(No Model.)

4 Sheets—Sheet 1.

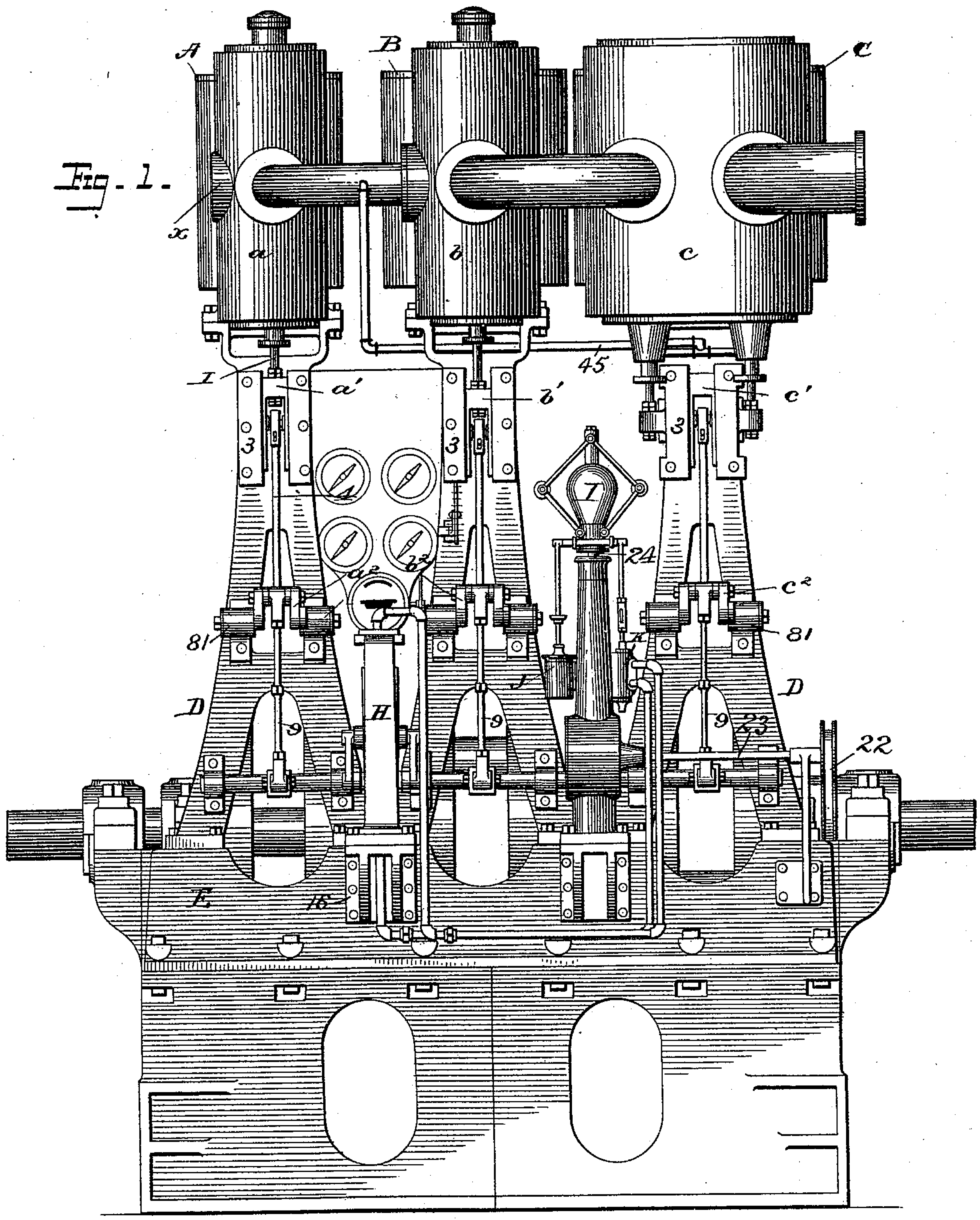
J. W. SARGENT.

STEAM ENGINE.

No. 485,432.

