(No Model.)

5 Sheets—Sheet 1.

F. M. RITES.

VALVE GEAR.

No. 542,424. Patented July 9, 1895.

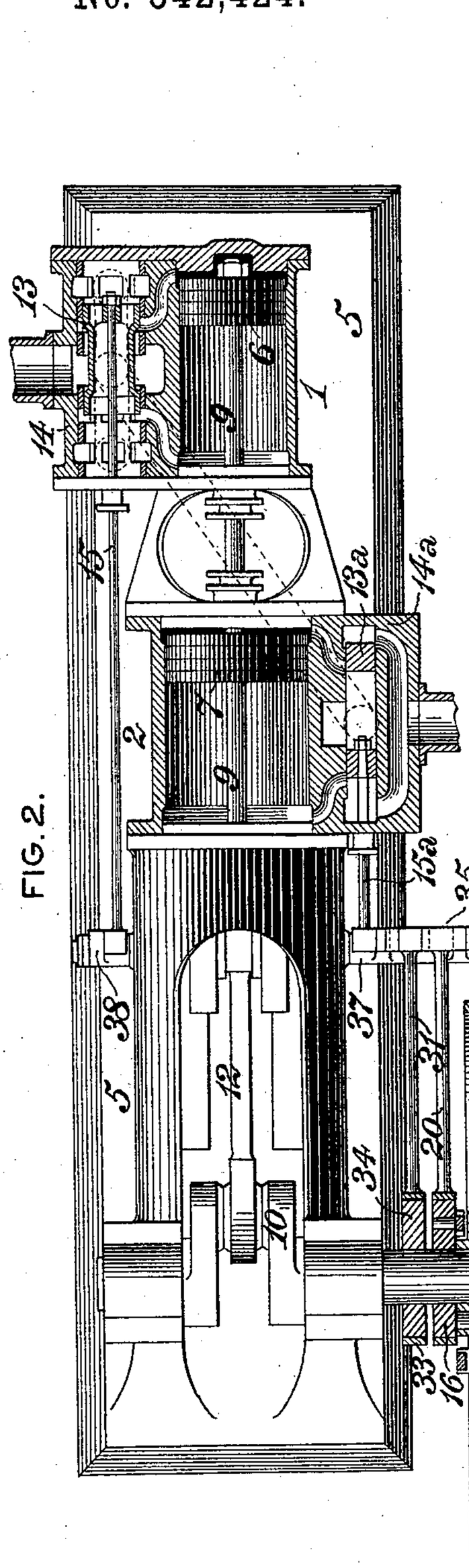

FIG. 2.

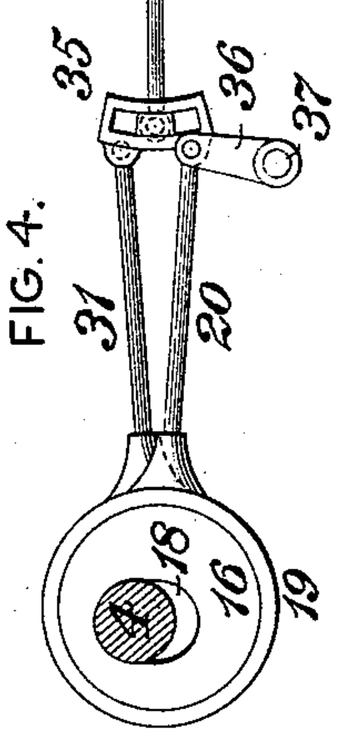

FIG. 4.

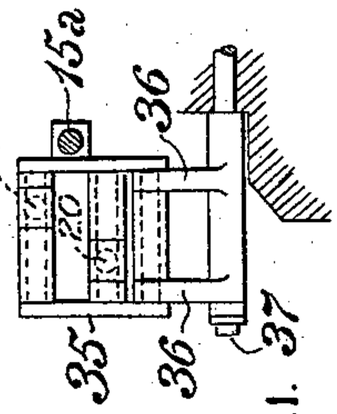

FIG. 3.

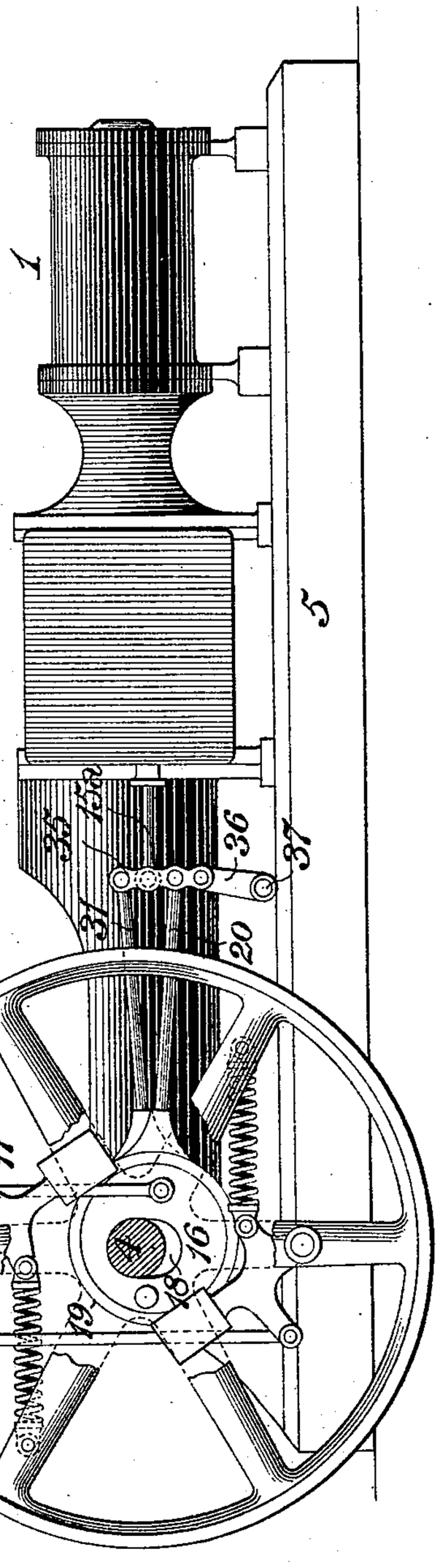

FIG. 1.

