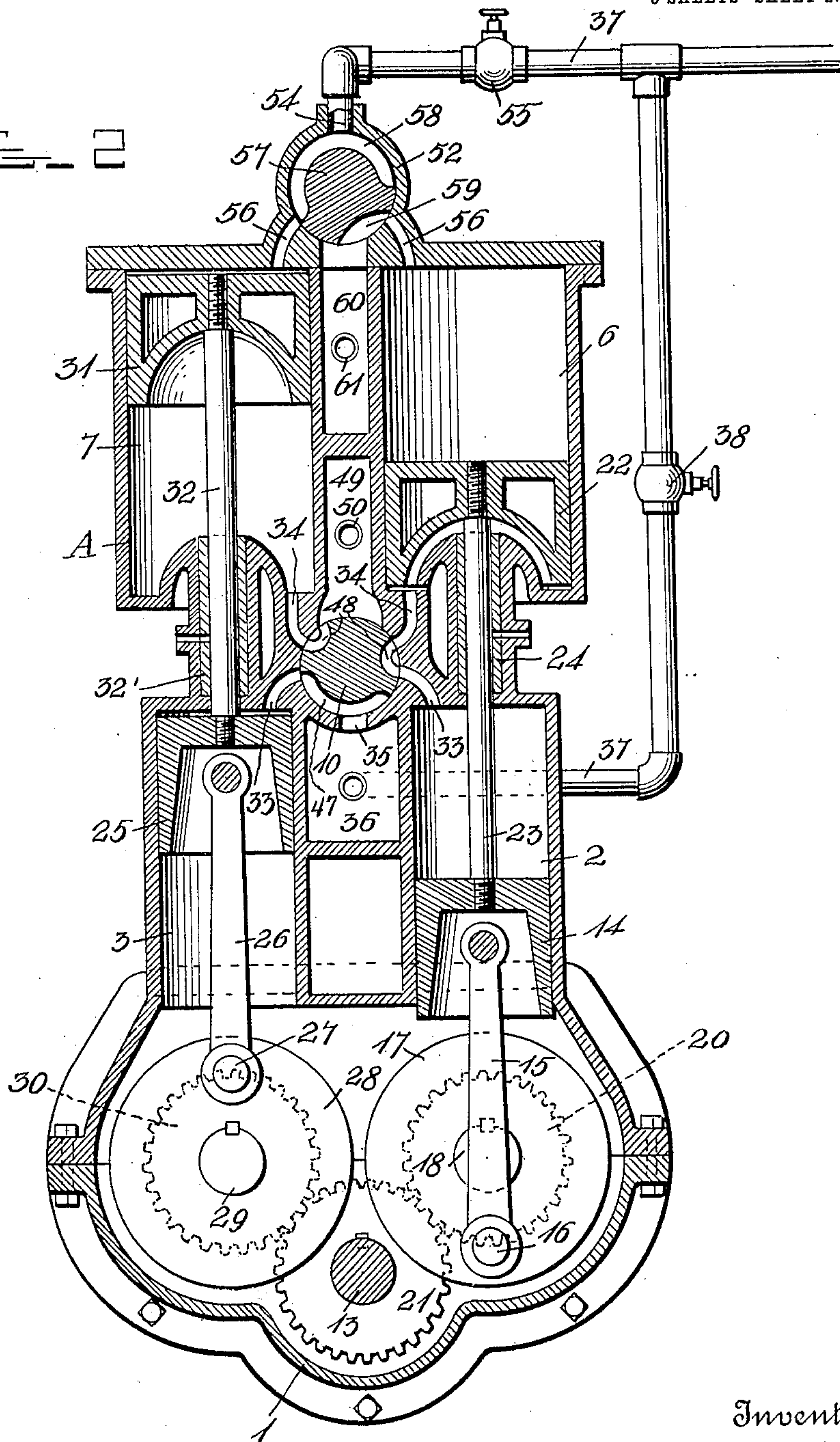
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5 SHEETS—SHEET 2.

