

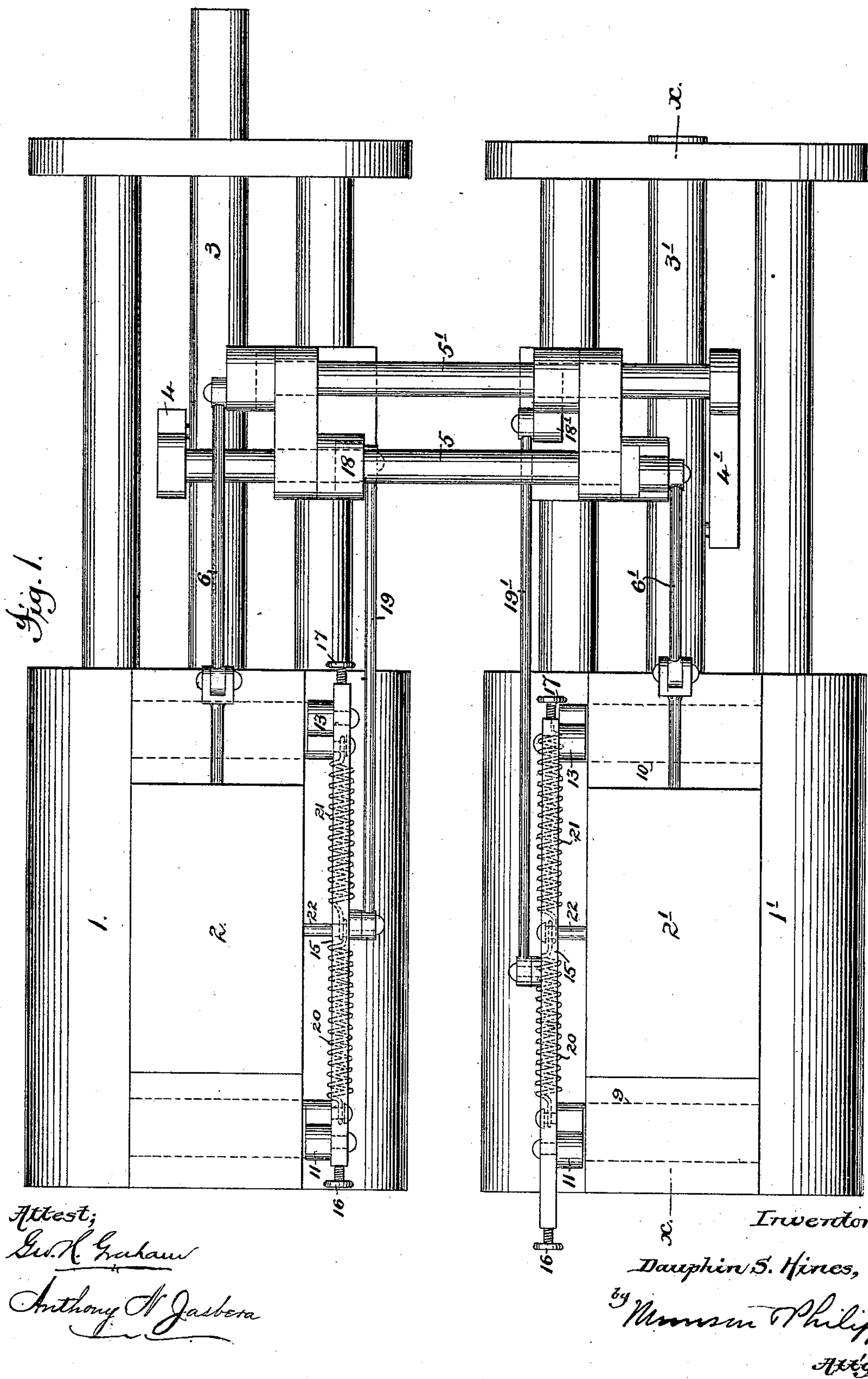
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5 Sheets—Sheet 1.

D. S. HINES.
DUPLEX PUMPING ENGINE.

No. 253,604.

