No. 646,317. Patented Mar. 27, 1900.

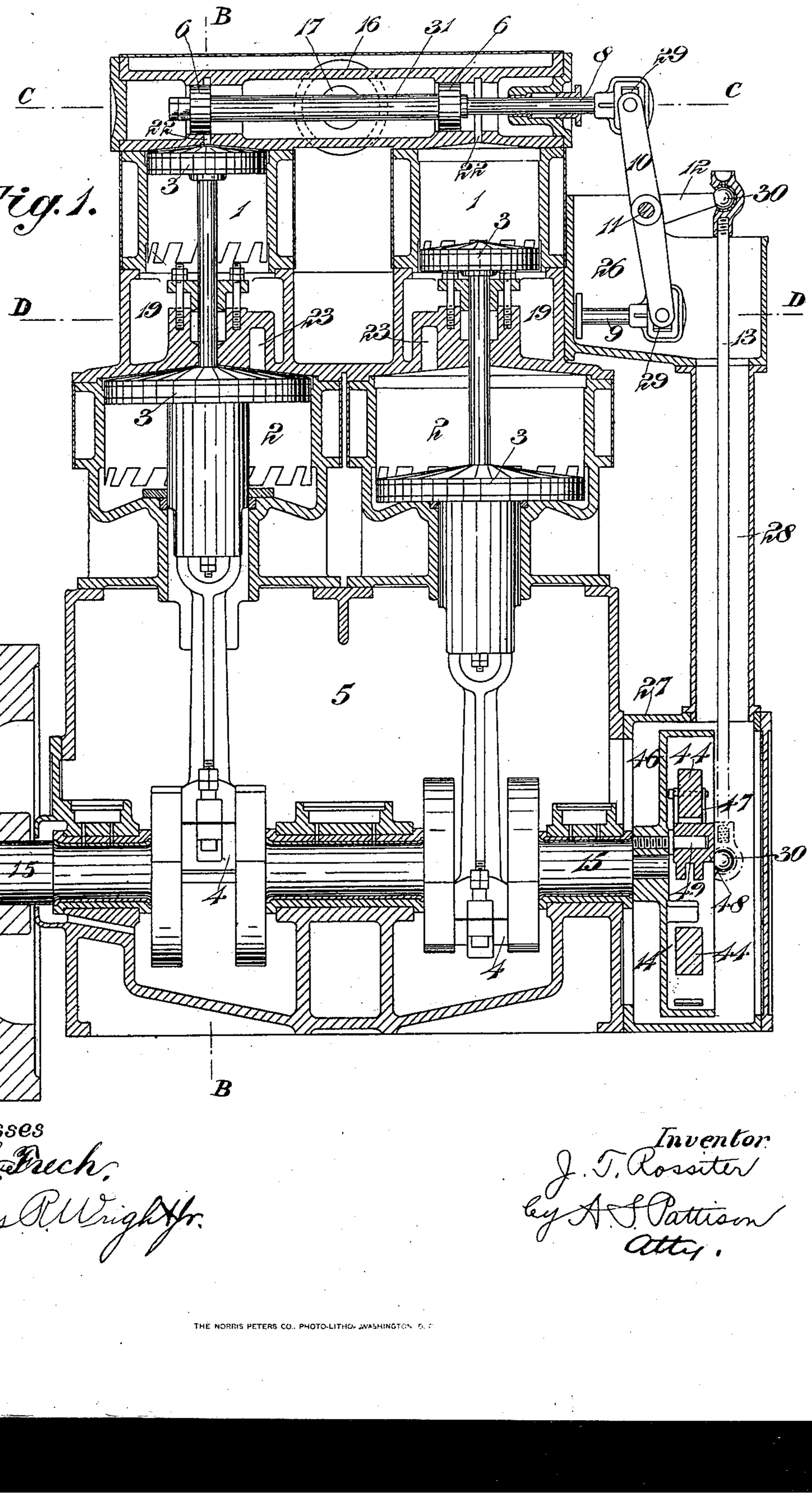
J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 1.

Fig. 1.



Witnesses
Geo. E. Buck.
Chas. R. Wright Jr.

Inventor
J. T. Rossiter
by A. S. Pattison
Atty.

No. 646,317. Patented Mar. 27, 1900.

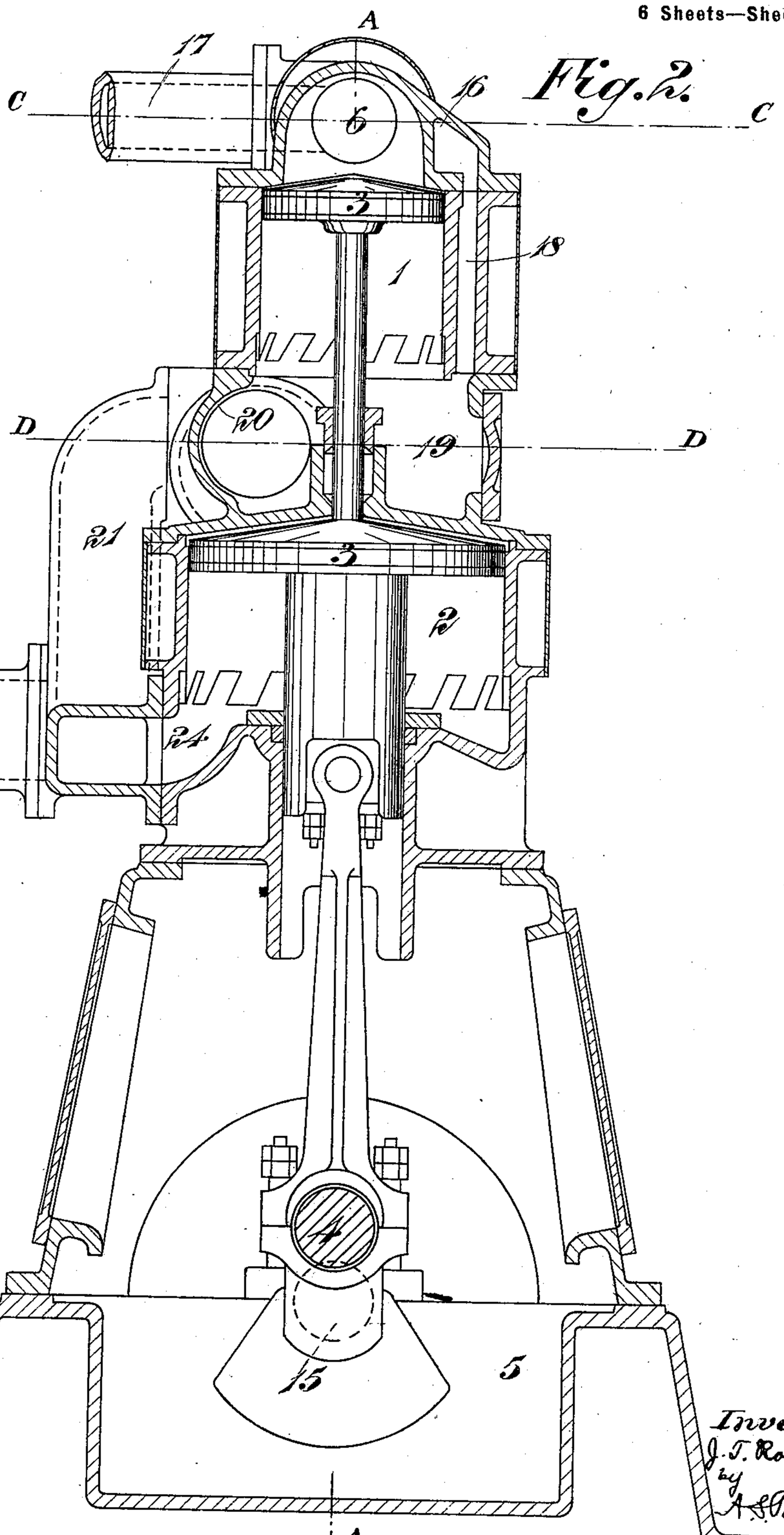
J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 2