Fig. 2



Witnesses

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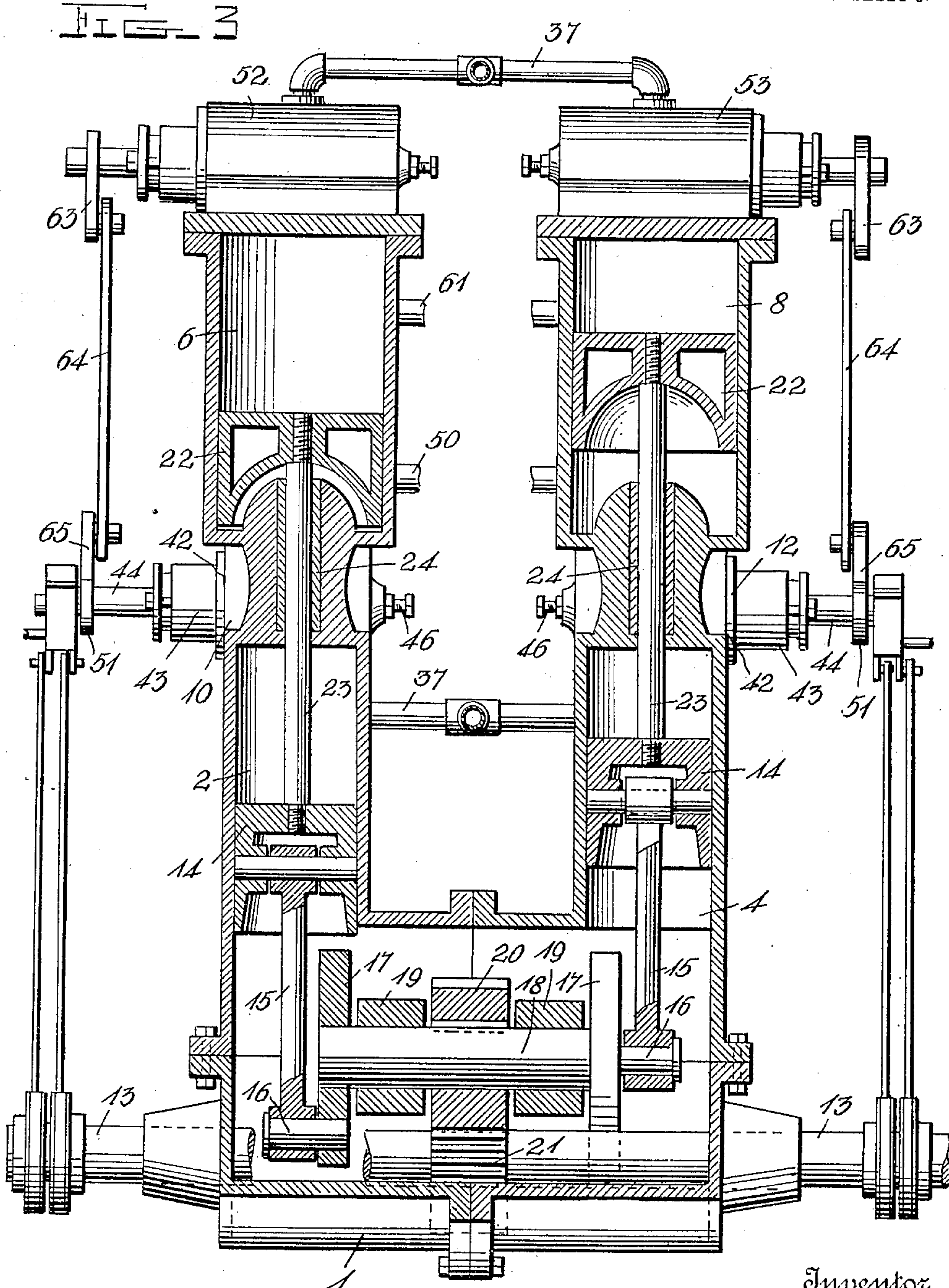