Patented Feb. 14, 1882.



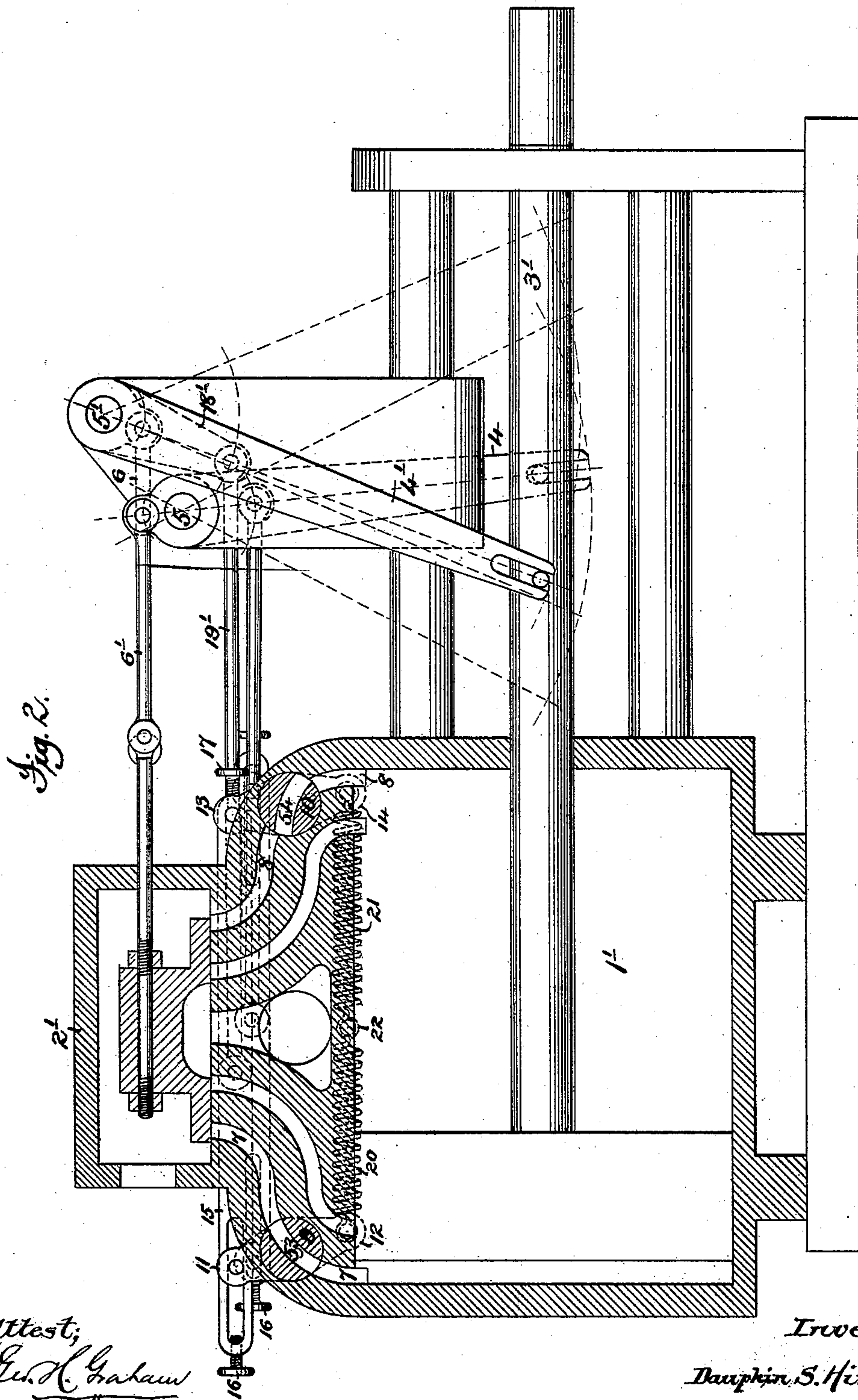
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