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(No Model.) 5 Sheets—Sheet 2.

F. M. RITES.

VALVE GEAR.

No. 542,424. Patented July 9, 1895.

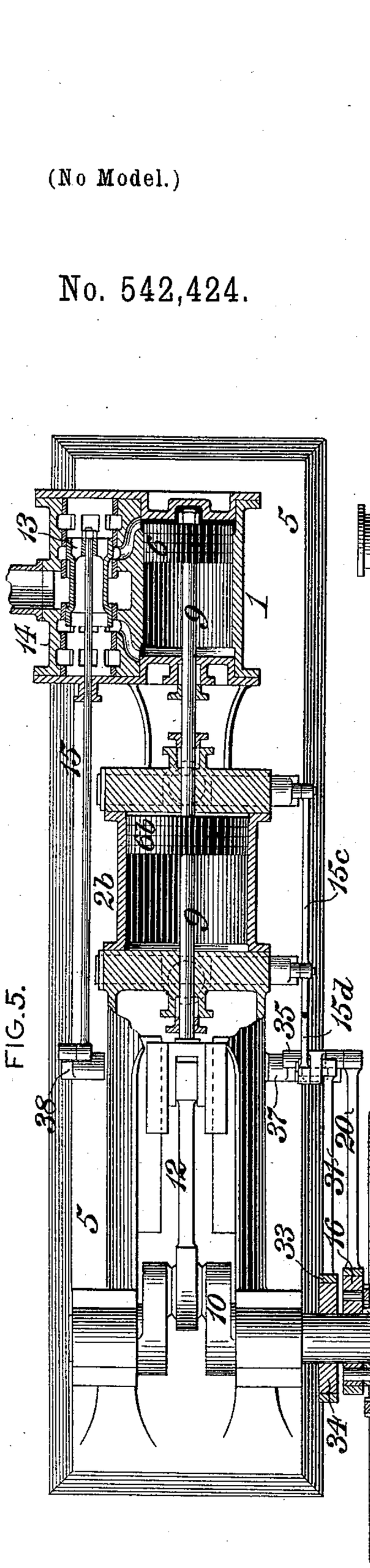

FIG. 5.

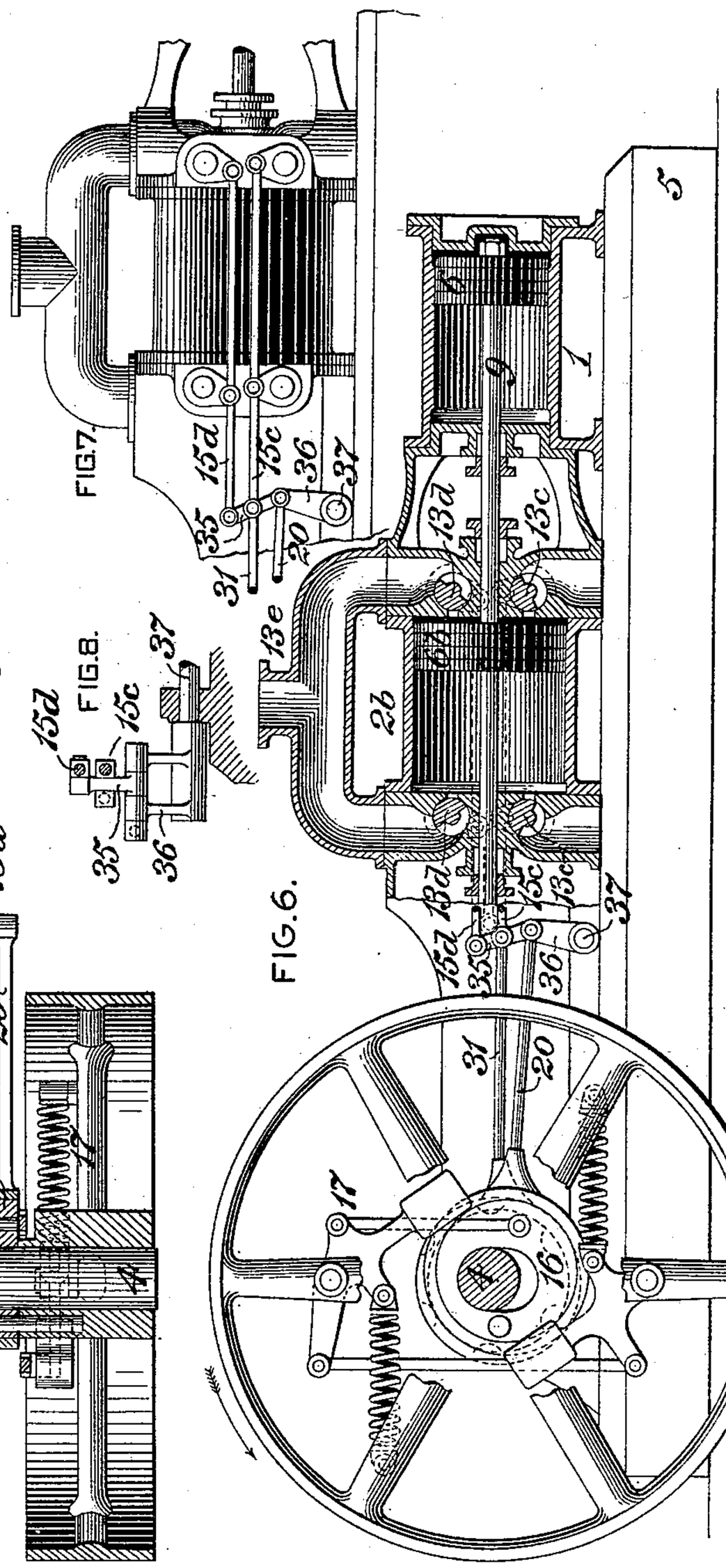

FIG. 7.