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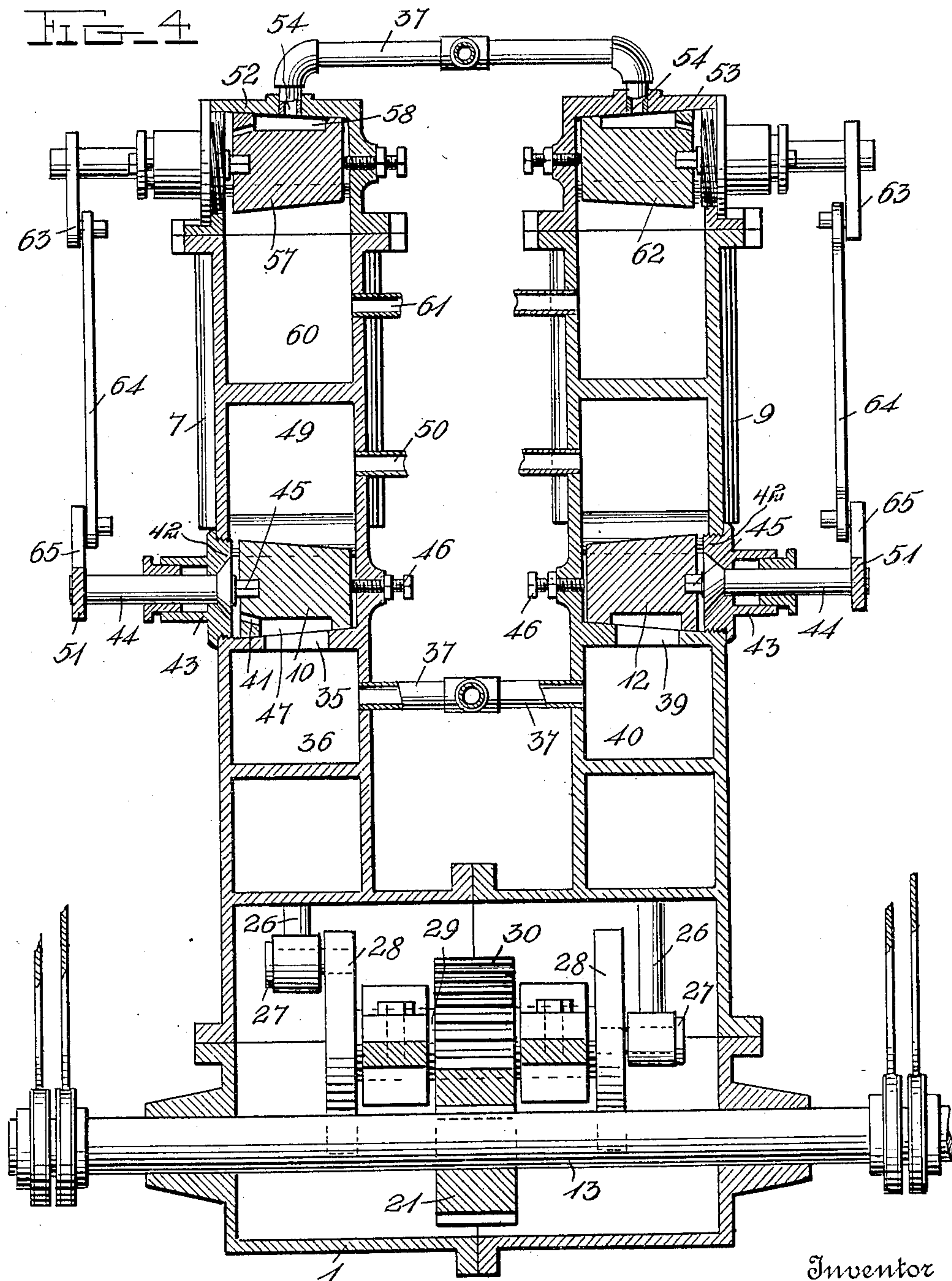