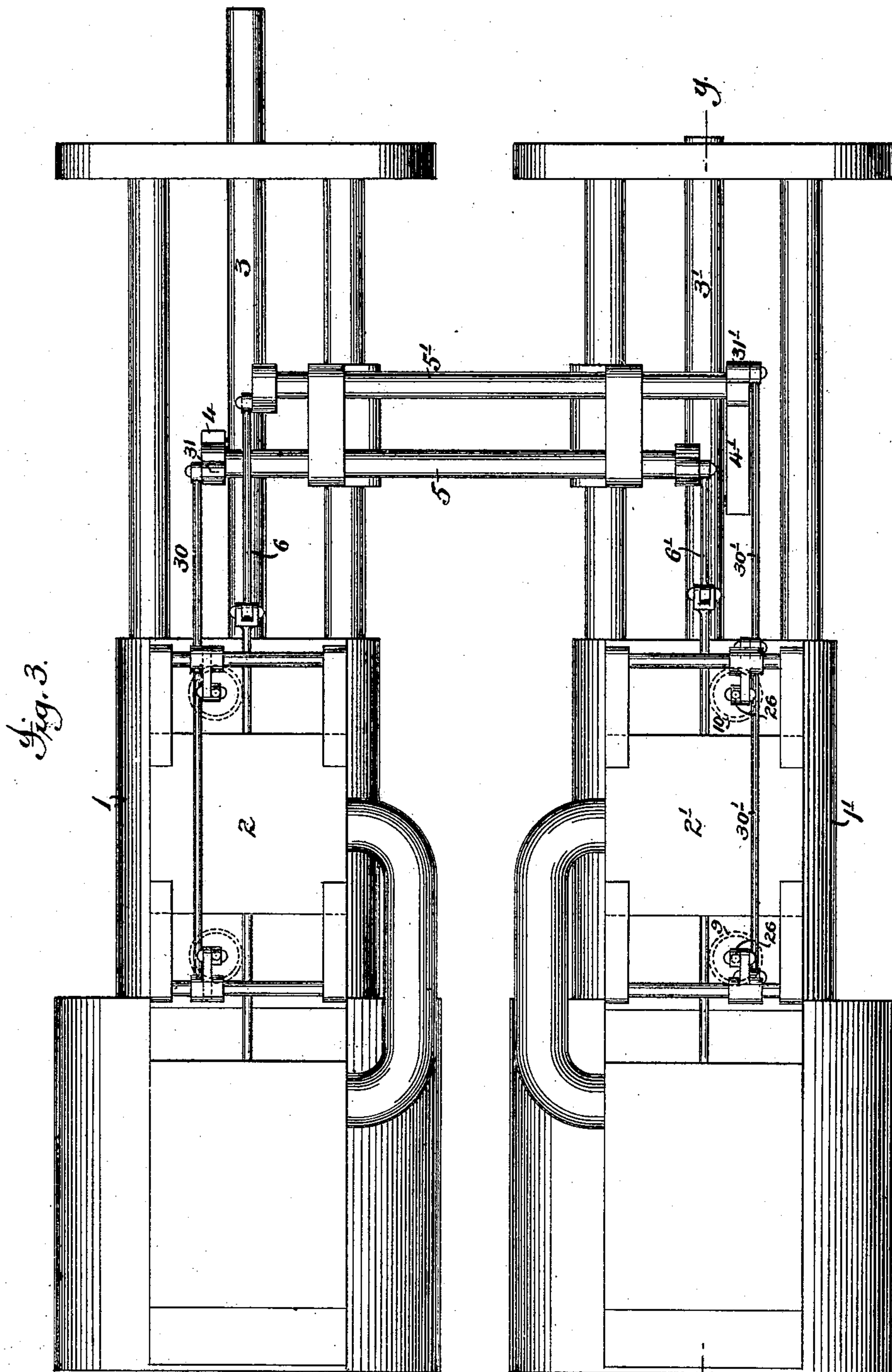
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