Fig. 2.



Witnesses
Geo. E. Breck.
Chas. B. Wright.

Inventor
J. T. Rossiter
by
A. S. Pattison
Atty

No. 646,317. Patented Mar. 27, 1900.

J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 3.

Fig. 3.

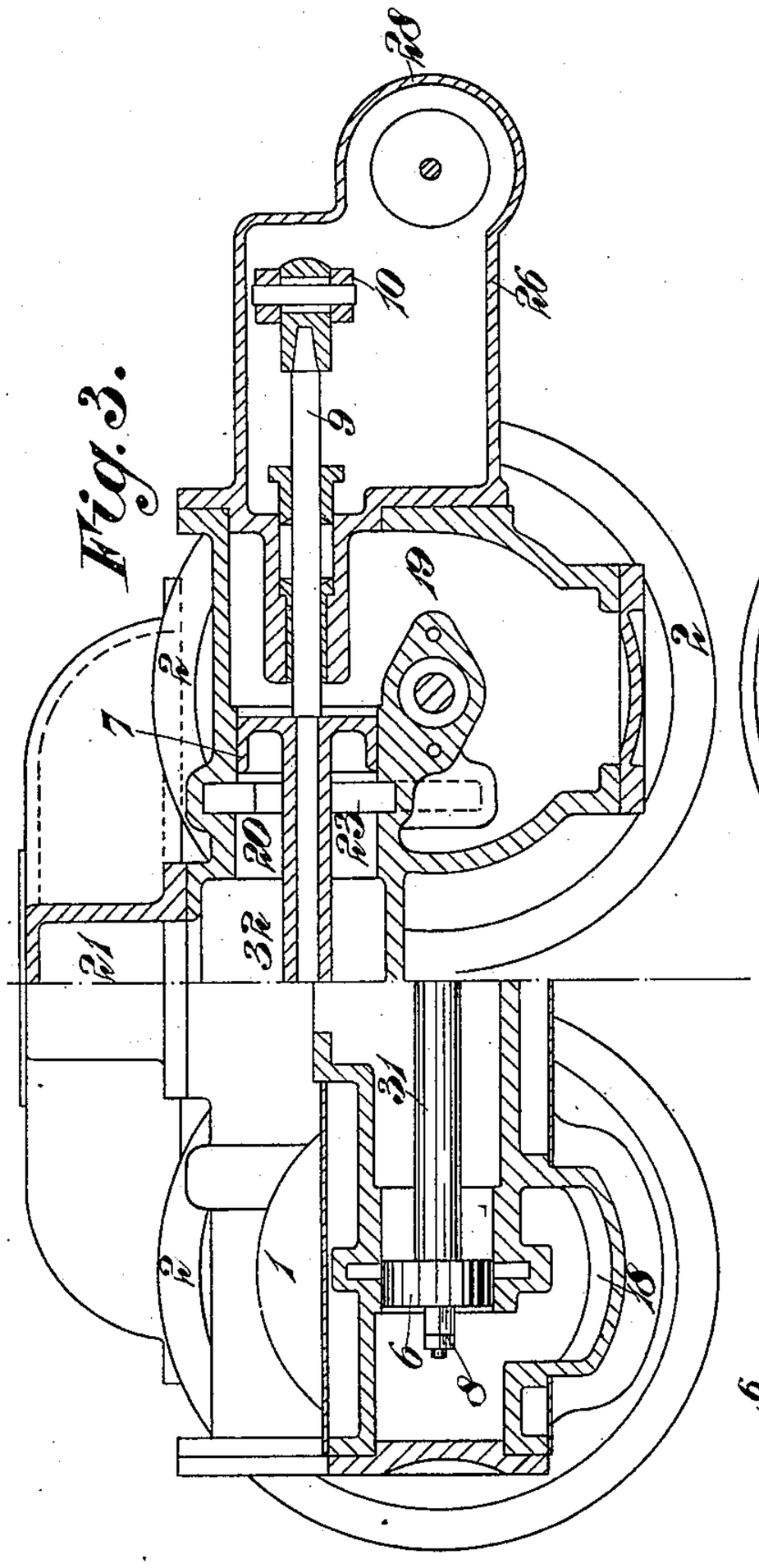


Fig. 10.

