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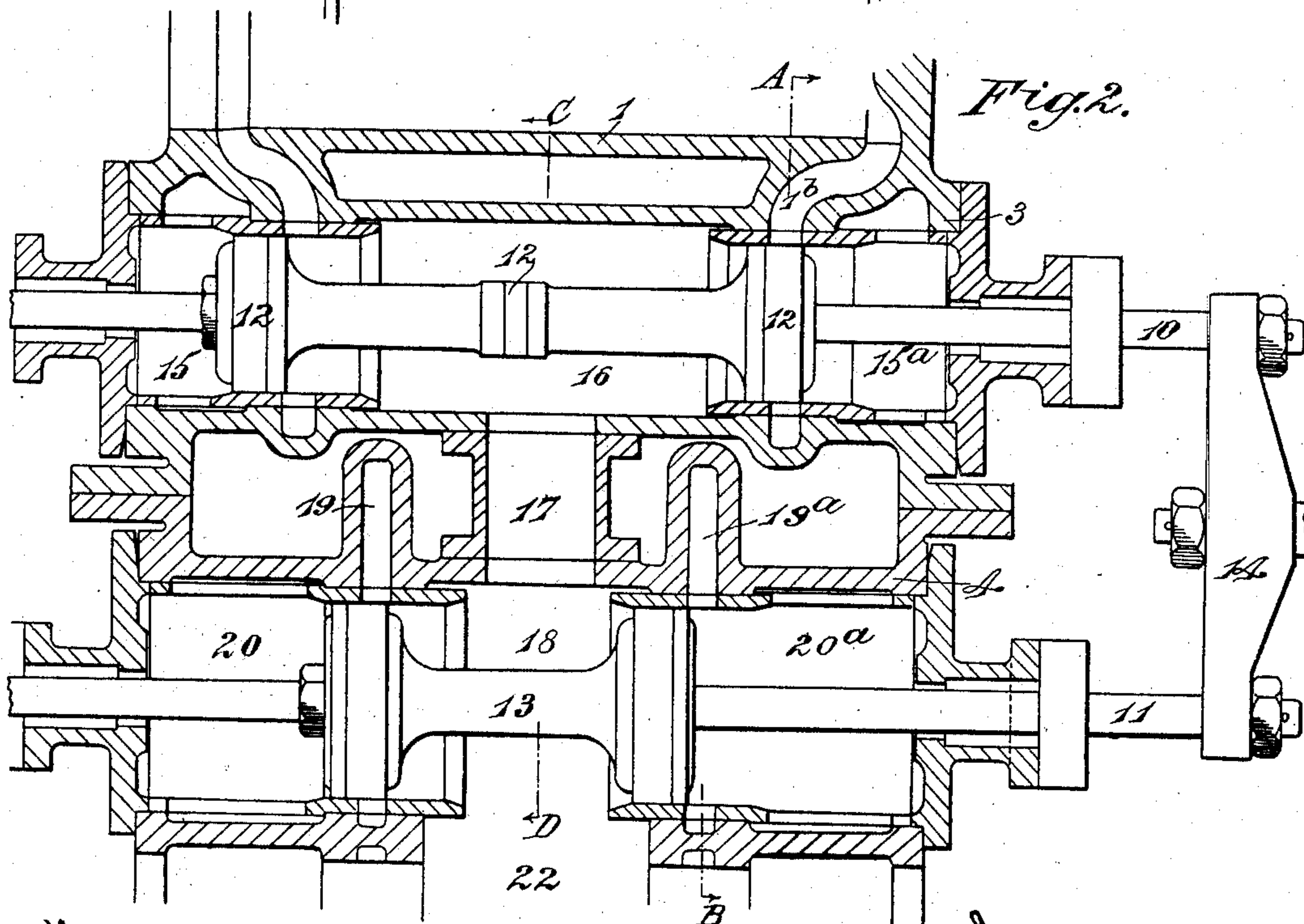
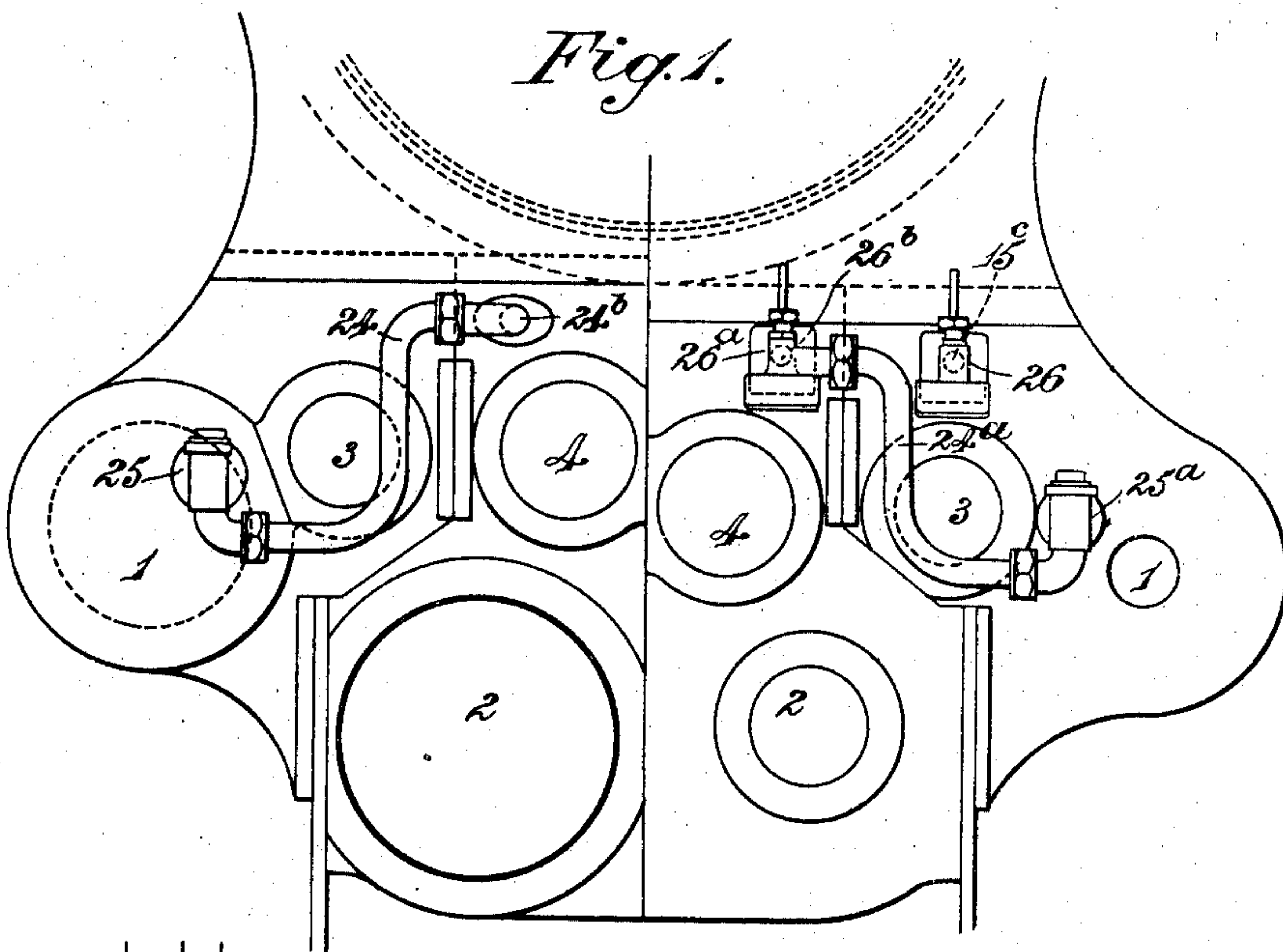
PATENTED AUG. 18, 1903.