Patented Nov. 1, 1892.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

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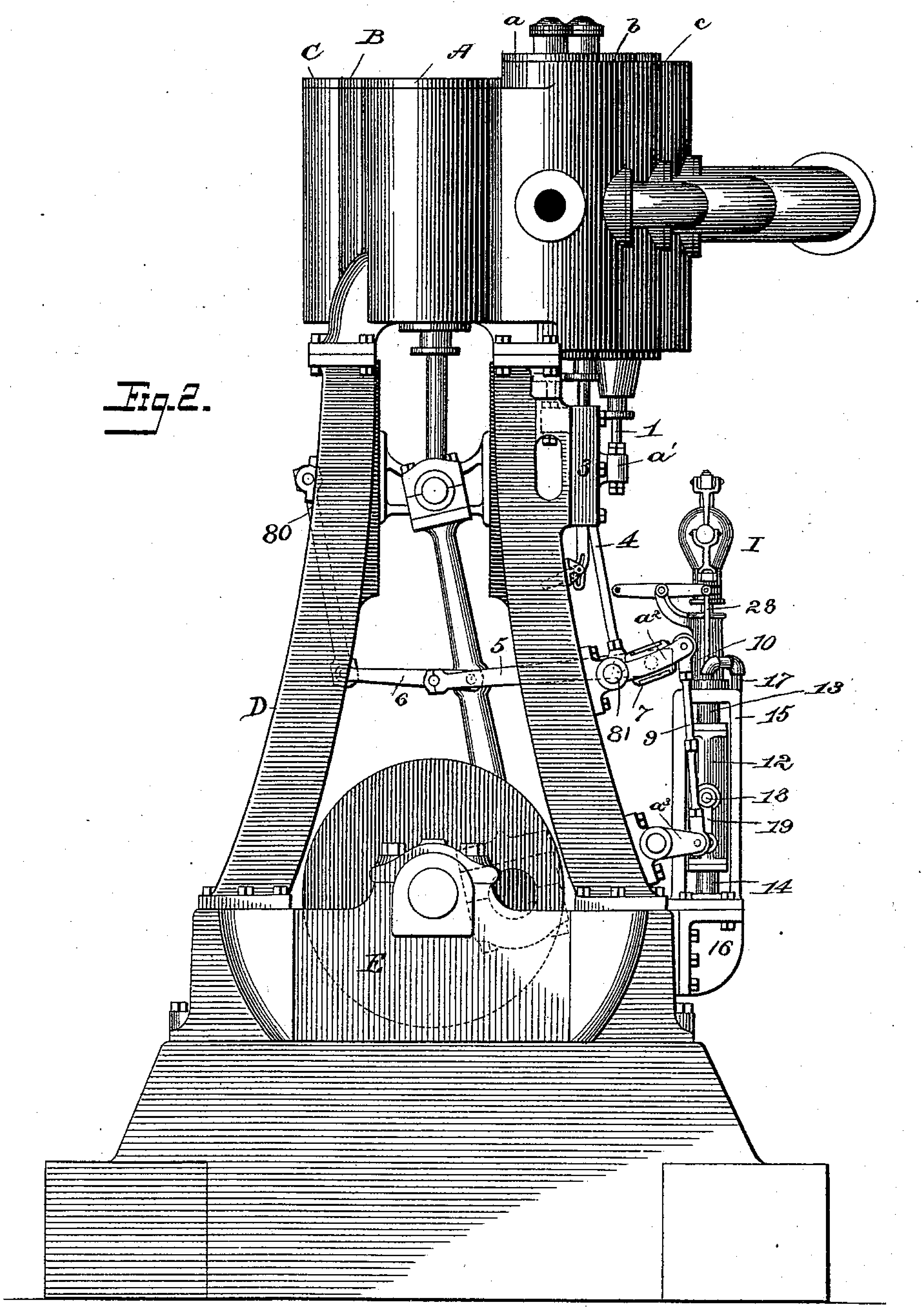
Fig. 2.



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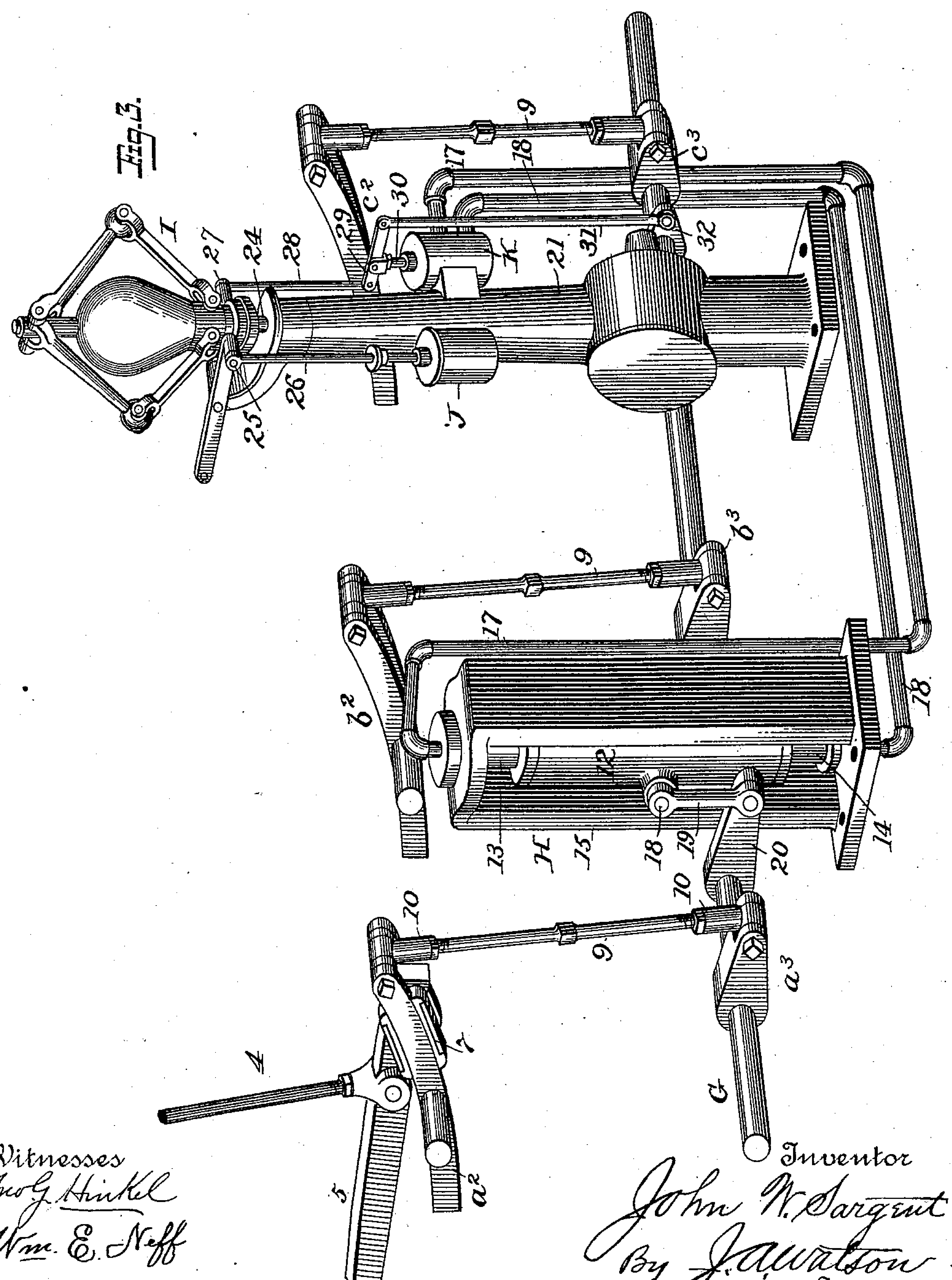