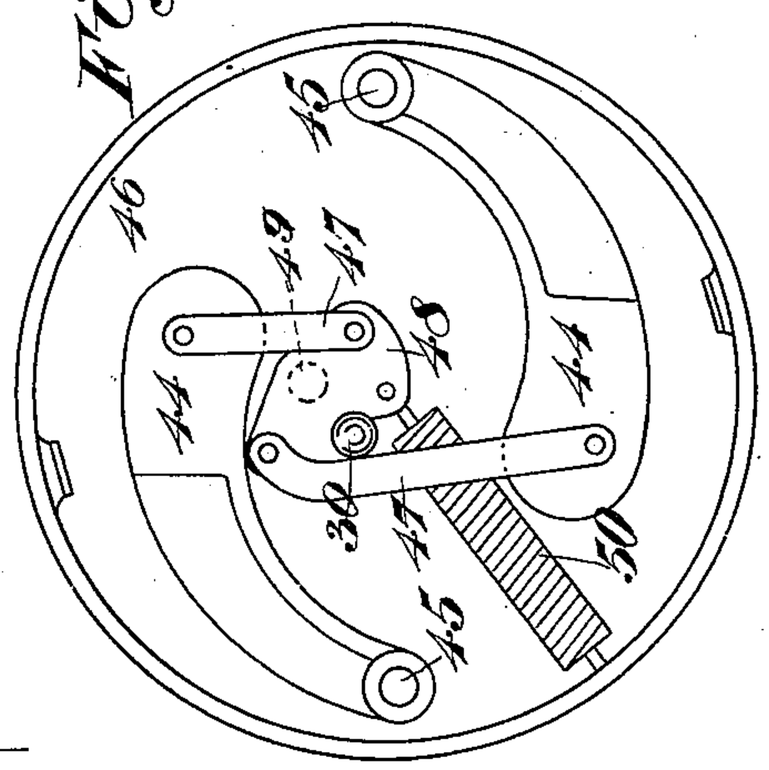
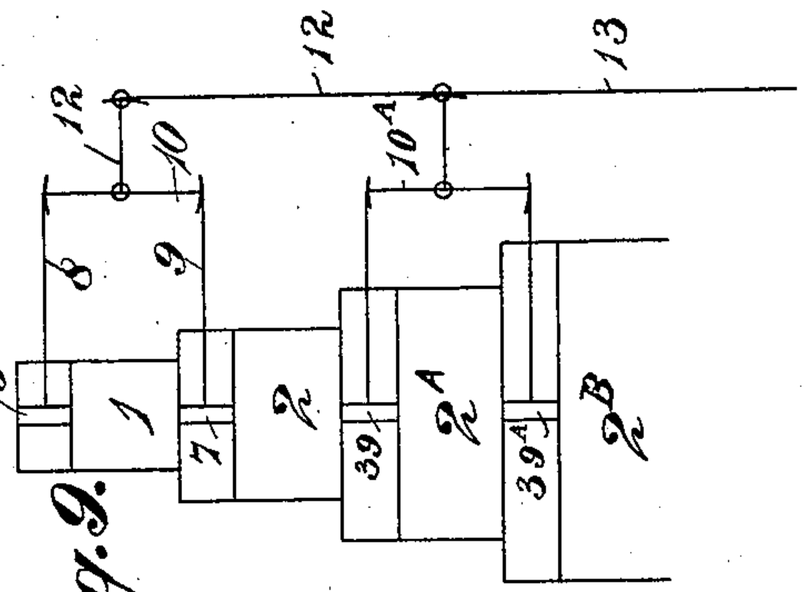


Fig. 9.



Witnesses
Geo. E. Frech.
Chas. R. Wright Jr.

Inventor
J. T. Rossiter
by A. S. Pattison
Atty.

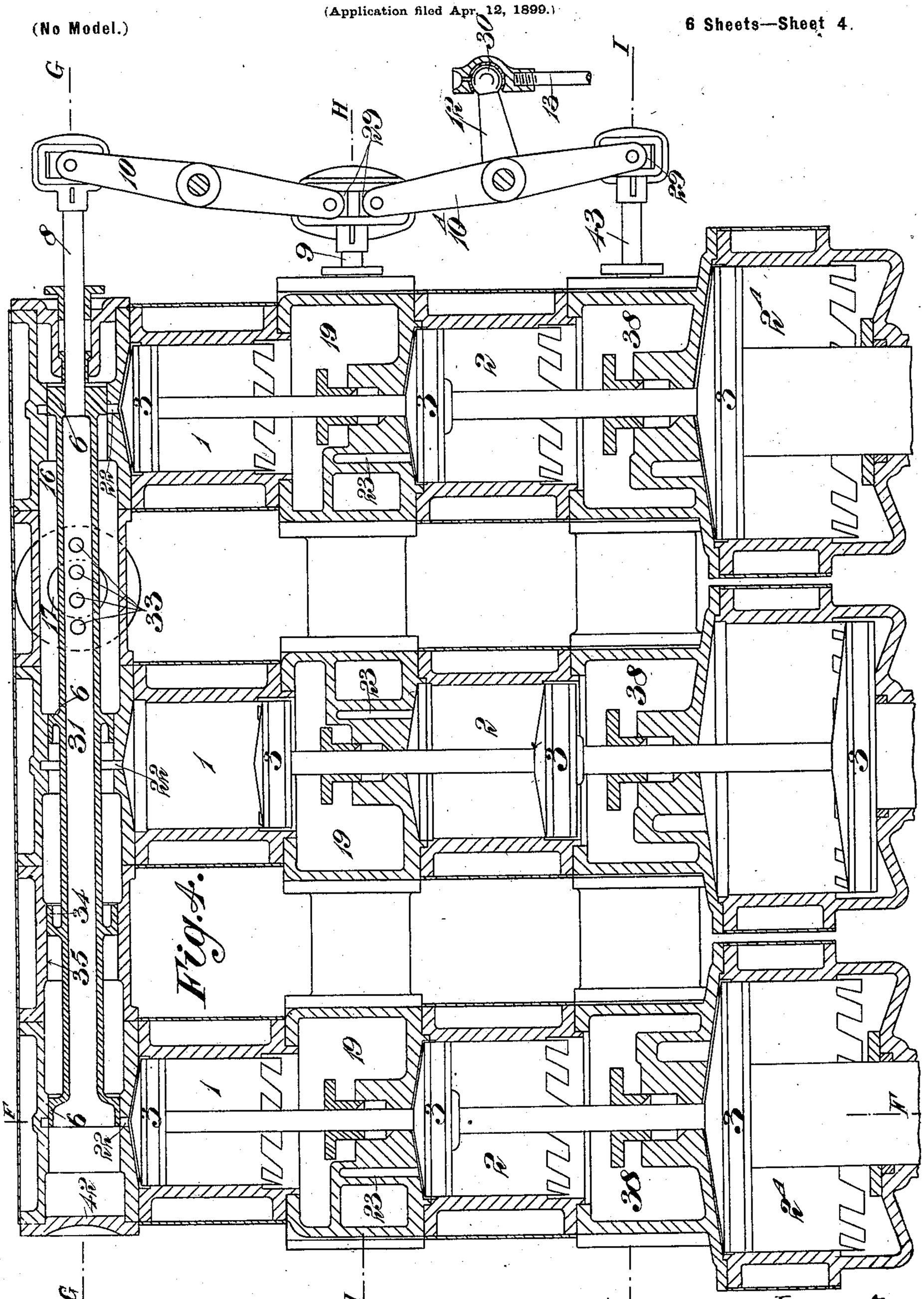
No. 646,317. Patented Mar. 27, 1900.