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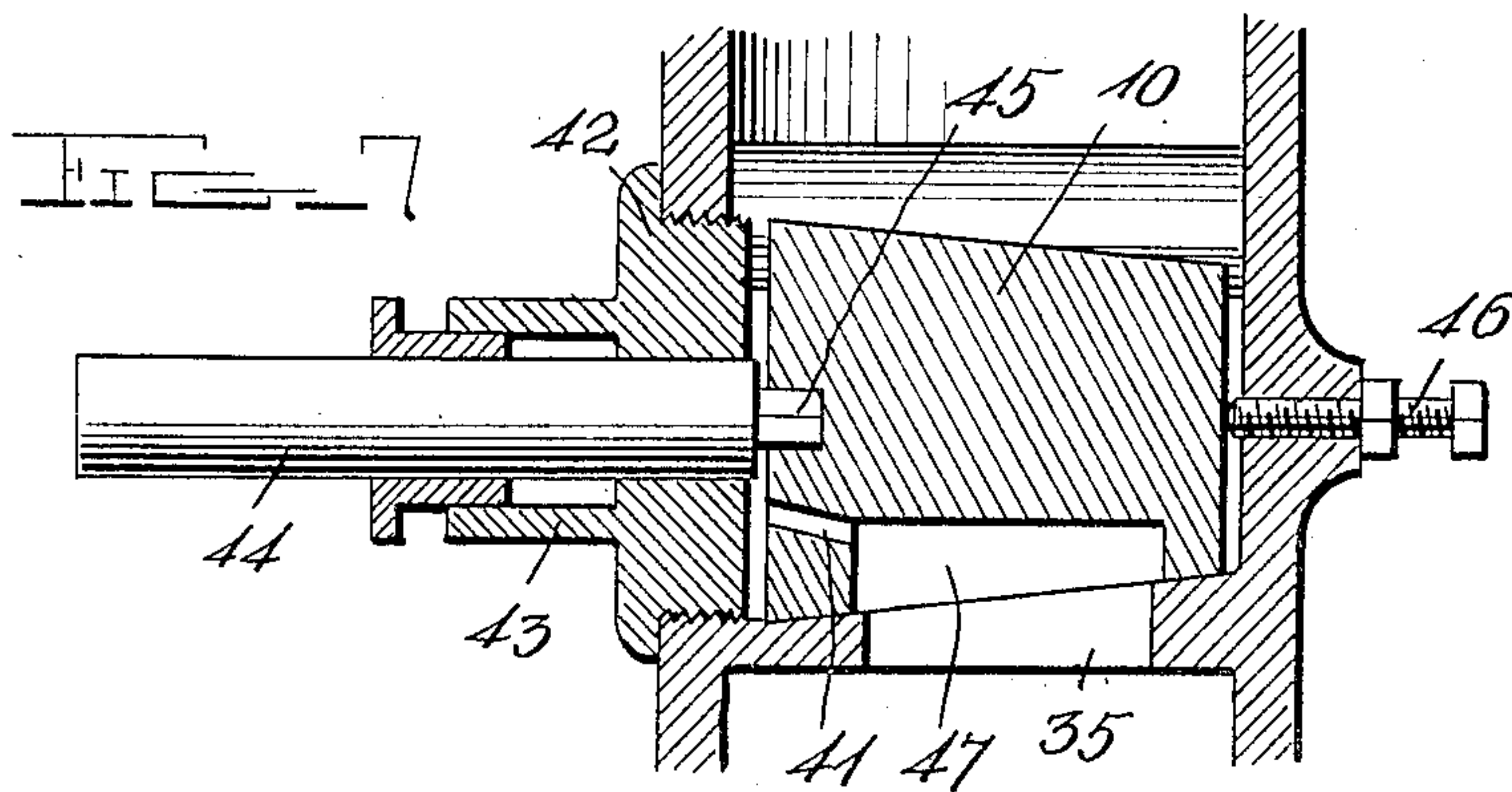
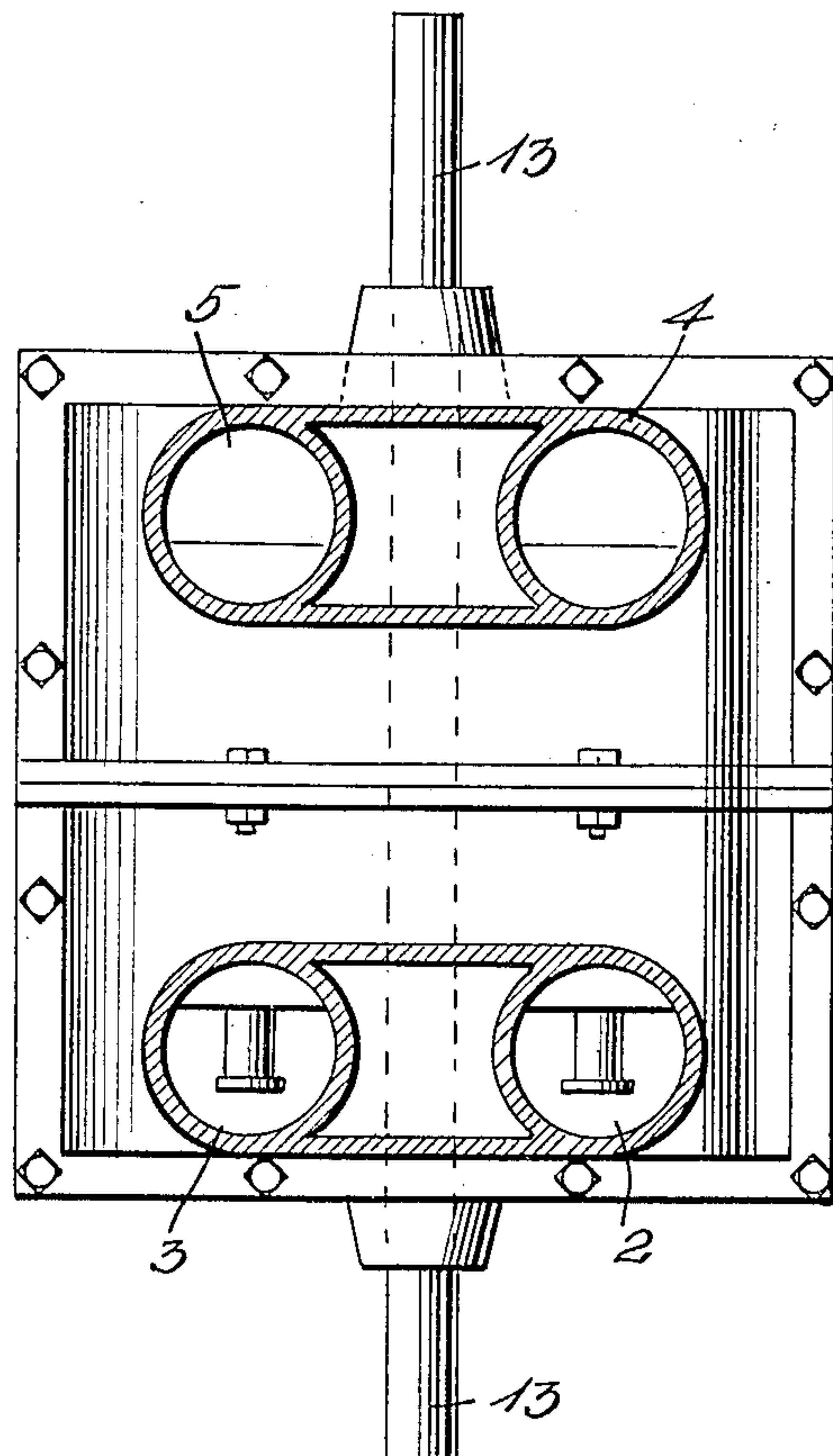
