No. 771,415. PATENTED OCT. 4, 1904.

W. C. BROWN.

VALVE MOVEMENT FOR STEAM ENGINES.

APPLICATION FILED APR. 2, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

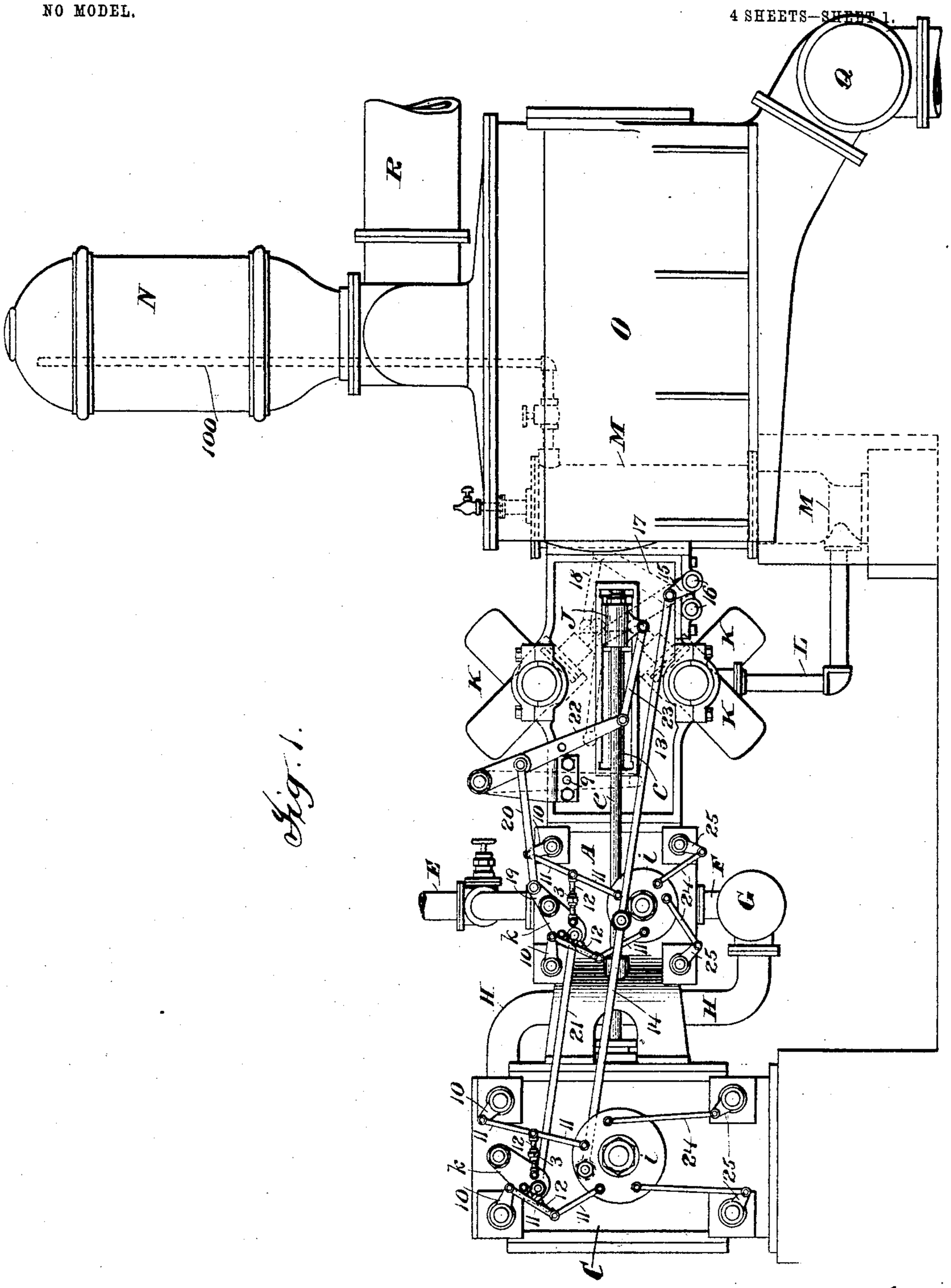

Fig. 1.