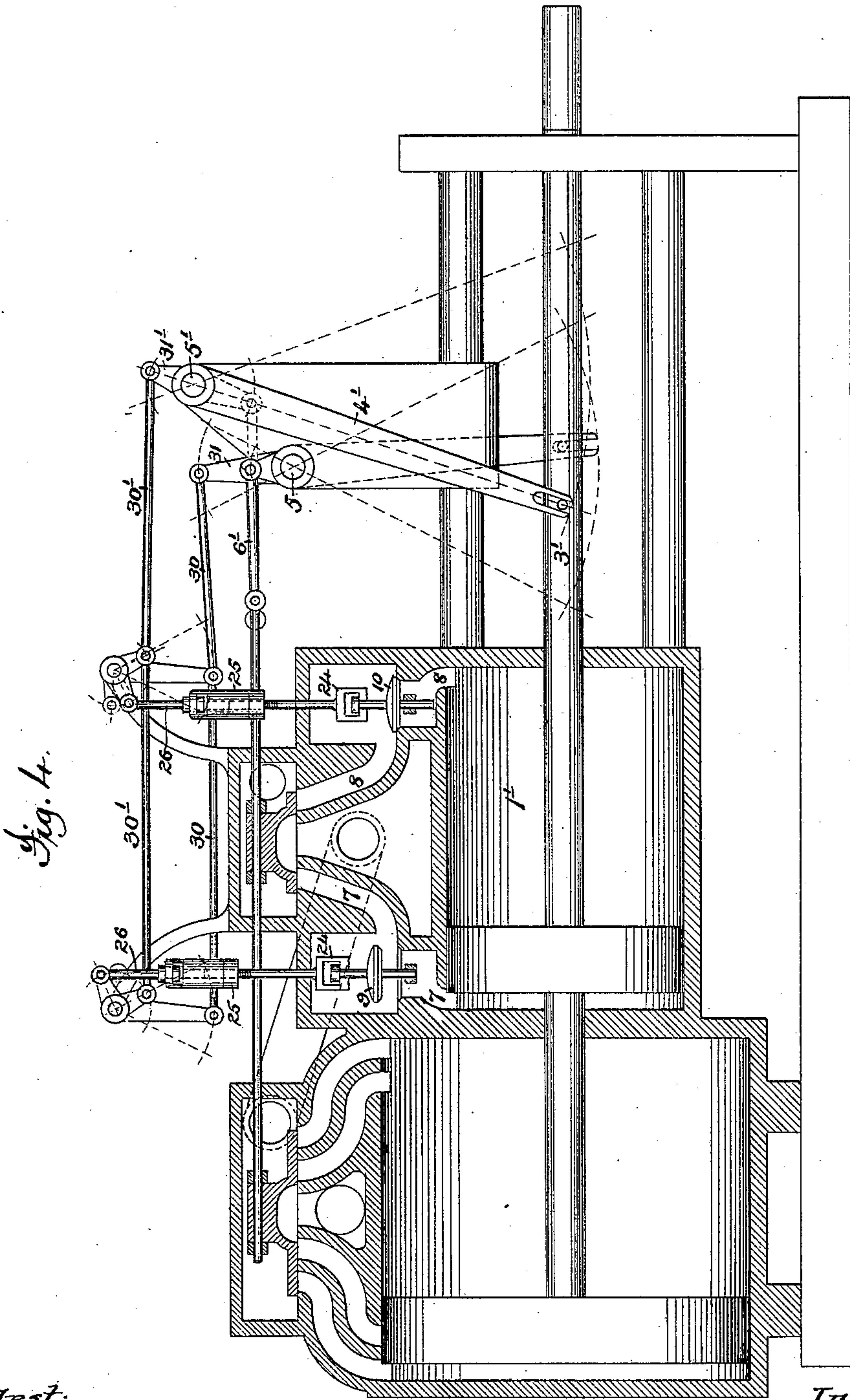
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