J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 4.



Witnesses
Geo. E. Frech.
Chas. P. Wright Jr.

Inventor
J. T. Rossiter
by A. S. Pattison, atty

No. 646,317. Patented Mar. 27, 1900.

J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 5.

Fig. 5.

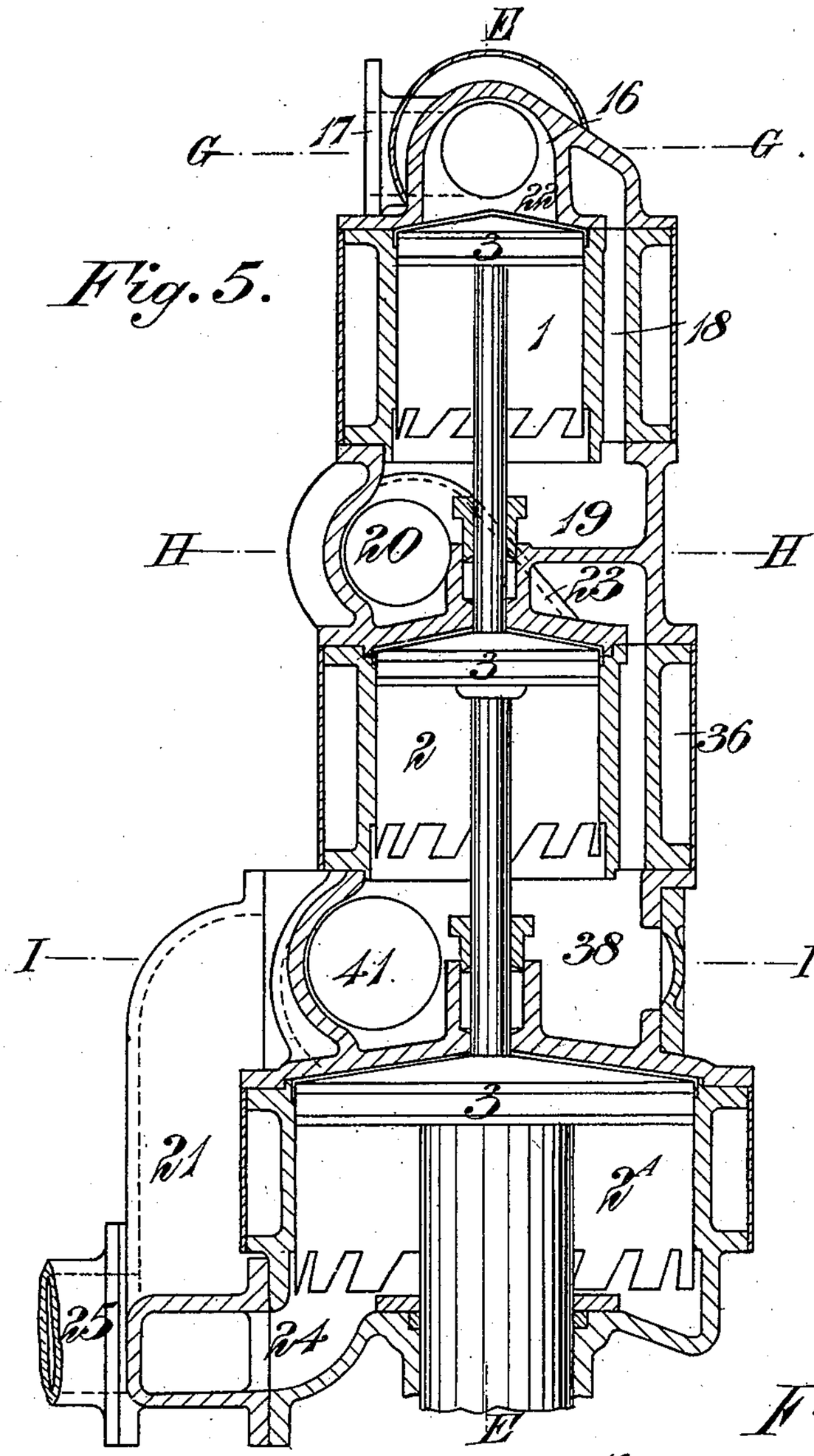
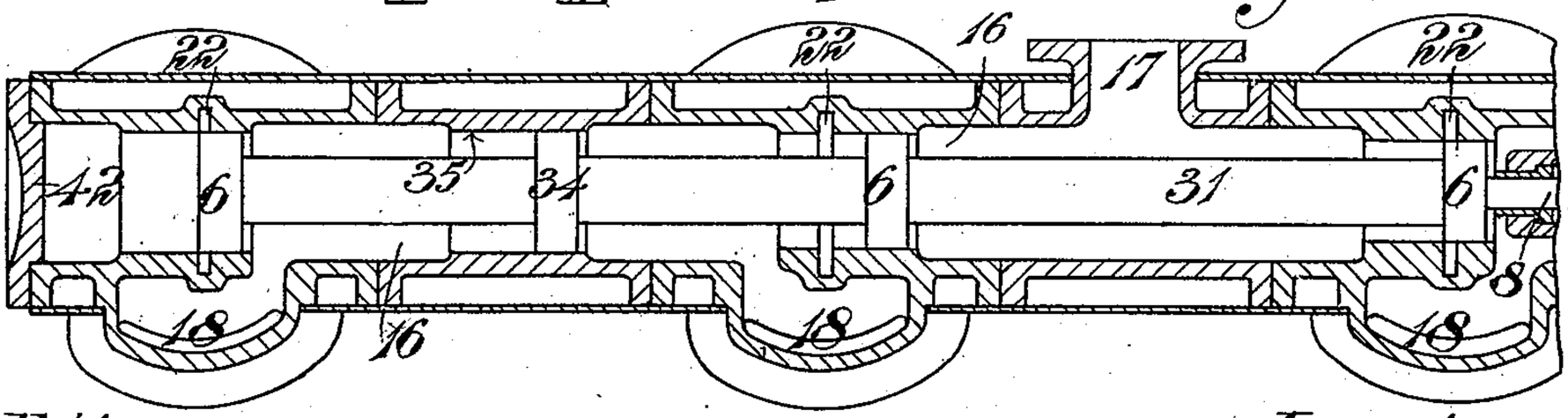