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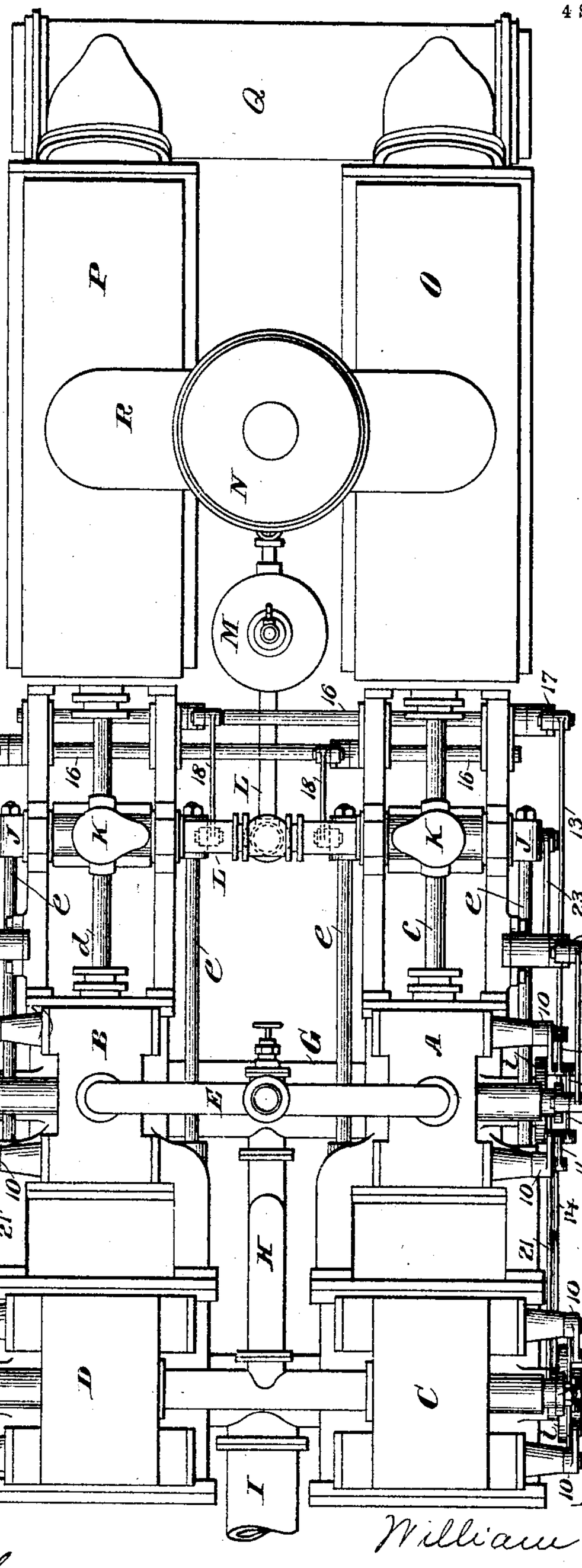

Fig. 2.

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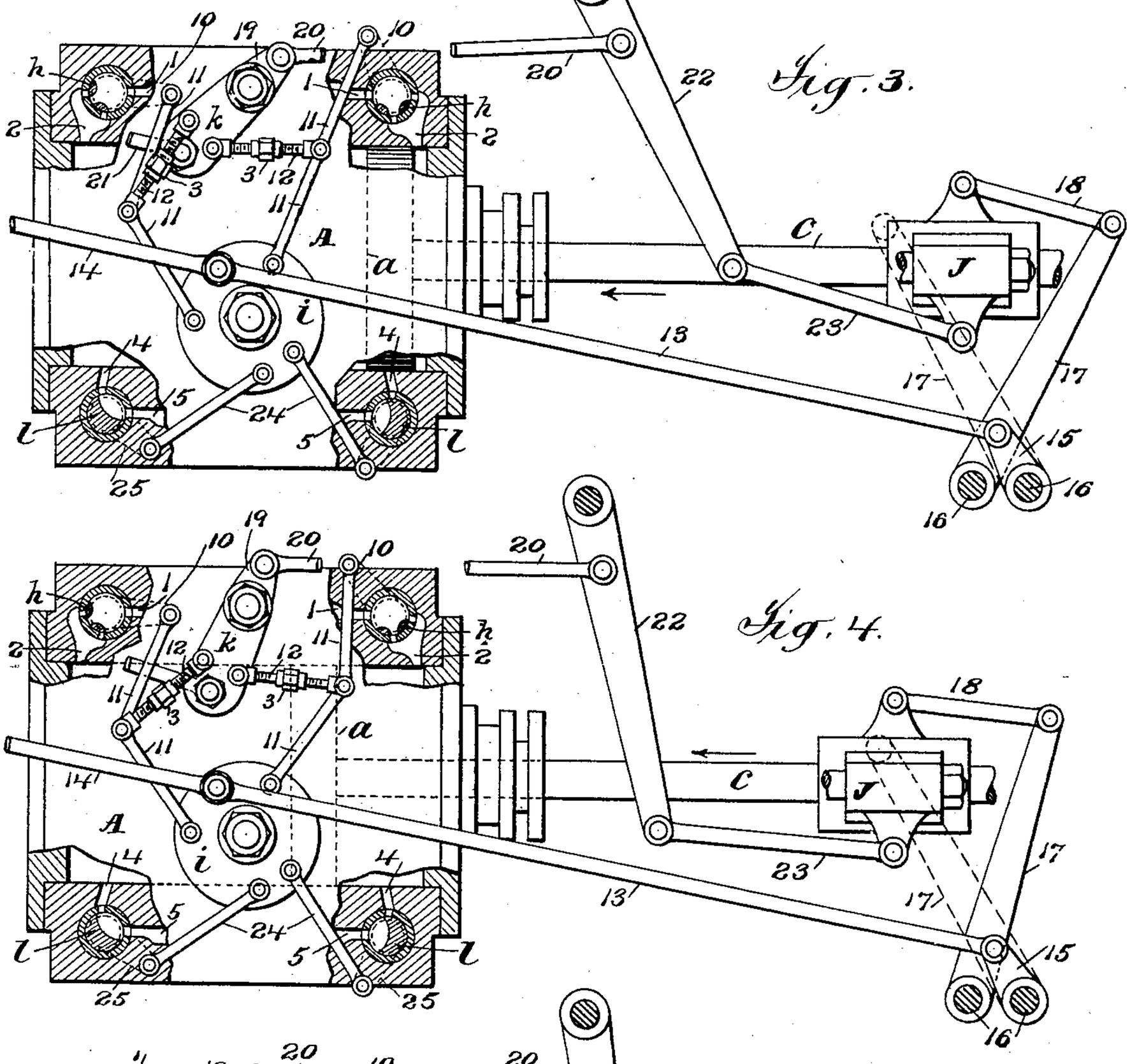

Fig. 3.