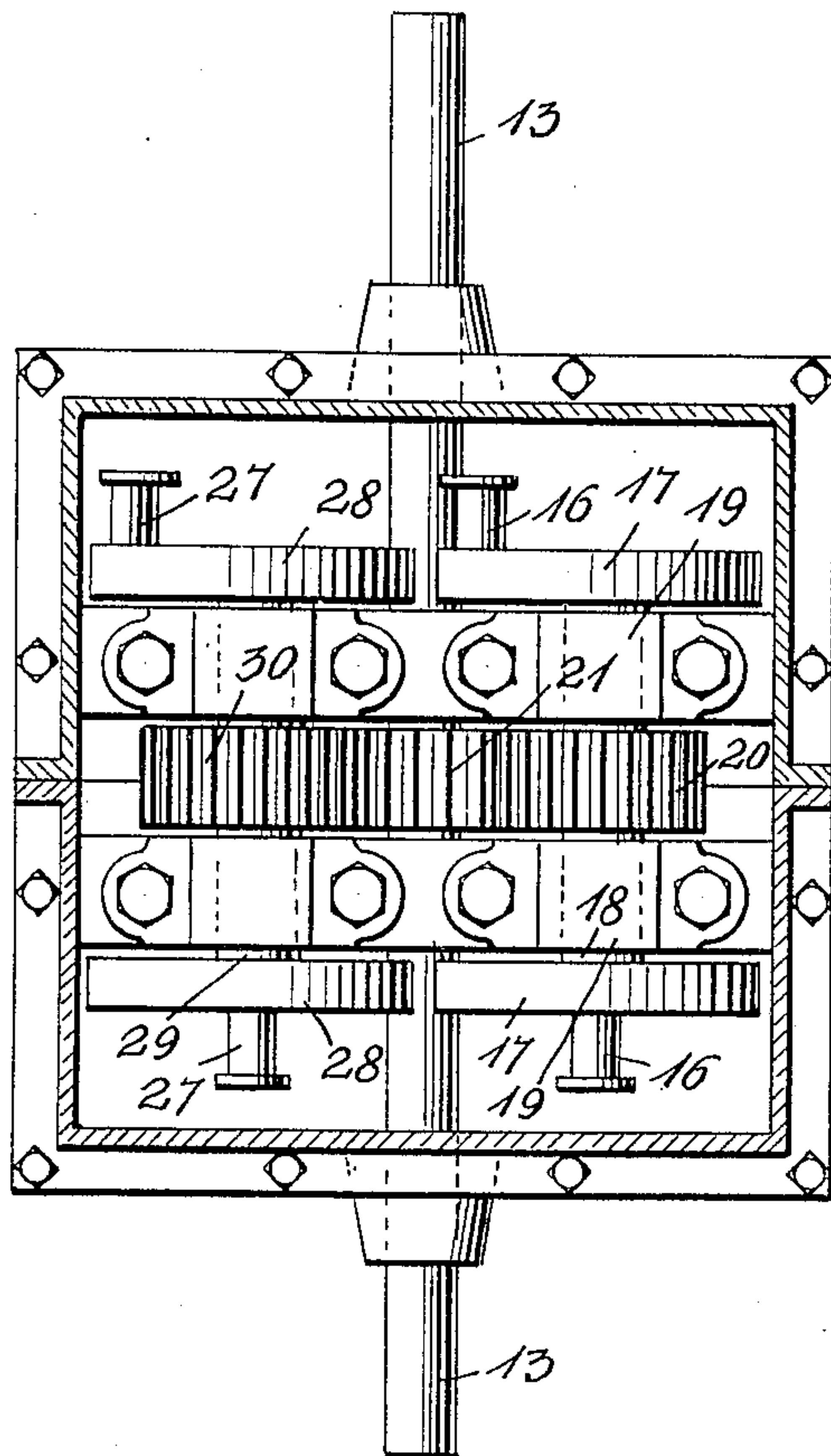
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5 SHEETS—SHEET 5.