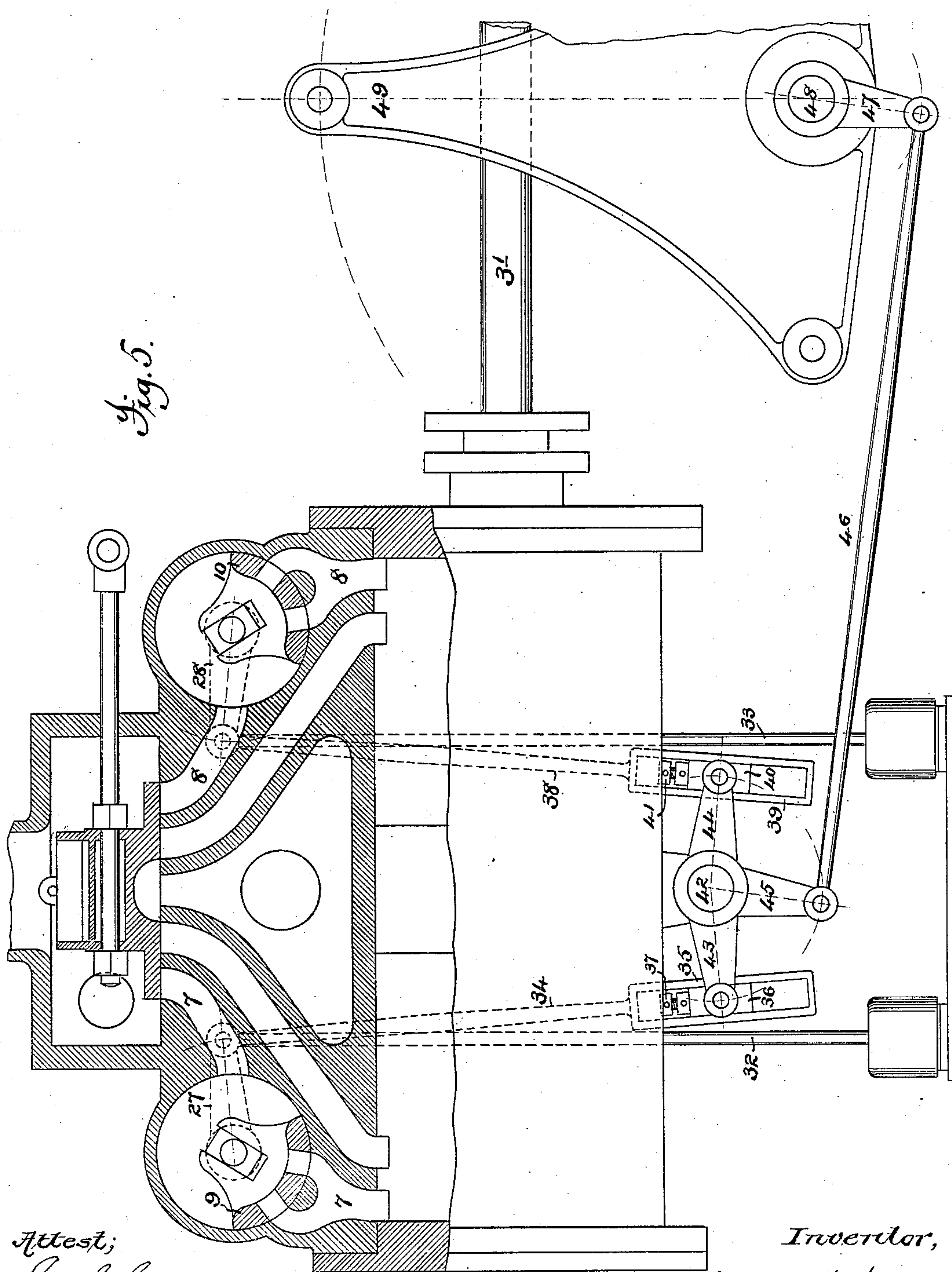
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UNITED STATES PATENT OFFICE.