Fig. 4.

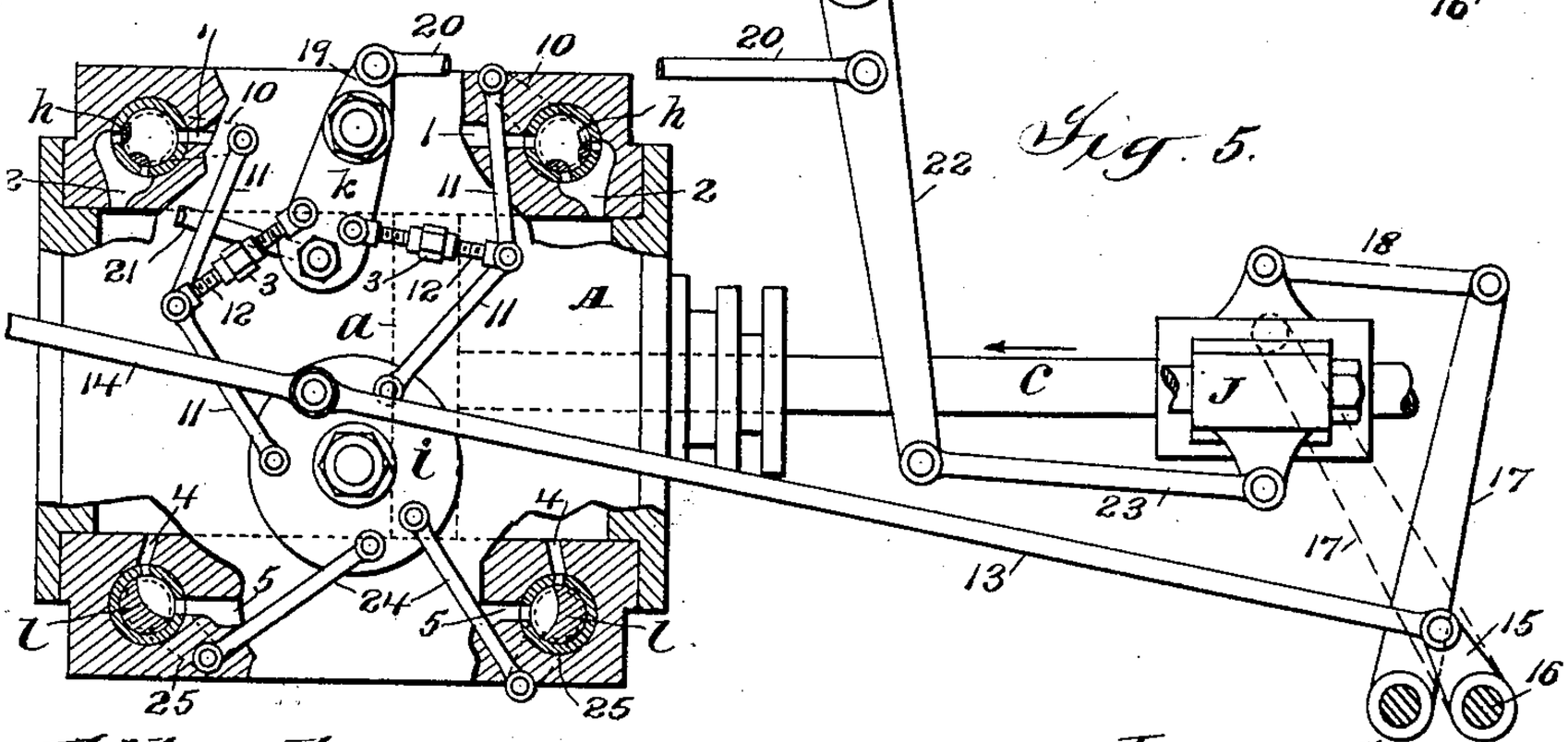

Fig. 5.

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NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6.