Fig. 6.



Witnesses:
Geo. E. Frech.
Chas. R. Wright Jr.

Inventor:
J. T. Rossiter,
by A. S. Pattison, Atty.

No. 646,317. Patented Mar. 27, 1900.

J. T. ROSSITER.

STEAM ENGINE.

(Application filed Apr. 12, 1899.)

(No Model.) 6 Sheets—Sheet 6.

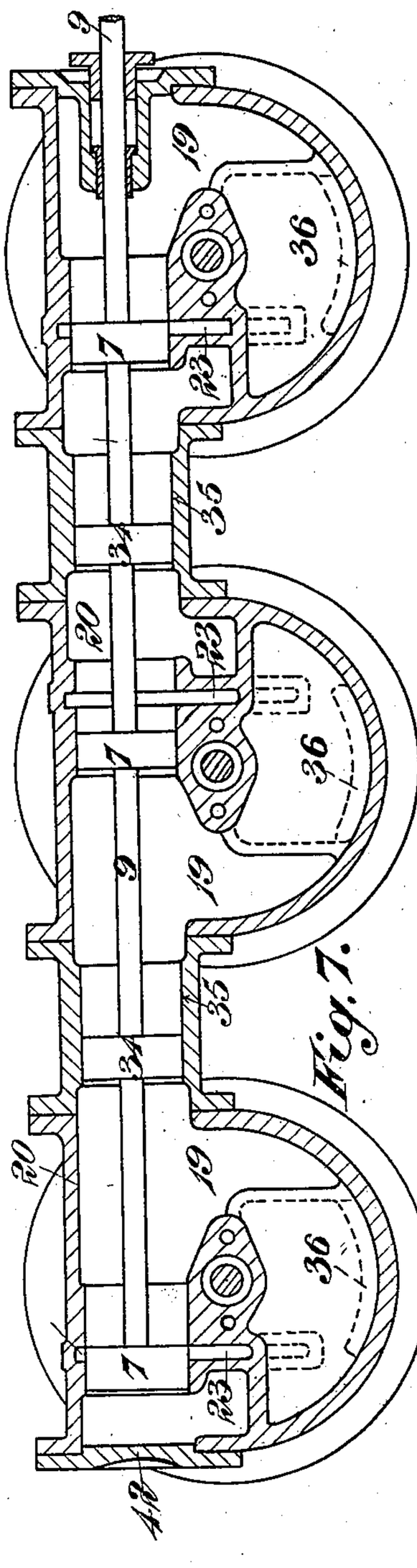


Fig. 7.

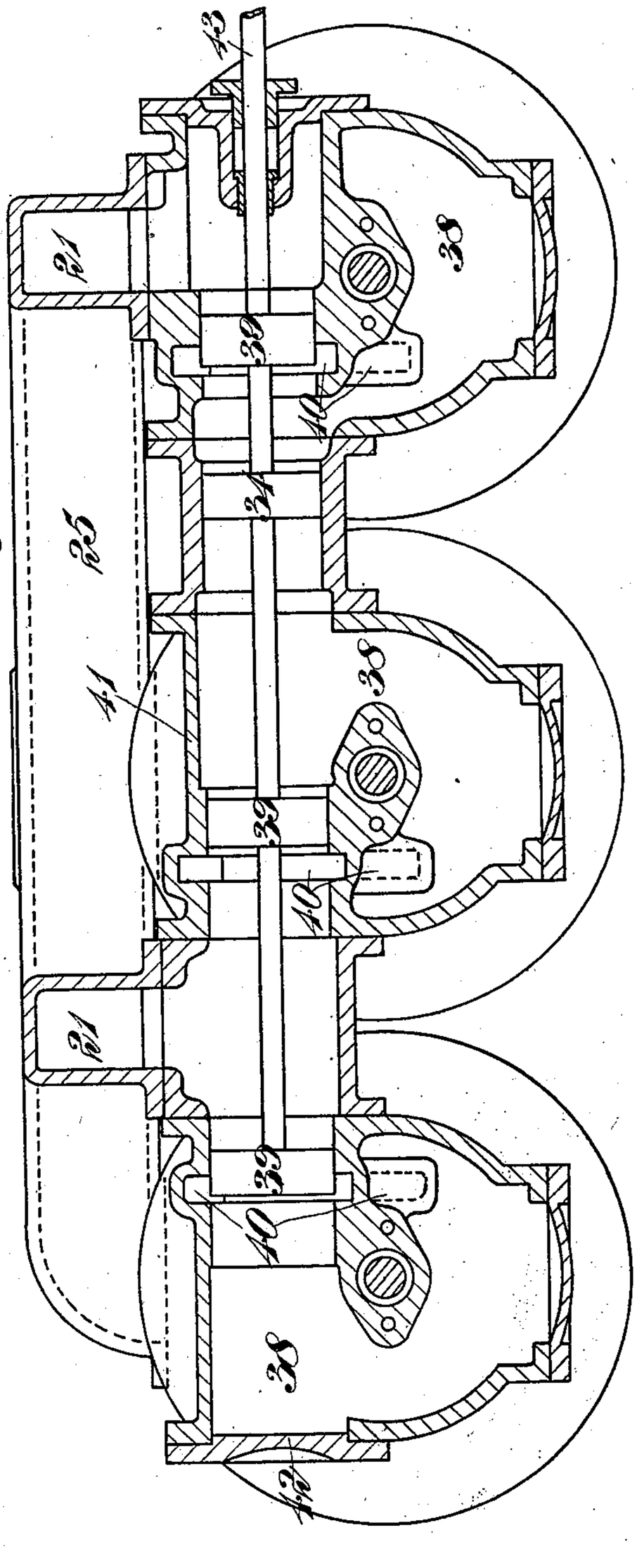


Fig. 8.