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STEAM ENGINE.

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Fig. 4.

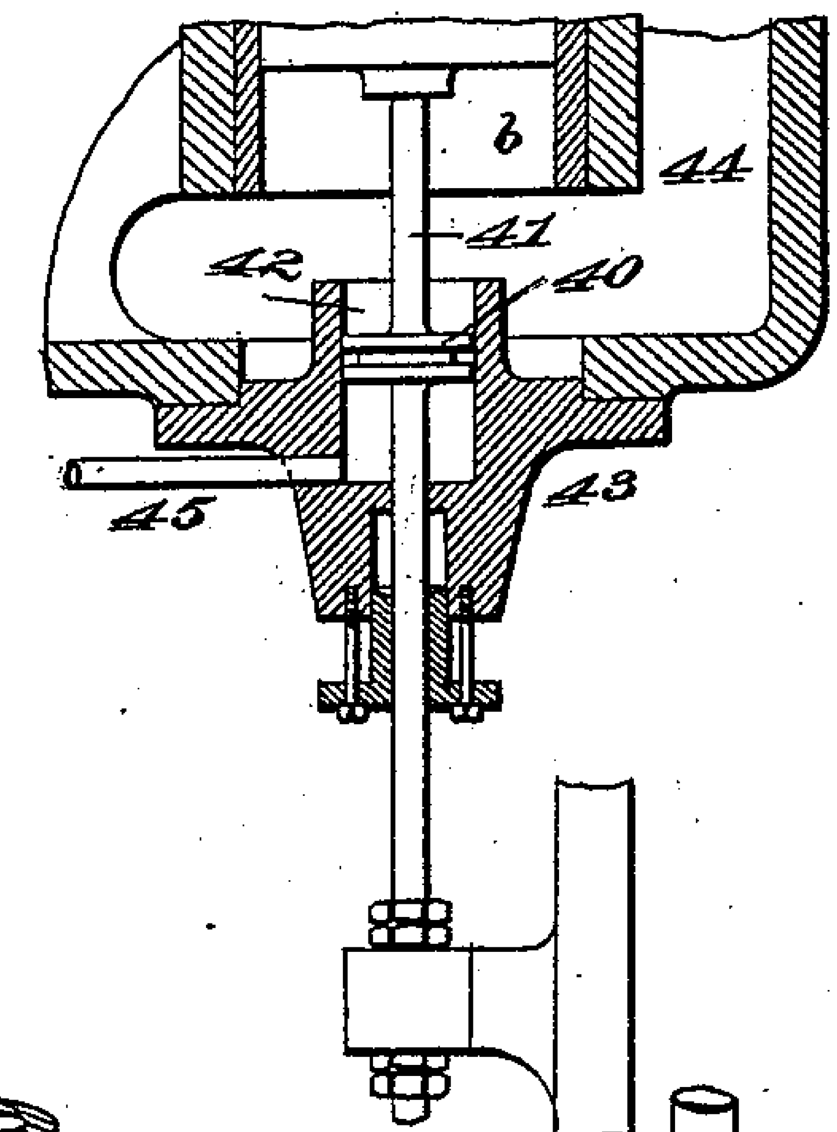


Fig. 8.