DAUPHIN S. HINES, OF BROOKLYN, NEW YORK.

DUPLEX PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 253,604, dated February 14, 1882.

Application filed September 15, 1881. (No model.)

To all whom it may concern:

Be it known that I, DAUPHIN S. HINES, a citizen of the United States, residing in the city of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Duplex Pumping-Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

In said drawings, Figure 1 is a plan view of a two-cylinder duplex high-pressure engine containing my invention. Fig. 2 is a vertical longitudinal section of one of the cylinders with ports and valves, taken on the line *x x* of Fig. 1, with the parts for moving the valves in elevation. Fig. 3 is a plan view of a four-cylinder compound duplex engine containing my invention. Fig. 4 is a vertical longitudinal section of two of said cylinders, showing the ports and valves, taken on the line *y y* of Fig. 3, the means for operating the valves being shown in elevation. Fig. 5 is a longitudinal section of a cylinder with ports and valves, the means for operating the latter being shown in elevation, embodying my invention.

This invention relates to certain improvements in duplex pumping-engines of the construction heretofore patented to Henry R. Worthington, in which the main steam-valve of each engine is operated by the other engine, and in which said steam-valves are constructed and operated to produce a slight rest or pause at the end of each piston-stroke to permit the closing of the pump-valves without concussion. In such engines, as in most others, the steam suffers considerable reduction below the boiler-pressure by the operation of the throttle and induction valves while the piston is in motion; but when its speed is checked and it pauses during the reversal of the stroke for a brief interval of time the pressure in the cylinder rises until under certain circumstances it approximates closely to the boiler-pressure, and may be exhausted perhaps at one hundred pounds to the square inch when the effective working pressure does not exceed eighty pounds.

The object of my invention is to prevent such increase of the pressure upon the piston at the close of the stroke; and it consists, in a duplex

pumping-engine, of the combination, with each induction-port of the high-pressure steam cylinder or cylinders, of an intermediate valve operated to close such port during the pause on the reversal of the piston.

It also consists in other combinations of parts, hereinafter fully described and claimed.

In the drawings I have shown three modes of carrying out my invention, one shown in Figs. 1 and 2, the second in Figs. 3 and 4, and the third in Fig. 5, the second and third being modifications of the first.

In these drawings, 1 1' are the high-pressure steam-cylinders.

2 2' are the steam-chests, each containing a main distributing steam-valve of **D** form.

3 3' are the piston-rods, having pistons working in the cylinders 1 1', respectively. Each piston-rod is connected to a pump-plunger in the ordinary and well-known way in duplex pumping-engines.

4' is a rocker-arm connected to a suitably-journaled shaft, 5', which, through a crank on its end and a connecting-rod, 6, operates the **D**-shaped valve in the steam-chest 2 of the cylinder 1, the rocker-arm 4' being moved by a pin secured to the piston-rod 3' and working in a slot in its end.

4 is also a rocker-arm secured to a properly-journaled shaft, 5, which in turn has a crank on its end connected by a rod, 6', with a **D**-shaped valve in the steam-chest 2' of the cylinder 1', and is operated by a pin on the piston-rod 3 engaging the slot in the end of the rocker-arm 4. This is the well-known form of the Worthington duplex engine, and needs no further description to enable those skilled in the art to understand the same and how it operates.

Each high-pressure steam-cylinder is provided with induction-ports 7 8, leading from the steam-chest to the cylinder at either end, which convey the live steam to the high-pressure cylinder to work the piston therein. These ports are opened and closed by the **D**-shaped valve in the well-known manner. Controlling the induction-ports 7 8 are intermediate valves, 9 10, one for each port. As shown in Figs. 1 and 2, these valves are rotary ones extending across the port from side to side, and provided