Witnesses
Geo. E. Frech.
Chas. R. Wright Jr.

Inventor
J. T. Rossiter.
by A. S. Pattison, Atty

UNITED STATES PATENT OFFICE.

JAMES THOMAS ROSSITER, OF LONDON, ENGLAND.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 646,317, dated March 27, 1900.

Application filed April 12, 1899. Serial No. 712,825. (No model.)

To all whom it may concern:

Be it known that I, JAMES THOMAS ROSSITER, a subject of the Queen of Great Britain and Ireland, residing at Chiswick, London, in the county of Middlesex, England, have invented Improvements in Steam-Engines, of which the following is a specification.

This invention has reference to constructions of single-acting compound or multiple-expansion engines wherein the admission and exhaust of high-pressure steam to and from the upper or outer end of the high-pressure cylinder and the passage of such steam from that end of the cylinder to the opposite end thereof, to the upper or outer end of the next cylinder—say the low-pressure cylinder—and to an exhaust-pipe in communication with the opposite end of such cylinder are controlled by two valves arranged with their axes at right angles to the axes of the cylinders or to a plane containing such axes and operated and controlled as hereinafter described. The engine may comprise one or more sets of cylinders and valves, and each set may comprise two, three, or more cylinders in tandem, in which case two, three, or more valves arranged as described are used for controlling the passage of steam to and from the respective cylinders.

The invention consists in the novel features of construction and combinations of parts hereinafter set forth, and specially pointed out in the claims.

In the accompanying illustrative drawings, Figure 1 shows in vertical section on the line A A of Fig. 2, and Fig. 2 in vertical section on the line B B of Fig. 1, one construction of compound engine according to this invention. Fig. 3 is a horizontal section, the left and right hand portions of the figure being on the lines C C and D D, respectively, of Fig. 2. Figs. 4 and 5 are vertical sections at right angles to each other of a multiple-expansion engine according to this invention, Fig. 4 being taken on the line E E of Fig. 5 and Fig. 5 on the line F F of Fig. 4. Figs. 6, 7, and 8 are horizontal sections on the lines G G, H H, and I I, respectively, of Figs. 4 and 5. Fig. 9 shows diagammatically a modified construction. Fig. 10 shows in end elevation a construction of expansion-governor suitable for use in such engines.

The engine shown in Figs. 1, 2, and 3 is constructed with two sets of cylinders, each comprising a high-pressure cylinder 1 and a low-pressure cylinder 2, arranged in line with each other, the two sets of cylinders being arranged side by side, with the two sets of pistons 3 working onto oppositely-arranged cranks 4 in a closed crank-chamber 5.

6 6 are two connected high-pressure valves, and there are two similarly-connected low-pressure valves 7, of which only one is seen in Fig. 3, the two sets of valves being connected by their spindles 8 and 9, respectively, to the opposite arms of a lever 10, pivoted at 11 and worked by a third lever-arm 12 through a coupling-rod 13 from an expansion-drum governor 14 on the engine-shaft 15. The high-pressure valves 6 are of the piston type, arranged to work in a horizontally-arranged cylindrical valve-chest 16, the central portion of which, constituting a steam-chamber, is provided with an inlet 17 for high-pressure steam and the end portions of which, beyond the valves, are each connected through a vertical passage 18 to a steam-receiver 19, which is located between the corresponding high and low pressure cylinders 1 and 2, respectively, and is in constant communication with the lower end of the former cylinder—viz., 1. The two low-pressure valves 7 are also of the piston type and are arranged to work in a horizontal cylindrical valve-chamber 20, that is connected at its central portion to a vertical exhaust-pipe 21 and at its ends with the two steam-receivers 19. The arrangement is such that the inner end of each of the high-pressure valves 6 controls the admission of high-pressure steam to the corresponding high-pressure cylinder 1 through a port 22, and the outer end of such valve controls the exhaust of steam from such cylinder through the port 22 and vertical passage 18 to the corresponding receiver 19, and the outer end of each of the low-pressure valves 7 controls the admission of steam from the corresponding receiver 19 to the corresponding low-pressure cylinder 2 through a passage 23, and the inner end of each of such valves controls the exhaust from such cylinder through the said passage 23 to the exhaust-pipe 21, the two sets of valves moving in opposite directions during the working of

the engine. The valves and their connections are or may advantageously be so arranged that each high-pressure valve 6 opens the top of its high-pressure cylinder 1 to the steam-chest 16 after the corresponding low-pressure valve 7 places the top of its low-pressure cylinder in communication with the corresponding receiver and opens communication with the receiver 19 after the low-pressure valve has closed the communication between such receiver and the low-pressure cylinder. There being two sets of cylinders and pistons the valves are arranged so as to cause one set of pistons to commence their active downstrokes while the pistons of the other set are making their idle upstrokes, at which time the pressure on the two sides of each of the two ascending pistons is nearly balanced.

The high-pressure-valve chest 16 may, as shown, be arranged centrally over the cylinders 1 and 2 and the low-pressure-valve chest 20 to one side of the two receivers 19, the vertical exhaust-pipe 21 from the latter valve-chest communicating by an upwardly-extending pipe or passage 24 with the lower end of each low-pressure cylinder and with a common exhaust-pipe 25, into which the lower ends of the two cylinders can readily drain. The three-armed or T-shaped lever 10 12 for working the valves 6 and 7 may, as shown, be formed by three separate arms fixed on a spindle 11, journaled in a box or casing 26, arranged at one end of the engine and connected to a lower box or casing 27, inclosing the expansion-governor, by a tubular connecting-piece 28, in which works the coupling-rod 13, that connects the governor to the lever. The connections between the lever 10 and the projecting ends of the valve-rods 8 and 9 may be pin-and-slot connections, with sliding blocks 29, as shown, and those between the rod 13 and the governor 14 and lever-arm 12 may be ball-and-socket joints 30. Each pair of valves 6 6 and 7 7 may be formed in one piece, with a connecting-sleeve 31 or 32, respectively, fixed upon the corresponding valve-rod 8 or 9.