FIG. 8.

FIG. 6.

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(No Model.) 5 Sheets—Sheet 3.

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VALVE GEAR.

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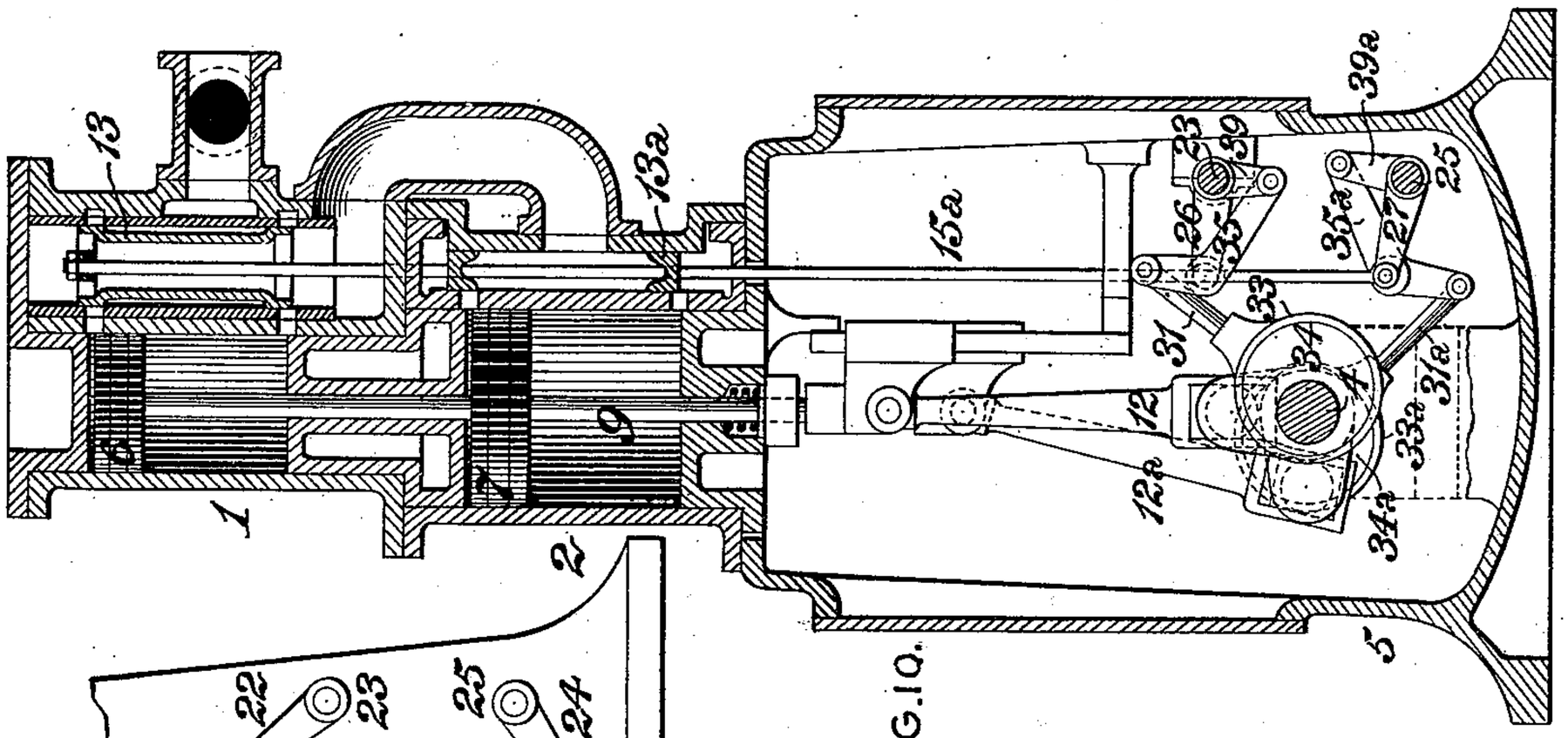

FIG. 10.