with passages 53 54, each extending the width of the ports 7 8, which passages at the proper time are made to coincide with the latter to permit the passage of the live steam. The rotating valve 9 is provided at its end outside of the cylinder with a double crank, 11 12, and the rotating valve 10 is provided with a double crank, 13 14, outside of the cylinder. The cranks 11 13 are provided with pins, which enter slots in a bar, 15. This bar is provided with adjusting-screws 16 17 at its ends. The bar 15 belonging to the cylinder 1' is reciprocated by means of a crank, 18', secured to the shaft 5' and a connecting-rod, 19', while the bar 15 with which the cylinder 1 is provided is operated by a crank, 18, secured to the shaft 5 and the connecting-rod 19. The cranks 12 and 14 are provided with springs 20 21, secured to a common stud, 22, which springs operate to rotate the valves 9 and 10, so that the passages 53 54 may coincide with the ports 7 8 at the proper time, any convenient stop being applied to each valve to prevent it from turning too far under the pressure of its spring. At the time the piston in the high-pressure cylinder 1' comes to a pause, as is usual in the Worthington duplex pumping-engines, at the left-hand end of the cylinder, as shown in Fig. 2, through the operation of the rocker-arm 4', shaft 5', crank 18', and connecting-rod 19', the set-screw 17 has struck the pin on the crank 13 and turned the valve 10 into a position to close the induction-port 8, and thus cut off communication between the steam-chest and the cylinder. Upon the return movement of the piston, the bar 15 being again moved by the instrumentalities described, the adjusting-screw 17, moving away from the pin on the crank-arm 13, permits the spring 21 to rotate the valve until its passage 54 coincides with the induction-port 8, and when the piston arrives at the end of its return-stroke and pauses, the bar 15 will have been moved so that its set-screw 16 will have come in contact with the pin on the crank 11, and will have rotated the valve 9 and closed the induction-port 7. Upon the return of the piston the valve 9 is again opened.

By means of the adjusting-screws 16 and 17 the point of contact of the pins with the cranks 11 and 13 may be regulated, so that the intermediate valves may be closed at the proper time and remain closed as long as may be required.

It is obvious that the intermediate valves of the cylinder 1 will be operated in the same way and produce the same effect as those belonging to the cylinder 1' through the instrumentality of the rocker-arm 4, shaft 5, crank 18, and connecting-rod 19.

As shown in Figs. 3 and 4, the intermediate valves, 9 10, are of puppet form, operating in chambers communicating with the respective ports 7 and 8. These puppet-valves are of the well-known form, having stems guided in spiders, and each provided with a collar which

operates in connection with a slotted link or swivel, 24. Each link 24 is at its upper end provided with a screw-thread engaging with a nut, 25, which in turn is swiveled upon a stem, 26, connected to one lever of a bell-crank, the other lever being connected to a rod, 30'. The rod 30' is pivoted to a crank-arm, 31', secured to the shaft 5', operated by the rocker-arm 4' through the pin on the piston-rod 3'. The connecting-rod 30, belonging to the high-pressure cylinder 1, is in turn pivoted to the bell-cranks to which the stems 26 are connected, and is actuated by a crank, 31, on the shaft 5, to which it is pivoted. When the piston of the high-pressure cylinder 1' pauses at the end of its stroke at the left-hand end of the cylinder, as shown in Fig. 4, the puppet-valve 10 will be permitted, through the operating mechanism just described, to seat itself by gravity, and thus close the port 8 and prevent the ingress of the live steam through it. Upon the piston of said cylinder reaching the other end of its stroke the intermediate valve 10 is raised through the connecting mechanism described, while the valve 9 is allowed to descend and seat itself by the force of gravity, and thus close the induction-port 7. Upon the return of the piston the valve 9 is again raised to permit the passage of live steam.

By means of the nut 25 the opening and closing of the intermediate valves in relation to the movement of the pistons may be regulated.

It is obvious that the intermediate valves, 9 10, of the cylinder 1 will be operated in the same way and produce the same effect, through the instrumentality of the crank 31 on the shaft 5, connecting-rod 30, and the bell-crank levers, as those with which the cylinder 1' is provided.

As shown in Fig. 5, the intermediate valves, 9 10, are rotating ones, extending across the induction-ports 7 8 in a chamber provided for them. The intermediate valve 9 is provided with a crank, 27, and the intermediate valve 10 with a crank, 28, both being on the outside of the cylinder. The crank 27 is pivoted to a weighted rod, 32, and the crank 28 to a weighted rod, 33, these rods resting in their normal position upon supports placed beneath their weights, as shown in the drawings, and serve to keep the intermediate valves, 9 and 10, in a position with their passages coinciding with the ports 7 and 8, respectively, so that live steam, when allowed to enter the induction-ports 7 and 8, may pass into the cylinder unobstructed. The crank 27 has also pivoted to it a rod, 34, having a slotted extension, 35, in which a box, 36, provided with an adjusting-screw, 37, works, this adjusting-screw in the operation of the mechanism coming against the upper end of the slot in the extension. The crank 28 is provided with a similar rod, 38, having a similar extension, 39, and similar box, 40, and adjusting-screw 41. Pivoted to shaft 42 are three levers, 43