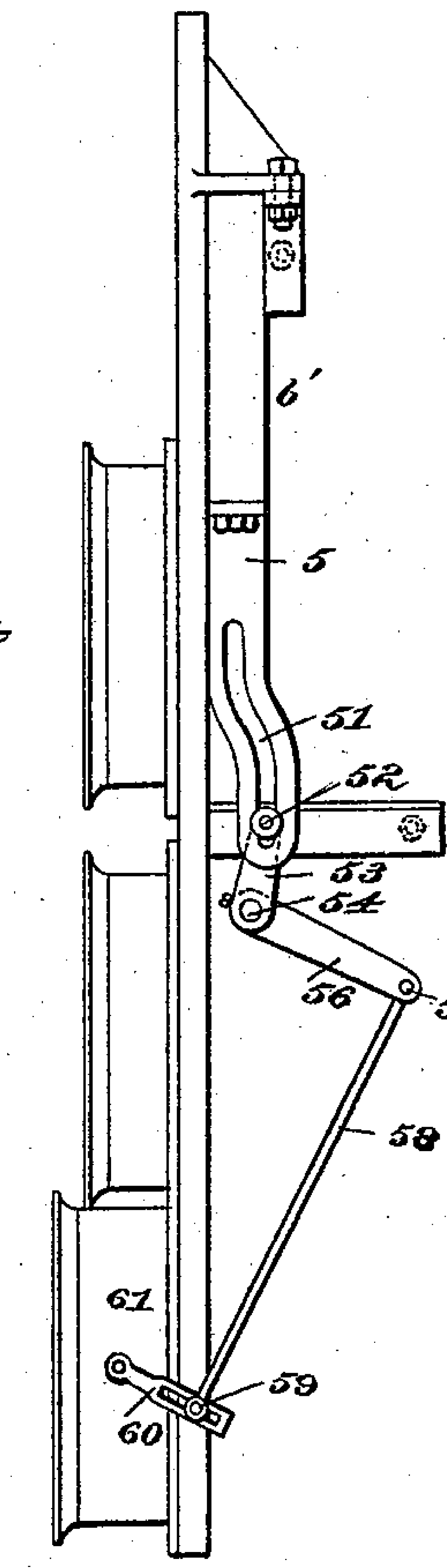


Fig. 6.

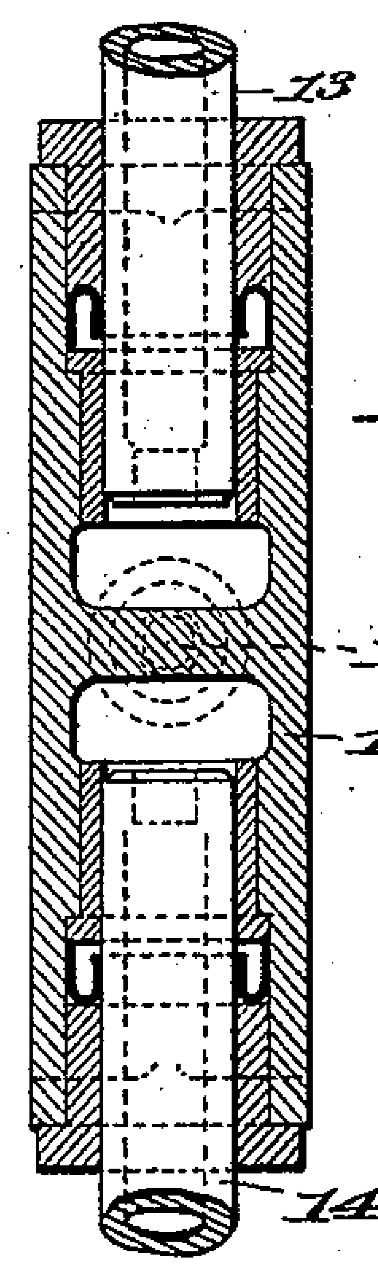


Fig. 5.

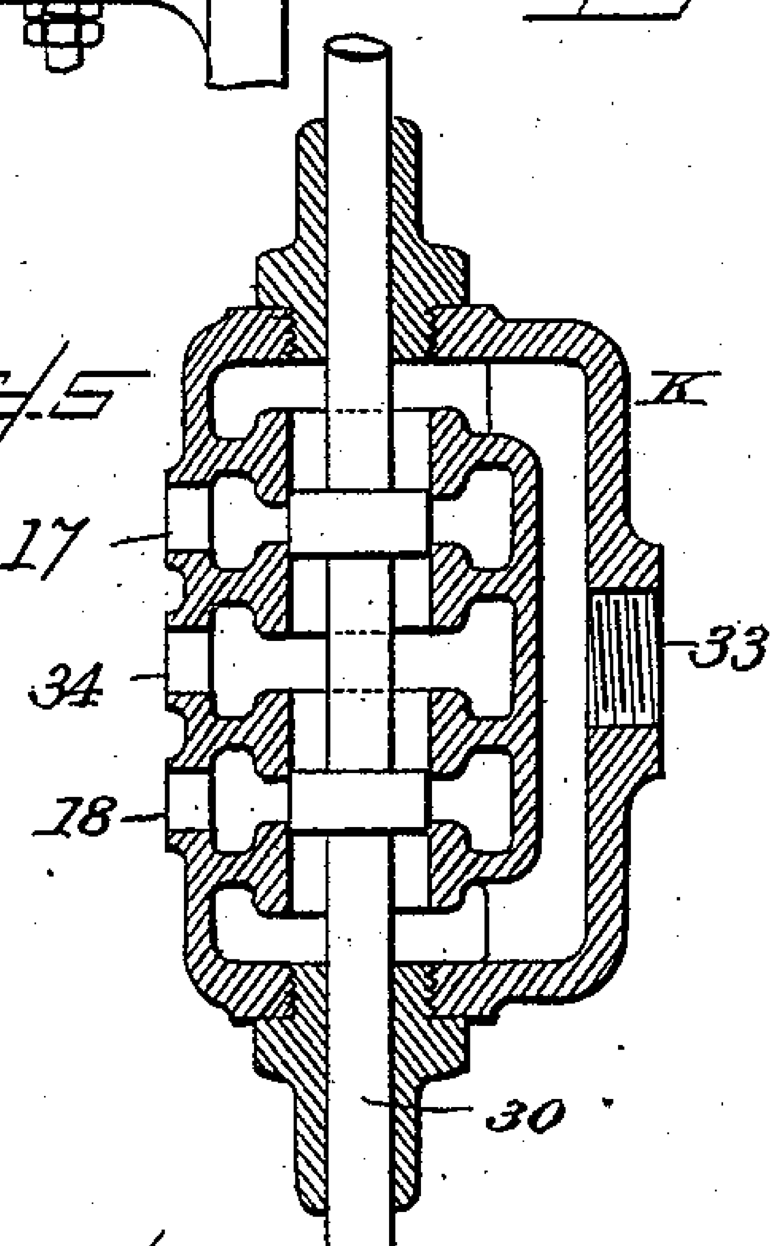


Fig. 7.