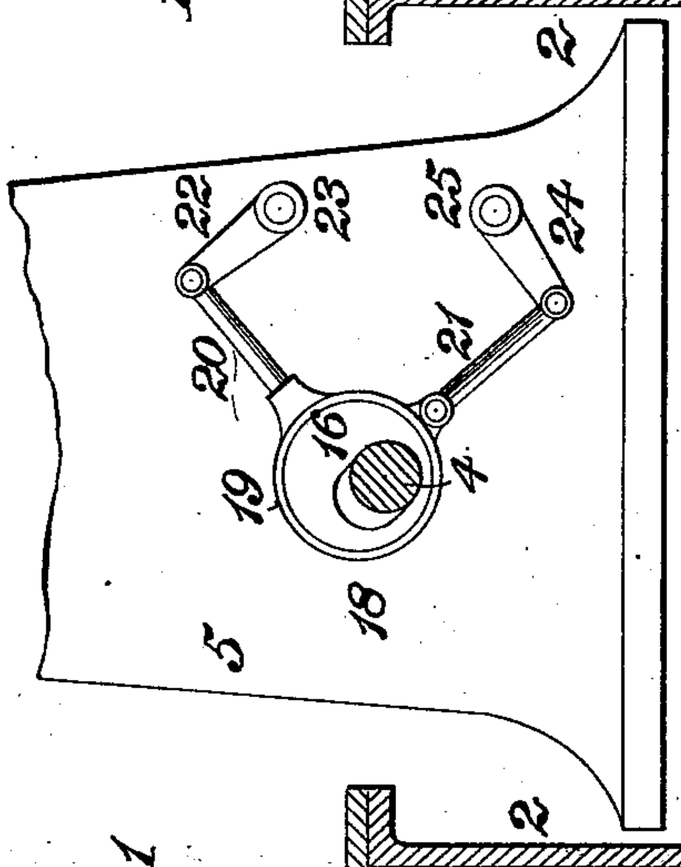

FIG. 11.

FIG. 9.

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(No Model.) 5 Sheets—Sheet 4.

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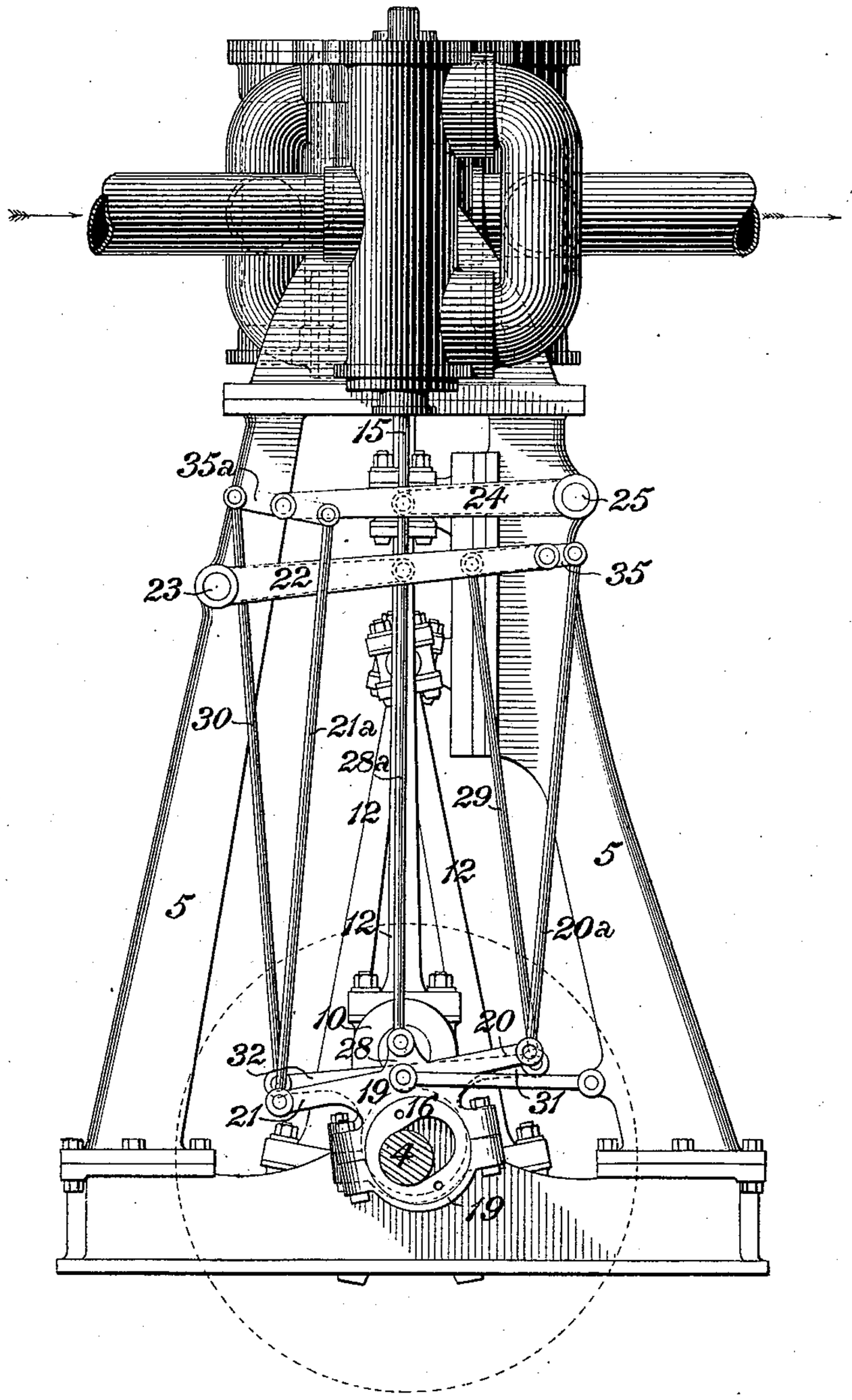
VALVE GEAR.

No. 542,424. Patented July 9, 1895.

FIG. 12.



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(No Model.) 5 Sheets—Sheet 5.

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VALVE GEAR.

No. 542,424. Patented July 9, 1895.

FIG. 13.