W. M. SMITH.
STEAM ENGINE.

APPLICATION FILED APR. 10, 1901.

NO MODEL.

7 SHEETS—SHEET 1.



Witnesses.
Giles H. Hoffman.
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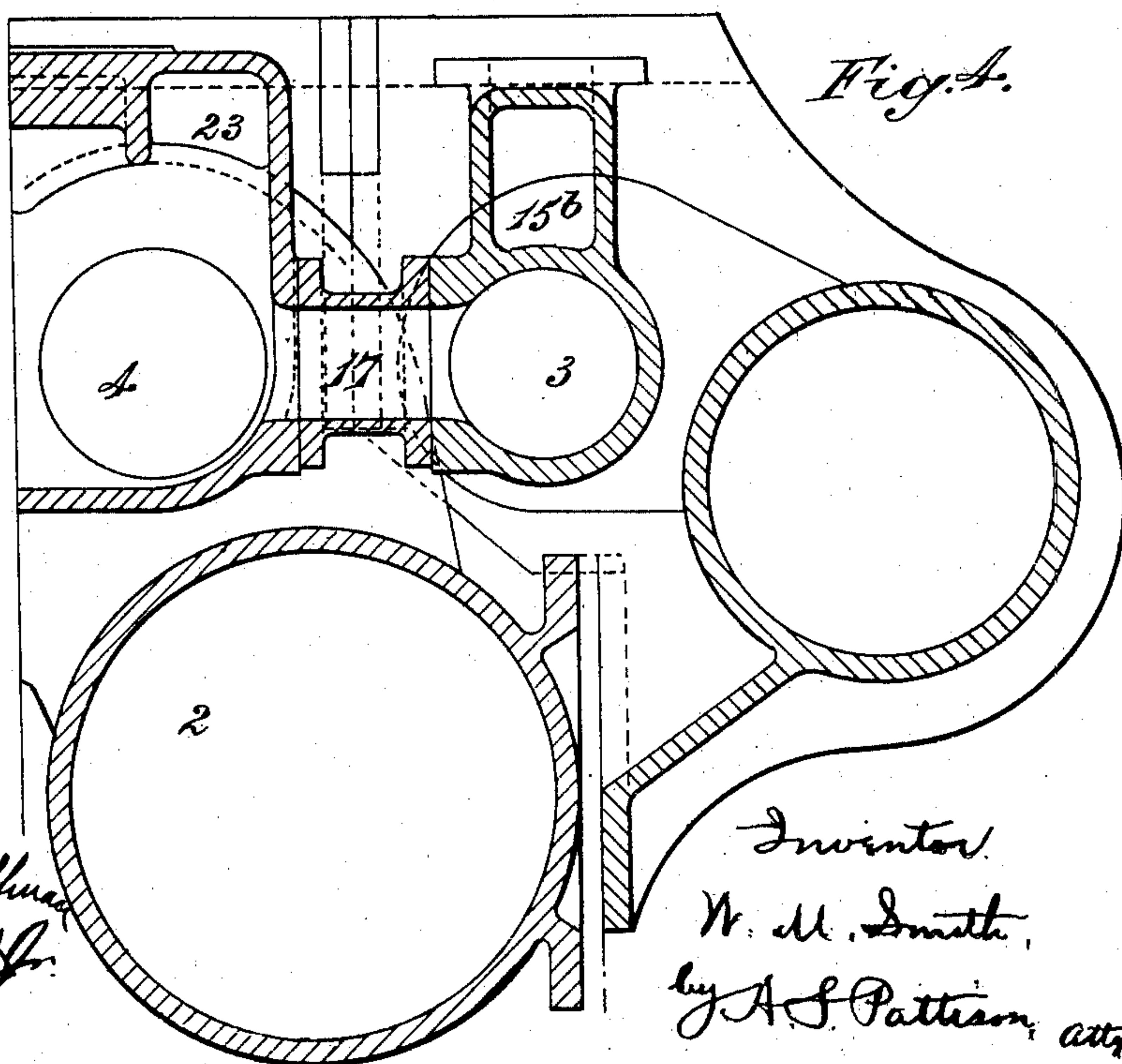
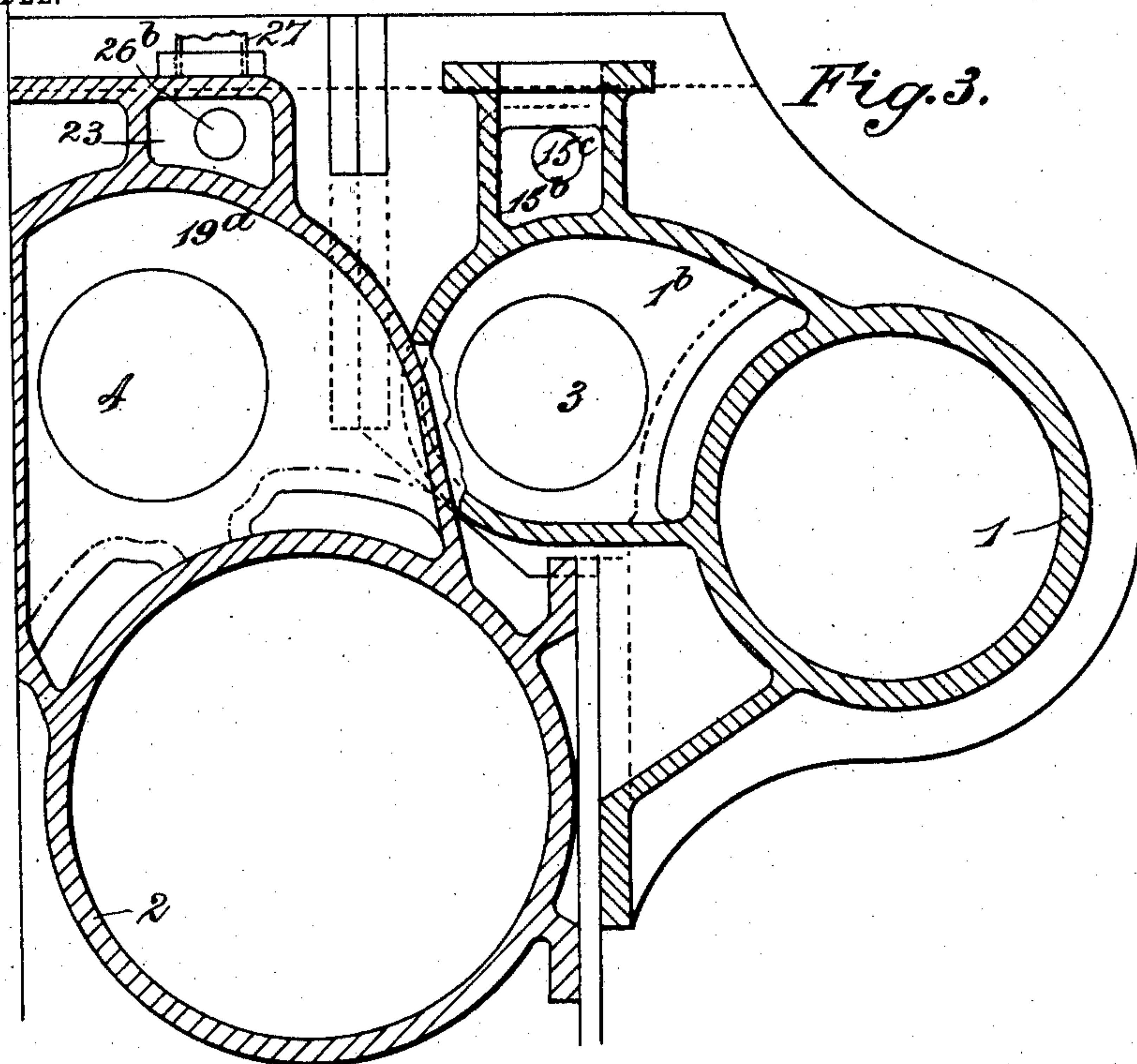
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7 SHEETS—SHEET 2.