The left-hand valves 6 and 7 are made of larger diameter than the right-hand valves for the purpose of putting the valve-rods 8 and 9 in tension and compression, respectively, thereby preventing backlash in the joints 29 and 30.

For an engine having only one high-pressure cylinder 1 and one low-pressure cylinder 2 the arrangement is or may be similar to that hereinbefore described, except, of course, that one of the high-pressure valves 6 and one of the low-pressure valves 7 are dispensed with and the valve-chests 16 and 20 shortened.

For a triple-expansion engine having three cylinders arranged in line two levers may be used, pivoted one above the other, the upper valve being connected to the upper end of the upper lever, the lower valve to the lower end of the lower lever, and the intermediate valve to the adjacent end of the two levers, one or other of which is connected to the governor.

Figs. 4 to 8, inclusive, show a triple-expansion-engine having three sets of cylinders, each set comprising a high-pressure cylinder 1, an intermediate-pressure cylinder 2, and a low-pressure cylinder 2^A, the three sets of pistons working onto three cranks, whereof the middle one is set at one hundred and eighty degrees from the other two, so that the pistons 3, connected thereto, make their up and down strokes while the other two sets of pistons, respectively, make their down and up strokes. The three high-pressure-piston valves 6, which control the ports 22 of the three high-pressure cylinders 1, are connected together by a hollow sleeve 31, which is formed with holes 33, whereby high-pressure steam can pass through the sleeve from the part of the valve-chest 16 in connection with the steam-inlet 17 to the left-hand end of the said valve-chest. The said hollow sleeve is also formed with a piston-like partition 34, arranged to work steam-tight in a guide 35 and separate the part of the steam-chest in which the two right-hand valves 6 work from that in which the left-hand valve 6 works, so that steam can exhaust separately from each high-pressure cylinder 1 through its corresponding passage 18 into the receiver 19 below.

The intermediate-pressure valves 7, which control the ports 23, communicating with the upper ends of the intermediate-pressure cylinders 2, are located in a valve-chest 20, that is divided into three separate parts by piston-like partitions 34, fixed on the valve-rod 9 between each adjacent pair of valves 7 and working steam-tight in guides 35, so that steam can be separately admitted to each of the intermediate-pressure cylinders 2 by the corresponding port 23 and afterward separately exhausted therefrom through a vertical passage 36 into a receiver 38, that is located between the corresponding intermediate and low pressure cylinders 2 and 2^A and is in free communication with the lower end of the former cylinder 2.

39 are the low-pressure valves, that control the passage of steam from the receivers 38 through passages 40 into the upper ends of the low-pressure cylinders 2^A. These valves 39 are arranged to work in a valve-chest 41, that is divided by a partition 34 like the others into two parts that are in communication by connected vertical exhaust-passages 21 with the lower end of each low-pressure cylinder 2^A through an upwardly-extending branch 24 and with a common exhaust-pipe 25.

The valves 6, 7, and 39, with piston-like partition or partitions 34, are made of such diameters that each set forms practically one body that can be readily inserted within or withdrawn from their corresponding valve-chest through one end 42 thereof, the rod to which the set of valves and partition or par-

titions are fixed working through a stuffing-box at the other end of the valve-chest. The valve-rods 8 and 9 are connected by a pin-and-slot connection to the respective ends of the lever 10, and the valve-rod 43 is similarly jointed to the lower end of a second lever 10^A, that has its upper end jointed in a like manner to the lever 10 and valve-rod 9 and is connected to an arm 12, by which the several valve-rods are worked from an expansion-governor through a coupling-rod 13, as in Figs. 1, 2, and 3, the two valve-rods 8 and 43 moving inward while the valve-rod 9 is moving outward, and vice versa.

In the working of this engine the left-hand ends of the two outer valves 6 and the right-hand end of the intermediate valve 6 control the admission of high-pressure steam from the valve-chest 16 to the high-pressure cylinders 1, the opposite ends of the said valves controlling the exhaust of such steam from the said cylinders to the receivers 19. The right-hand ends of the two outer valves 7 and the left-hand end of the intermediate valve 7 control the admission of steam from the receivers 19 through the passages 25 to the intermediate-pressure cylinders 2, the opposite ends of these valves controlling the exhaust from such cylinders through the passages 23 and the passages 36 to the receivers 38. The left-hand ends of the outer valves 39 and the right-hand end of the intermediate valve 39 control the admission of steam from the receivers 38 through the passages 40 to the low-pressure cylinders, the opposite ends of such valves controlling the exhaust of steam from such cylinders to the exhaust-passages 21.

For a quadruple engine having four cylinders 1 2 2^A 2^B in line, as shown diagrammatically in Fig. 9, the two upper valves 6 and 7 (or sets of valves) may be connected by their rods 8 and 9 to the opposite ends of one lever 10 and the two other valves 39 and 39^A (or sets of valves) to the opposite ends of a second lever 10^A, each lever being connected by a lever-arm 12 to a coupling-rod 13 common to them and worked from the governor.

As will be obvious, various forms of valves other than reciprocating piston-valves can be used in engines according to this invention.

The several sets of valves may advantageously be worked from a single expansion-governor common to them.

The expansion-governor may be variously constructed. Figs. 1 and 10 show one construction that may advantageously be used. It comprises a pair of weighted arms 44, pivoted at one end 45 to a plate or drum 46, fixed on the crank-shaft 15, and connected by links 47 to a plate 48, that is pivoted eccentrically at 49 to the plate or drum 46 and is acted upon by a spring 50. The center of connection 30 of the coupling-rod 13 to the eccentrically-pivoted plate 48 is, as shown, such that as the pivoted weights 44 move outward or inward the said center of connection will be moved in such a way as to respectively reduce and increase the travel and lead of the valves 6 and 7 or 6, 7, and 39, controlled by the governor.