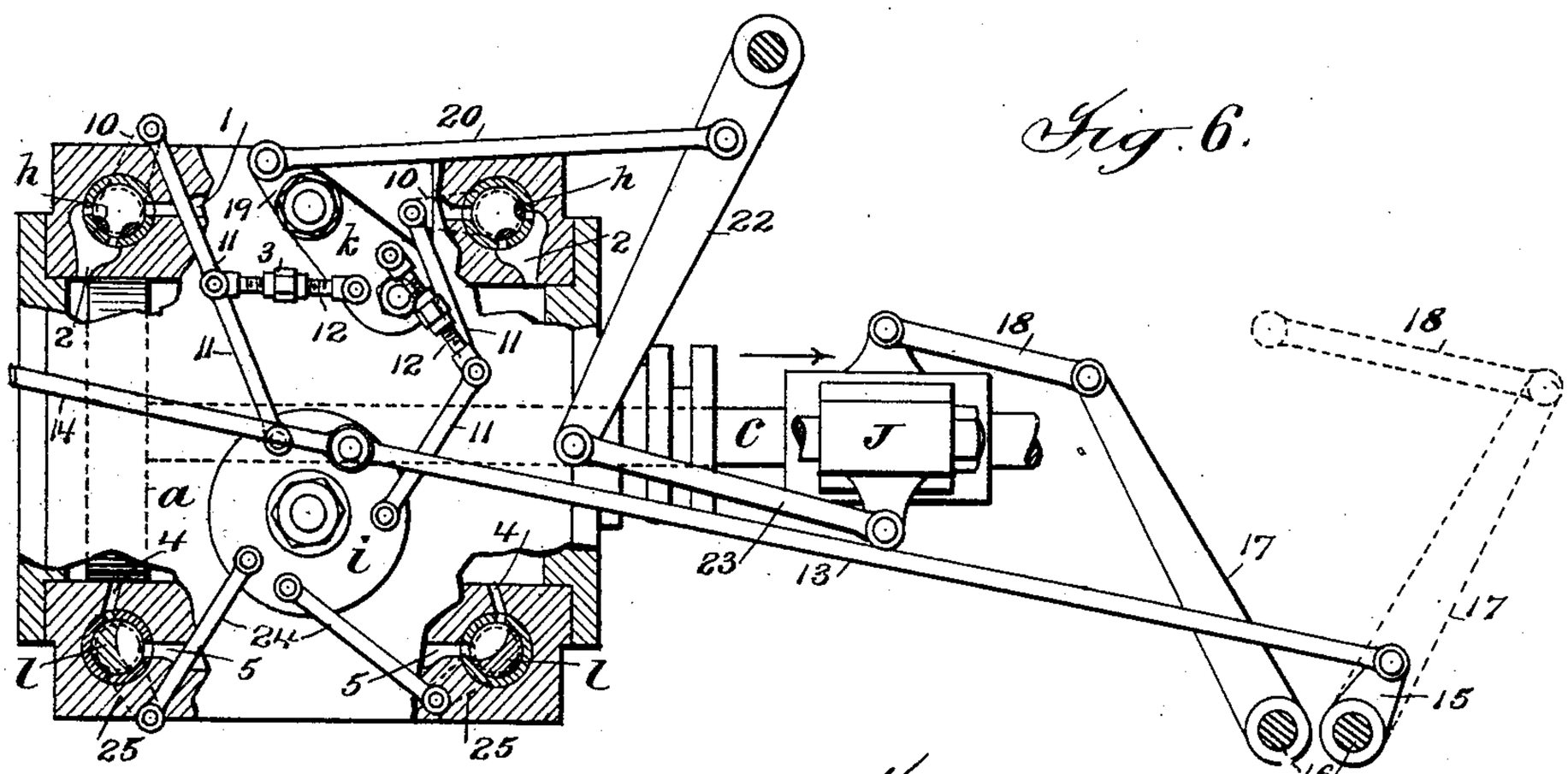


Fig. 7.