Witnesses
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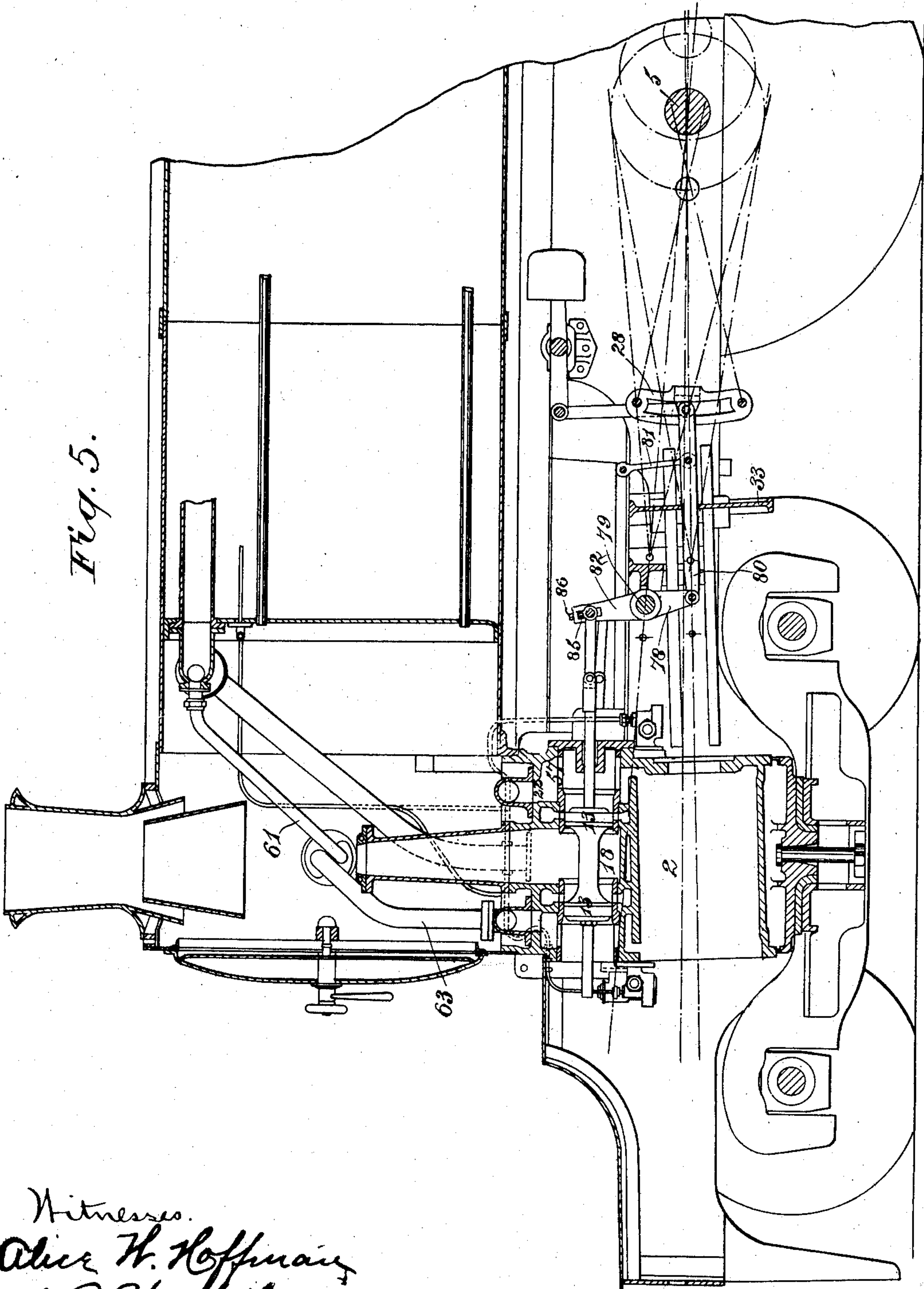
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NO MODEL.

7 SHEETS—SHEET 3.



Witnesses.
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No. 736,888.