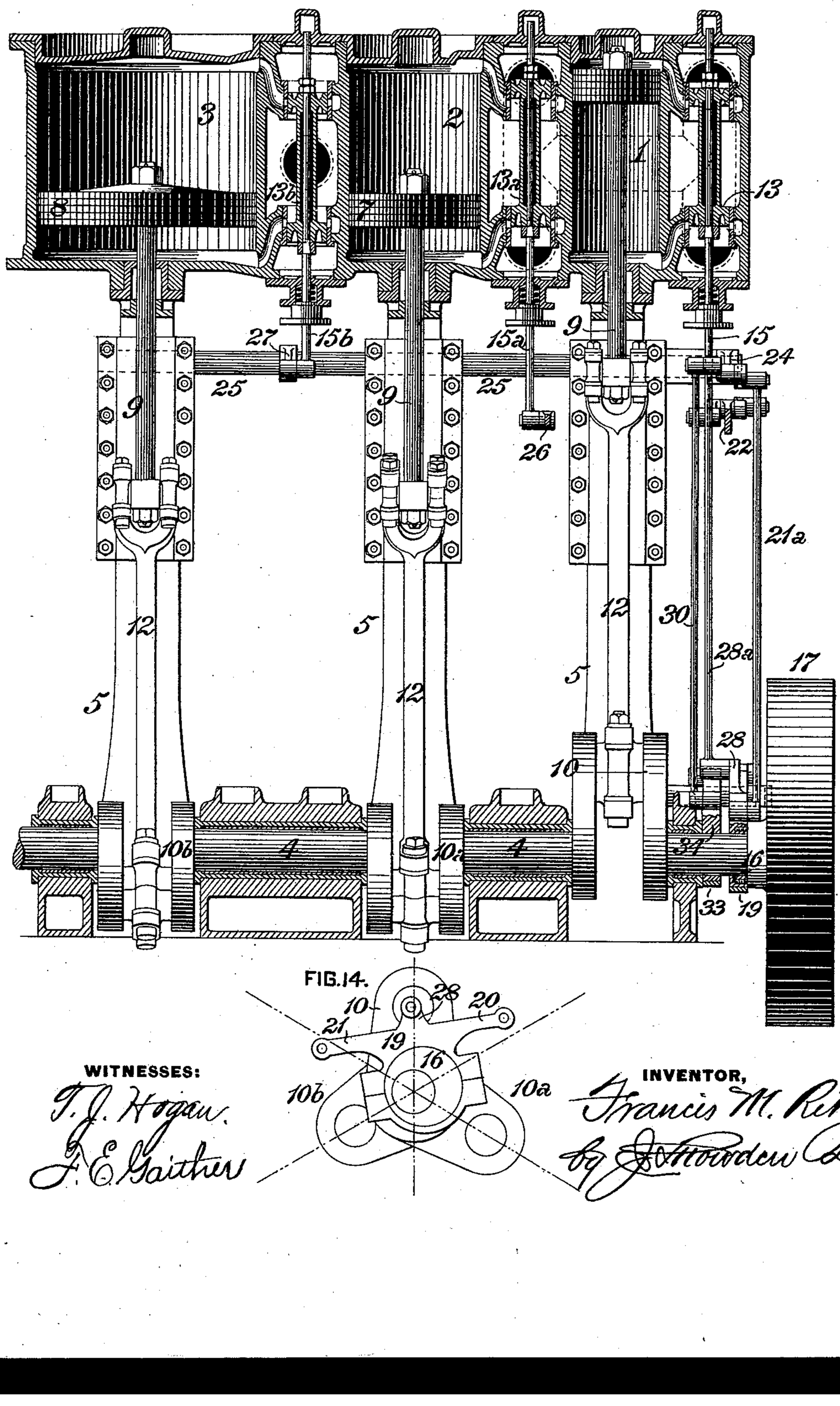

FIG. 14.

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UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF PITTSBURG, PENNSYLVANIA.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 542,424, dated July 9, 1895.

Application filed October 16, 1894. Serial No. 526,042. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Valve-Gear, of which improvement the following is a specification.

The object of my invention is to provide simple and efficient means whereby distribution functions of two or more fluid-pressure cylinders may be coincidently and differentially varied in such manner that a system of distribution mechanisms of differential variability may be controlled by a single governor.

To this end my invention, generally stated, consists in the combination of an adjustable eccentric, a fixed eccentric, a link or frame connecting the rods of said eccentrics, a distribution-valve mechanism connected to the adjustable eccentric or to the link or frame, and a distribution-valve mechanism independently connected to the link or frame.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a side view in elevation of a tandem compound engine, illustrating an application of my invention; Fig. 2, a plan view, partly in section, of the same; Fig. 3, a side view in elevation of the link or frame which connects the rods of the adjustable and fixed eccentrics and the rocker operated thereby; Fig. 4, a view in elevation showing a modified form of link; Fig. 5, a plan view, partly in section, of a high-speed air-compressor, illustrating another application of my invention; Fig. 6, a side view, partly in section, of the same; Fig. 7, a view in elevation showing the connections of the air-cylinder valves; Fig. 8, a side view in elevation of the link or frame which connects the rods of the adjustable and fixed eccentrics and the rocker operated thereby; Fig. 9, a vertical longitudinal central section through a double tandem compound engine having my invention applied; Fig. 10, a transverse section through the same at the line $x\ x$ of Fig. 9; Fig. 11, a partial end view showing the adjustable eccentric and its connections; Fig. 12, an end view in elevation showing an application in a three-cylinder engine of the marine type having its cranks set one hundred and twenty degrees apart; Fig. 13, a vertical longitudinal central section through the same; and Fig. 14 an end view in elevation showing the eccentric, strap, and cranks.

Referring first to Figs. 1 to 4, inclusive, my invention is exemplified in a two-cylinder tandem compound engine having a high-pressure cylinder 1 and a low-pressure cylinder 2, which are fixed in line axially on a bed-plate 5, near one end of which a crank-shaft 4 is mounted in suitable bearings. The high and low pressure pistons 6 and 7 are secured upon a common piston-rod 9, which is coupled in the ordinary manner to the pin of a crank 10 on the shaft 4 by a connecting-rod 12. The distribution functions of the high-pressure cylinder 1 are effected and controlled by a distribution-valve 13, which is fixed upon a stem 15 and is fitted to reciprocate in a valve-chest 14 on the cylinder 1. The distribution functions of the low-pressure cylinder 2 are effected and controlled by a distribution-valve 13^a, which is fixed upon a stem 15^a and is fitted to reciprocate in a valve-chest 14^a on the cylinder 2. The distribution-valves 13 13^a are reciprocated through connections to their stems by an actuating mechanism, which will now be described.