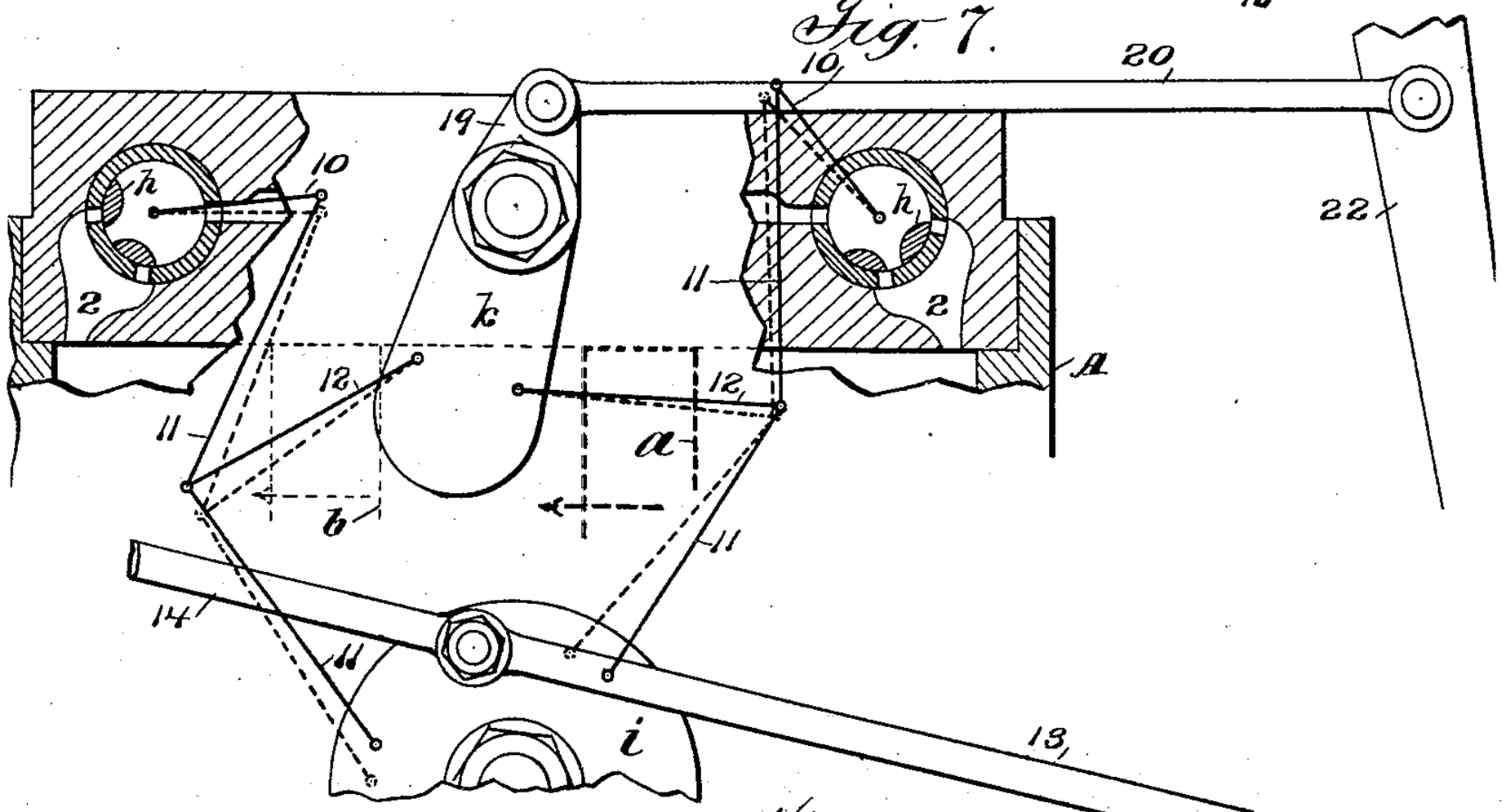
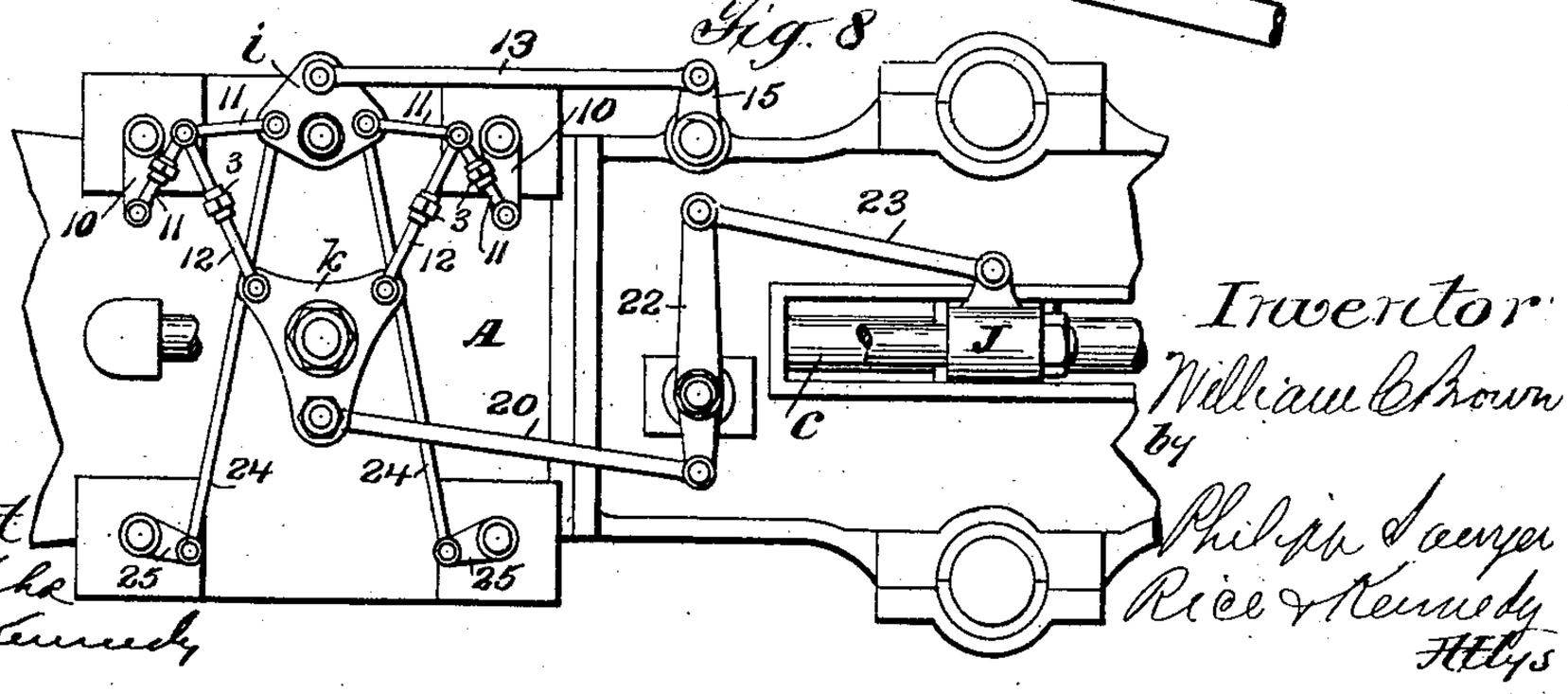


Fig. 8



Attest
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No. 771,415. Patented October 4, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM C. BROWN, OF NEW YORK, N. Y., ASSIGNOR TO HENRY R. WORTHINGTON, A CORPORATION OF NEW JERSEY.

VALVE-MOVEMENT FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 771,415, dated October 4, 1904.

Application filed April 2, 1902. Serial No. 101,023. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. BROWN, a citizen of the United States, residing at New York city, county of Richmond, and State of New York, have invented certain new and useful Improvements in Valve-Movements for Steam-Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of the present invention is to provide an improved valve-movement for steam and similar expansion engines of that class in which a single valve controls both the admission and cut-off of the steam or other motive fluid.

My improved valve-movement is especially adapted for use with duplex direct-acting steam-pumps and similar duplex engines of that class in which the valves on one side of the engine are operated by the other side for admission and by their own side of the engine for cut-off.