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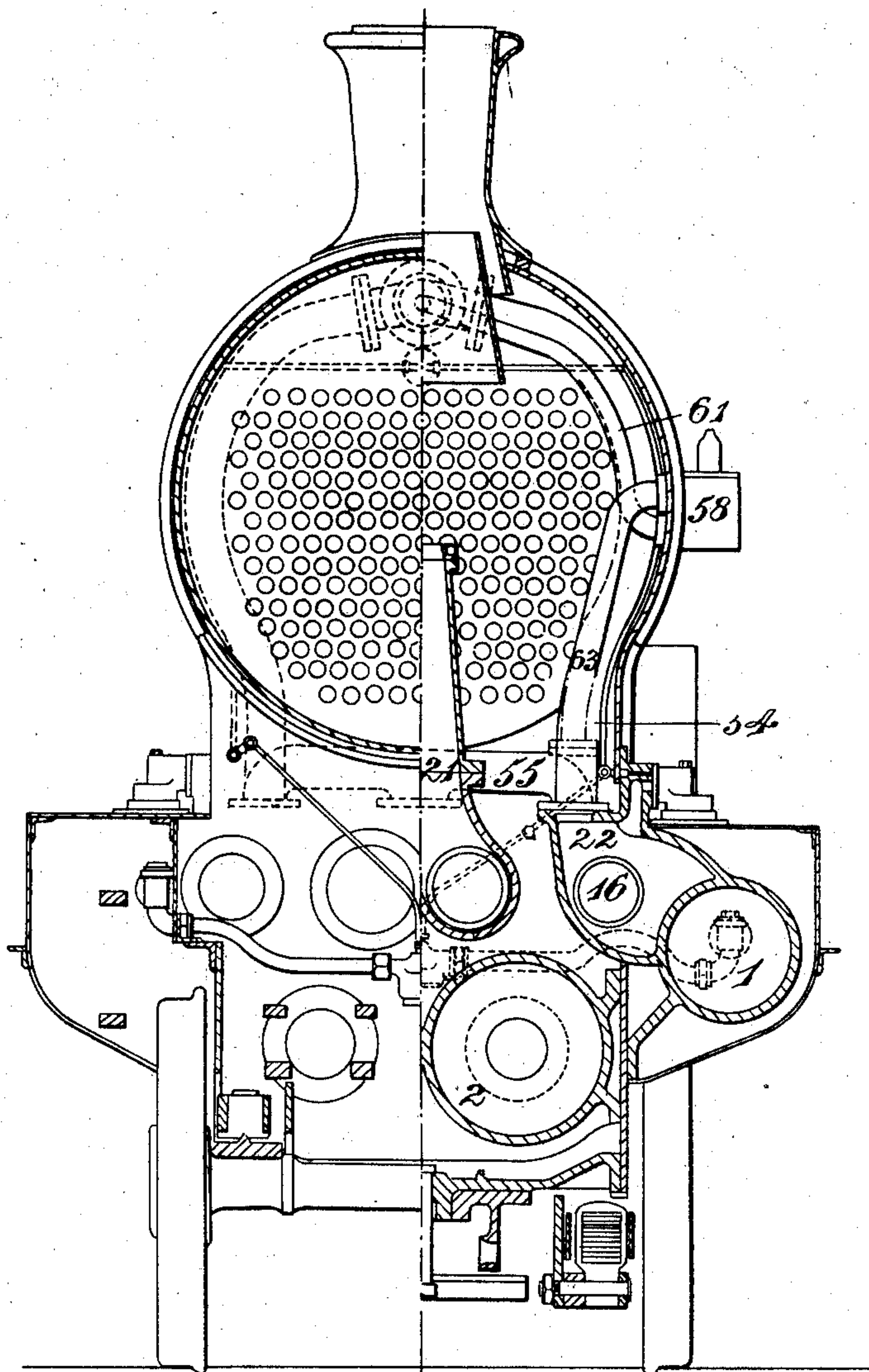
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7 SHEETS—SHEET 4.

Fig. 6.



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7 SHEETS—SHEET 5.

Fig. 7.

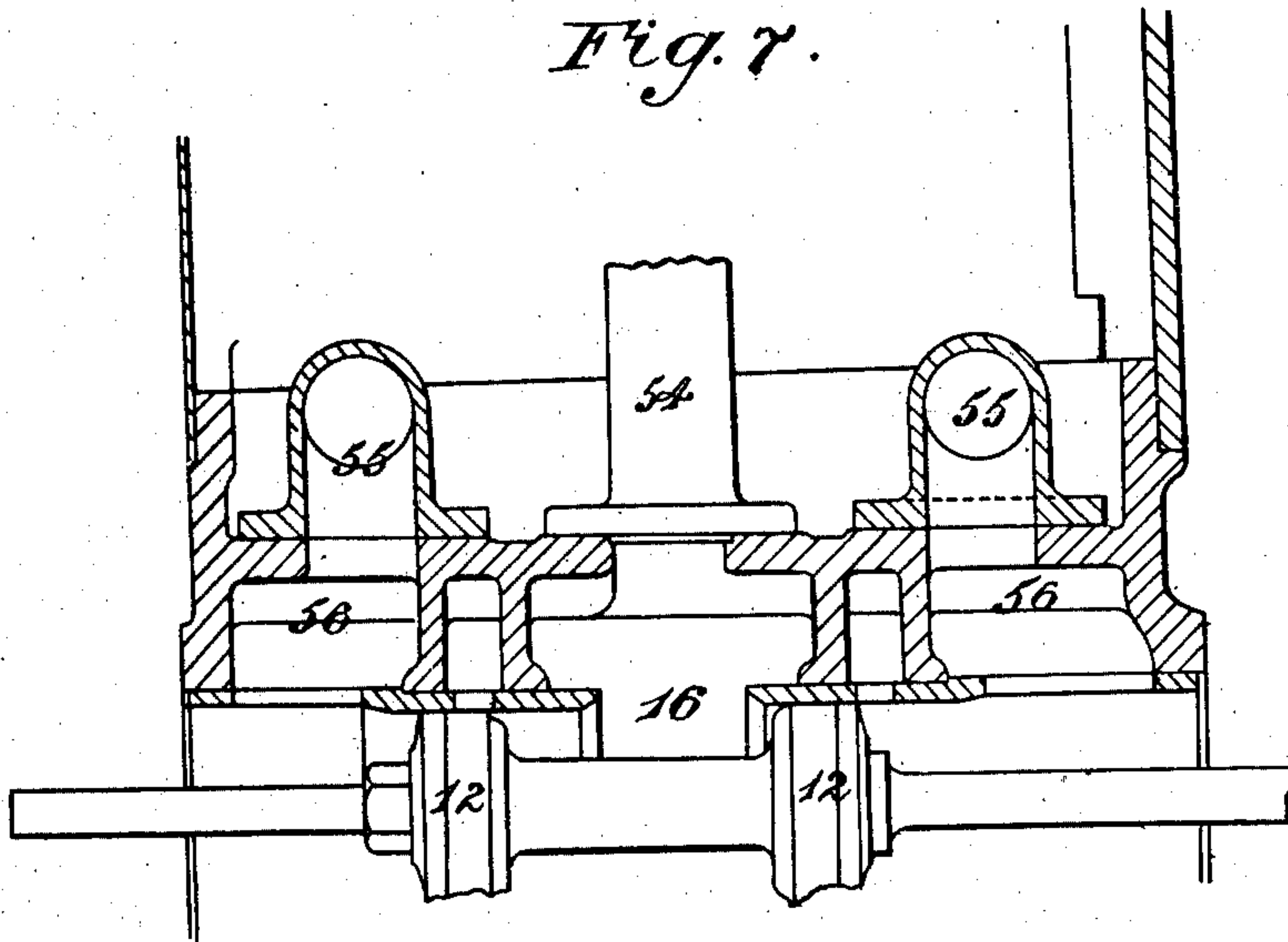
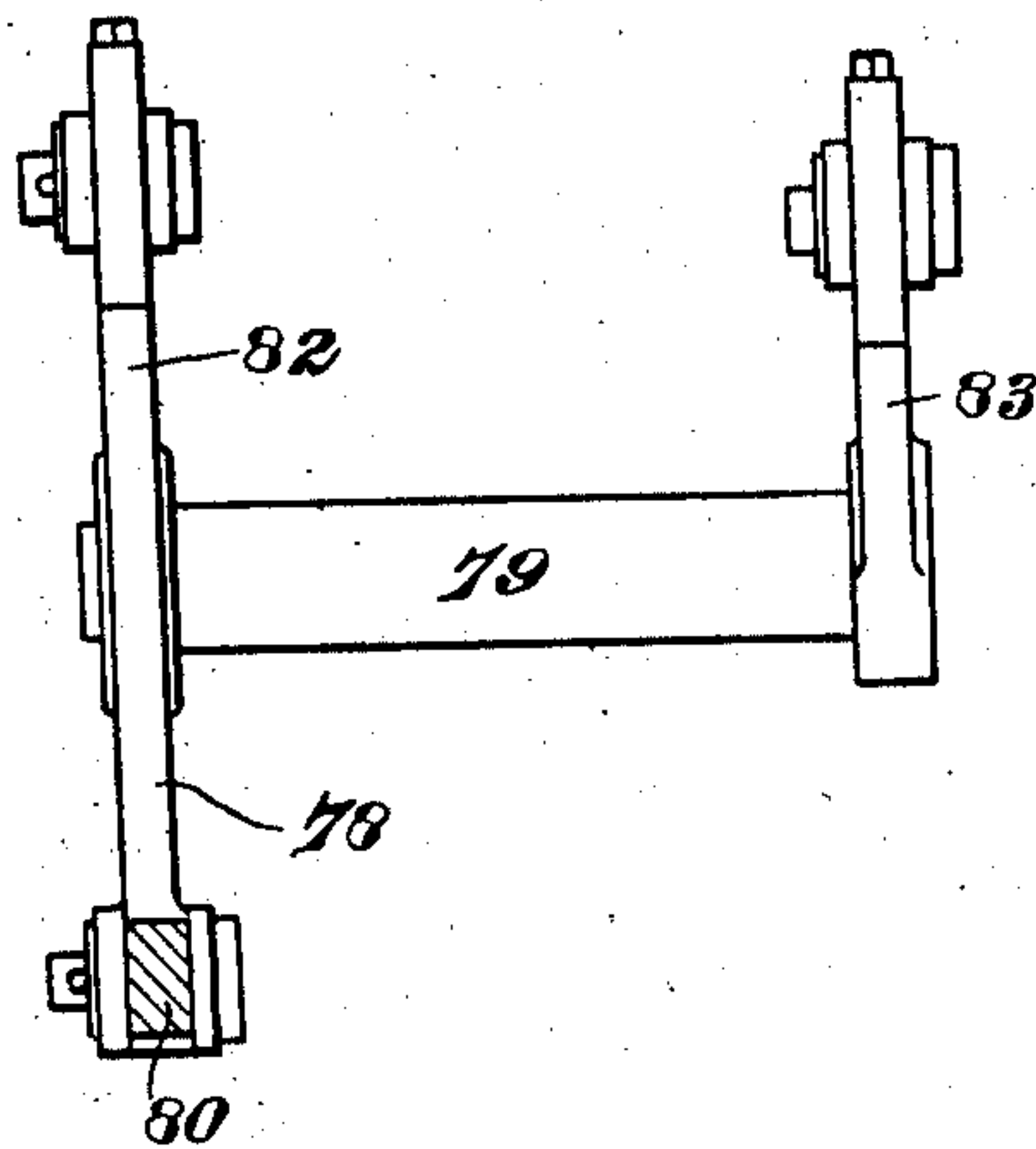