What I claim is—

1. In a single-acting fluid-pressure engine two cylinders arranged in tandem with their pistons attached to a common piston-rod, a steam-receiver located between the adjacent ends of said cylinders, a passage whereby steam can exhaust from the outer end of the first cylinder into said receiver, a valve-chest and valve external to said first cylinder, said valve being adapted to control the passage of steam from said valve-chest to the outer end of the first cylinder and the exhaust of steam from such cylinder to said steam passage and receiver, a second valve-chest connected to a second steam-passage that is in communication with the lower or inner end of the second cylinder and with an exhaust-pipe, a second valve adapted to control the communication between the outer end of the second cylinder and the receiver and the said second steam-passage, and means for operating said valves, substantially as described.

2. A single-acting engine comprising two cylinders arranged in tandem with their pistons attached to a common piston-rod, a steam-receiver between the adjacent ends of said cylinders, a valve-chest at the outer end of first cylinder, an exhaust-passage whereby steam can pass from the outer end of the first cylinder into said receiver, a valve located in said valve-chest and adapted to place the outer end of said first cylinder alternately in communication with a steam-supply and with said steam-passage, a second valve-chest arranged to one side of the center line of said cylinders, a second exhaust-passage extending from said second valve-chest and in communication with the inner end of the second cylinder and with an exhaust-pipe, a second valve located in said second valve-chest and adapted to place the outer end of said second cylinder alternately in connection with said receiver and said second exhaust-pipe, and means for operating said valves, substantially as described.

3. In a steam-engine, two cylinders arranged in tandem with their pistons attached to a common piston-rod, a receiver located between the adjacent ends and in free communication with the inner end of said cylinders, of the high-pressure cylinder, a valve-chest arranged at right angles to the cylinders, a valve located in said valve-chest and adapted to control the supply of steam from said valve-chest to the outer end of the high-pressure cylinder and the exhaust of steam therefrom to the receiver, a second valve-chest arranged at right angles to the cylinders and in communication with said receiver and with an exhaust-passage leading to the inner end of the second or lower-pressure cylinder and to an exhaust-pipe, a second valve located in said second valve-chest and adapted to control the passage of steam from said receiver to said

second cylinder and from that cylinder to said exhaust-passage, and means for operating said valves, substantially as described.

4. A single-acting engine comprising a high-pressure cylinder and a low-pressure cylinder arranged in tandem with their pistons attached to a common piston-rod, a steam-receiver between the adjacent ends of said cylinders, a valve-chest arranged adjacent to and transverse to the outer end of the high-pressure cylinder and having a steam-supply inlet, a port or passage between said valve-chest and the outer end of the high-pressure cylinder, an exhaust-passage connecting said receiver to said valve-chest, a valve adapted to place the upper end of said cylinder in communication with the steam supply and exhaust passages alternately, a second valve-chest in communication at one part with said receiver and at another part with a second exhaust-passage in connection with the inner end of the lower-pressure cylinder and with an exhaust-pipe, a port or passage between said second valve-chest and the outer end of the second cylinder, a second valve arranged to work in said second valve-chest and place the upper end of said second cylinder in communication with said receiver and said second exhaust-passage alternately, a lever connected to said valves and adapted to move them in opposite directions, and an expansion-governor connected to said lever, substantially as described.

5. A single-acting steam-engine comprising parallel sets of cylinders, each set comprising high and low pressure cylinders arranged in tandem with a receiver between adjacent ends thereof and with their pistons attached to a common piston-rod, valve-chests arranged at right angles to the axes of the cylinders and each common to and adapted to be placed in communication with the outer ends of the cylinders of corresponding pressure, exhaust-steam passages connecting each steam-chest to the receiver located between the corresponding cylinder and the next adjacent cylinder, valves located in said steam-chests and each adapted to control the passage of steam from its steam-chest to one cylinder and from that cylinder to the corresponding exhaust-steam passage, the valves in each steam-chest being connected together and to a common rod, and means for operating said valves, substantially as described.

6. A single-acting steam-engine comprising high and low pressure cylinders with their pistons attached to a common piston-rod each of said cylinders being provided with a steam-inlet passage leading to its outer end, a steam-receiver located between the adjacent ends of said cylinders, a steam-chest, a steam-passage between the upper end of the high-pressure cylinder and said steam-receiver, a steam-passage between the said receiver and the lower or inner end of the lower-pressure cylinder and an exhaust-pipe, a valve adapted to control the passage of steam from said steam-chest to the outer end of the high-pressure cylinder and from that cylinder to the first-mentioned steam-passage, a second valve adapted to control the admission of steam from said receiver to the second cylinder and from that cylinder to said second steam-passage, and an expansion-governor for operating and controlling said valves, substantially as described.

7. A single-acting steam-engine comprising two or more parallel sets of high and low pressure cylinders arranged in tandem with the pistons of each set connected to a common piston-rod, a horizontally-arranged valve-chest adjacent to and common to each of the high-pressure cylinders, a steam-receiver between the lower ends of the higher-pressure cylinders and the upper ends of the lower-pressure cylinders of each set, a valve-chest between the lower ends of the higher-pressure cylinders and the upper ends of the lower-pressure cylinders and in communication with said steam-receiver and common to the cylinders of like and lower pressure, a set of connected valves arranged in each valve-chest and adapted to separately control the passage of steam to and from the corresponding cylinders, and means for operating said connected valves, substantially as described.

8. A single-acting engine comprising three sets of high and low pressure cylinders arranged side by side with the pistons of each set connected to a common piston-rod, valve-chests each common to the three cylinders of like pressure, those for the high and low pressure cylinders being each formed with an internal guideway and that for the intermediate-pressure cylinders with two internal guideways, a set of connected valves arranged in each valve-chest for controlling the passage of steam to and from the corresponding cylinders, each set of high and low pressure valves having connected to and arranged between two of the valves of the set a piston or division arranged to slide in the guideway of the corresponding valve-chest and the set of intermediate-pressure valves having connected to and arranged between the three valves of the set two pistons or divisions arranged to slide in the two guideways of the corresponding valve-chest, and means for operating said valves and pistons or divisions, substantially as described for the purposes specified.

Signed at 77 Cornhill, in the city of London, England, this 29th day of March, 1899.

JAMES THOMAS ROSSITER.

Witnesses:
EDMUND S. SNEWIN,
WM. V. BROWN.