44 45. The lever 43 is connected by a wrist-pin with the box 36, and the lever 44 with the box 40, while the lever 45, through a rod, 46, is connected to a crank, 47, on a shaft, 48, which receives vibrating motion through the lever 49, receiving motion from some moving parts of the engine or pump. When the piston of the cylinder pauses at the end of the stroke at the right-hand end of the cylinder shown in Fig. 5, through the movement of the lever 49, shaft 48, crank 47, lever 45, lever 43, and connecting-rod 46, the box 36, with its set-screw 37, is caused to rise until the latter strikes the upper end of the slotted extension of the rod 34, which, through the crank 27, rotates the valve 9 until it closes the induction-port 7, thus preventing steam from entering that end of the cylinder. As soon as the piston starts upon its return-stroke the lever 43 is lowered through the instrumentalities that raised it, which permits the weighted rod 32 to return the valve to a position where the induction-port 7 will be open for the passage of live steam. As soon as the piston reaches the end of its return-stroke and pauses at the left-hand end of the cylinder shown in Fig. 5 the lever 44, through the instrumentalities before described for working the lever 44, will be in turn raised, and with it the box 40 and set-screw 41, which latter, coming in contact with the upper end of the slotted extension of the rod 38, will raise the lever 28, and through it cause the valve 10 to rotate and close the port 8. As soon as the piston begins to return again the lever 44 will be lowered through the instrumentalities that raised it, which permits the weighted rod 33 to cause the valve 10 to return to the position shown in the drawings, where the port 8 is open for the passage for live steam.

It is obvious that each high-pressure cylinder is to be provided with the mechanism shown in Fig. 5 for operating the valves 9 and 10.

By means of the adjusting-screws 37 and 41 the point of contact with the bottom of the slotted extension of the rods 34 38 may be regulated, so that the intermediate valves may be closed at the proper time and remain closed as long as may be required.

The slots of the bars 15, as shown in Figs. 1 and 2, and of the swivels 24, as shown in Figs. 3 and 4, and of the rods 34 38, as shown in Fig. 5, permit of the constant movement of the intermediate mechanism that operates the valves

9 and 10, and yet allows such mechanism to operate the valves at the proper time.

In Figs. 2, 4, and 5 exhaust-ports 50 51 are shown, which also permit a cushion to be formed behind the piston as it nears the end of its stroke.

Where the duplex pumping-engine is composed of one high and one low pressure cylinder, with a tank or not between them, my invention is applied to the high-pressure cylinder.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a duplex pumping-engine in which the main steam-valve of one engine is operated by the other engine, the combination, with each induction-port of the high-pressure steam cylinder or cylinders, of an intermediate valve operated to close such port during the pause on the reversal of the movement of the piston, substantially as described.

2. In a duplex pumping-engine in which the main steam-valve of one engine is operated by the other engine, the combination, with each induction-port of the high-pressure steam cylinder or cylinders, of an intermediate valve and mechanism for operating the same, substantially as described.

3. In a duplex pumping-engine in which the main steam-valve of one engine is operated by the other engine, the combination, with each induction-port of the high-pressure steam cylinder or cylinders, of an intermediate valve, with mechanism for operating the same, provided with means for adjusting the opening and closing of the same, substantially as described.

4. In a duplex pumping-engine in which the main steam-valve of one engine is operated by the other engine, the combination, with the high-pressure steam cylinder or cylinders, of ports 7 8, intermediate valves, 9 10, slotted bar 15, provided with adjusting-screws, and means for timely reciprocating said bar, substantially as described.

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

DAUPHIN S. HINES.

Witnesses:

ANTHONY N. JASBERA,
GEO. H. GRAHAM.