Fig. 12.



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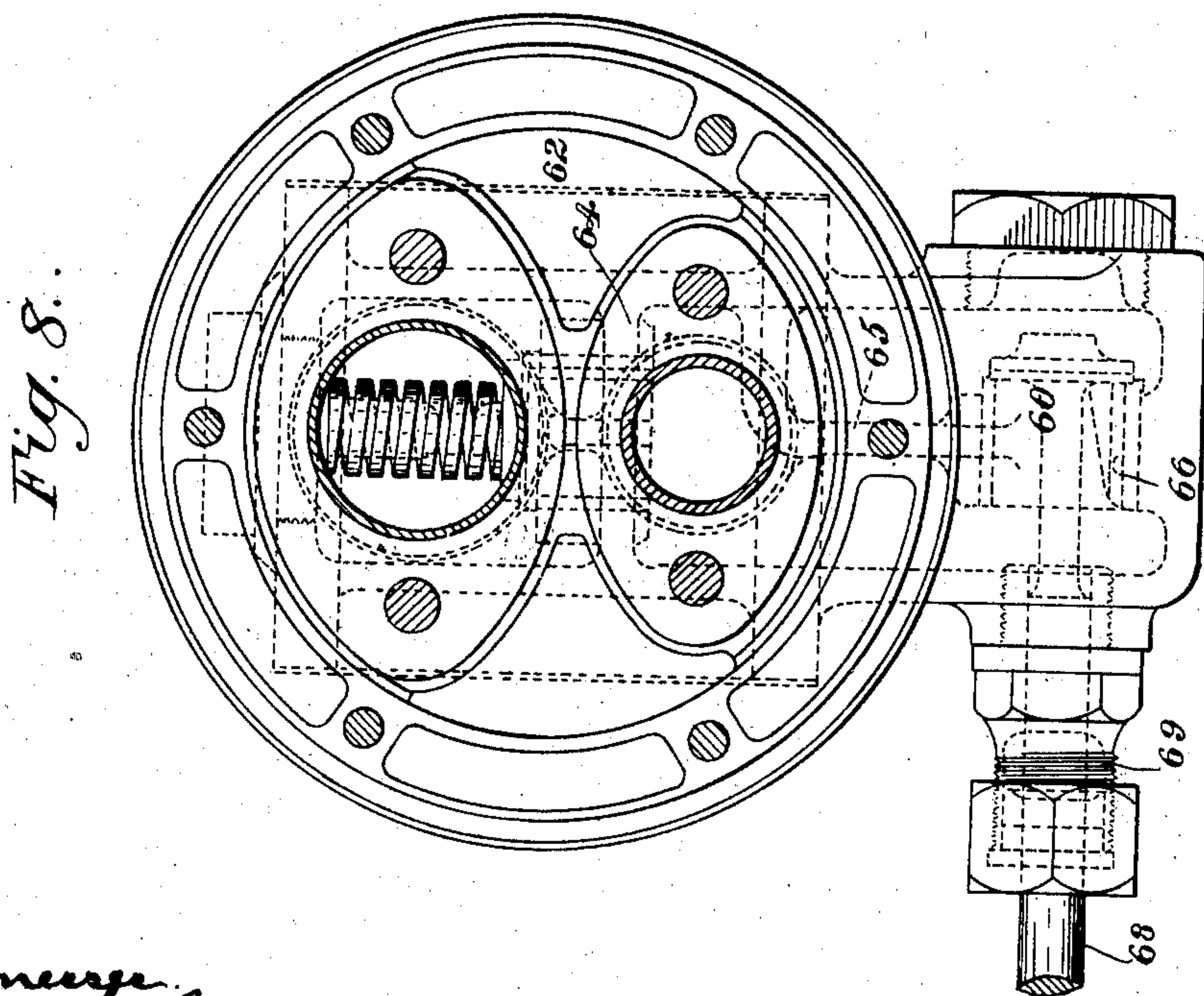
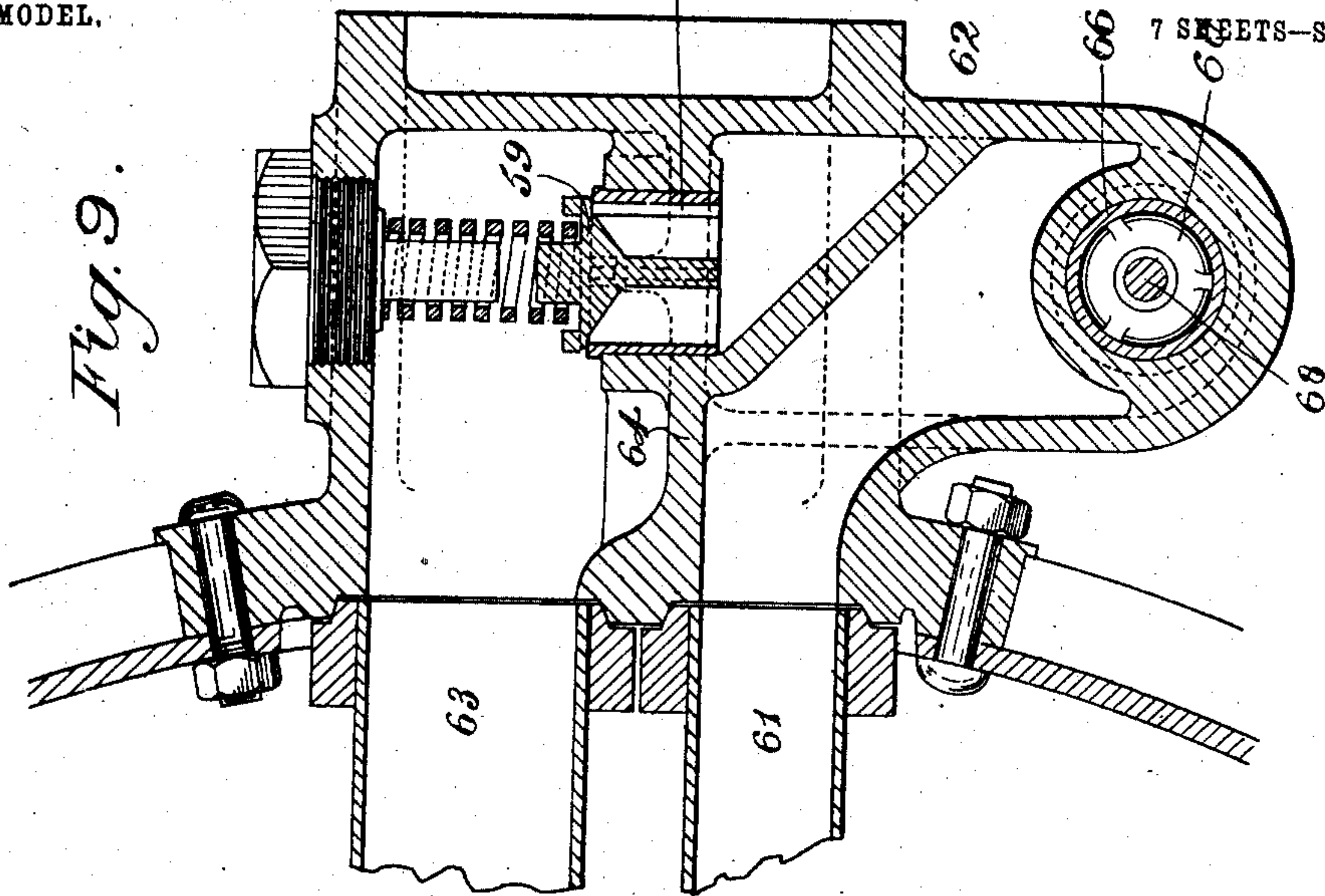
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W. M. SMITH,
STEAM ENGINE.