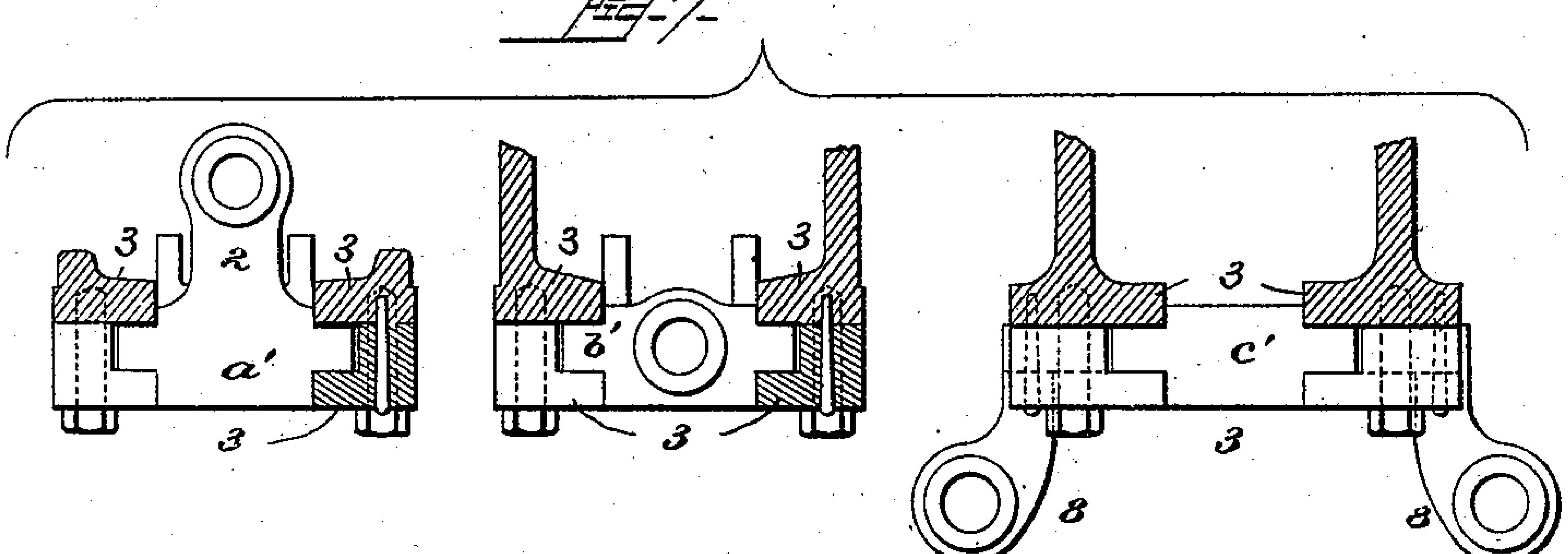
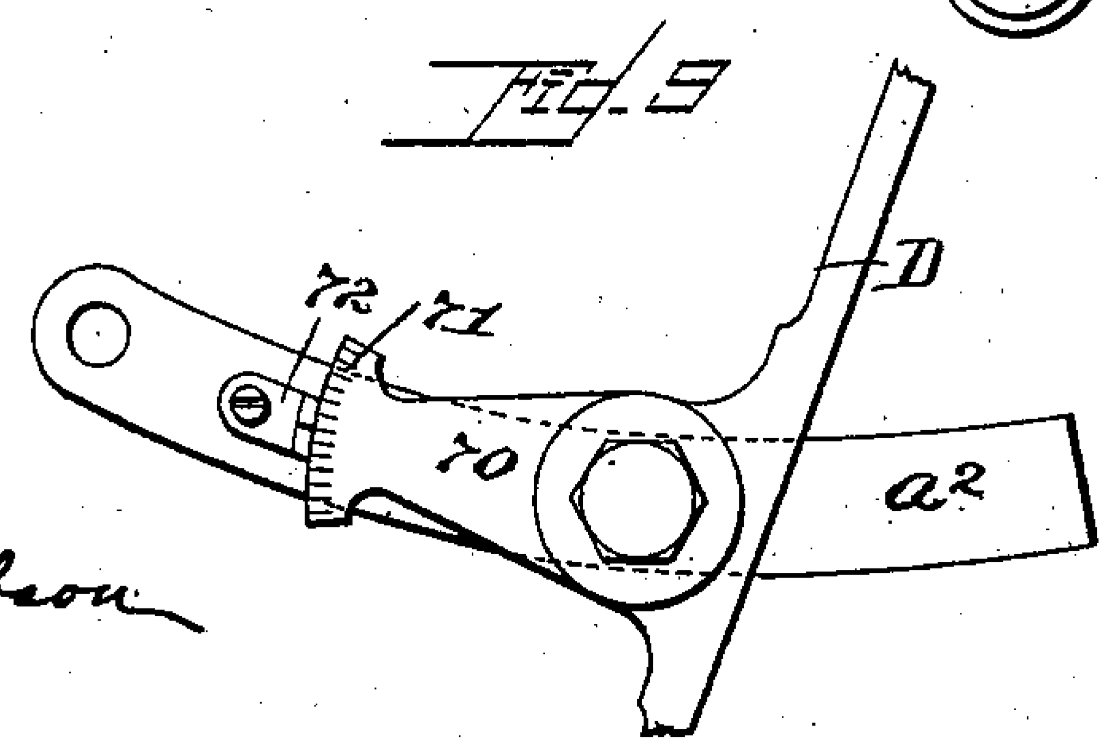


Fig. 9.