The invention consists in a valve-movement by which the shortening of the stroke on one side of the engine does not result in an earlier cut-off on the other side of the engine, but either does not vary such point of cut-off or, which may be found preferable, results in a slightly later cut-off on the opposite side of the engine, by which later cut-off and longer admission of steam the engine will more quickly be brought back to full stroke, the normal point of cut-off then being resumed.

As a full understanding of the invention can best be given by a detailed description of a construction embodying the same, such a description will now be given in connection with the accompanying drawings, which show the invention as applied in preferred forms in connection with a well-known form of compound duplex direct-acting pumping-engine, and the features forming the invention will then be specifically pointed out in the claims.

In the drawings, Figure 1 is a side elevation of the engine. Fig. 2 is a plan view of the same. Figs. 3 to 6 are enlarged details showing different positions of the valve-movement through the stroke of the piston on one side of the engine. Fig. 7 is a diagrammatic enlarged view corresponding in position of the piston to Fig. 5 and illustrating the action when the stroke on the opposite side of the engine is shortened. Fig. 8 is a detail side elevation of a high-pressure cylinder corresponding to Fig. 1, but showing a modified form of valve-movement with the parts in central position.

Referring to said drawings, A B and C D are respectively the high-pressure cylinders and the low-pressure cylinders on opposite sides of the engine; E, the induction-pipe for the high-pressure cylinders; F, the exhaust-pipe to receiver G; H, the induction-pipe for the low-pressure cylinders, and I the low-pressure exhaust-pipe. The pistons *a b* of the high-pressure cylinders on opposite sides of the engine are connected by piston-rods *c d* to cross-heads J, with which are connected the pistons of swinging compensating cylinders K, and to the cross-heads J are connected by side rods *e* the low-pressure steam-pistons. The compensating cylinders K are connected by pipe L with the accumulator M, which may be of any suitable construction, the pressure for the accumulator being shown as controlled from the top of the usual air-chamber N through the pipe 100, as common in such constructions. The pump end is shown as having the opposite sides O P, and Q is the suction-main, and R the force-main on which is mounted the air-chamber N, previously referred to.

The construction so far as above described is well known, and it will be understood that the invention is equally applicable to other types of high-duty duplex engines.

Referring now to the parts in which the present invention is embodied, the admission and cut-off valves *h* at the top of the cylinders which control the ports 1 from the steam-chest, and the ports 2, leading to the cylinder ends, are shown as the usual two-lobed oscillating valves, and the crank-arms 10 on the stems of these valves are connected by two links 11 to a primary rocker *i* and by a link

12, jointed to the links 11 at their point of connection, to a secondary rocker *k*, these links 12 being preferably made adjustable in length, for which purpose turnbuckles 3 are shown. The primary rockers *i* of the high-pressure cylinders are connected by links 13 with the valve-movement and by links 14 with the rockers of the low-pressure cylinders, so that the primary rockers *i* of both cylinders on one side are actuated from the valve-movement through link 13. These links 13 are connected to crank-arms 15 on crossover-shafts 16 and the admission-levers 17 on rock-shafts 16 on the opposite sides of the engine are connected to cross-head J by links 18, as usual in valve-movements of duplex engines. The secondary rockers *k* of the high-pressure cylinders have crank-arms 19, which are connected by links 20 to the cut-off levers of the valve-movement, and the rockers *k* of the high-pressure cylinders are connected by links 21 to the rockers *k* of the low-pressure cylinders, so that the secondary rockers of both the high and the low pressure cylinders are actuated by links 20 from the cut-off levers. The cut-off levers 22 on each side of the engine are actuated from the cross-heads J of their own side through links 23.

The exhaust-valves *l*, which are shown as ordinary single-lobed oscillating valves controlling ports 4, connecting with the cylinder, and ports 5, connecting with the exhaust-pipe, are actuated from the primary rocker *i* through links 24, connected to crank-arms 25 on the valve-stems.

As the movement of the valves on opposite sides of the engine is the same, only the operation of the valves on one side of the engine has been illustrated. Referring now particularly to Figs. 3 to 7, the operation of the valve-movement is as follows: Fig. 3 corresponds with the general views, Figs. 1 and 2, and shows the valves of cylinder A in the position they occupy with the piston *a* just starting on its stroke to the left. The piston *b* on the opposite side of the engine is now just approaching the end of its stroke; but as the movement of said piston *b* to the end of its stroke does not affect the position of the valves of cylinder A so far as the admission of steam is concerned the admission-lever 17 of the cylinder B is shown in Figs. 3 to 5 as in its extreme position reached at the end of the stroke of piston *b*. As the piston *a* starts on its stroke from the position shown in Fig. 3 the secondary rocker *k* is moved by the piston-rod *c* through cut-off lever 22, link 20, and crank-arm 19, so as to break the links 11 connected to the valve *h* at the right-hand end of the cylinder or behind the piston, and when the piston *a* has reached the point of one-quarter stroke, as shown in Fig. 4, the valve *h* has been thus moved into position so that it is just about to close the ports 2, as shown in Fig. 4. The valve *h* has been thus moved into position so that it is just about to close the ports 2, by which steam is being admitted behind the piston, and thus cut off the steam, and when the piston *a* has reached the point of one-third stroke, as shown in Fig. 5, the secondary rocker *k* has been moved and the links 11 broken to shift the valve *h* so as to fully cut off the steam behind the piston. This movement of the valve *h* at the right-hand end of the cylinder by the secondary rocker *k* has been secured without materially changing the position of the valve *h* at the left-hand end of the cylinder, the link 12 at that end of the cylinder swinging with the secondary rocker *k* upon the links 11 without materially changing their position. The valve *h* at the right-hand end of the cylinder having been thus shifted from the position shown in Fig. 3 to that shown in Fig. 5, so as to cut off the steam behind the piston *a*, the link 12 at the right-hand end of the cylinder then swings with the secondary rocker *k* through the remainder of the stroke of the piston, so as not to materially affect the position of this valve, which thus remains closed during the remainder of the stroke of the piston *a*. During this remainder of the stroke, however, the piston *b* on the opposite side of the engine has been started on its stroke by the piston *a*, acting through its rod *c* upon the primary rocker *i* on the opposite side of the engine, and the piston *b* at the proper point in its stroke, which is usually during its movement from one-half to three-quarter stroke, moves the primary rocker *i* on cylinder A through the admission-lever 17 on the B cylinder side of the engine, crossover-shaft 16 and crank-arm 15 and link 13 on the A cylinder side of the engine from the position shown in Figs. 3 to 5 to that shown in Fig. 6, thus straightening the links 11 at the left-hand end of the cylinder to shift the valve *h* at the left-hand end of the cylinder A for admission of steam behind the piston *a* at that end of the cylinder, and this movement is effected without opening the valve *h* at the right-hand end of the cylinder. By this movement of the primary rocker *i* also the exhaust-valves *l l* are shifted through links 5 and crank-arms 25 for reversing the exhaust from the cylinder. All the parts on cylinder A are thus brought into the position shown in Fig. 6, in which figure the piston *a* is just about to start on its stroke to the right.