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FIG. 5

FIG. 6



Witnesses

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UNITED STATES PATENT OFFICE.

JOSEPH E. J. GOODLETT, OF MEMPHIS, TENNESSEE.

COMPOUND ENGINE.

No. 906,703.

Specification of Letters Patent.

Patented Dec. 15, 1908.

Application filed July 11, 1907. Serial No. 383,302.

To all whom it may concern:

Be it known that I, JOSEPH E. J. GOODLETT, a citizen of the United States, residing at Memphis, in the county of Shelby and State of Tennessee, have invented certain new and useful Improvements in Compound Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in compound engines.

The object of the invention is to provide an eight-cylinder compound engine having means whereby high-pressure steam may be applied to the low-pressure cylinders of each set when desired without interfering with the compounding or the exhaust action of the engine.

With this object in view, the invention consists of certain novel features of construction, combination and arrangement of parts as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a front elevation of an engine constructed in accordance with the invention; Fig. 2 is a vertical sectional view through the center of the front set of the cylinders; Fig. 3 is a similar view through the front and rear cylinders of one side of the engine; Fig. 4 is a central vertical sectional view taken between the cylinders on a line with the valves which admit the steam thereto; Fig. 5 is a horizontal sectional view through the base of the engine, showing the arrangement of the drive shaft and the parts geared thereto; Fig. 6 is a similar view taken through the lower cylinders above the base; and Fig. 7 is an enlarged detail view through one of the valves.

Referring more particularly to the drawings, A denotes the engine, which consists of a base, 1, having mounted thereon four main, or high-pressure cylinders, 2, 3, 4 and 5, above which and connected thereto are four low-pressure cylinders, 6, 7, 8 and 9, the pistons of which are operated by the exhaust steam from the lower cylinders. The steam for the high-pressure cylinders, 2 and 3, and the low-pressure cylinders, 6 and 7, above the same, and, which, together, form the forward set of cylinders, is controlled by a single valve, 10, while the steam for the

four cylinders forming the rear set is controlled by a similar valve, 12, said valves 10 and 12 being independently operated by eccentrics and operating rods connected to the opposite ends of a main drive shaft, 13, journaled in suitable bearings in the base of the engine.

The construction and arrangement of the parts in each high and low-pressure cylinder is the same. In the front and rear right-hand lower high-pressure cylinders are slidably mounted pistons, 14, which are connected by piston rods, 15, to wrist-pins, 16, which are eccentrically mounted on disks, 17. The disks 17 are fixedly mounted on a countershaft, 18, journaled in suitable bearings, 19, in the base 1. On the shaft 18 is fixedly mounted a spur gear, 20, which is in engagement with and drives a pinion, 21, on the main drive shaft, whereby the power from the cylinders on this side of the engine is applied to the drive shaft.

In the upper cylinders, 6 and 8, of the front and rear right-hand sets, are arranged pistons, 22, which are attached by piston rods, 23, to the pistons, 14, of the lower high-pressure cylinders and operate simultaneously therewith from the pressure of the exhaust steam from the high-pressure cylinders below. This steam is admitted to the upper low-pressure cylinders through the valves 10 and 12. The rods 23 work in bearings, 24, arranged between the upper and lower cylinders.

The arrangement of the parts for the lower high-pressure cylinders 3 and 5, on the left-hand side of the engine is the same as that described in connection with the high-pressure cylinders on the right-hand side, and consists of pistons, 25, arranged therein and to which are connected piston rods, 26, the lower ends of which are connected to wrist-pins, 27, which are eccentrically mounted on disks, 28. The disks 28 are fixedly mounted on the opposite ends of a counter-shaft 29, which is journaled in suitable bearings in the base of the engine, and which is disposed in the same horizontal plane and is parallel to the counter-shaft, 18, on the opposite side of the engine. The shaft, 29, is provided with a centrally disposed spur gear, 30, which is adapted to engage the pinion, 21, on the drive shaft, 13, whereby power from this side of the engine is applied to said drive shaft. The arrangement of the low-pressure cylinders on the

left-hand side of the engine is also the same as the low-pressure cylinders, 6 and 7, and the parts therein on the opposite side of the engine, and in said left low-pressure cylinders are slidably mounted pistons, 31, the piston rods 32, of which work through guide bearings, 32', and are connected at their lower ends to the pistons, 25, of the high-pressure cylinders below.