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UNITED STATES PATENT OFFICE.

JOHN W. SARGENT, OF SCRANTON, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 485,432, dated November 1, 1892.

Application filed February 19, 1892. Serial No. 422,107. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. SARGENT, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to steam-engines; and it consists in various improvements, of which the following is a specification.

In the accompanying drawings, Figure 1 is a front elevation of a triple-expansion automatic-cut-off steam-engine embodying my invention. Fig. 2 is an end view of the same, some of the parts of the intermediate and low-pressure valve-gear and connections being omitted for clearness. Fig. 3 is a perspective view of the mechanism for effecting the automatic adjustment of the points of cut-off of the several valves. Fig. 4 is a sectional view of part of one of the low-pressure valve-chests, showing the manner of balancing the valve and valve connections. Fig. 5 is a sectional view of the hydraulic valve. Fig. 6 is a sectional view of the hydraulic motor. Fig. 7 is a plan of the valve-stem cross-heads. Fig. 8 is a view showing the connections between the valve-gear and the revolution-counter; and Fig. 9 shows one of the cut-off indicators.

The objects of my invention are to provide improved means for effecting automatic adjustment of cut-off or expansion, to render the points of cut-off of the several valves of compound engines independently adjustable, and to improve the general construction of steam-engines in various details, which will be hereinafter pointed out and described.

Referring to the drawings, A, B, and C indicate, respectively, the high-pressure, intermediate, and low-pressure cylinders of a triple-expansion steam-engine. These cylinders rest upon columns D, which in turn are bolted to a suitable base or bed plate E. The piston-rods and pitmen are of ordinary construction, the latter being connected to three cranks, which are preferably set one hundred and twenty degrees apart upon a common crank-shaft F, which is mounted in bearings on the bed-plate. The piston-rod cross-heads run in guides upon the columns.

As the valve-gears of the several cylinders are similar, I shall describe that connected with the high-pressure engine. The valve-chests *a b c* are located, as usual, adjacent to their respective cylinders A B C. The steam-inlet pipe *x* leads into the steam-chest *a* and suitable piping leads the exhaust-steam from the high-pressure to the intermediate and from the intermediate to the low-pressure cylinders either directly or through receivers, as desired. The exhaust from the low-pressure cylinder may be conveyed to the atmosphere or to a condenser. The valves may be of any desired form. In the present instance they are piston-valves working in cylindrical chests. As they form no part in my present invention, it will not be necessary to illustrate and describe them.

Referring to Figs. 1 and 2 of the drawings, the valve-stem 1 of the high-pressure cylinder is connected to a cross-head a', which slides vertically in guides 3 upon the columns supporting the cylinder. A link 4 connects the cross-head with a lever 5, the inner end of which is pivoted to a second lever 6, while the outer end, which forms the fulcrum of the lever is connected to a block or cross-head 7, which slides in a pair of curved guides a^2, which I shall hereinafter call "fulcrum-guides." The lever 6 is pivotally connected at one end to the pitman of the engine, and its opposite end is supported and guided by a pendent link 80, which swings from a bearing upon a column. The fulcrum-guides a^2, between which the block 7 slides, are each provided with a laterally-extending journal about midway between its ends, and these journals are mounted in bearings 81 upon the columns. The fulcrum-guides may be adjusted vertically to different angles by rocking them upon their journals. The means for this adjustment, which forms a leading feature of my invention, will be described hereinafter.

The form of valve-gear above described is that well known in the art as the "Joy valve-gear." Its operation is well known and need not be set forth in detail. Suffice it to say that by varying the position of the curved fulcrum-guides various degrees of cut-off or expansion may be given to the valve. In the arrangement shown raising the outer ends of fulcrum-guides makes the cut-off later, and lowering them makes the cut-off earlier.

The fulcrum-guides a^2, b^2, and c^2 of the several engines are connected by the links 9, respectively, with arms a^3, b^3, and c^3 upon a rock-shaft G, which is journaled in bearings g upon the columns. The links 9 are made adjustable in length, so that the degrees of cut-off of the several valves may be varied independently of each other. As shown, each link consists of a rod provided with right and left hand screw-threads at its ends and a head 10 at each end provided with an eye to receive a journal-pin and a threaded socket, into which the rod screws, lock-nuts being added to prevent the rod from turning accidentally. The variation in cut-off of each of the valves for a given movement of the rock-shaft depends upon the length of the rocker-arms. In the present instance the rocker-arm a^2 for the high-pressure cylinder is longer than that for the intermediate cylinder, a wider range of cut-off being required in the high-pressure cylinder. For a similar reason the low-pressure rocker-arm is shorter than the intermediate. The rock-shaft G is actuated by a motor H, which in turn is controlled by the engine-governor. As shown, the motor is operated by hydralic pressure which is controlled by a valve connected both to the governor and the rock-shaft. The motor H consists of a cylinder 12, open at both ends and having stationary plungers 13 and 14, supported by a frame 15, which frame rests upon a bracket 16, attached to the bed-plate. Pipes 17 and 18 lead water to opposite ends of the cylinder through the plungers 13 and 14, which are hollow. The motor H is situated adjacent to the rock-shaft, trunnions 18 upon opposite sides of the cylinder 12 being connected by links 19 to rocker-arms 20, which are fixed upon the shaft. As the cylinder is moved up and down by alternate pressure upon opposite sides of its partition the rock-shaft is vibrated through the connections above specified.