APPLICATION FILED APR. 10, 1901.

NO MODEL.

7 SHEETS—SHEET 6.



Witnesses
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No. 736,888.

PATENTED AUG. 18, 1903.

W. M. SMITH.
STEAM ENGINE.

APPLICATION FILED APR. 10, 1901.

NO MODEL.

7 SHEETS—SHEET 7.

Fig. 11.

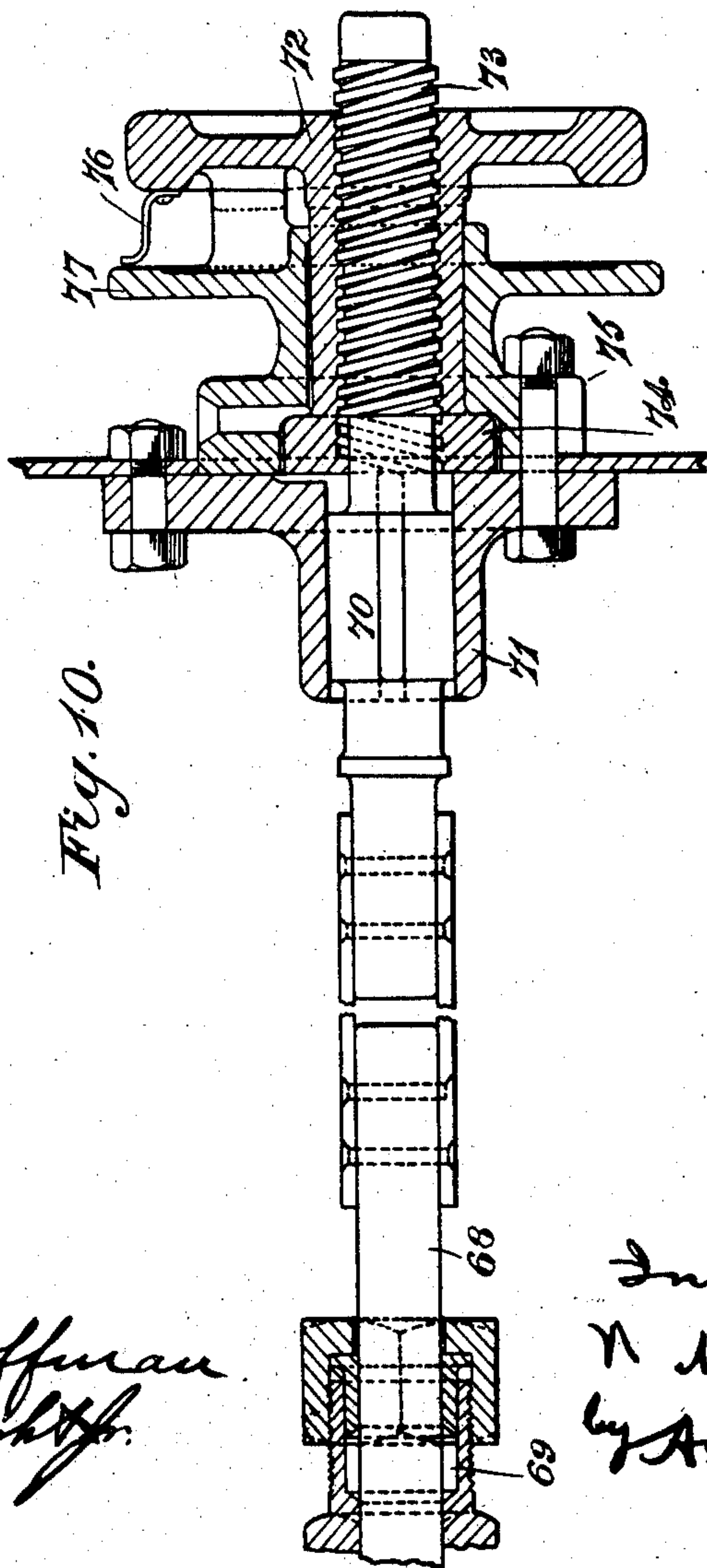
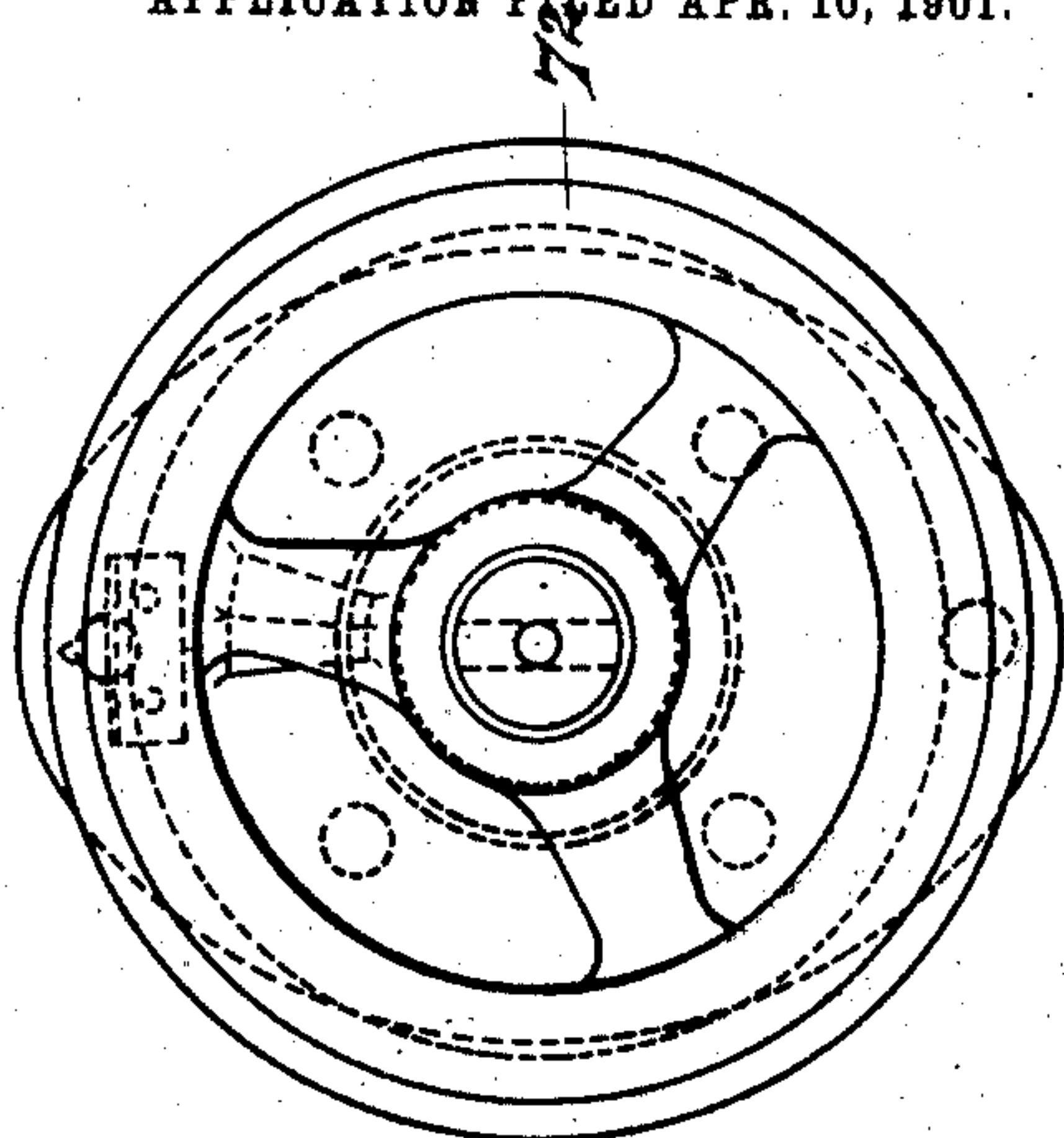


Fig. 10.

Witnesses.
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UNITED STATES PATENT OFFICE.

WALTER MACKERSIE SMITH, OF NEWCASTLE-UPON-TYNE, ENGLAND.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 736,888, dated August 18, 1903.

Application filed April 10, 1901. Serial No. 55,261. (No model.)

To all whom it may concern:

Be it known that I, WALTER MACKERSIE SMITH, a subject of the King of Great Britain and Ireland, residing at Newcastle-upon-Tyne, in the county of Northumberland, England, have invented Improvements in Steam-Engines, of which the following is a specification.

This invention has reference more particularly to improvements in and relating to the valves and valve-gear of locomotive-engines, an object being to control the passage of steam to and from two cylinders of an engine by means of a single set of valve-gear.

Referring to the accompanying drawings, Figures 1 to 6, inclusive, represent one construction of a four-cylinder compound locomotive-engine according to this invention. Fig. 1 shows at its left-hand and right-hand halves, respectively, a front elevation and a rear elevation of the cylinders, valve-chambers, and connected parts of the right-hand half of the engine. Fig. 2 shows the two valve-chests of the right-hand half of the engine in horizontal section, with the valves therein. Figs. 3 and 4 are sections, respectively, of the left and right hand halves of the engine, which are similar to each other, and corresponding to the lines A B and C D of Fig. 2, the directions in which the views are taken being indicated by arrows attached to the section-lines. Fig. 4^a is a sectional elevation showing the inclination of the valve-chambers. Fig. 5 shows a longitudinal vertical section of a locomotive-engine embodying my improvements in a modified form; and Fig. 6 shows a transverse vertical section, its right-hand and left-hand halves being taken behind the cylinders and through the smoke-box, respectively, of the locomotive-engine shown in Fig. 5. Fig. 7 is a sectional view showing the high-pressure valve. Figs. 8, 9, 10, 11, and 12 are detail views hereinafter referred to.

The figures are drawn to different scales.