The important feature of this valve-movement is that the short stroking of one side of the engine does not advance the cut-off so as to shorten the time of admission of steam on the opposite side. This feature is of great value in this class of duplex engines, because if an earlier cut-off on one side results from short stroking on the opposite side the side on which the earlier cut-off occurs will also short stroke. This will produce an earlier cut-off and shorter stroke on the opposite side

until the engine will finally work itself onto a center and stop dead by gradually shortening the stroke and cut-off on opposite sides.

The valve-movement of the present application may be arranged and adjusted so that short stroking on one side simply does not affect the cut-off on the opposite side, but the regular admission of steam on such other side being attained no short stroke of this side will be caused and the engine will gradually be brought back to full stroke. It is preferable, however, that the valve-movement be arranged and adjusted so that a short stroke on one side of the engine will result in slightly delaying the cut-off on the opposite side of the engine, so as to secure a longer admission of steam, and thus result in greater power on that side of the engine, which will insure a full stroke and result in the more certain and speedy attainment of full stroke on both sides of the engine. This lengthening of the cut-off, however, is slight and limited by the valve-movement, so that it cannot exceed a small amount under any condition of short stroke that produces it, so that there is no danger of the engine striking the head violently from too late a cut-off. In order to secure this result, that the shortening of the movement of the admission-rocker *i* on the valve-opening movement shall not result in an earlier closing of the valve for cut-off, but shall preferably result in a slightly later cut-off, the length of the links 11 are such and the points at which one of each pair of these links is connected to the admission-rockers *i* are so located on the rocker that after actuating the valve for admission, as shown in Figs. 3 and 6, the link 11, connected to the rocker *i*, will be moved past the position of a radius to the rocker *i* when the admission-rocker *i* makes the complete movement produced by a full stroke on the opposite side of the engine, so as to shorten the link connection between the rocker *i* and the valve as compared with the radial position of the link. The shortening of the movement of the admission-rocker *i* a small amount will thus leave the link 11 in a position which is nearer the line of a radius to the admission-rocker passing through the point of connection of the link to the rocker, and thus slightly increase the distance of the outer end of the link from the center of the disk as compared with the distance of this outer end from the center of the rocker had the rocker made its full movement, and this greater distance of the outer end of the link from the center of the radius increases slightly the distance that the valve must move through before closing to cut off the steam and if the shortening is considerable will delay the cut-off and lengthen the time during which steam is admitted. The construction and operation of such a valve movement with the cut-off on one side slightly lengthened or delayed in case of short stroke on the opposite side is illustrated diagrammatically in Fig. 7, in which the piston *b* is shown in dotted lines as having stopped at about three-quarter stroke in its movement to the left and the piston *a* is shown as at one-third stroke, or the same position as in Fig. 5. The position of the links and valve *h* in this condition of short stroke of the piston *b* is shown in full lines and the position the links would occupy if the piston *b* had made a full stroke is shown in dotted lines. It will be seen that the valves and links being in the position shown in full lines on account of the piston *b* having made a short stroke the valve *h* is not yet closed so as to cut off the steam from the piston *a*, but will be closed by a slight further movement of the rocker *k*. It will be seen also from this figure that if the links 11 12 in this figure were in the position shown in dotted lines, which would be the case if the piston *b* had made a full stroke, the valve *h* would be fully closed to cut off the steam from behind the piston *a*. The point of cut-off may be varied, so as to admit steam behind the piston through just the portion of the stroke required in accordance with the running conditions of the engine, and thus employ the steam expansively to the best effect by adjusting the length of the cut-off links 12, which may readily be done by the turnbuckles 3 shown. It will be understood, however, that any other suitable means may be used for adjusting these links 12 so as to vary the point of cut-off—as, for instance, by adjusting their point of connection to the rockers *k*. For running the engine low duty—that is, without cutting off the steam, but admitting steam throughout the stroke—the rockers 12 will be swung into and secured in their central position and disengaged from the piston-rod and the links 12 will be lengthened to their full extent. The securing of the rockers *k* in their central position and their disengagement from the piston-rod may well be secured by removing links 23, which connect the cut-off levers 22 with the cross-heads J, and securing the cut-off levers 22 in central position, as shown by dotted lines in Fig. 1.