10 In the upper ends of the lower high-pressure cylinders are formed combined steam inlet and exhaust ports, 33, the upper ends of which communicate with the valve chambers of the valves, 10 and 12. The ports of the cylinders 2 and 3, communicate with the chamber of the valve, 10, while the ports of the cylinders 4 and 5 communicate with the chamber of the valve 12. The lower ends of the upper low-pressure cylinders are provided with combined inlet and exhaust ports, 34. The ports 34 of the forward pair of cylinders, 6 and 7, communicate with the chamber of the valve 10, while the ports 34 for the cylinders 8 and 9 communicate with the chamber of the valve 12. The chamber of the valve 10 is also provided with an inlet port, 35, which opens into an inlet steam chamber or chest, 36, with which is connected a steam supply pipe, 37, having arranged therein a cut-off valve, 38. The steam chest 36 is arranged between the two forward high-pressure cylinders, as shown. The valve chamber for the valve 12 is provided with an inlet port, 39, which communicates with a steam chest, 40, arranged between the rear pair of the high-pressure cylinders, and with which is also connected the steam supply pipe 37.

40 The valves 10 and 12 are preferably tapered and are adapted to be oscillated or partially rotated in their chambers or casings, said chambers being preferably tapered to receive the valves which are forced or seated into steam-tight engagement with the tapered wall of the casings or chambers by means of steam which is admitted from one of the ports of the valve through a by-pass, 41, to the larger end of the valve where the steam expands against said end and between the same and a cap, 42, which screws into the larger open end of the casing. The cap, 42, is provided with a stuffing-box, 43, through which and the cap is arranged a valve stem, 44, the inner end of which is reduced to form a squared lug, 45, which is adapted to be loosely engaged with a socket or recess formed in the adjacent larger end of the valve, whereby the same may be turned or oscillated through said stem by a suitable operating mechanism hereinafter described. The valves 10 and 12 are prevented from being forced too tightly into their seats or chambers by means of a regulating screw, 46, which is screwed into the opposite end of the chamber and is pro-

vided with a jam nut to hold the same in its adjusted position. The valve 10 is provided in one side with a steam inlet passage 47, which, when said valve is turned, is adapted to connect the inlet port 35 of the steam chest 36 with the ports 33 of first one high-pressure cylinder and then the other of the forward set of cylinders, 2 and 3, whereby steam is alternately let into said cylinders. The valve 10 is also provided in its opposite sides with steam passages, 48, which connect the ports 33 of the high-pressure cylinders with the inlet port 34 of the low-pressure cylinders immediately above on first the right-hand and then the left-hand side of the engine, whereby the exhaust steam from said high-pressure cylinders, 2 and 3, is conveyed to first one and then the other of the upper or low-pressure cylinders, 6 and 7. The passages 48 in the valve 10 also serve to alternately connect the ports 34 of the low-pressure cylinders with an exhaust chamber 49 arranged between the upper low-pressure cylinders 6 and 7, whereby the steam from said cylinders is exhausted, said exhaust steam being conducted from the chamber 49 through suitable exhaust pipes, 50.

The valve 12 for the opposite or rear set of cylinders is provided with a similar arrangement of passages which are adapted to be connected with the inlet and exhaust ports of the high and low-pressure cylinders of the said rear set in the same manner as described in connection with the valve 10, for the forward set of cylinders. The outwardly projecting ends of the stems 44 of the valves 10 and 12 are provided with crank arms, 51, said crank arms being preferably connected to the main drive shaft on each side of the engine by a Stevenson's link motion, by means of which the valves are operated and controlled to admit and exhaust the steam from the various cylinders of the engine at the proper time. The crank or wrist-pins for the piston rods for the sets of cylinders are arranged 180° apart, but the said crank or wrist-pins for the one set are arranged at 90° from the other set, thus providing for the elimination of "dead" centers.

115 On the upper ends of the front and rear sets of the upper or low-pressure cylinders are arranged valve casings, 52 and 53, which are provided with steam inlet ports, 54, to which are connected a branch of the steam supply pipe 37, said branch pipe having arranged therein a cut-off valve, 55, by means of which steam may be admitted to the casings 52 and 53 when desired. Between the casing 52 and the upper low-pressure cylinders, 6 and 7, of the forward set are arranged combined steam inlet and exhaust ports, 56, and in said casing 52 is mounted a valve, 57, which is similar in construction and operation to the valves 10 and 12. The valve 57