In the example illustrated in Figs. 1 to 4 there are two high-pressure cylinders 1 and two low-pressure cylinders 2. Each high-pressure cylinder is provided with a valve-chamber 3 and each low-pressure cylinder with a valve-chamber 4, and prolongations of the axes of these chambers, which at any

given cross-section are in the same horizontal plane, pass through the axis of the crank-shaft 5. The pistons 6 and 7 are connected to cranks 8 and 9 at one hundred and eighty degrees to each other, so as to be at opposite ends of their strokes at the same time and the rods 10 and 11 of the distributing-valves 12 and 13, which are of the piston type. Steam is admitted to the two ports 1^a and 1^b of the high-pressure cylinder 1 through two steam-chests 15 and 15^a, external to the valve 12, and issues from the said ports into an exhaust-chamber 16, internal to the valve 12. The steam-chests 15 and 15^a are connected together by a passage 15^b, Figs. 3 and 4, leading to the steam-pipe. A pipe 17 connects the exhaust-chamber 16 to a low-pressure steam-chest 18, which is internal to the valve 13 and whence steam passes to the low-pressure cylinder through ports 19 and 19^a, from which it enters two exhaust-chambers 20 and 20^a, which are external to the valve 13 and communicate with the exhaust-pipe 21. The admission being external and internal in the case of the high and low pressure valves, respectively, the laps of the former valve are on its outside edges and those of the other on its inside edges. The chambers 18 of the two low-pressure cylinders in the example communicate together, forming part of a receiver 22, which is connected with the front and rear ends of each high-pressure cylinder by means of a passage 23, Figs. 3 and 4, and pipes 24 and 24^a, Fig. 1, respectively, non-return valves 25 and 25^a being interposed between the pipes 24 and 24^a and the corresponding ends of the cylinders for the purpose of enabling the engine to start easily and safely, as described in the specification of Letters Patent No. 464,833 and No. 662,578, previously granted to me. To destroy the vacuum created in the steam-chests and the cylinders when the engine is running with the regulator closed, apparatus 26 and 26^a, such as described in the specification of British Letters Patent No. 571, of 1889, are provided to admit steam and air as required to the steam-chests of the high and low pressure cylinders 15, 15^a, and 18 by the passages 15^b and 23, respectively, the interior of the casing of the apparatus 26 communicating directly with the passage 15^b through a hole 15^c, Figs. 1 and 3, in the flange of the cylinder,