The construction and operation of the valve-movement shown in Fig. 8 are the same as those shown in Figs. 1 to 7 and above described, except that the position of the primary and secondary rockers is reversed, the primary rockers *i* being placed at the top of the cylinder and the secondary rockers *k* being mounted centrally of the cylinders. In this construction one of the links 11 is preferably made adjustable, as well as the link 12, two sets of turnbuckles 3 for each valve being shown. This construction also may readily be arranged so that a short stroke on one side of the engine will either not affect the cut-off on the opposite side of the engine or will slightly delay or lengthen the cut-off, and the exact point of cut-off may readily be adjusted as desired by the turnbuckles 3. In this construc-

tion also the engine may readily be run low duty by disconnecting the secondary rockers *k* from the piston-rods and securing them in central position, the links 12, connecting the rocker *k* with the links 11, then being in this case shortened.

The invention provides a very efficient valve-movement for steam distribution, avoiding all liability of the engine stopping on account of the action of a short stroke on one side upon the cut-off on the opposite side, while at the same time the full advantage of the use of the steam expansively is secured, and there is no danger of the cut-off on either side being delayed too long.

It will be understood that my improved valve-movement may be used with valves of different form and movement from those shown and that many other modifications may be made in the constructions illustrated without departing from the invention and that I am not to be limited to the exact form or arrangement of valves or of any of the devices shown for actuating them.

While the invention has been illustrated in connection with a valve-movement employing separate exhaust-valves, it will be understood that the invention may be applied also in constructions in which the same valve acts to control the steam for admission, cut-off, and exhaust, although separate exhaust-valves are preferably used.

What is claimed is—

1. The combination with an engine-cylinder and single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers, and means for actuating said valves by the rockers for admission and cut-off and permitting the shortening of the movement of the admission-rocker on the admission movement without advancing the time of closing the valve on the cut-off movement, substantially as described.

2. The combination with an engine-cylinder and single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers, and means for actuating the valves by the rockers for admission and cut-off and delaying the closing of the valve on the cut-off movement when the movement of the admission-rocker is shortened, substantially as described.

3. The combination with an engine-cylinder and single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers, means for actuating said valves by the rockers for admission and cut-off and permitting the shortening of the movement of the admission-rocker on the admission movement without advancing the time of closing the valve on the cut-off movement, and separate exhaust-valves connected to the admission-rocker, substantially as described.

4. The combination with an engine-cylinder and single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers, means for actuating the valves by the rockers for admission and cut-off and delaying the closing of the valve on the cut-off movement when the movement of the admission-rocker is shortened, and separate exhaust-valves connected to the admission-rocker, substantially as described.

8. The combination with two cylinders and their single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers for each cylinder, connections for actuating the admission-rocker of each cylinder by the piston of the other cylinder and the cut-off rocker of each cylinder by its own piston, and means for actuating the valves by the rockers for admission and cut-off, and permitting the shortening of the movement of the admission-rocker on one cylinder by the short-stroking of the piston of the other cylinder without advancing the valves of the first-mentioned cylinder on the cut-off movement, substantially as described.

6. The combination with two cylinders and their single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers for each cylinder, connections for actuating the admission-rocker of each cylinder by the piston of the other cylinder and the cut-off rocker of each cylinder by its own piston, and means for actuating the valves by the rockers for admission and cut-off and delaying the closing of the valves on the cut-off movement when the movement of the admission-rocker on one cylinder is shortened by the short-stroking of the piston of the other cylinder, substantially as described.

7. The combination with two cylinders and their single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers for each cylinder, connections for actuating the admission-rocker of each cylinder by the piston of the other cylinder and the cut-off rocker of each cylinder by its own piston, means for actuating the valves by the rockers for admission and cut-off, and permitting the shortening of the movement of the admission-rocker on one cylinder by the short-stroking of the piston of the other cylinder without advancing the time of closing the valves of the first-mentioned cylinder on the cut-off movement, and separate exhaust-valves connected to the admission-rocker, substantially as described.

8. The combination with two cylinders and their single valves controlling the admission and cut-off of the motor fluid, of admission and cut-off rockers for each cylinder, connections for actuating the admission-rocker of each cylinder by the piston of the other cylinder and the cut-off rocker of each cylinder by its own piston, means for actuating the valves by the rockers for admission and cut-off and delaying the closing of the valves on

the cut-off movement when the movement of the admission-rocker on one cylinder is shortened by the short-stroking of the piston of the other cylinder, and separate exhaust-valves connected to the admission-rockers, substantially as described.

9. The combination with a cylinder and an oscillating valve at each end of the cylinder controlling the admission and cut-off and cranks 10 on the valve-stems, of rockers *i*, *k*, links 11 connecting the rocker *i* to the valve-stems, and link 12 connecting the rocker *k* to the links 11, the links being of such length and connected to the rockers at such points that links 11 move past the position of radius to the rocker *i* on the full normal movement of said rocker *i* whereby the shortening of the movement of said rocker *i* leaves the link 11 in a position nearer radius to the rocker *i* than on the full movement, substantially as described.

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

WILLIAM C. BROWN.

Witnesses:
T. F. KEHOE,
C. J. SAWYER.