An eccentric 16 is fitted adjustably upon the crank-shaft 4 and is adapted to be regulated in position thereon by a governor 17, by which it is moved transversely to the shaft through a range of traverse admitted by a slot 18 in the eccentric. An eccentric 34 is fixed upon the crank-shaft adjacent to the adjustable eccentric. The eccentric-rods 20 and 31 of the adjustable and fixed eccentrics 16 and 34 are pivotally connected at their outer or free ends to a link or frame 35, through which the resultant effects of the movements of the eccentric-rods are transmitted to the stems of the distribution-valves for the reciprocation thereof. In the instance shown the rod 31 of the fixed eccentric is coupled to the link or frame 35 near its top and the rod 20 of the adjustable eccentric at or near its bottom. The link or frame 35 is coupled to arms 36 on a transverse rock-shaft 37, journaled in bearings on the bed-plate 5. The stem 15^a of the low-pressure-cylinder distribution-valve 13^a is coupled to the link or frame 35 at a point between the connections of the eccentric-rods

20 and 31 and the stem 15 of the high-pressure-cylinder distribution-valve 13 is coupled to an arm 38 on the end of the rock-shaft 37 opposite that which is connected to the link or frame 35.

It will be seen that under the construction above described the cut-off obtainable by the connection of a valve-stem to the top of the link or frame 35 is that due to the fixed eccentric and is therefore invariable. The valve-stem 15 of the high-pressure distribution-valve being in this instance connected (through the arms 36 and 38 and rock-shaft 37) to the link or frame 35 at a point below the connection of the rod of the adjustable eccentric, the high-pressure distribution-valve 13 will be variable not only through the entire range of cut-off due to the adjustable eccentric, but also through an increased range, due to the lever-arm formed by the vertical distance between the centers of the connections of the rod or frame 35 to the eccentric-rod 20 of the adjustable eccentric and to the rocker-arm 36, respectively. If these two centers are made coincident, as may be done, if preferred, the range of cut-off of the high-pressure distribution-valve will be equal to that due to the adjustable eccentric. The valve-stem 15^a of the low-pressure distribution-valve, being connected to the link or frame 35 at a point out of line with the connections of the rods of the fixed and adjustable eccentrics, is influenced by both of said eccentrics, and the range of cut-off of the low-pressure distribution-valve will therefore be less in extent and have a less degree of variation than that of the high-pressure distribution-valve, the difference being greater or less proportionately as the low-pressure valve-stem is connected to the rod or frame 35 farther from or nearer to the point of connection of the rod of the adjustable eccentric. As the lower side of the rod or frame 35 has the wider and the upper side the narrower range of cut-off, any point between the two will correspondingly have a wider or a narrower range of cut-off as it approaches the lower or the upper side, respectively. Variation of cut-off in the two cylinders will, for the reasons stated, be effected coincidently, but differentially, by the governor.

Fig. 4 shows the centers of the connections of the eccentric-rod 20 and the rocker-arm 36 to the link or frame 35 made coincident, as above specified, and also shows the link or frame 35 as slotted, in order to admit of the connection of the low-pressure valve-stem 15^a being made at such desired point as may be determined by experiment to be best suited to the conditions of operation.

It will be obvious that if a valve-stem connection be made to the link or frame 35 beyond or above the connection of the rod 31 of the fixed eccentric thereto distribution functions of the valve or valves actuated through such valve-stem connection will be varied differentially relatively to those of the valve or valves actuated by connections made to the link or frame 35 between the connections of the rods of the fixed and the adjustable eccentrics or below the connection of the rod of the adjustable eccentric.

It will also be seen that the direction of variation of distribution functions of the valve or valves actuated through a valve-stem connected to the link or frame 35 beyond or above the connection of the rod 31 of the fixed connection will be reversed relatively to that of the valve or valves connected to the link or frame 35 below the connection of the rod of the fixed eccentric thereto.

An application of the invention in which such reversal of direction is effected is illustrated in Figs. 5 to 8, inclusive, which represent a high-speed air-compressor, having a steam-cylinder 1 and an air-cylinder 2^b secured in line axially upon a bed-plate 5 and fitted respectively with pistons 6 and 6^b, secured upon a common piston-rod 9, which is coupled by a connecting-rod 12 to a crank 10 on a crank-shaft 4 journaled in bearings on the bed-plate. The distribution functions of the steam-cylinder 1 are effected and controlled by a single distribution-valve 13 of the piston type, which is fixed upon a stem 15 and is fitted to reciprocate in a valve-chest 14 on the cylinder 1. The distribution functions of the air-cylinder 2^b are effected and controlled by two inlet-valves 13^c, of the plug type, one at each end of the cylinder, and two similar outlet-valves 13^d, each controlling communication between one end of the air-cylinder and a reservoir, into which the air is compressed.

The distribution-valves of the steam and air cylinders are, as in the instance first described, actuated from an adjustable eccentric 16, controlled by a governor 17, and a fixed eccentric 34 through a link or frame 35, connecting the free ends of the rods 20 and 31 of the adjustable and fixed eccentrics. In this instance, however, the stem 15^d, which is coupled to and actuates the outlet-valves 13^d of the air-cylinder, is connected to the link or frame 35 above or beyond the point of connection of the rod 31 of the fixed eccentric therewith. The stem 15^c of the inlet-valves 13^c of the air-cylinder is coupled to the link or frame 35 in line with the connection of the rod of the fixed eccentric therewith, and the stem 15 of the distribution-valve 13 of the steam-cylinder is coupled to the link or frame 35 (through the rocker-shaft 37 and its arms 36 and 38) in line with the connection of the rod 20 of the adjustable eccentric 16 to the link or frame.