is provided with a steam inlet passage, 58, which, when the valve 57 is turned in one direction or the other, is adapted to provide communication between the steam inlet port 54 and first one and then the other of the ports 56 which communicate with the upper ends of the low-pressure cylinders, 6 and 7, thus providing for the admission of live or high-pressure steam to the upper ends of said low-pressure cylinders in case of emergency or whenever it is desired to convert the low-pressure cylinders into high-pressure cylinders. The valve 57 is provided with an exhaust passage 59, which, when the valve is turned, is adapted to afford communication between an exhaust chamber, 60, arranged between the cylinders 6 and 7, and first one and then the other of the ports, 56, whereby the steam is exhausted from the upper ends of the low-pressure cylinders, 6 and 7, at the proper time. The exhaust chamber 60 has connected thereto an exhaust pipe, 61. In the valve casing 53 on the upper end of the cylinders 8 and 9, of the rear set, is arranged a valve, 62, which is similar in construction and operation to the valve 57, and is adapted to admit live or high-pressure steam through the combined inlet and exhaust ports which connect the casing 53 with said low-pressure cylinders, 8 and 9, whereby said cylinders are converted into high-pressure cylinders. Steam is admitted to and cut off from the valve casings 52 and 53 by means of the cut-off valve 55 arranged in the branch steam supply pipe, as hereinbefore described.

The stems of the valves 57 and 62 project through the outer ends of the valve casings and have connected thereto crank arms, 63, which are connected at their outer ends to operating rods, 64. The rods 64 are connected at their lower ends to crank arms 65 on the stems of the main or regular valves, 10 and 12, thus providing for the operation of the emergency valves 57 and 62 at the proper time to admit high-pressure steam to the upper ends of the low-pressure cylinders without interfering with the action of the exhaust steam which enters the lower ends of said cylinders.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In an engine of the class described, a series of high-pressure cylinders, a series of low-pressure cylinders, reciprocating pistons in said cylinders, valves adapted to control the admission of high-pressure steam to said high-pressure cylinders, and the exhaust steam from the latter to said low-pressure cylinders, and an automatically operated, combined live steam and exhaust valve adapted to admit live or high-pressure steam to said low-pressure cylinders, simultaneously with the admission of the exhaust

steam from the high-pressure cylinders, substantially as described.

2. A multiple-cylinder compound engine comprising a series of high-pressure cylinders, a series of low-pressure cylinders arranged thereon, pistons adapted to reciprocate in said cylinders, piston rods to connect the pistons in said high-pressure and low-pressure cylinders, a main drive shaft, counter-shafts geared to said main shaft, operating disks fixed on said counter-shafts, eccentrically mounted wrist-pins on said disks, piston rods to connect said high-pressure pistons with said wrist-pins, valves to control the admission of high-pressure steam to said high-pressure cylinders and the exhaust steam from the latter to said low-pressure cylinders, and emergency valves to admit high-pressure steam to said low-pressure cylinders, substantially as described.

3. A multiple-cylinder compound engine comprising a base, a series of high-pressure cylinders mounted on said base, a series of low-pressure cylinders arranged above and connected to said high-pressure cylinders, said cylinders being arranged in front and rear sets, a valve adapted to control the admission and exhaust of steam to and from the high and low-pressure cylinders of each set, pistons slidably mounted in said cylinders, piston rods to connect the pistons of the low-pressure cylinders with the piston of the high-pressure cylinders, whereby said pistons are moved in unison, a main drive shaft journaled in said base, countershafts geared to said main shaft, crank disks fixedly mounted on the opposite ends of said counter-shafts, piston rods to connect the high-pressure pistons with said crank disks, an emergency valve adapted to be connected with the low-pressure cylinders of each of said sets, whereby high-pressure steam is admitted to said cylinders to reciprocate the pistons therein, and means whereby said emergency valves are operated by the movement of the regular engine valves, substantially as described.

4. A multiple-cylinder compound engine comprising a base, a series of high-pressure cylinders arranged on said base said cylinders having combined steam inlet and exhaust ports, steam chests arranged between said cylinders, a series of low-pressure cylinders arranged above said high-pressure cylinders and connected thereto, pistons slidably mounted in said cylinders, piston rods to connect the pistons of the low-pressure cylinders with the pistons of the high-pressure cylinders whereby said pistons are moved in unison, valve casings arranged between the front and rear sets of said cylinders, rotary valves mounted in said casings adapted to open and close said combined steam inlet and exhaust ports of the high-pressure cylinders whereby steam is alter-

nately admitted to and exhausted from the same, a main drive shaft journaled in said base, a gear pinion on said shaft, counter-shafts having spur gears to engage the gear
5 pinion on said main shaft, crank disks on said counter-shafts, piston rods to connect said high-pressure pistons with said crank disks, emergency valves adapted to admit high-pressure steam to the low-pressure cylinders, valved steam supply pipes connected to
10 said emergency valve and to the steam chest of said regular valves, valve operating gear connected to said main drive shaft and to

said valves, whereby the latter are operated, and a system of crank arms and connecting
15 rods between said regular valves and said emergency valves whereby the latter are operated by said regular valves, substantially as described.

In testimony whereof I have hereunto set
20 my hand in presence of two subscribing witnesses.

JOSEPH E. J. GOODLETT.

Witnesses:

J. G. TATE,
B. S. BYRD.