The governor I, which, as shown, is of the Porter type, is mounted upon a stand 21. This governor is driven from the crank-shaft by means of a belt 22 and horizontal shaft 23 and spindle 24, which are connected by beveled gears. (Not shown.) If desirable, the governor may be driven from the main shaft by a chain belt or by a train or gears. To a journal-pin 25, extending laterally from one side of the governor-slide, is connected the piston-rod 26 of a dash-pot or cataract cylinder J. To a similar pin 27 on the other side of the governor-slide is connected a link 28, the lower end of which is connected to one end of a floating lever 29, which is pivoted near its middle point upon the valve-stem 30 of the governing-valve K. The opposite end of the lever 29 is connected by a rod 31 to the outer end of a short rocker-arm 32 upon the shaft G. The rocker-arm 32 extends from the shaft in the same direction as the rocker-arms 20, which are connected to the hydraulic motor.

The valve-chest of the governing-valve K has two ports communicating with the pipes 17 and 18, leading to the hydraulic motor. A pipe 34 supplies water under pressure, and a discharge-pipe 33 takes it away. The valve-stem is provided with two pistons, which when the valve is in mid-position, as shown in Fig. 5, cover both ports, thus rendering the hydraulic motor immovable and holding the rock-shaft rigidly in one position.

The operation of the valve-governing devices above described is as follows: When the load upon the engine is decreased and the speed increases above what is required, the rising governor-slide raises one end of the floating-lever 29, and as the other end is normally held stationary by the rock-shaft the valve-stem 30 is also raised. The effect of this is to put the pipes 33 and 18 in communication through their respective ports and also the pipes 17 and 34. Thus the cylinder of the hydraulic motor is forced downward, carrying with it the rocker-arms 20 and rotating the rock-shaft. The downward movement of the arms 20 upon one side of the rock-shaft causes a downward movement of the arm 32, and this in turn draws down the inner end of the floating lever until the governing-valve is restored to its mid-position and the supply of fluid to the hydraulic motor cut off. Thus each of the fulcrum-guides is moved in proportion to the motion of the governor and to the length of its respective rocker-arm and the operation of the valve-gear changed so as to vary the cut-off and bring the engine back to its normal speed. Should the speed of the engine decrease, the operation of the floating lever, the valve-pistons, the hydraulic motor, and the rock-shaft would be the same as above described, excepting that the motions would be in the reverse direction and the effect upon the valves would be to lengthen the cut-off and permit more steam to enter the cylinders. The axes of the several cylinders lie in a common plane which intersects the crank-shaft. The cylinders are of different sizes and the valves and valve-stems are necessarily located at different distances from the axes of the cylinders. In order to utilize the same supporting-columns for the different cylinders and to preserve the symmetry of the engine, I locate the guides 3 for the valve-stem cross-heads in line with each other and attach the valve-stems to arms projecting from the cross-heads when the stems are out of line with the guides. Thus, as shown best in Fig. 7, the valve-stem of the high-pressure engine is connected to an arm 2, extending inward from the cross-head a', the valve-stem on the intermediate engine passes through the center of the cross-head b', and the valve-stems of the low-pressure engine are attached to arms 8, which extend outwardly from the cross-head c'. Thus by altering the forms of the valve-stem cross-heads, I avoid changing the shape and size of the columns, and I am enabled to construct the corresponding portions of the different valve-gears of uniform size.

The weight of the piston-valve, stems, cross-heads, links, &c., of the high-pressure and intermediate cylinders is balanced in the usual way by connecting a balance-piston to the valve-stem at the top of the steam-chest. When the steam enters at the middle of the piston-valve and exhausts at the ends, as in my engine, the valve of the low-pressure cylinder cannot be balanced in this way, owing to the fact that the exhaust-pressure in the ends of valve-chest is too low, and a feature of my invention consists in the following means for balancing the low-pressure valve, &c.: Referring to Fig. 4 of the drawings, which shows a portion of the low-pressure valve-chest *b*, a piston 40 is fixed upon the valve-stem 41, and moves in a cylinder 42 in the lower steam-chest bonnet 43. The upper end of this cylinder is in communication with the exhaust-passage 44 of the low-pressure cylinder and the lower end of the cylinder receives steam of a higher pressure through a pipe 45 from a suitable source. The pipe 45 is put in communication either with the boiler or with one of the receivers or steam-passages between the cylinders, depending upon the amount of pressure necessary to counterbalance the weight of the valves, &c., upon the piston 40. As shown, the pipe 45 is connected with the receiver between the high and intermediate pressure cylinders. In order to indicate the point of cut-off at which each of the valves is working, I use a scale and pointer, the preferred form of which is best illustrated in Fig. 9. Either the scale or the pointer of the indicator may be movable, the fixed part being attached to the frame and the movable part connected to the fulcrum-guide of the valve-gear. As shown, an arm 70 is cast integral with the bearing of one of the fulcrum-guides for each cylinder. The outer end of the arm is in the form of a circular segment and provided with suitable graduations 71 to indicate the different points of cut-off. The pointer 72 is fixed to the fulcrum-guide adjacent to the scale. By observing the indicator at any time the exact point of cut-off can be read off upon the scale. The relative positions of the fulcrum-guides may be readily changed while the engine is running and the amounts of expansion in the several cylinders regulated, as desired, by lengthening or shortening the connecting-rods 9 and observing the cut-off indicators.