Instead of actuating the distribution-valves of both cylinders by and through the rod or frame 35, which connects the rods of the adjustable and fixed eccentrics, one of said valves may be actuated through said rod or frame and the other independently thereof, as in the construction shown in Figs. 9, 10, and 11. In this case the engine is a double tandem compound, having two high-pressure cylinders 1

1ª and two low-pressure cylinders 2 2ª, set in line, respectively, with the high-pressure cylinders. The pistons 6 and 7 of the right-hand engine are fixed upon a common piston-rod 9, which is coupled by a connecting-rod 12 to the pin of a crank 10, and the pistons 6ª and 7ª of the left-hand engine are similarly fixed upon a common piston-rod 9ª and coupled by a connecting-rod 12ª to the pin of a crank 10ª, set at an angle of ninety degrees to the crank 10. The distribution functions of the right-hand high-pressure cylinder 1 are performed by a distribution-valve 13 of the piston type fixed upon a valve-stem 15, and those of the right-hand low-pressure cylinder by a slide distribution-valve 13ª, fixed upon a stem 15ª. The left-hand high and low pressure cylinders 1ª 2ª are provided with similar distribution-valves, which are not shown, and which are fixed, respectively, upon stems 15ᶜ and 15ᵈ.

The distribution-valves of the high-pressure cylinders 1 1ª are both actuated by a single adjustable eccentric 16 on the crank-shaft 4, which eccentric is varied and controlled in position by a governor 17, and are operated through angular connections from the strap 19 of said eccentric to rock-shafts 23 and 25, as described in my application (Case A) filed by me of even date herewith, Serial No. 526,041. Such construction, by which the movement of the single adjustable eccentric is converted into two independent motions and transmitted in proper directions from said eccentric to the high-pressure valve stems, is not in and of itself claimed herein and need only be described or considered so far as it relates to the transmission of motion from the adjustable eccentric 16 to the links or frames 35 35ª, through which the low-pressure valves of the engine are actuated in the manner previously described.

As in my application (Case A) above referred to, the strap 19 of the adjustable eccentric 16 is secured to two eccentric-rods 20 21, which project from the strap at right angles one to the other and are coupled, respectively, to an arm 22 on a rock-shaft 23 and to an arm 24 on a rock-shaft 25. The stem 15 of the distribution-valve of the right-hand high-pressure cylinder 1 is coupled to an arm 26 on the rock-shaft 23, and the stem 15ᶜ of the distribution valve of the left-hand high-pressure cylinder 1ª is coupled to an arm 27 on the rock-shaft 25. The high-pressure distribution-valves consequently have the full range of variable cut-off due to the adjustable eccentric 16.

An arm 39 on the rock-shaft 23 is coupled to the lower side of a link or frame 35, the upper side of which is coupled to an eccentric-rod 31, secured to the strap 33 of an eccentric 34, which is fixed upon the crank-shaft 4. The link or frame 35 thus partakes of the motions of the adjustable eccentric 16 and the fixed eccentric 34, as in the instance first described. The stem 15ª of the distribution-valve of the right-hand low-pressure cylinder is coupled to the link or frame 35 between the connections of the adjustable and fixed eccentrics thereto, and said distribution-valve will therefore, as in the former instance, have a lesser range of cut-off and degree of variation of cut-off than the high-pressure distribution-valve.

The stem 15ᵈ of the distribution-valve of the left-hand low-pressure cylinder is similarly coupled to a similar link or frame 35ª, which is coupled at one side to an arm 39ª on the rock-shaft 25 and at the other to the rod 31ª of an eccentric 34ª fixed upon the crank-shaft. The distribution-valve of the left-hand low-pressure cylinder will therefore be subject to the same operative conditions as that of the right-hand low-pressure cylinder, and the distribution functions of all the valves will be coincidently varied by the governor, but differentially, as between those of each high-pressure cylinder and of its associated low-pressure cylinder.

Figs. 12, 13, and 14 illustrate an application of the invention in a triple-expansion engine of the marine type, having a high-pressure cylinder 1, an intermediate pressure cylinder 2, and a low-pressure cylinder 3, all supported in a frame or housings 5, the pistons 6, and 8 of which cylinders are fixed upon piston-rods 9, which are coupled by connecting rods 12 to cranks 10 10ª 10ᵇ set at angles of one hundred and twenty degrees apart. The distribution functions of the cylinders 1 2 3 are effected by distribution-valves 13 13ª 13ᵇ, respectively, which are shown as of the piston type and are respectively fixed upon valve-stems 15 15ª 15ᵇ. The several distribution-valves are, in a broad and general sense, actuated by a single eccentric 16, fitted adjustably upon the crank-shaft, and adjusted in position by a governor 17. The specific construction, however, further embodies a fixed eccentric 34 having rods connected by links corresponding with the links or frames 35 35ª, previously described, to rods on the strap of the adjustable eccentric. The distribution-valves of the intermediate and low-pressure cylinders are actuated from said links, and that of the high-pressure cylinder is actuated by the adjustable eccentric indepentently of the links a coincident but unequal variation of cut-off by the governor being thus attained, as in the preceding instance.