while a similar hole 26^b forms a direct communication between the passage 23 and the interior of the casing of the apparatus 26^a, to which the pipe 24^a is attached. The pipe 5 24 is connected with the passage 23 by an elbow 24^b, Fig. 1. A pipe 27, Fig. 3, leads to the passage 23 from an automatic steam-regulator, such as described in the specification of the aforesaid Letters Patent No. 662,578, 10 for the purpose of supplying extra steam to the receiver 22 in order to work the engine in accordance with requirements as a compound engine, a semicompound engine, or a simple engine, as described therein. The two valves 15 are worked by a single expansion-link, as hereinafter described.

In the example shown in Figs. 1 to 4, inclusive, the two inside low-pressure cylinders are, as described in the said specification of 20 Letters Patent No. 662,578, secured to the engine-frames independently of the two outside high-pressure cylinders. The two cylinders at each side of the engine might, however, be cast together along with their valve-chambers. 25

It is obvious that means substantially as described for enabling the passage of steam to and from two cylinders to be controlled by a single set of valve-gear may be utilized in engines and with valve-gear of different constructions from that described hereinafter by way of example. Thus the steam-chests of the two cylinders whose valves are worked by a single set of gear may be unconnected 35 with each other and supplied direct from the boiler. The distributing-valves may be other than piston-type as long as they give external admission for one cylinder and internal admission for the other cylinder.

In the arrangement illustrated in Figs. 5 to 12 the cylinders and valve-chambers are arranged substantially in the manner described with reference to and illustrated in Figs. 1 to 4; but the valves are so constructed that 45 steam from the boiler is admitted by way of the pipe 54 to the high-pressure cylinders 1 through the central parts or cavities 16 of the high-pressure valves 12 and after doing duty in said cylinders exhausts past the ends of the said valves and through a tubular casting or castings 55, forming part or parts of the receiver 22 and adapted to connect the exhaust-chambers 56 of said valves to steam-chests 57 at the ends of the valves 13 of the 55 low-pressure cylinders 2, to which cylinders steam is admitted past the ends of the low-pressure valves and whence it exhausts through the central parts or cavities 18 thereof. The receiver 22 is connected with the 60 front and rear ends of the high-pressure cylinders, communication being controlled by non-return valves (not shown) arranged to permit, when starting, the passage of steam from the receiver to the high-pressure cylinders. A starting valve or regulator 58 is also 65 provided for admitting steam from the boiler to the low-pressure cylinders through the re-

ceiver 22 at a reduced pressure, as described in the specification of the aforesaid Letters Patent No. 464,833. 70

In the regulator illustrated in sectional elevation and section in Figs. 8 and 9, respectively, communication between the boiler and the receiver is controlled by means of a spring-loaded valve 59, opening toward the receiver, 75 and a hand-operated valve 60, interposed between said loaded valve and the pipe 61, leading from the boiler. Conveniently the two valves are arranged in a box or casting 62, with which the pipes 61 and 63, leading, respectively, from the boiler and to the receiver, are connected, the one above the other. The box or casting is divided horizontally by a partition 64, and its lower part is subdivided 80 into two parts by a vertical partition 65, the space on one side of which is in communication with the boiler. The hand-operated valve 60 controls an opening 66 in the partition 65, and the partition 64 is formed beyond the vertical partition or remote from the 90 boiler connection with an opening 67, which is controlled by the spring-loaded valve 59. The spindle 68 of the valve 60 extends through a stuffing-box 69 and is coupled to a rod extending into the cab of the locomotive. Figs. 10 and 11 illustrate the means for 95 actuating the rod, which is prevented from turning by a squared part of it, 70, fitting a guide 71, longitudinal movement of the rod being effected by means of a combined nut 100 and hand-wheel 72, working on a screw-threaded portion 73 of the rod and prevented from moving endwise by a collar 74 on its boss engaging with a fixed bearing 75, that is divided longitudinally and bolted to the 105 cab-frame. With this arrangement by opening the valve 60 steam is allowed to pass from the boiler through the spring-loaded valve 59, which reduces its pressure to the steam-chests of the low-pressure cylinders, so that 110 the pressure acting on the pistons thereof may be increased, though not up to the full boiler-pressure. The load on the reducing-valve may be adjustable and the hand-wheel may have a pointer 76, working over an index 77, to indicate the position of the valve, 115 or a suitable arrangement of rods and levers may be employed.

To work the two valves 12 and 13 of each pair of cylinders, a single suspended expansion-link 28, arranged to be actuated by one set of eccentrics, is connected to one arm 78 of a rock-shaft 79 (see Fig. 12) by a rod 80, that is supported by a link 81, pivoted to a stay fixed between the engine-frames. 125

The rock-shaft 79 is provided with two other arms 82 83, linked, respectively, to the spindle of the low-pressure valve 13 and the spindle of the high-pressure valve 12, and by varying the length of these arms the point 130 of relative cut-off for the high and low pressure cylinders may be increased or decreased to suit the necessary requirements.

To enable the travel of the low and high pres-

sure valves to be adjusted as required, the end of each of the arms 82 83 may be formed with a slot fitted with a sliding die 85, which can have its position altered and maintained by a suitable screw arrangement 86.

What I claim is—

In a four-cylinder compound locomotive-engine, the combination of two high-pressure cylinders arranged without the engine-framing, two low - pressure cylinders arranged within the engine-framing and at the inner side of said high-pressure cylinders, pistons in said cylinders, the pistons of a high and low pressure cylinder moving in opposite directions, a separate valve and valve-chest for each cylinder, said valve - chambers being arranged above their respective cylinders, steam-supply pipes to the high-pressure valve-

chests, a steam-receiver, said receiver being common to and arranged above the low-pressure valve-chests and in communication with the exhaust-ports of the high-pressure cylinders and the inlet-ports of the low-pressure cylinders, passages connecting the ends of the high-pressure cylinders with the receivers, a non-return valve in each of said passages, and a single set of valve-gear adapted to operate the valves of a pair of high and low pressure cylinders so that they move together in the same direction, substantially as described.

Signed at Gateshead, county of Durham, this 27th day of March, 1901.

WALTER MACKERSIE SMITH.

Witnesses:

I. H. TANSLEY,
O. L. JOBLING.