Another feature of my invention consists in a manner of operating the revolution-counter from the valve-gear. As shown in Fig. 8, an arm 50 is connected to the valve-stem cross-head *b'* of the intermediate cylinder. This arm, which extends vertically downward, is provided near its lower end with a slot 51, the upper and lower portions of which are straight and vertical and connected by a reversely-curved middle portion. Into this slot projects a pin 52 upon a rocker-arm 53, which is fixed upon one end of a rock-shaft 54. The rock-shaft 54 is mounted in a bearing 55, and upon its opposite end has an arm 56. A rod 58 connects a pin 57 upon the outer end of the arm 56 with a pin 59 upon an arm 60, which actuates the revolution-counter 61. It will be evident that the parts 53 to 58, inclusive, might be dispensed with, and that by simply changing the position of the revolution-counter the pin 59 might be passed directly through the slot 51 and the counter thus operated. The travel of the valve varies, sometimes being shortened at both ends, and for this reason the reverse curve in the slot 51, which gives motion to the revolution-counter, is in the middle of the slot. The upper and lower portions of the slot are straight and produce no effect upon the counter, and it therefore is of no consequence whether the pin travels the full length of the slot or not. It must always travel through the reversely-curved portion, and the motion imparted to it is therefore the same for each revolution of the shaft, no matter what the travel of the valve is.

Some of the features of my invention relate to engines generally and others more particularly to compound engines operating with valve-gear of the type described. It is to be understood that while I have shown my invention embodied in a triple-expansion engine I do not wish to confine the claims to such a construction, but desire protection for the several features of my invention in connection with all classes of engines to which they may be applicable. Therefore, without confining myself to the precise construction and arrangement shown and described,

I claim—

1. In a compound engine, the cylinders each having a valve and valve-gear provided with an adjustable fulcrum-guide, in combination with the governor, a rock-shaft controlled by the governor, and connections between the rock-shaft and each fulcrum-guide, constructed to impart different amounts of movement to the different guides, substantially as described.

2. In a compound engine, the cylinders each having a valve and valve-gear provided with an adjustable fulcrum-guide, in combination with the governor, a rock-shaft controlled by the governor, arms of different lengths upon the rock-shaft, and connections between said arms and the fulcrum-guides, substantially as described.

3. In a compound engine, the cylinders each having a valve and valve-gear provided with an adjustable fulcrum-guide, in combination with a governor, a rock-shaft controlled by the governor, arms of different lengths upon the rock-shaft, and an adjustable connection between each fulcrum-guide and its corresponding arm, substantially as described.

4. In a compound engine, the cylinders each having a valve and valve-gear provided with an adjustable fulcrum-guide, in combination

with a rock-shaft, a hydraulic motor for actuating the rock-shaft, a governor driven by the engine and arranged to control said motor, arms of different lengths upon the rock-shaft, and a link connecting each fulcrum-guide with its corresponding arm, substantially as described.

5. In a compound engine, means for automatically controlling the expansion of the several cylinders, consisting of a rock-shaft having arms connected to the valve-gear of the several cylinders, a hydraulic motor for rocking the shaft, a valve for controlling said motor, a governor, and a floating lever connected with the valve-stem, the governor-slide, and the rock-shaft, said parts being arranged to operate substantially as described.

6. In a compound engine, the combination, with the cylinders having their axes in a common plane and the valves and valve-stems located at different distances from said plane, of the valve-stem cross-head, guides located in a plane parallel to plane of the cylinders, and the cross-heads running in said guides, one or more of said cross-heads being provided with laterally-extending arms to which the valve-stems are connected, substantially as described.

7. The combination, with the low-pressure valve and valve-gear, of a balance-piston upon the valve-stem, a cylinder in which said piston slides, and a pipe connecting the lower end of the cylinder with a source of steam under suitable pressure, substantially as described.

8. The combination, in a steam-engine provided with valve-gear such as described, of the fulcrum-guide, the columns or main frame, and the indicator arranged to show the relative position of the fulcrum-guide and the degree of expansion, substantially as described.

9. The combination of the fulcrum-guides, the rock-shaft, the adjustable connections between the rock-shaft and the guides, and the indicators to show the positions of the guides and the degrees of expansion, substantially as described.

10. The combination of the column or support, the fulcrum-guide having a bearing on the column, the arm connected to said column and provided with a scale, and the index upon the fulcrum-guide, substantially as described.

11. In a steam-engine having a variable cut-off, the combination of the valve-stem cross-head, the slotted arm connected to said cross-head, a rocking arm having a pin passing through said slot, and a revolution-counter connected to said rocking arm, substantially as described.

12. In a steam-engine having a variable cut-off, the combination of the valve-stem cross-head, the arm extending in the direction of the cross-head guides and provided with a slot having straight ends and a reversely-curved middle portion, the rocking arm having a pin passing through said slot, and the revolution-counter connected to and operated by said arm, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN W. SARGENT.

Witnesses:
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