The strap 19 of the adjustable eccentric 16 is provided with three arms 28 20 21, which project from it in the manner of eccentric-rods and are set angularly, the central arm 28 being at angles of ninety degrees with the two side arms 20 21. The central arm 28 is coupled by a link 28ª to the stem 15 of the distribution-valve 13 of the high-pressure cylinder 1. The arm 20 is connected by a link 20ª with one end of a link or double-armed lever 35, the opposite end of which is coupled by a link 29 to an arm 31 projecting, in the manner of an eccentric-rod, from the strap 33 of the fixed eccentric 34. An arm 22 on a

horizontal rock-shaft 23 is coupled to the link 35 at a point between the connections of the fixed and adjustable eccentrics thereto, and an arm 26 on the opposite end of the rock-shaft 23 is coupled to the stem 15^a of the distribution-valve 13^a of the intermediate cylinder 2. The arm 21 of the eccentric-strap is connected by a link 21^a with one end of a link or double-armed lever 35^a, the opposite end of which is coupled by a link 30 to an arm 32 projecting in opposite direction to the arm 31 from the strap of the fixed eccentric 34. An arm 24 on a horizontal rock-shaft 25 is coupled to the link 35^a at a point between the connections of the fixed and adjustable eccentrics thereto, and an arm 27 on the opposite end of the rock-shaft 25 is coupled to the stem 15^b of the distribution-valve 13^b of the low-pressure cylinder 3.

As shown in Fig. 12, the arm 22 of the rock-shaft 23, through which motion is transmitted from the link 35 to the stem of the intermediate-cylinder distribution-valve, is coupled to the link 35 nearer to the connection thereof with the adjustable eccentric than is the arm 24 of the rock-shaft 25 to the connection of its companion link 35^a with the adjustable eccentric. It follows that the cut-off in the intermediate cylinder will be variable through a wider range than that in the low-pressure cylinder, and as the distribution-valve of the high-pressure cylinder is actuated through connections with the adjustable eccentric, by which it is variable through the entire range of cut-off due to said eccentric, the range of variable cut-off in the high-pressure cylinder will in turn be wider than that in the intermediate cylinder. It will therefore be seen that in this as in the preceding instances coincident and differential variation of cut-off in the several cylinders will be effected by the governor.

The leading and essential feature of my invention and that by which it is clearly differentiated from all prior valve mechanisms, so far as my knowledge and information of the art extend, is a valve actuating mechanism by which distribution functions of two or more fluid-pressure cylinders are varied coincidently and differentially by a governor through the influence of an adjustable eccentric and the resultant influence of an adjustable and a fixed eccentric upon valves independently controlling distribution in said cylinders.

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

1. A valve gear for operating two or more valves and adapted to be adjusted so as to effect variations in the operations of the valves, and a governing device controlling the adjustment of the valve gear to effect relative differential variations in the operations of the valves, substantially as set forth.

2. The combination, with a fixed eccentric, of an adjustable eccentric, a valve operated by the adjustable eccentric, and a valve connected to and operated by both the fixed and adjustable eccentrics, substantially as set forth.

3. The combination, with two separate, or independent, valves, of a fixed eccentric, an adjustable eccentric, connections from one of the valves to the adjustable eccentric and from the other valve to both eccentrics, substantially as set forth.

4. The combination with two or more cylinders, of valves for each of the cylinders, a fixed eccentric and an adjustable eccentric, connections from the adjustable eccentric to the valve or valves of one of the cylinders, and connections from the fixed and adjustable eccentrics to the valve or valves of the other cylinders, substantially as set forth.

5. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a link or frame connecting the rods of said eccentrics, a distribution valve mechanism connected to the link or frame or to the adjustable eccentric, and a distribution valve mechanism independently connected to the link or frame.

6. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a link or frame connecting system actuated by the rods of said eccentrics, two or more distribution valve mechanisms, and connections through which the movement of the adjustable eccentric is transmitted to one of said valve mechanisms, and a resultant of the movement of the adjustable and the fixed eccentric is transmitted, through the link or frame connecting system, to another one or more of said valve mechanisms.

7. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a link or frame connecting the rods of said eccentrics, a distribution valve mechanism connected to the link or frame or to the adjustable eccentric, a distribution valve mechanism independently connected to the link or frame, and a governor controlling the adjustable eccentric.

8. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a governor controlling the adjustable eccentric, two or more fluid pressure cylinders, valve mechanisms independently controlling the distribution of said cylinders, and connections through which the movement of the adjustable eccentric is transmitted to one of said valve mechanisms, and a resultant of the movement of the adjustable and the fixed eccentric is transmitted to another one or more of said valve mechanisms.

9. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a link or frame connecting system actuated by the rods of said eccentrics, and two distribution valve mechanisms connected to different points on the link or frame connecting system.

10. The combination, substantially as set forth, of an adjustable eccentric, a fixed ec-

centric, a link or frame connecting system actuated by the rods of said eccentrics, a governor controlling the adjustable eccentric, and two distribution valve mechanisms connected to different points on the link or frame connecting system.

11. The combination, substantially as set forth, of an adjustable eccentric, a fixed eccentric, a link or frame connecting the rods of said eccentrics, a distribution valve mechanism connected to the adjustable eccentric, and a distribution valve mechanism connected to the link or frame.

12. The combination, with two or more eccentrics, of two or more valves operated by the eccentrics, and a governor connected to and controlling the adjustment of one of the eccentrics, and thereby adapted to effect variations in the operation of the valves, substantially as set forth.

13. The combination, with an adjustable eccentric and one or more fixed eccentrics, of two or more valves operated by the eccentrics, and a governor connected to and controlling the adjustable eccentric and adapted by its movement to effect variations in the operation of the valves, substantially as set forth.

In testimony whereof I have hereunto set my hand.

FRANCIS M. RITES.

Witnesses:

J. SNOWDEN BELL,

F. E. GAITHER.