

No. 793,328.

PATENTED JUNE 27, 1905.

W. E. SYMONS.
VALVE GEAR.

APPLICATION FILED DEC. 22, 1904.

4 SHEETS—SHEET 1.

Fig. 1.

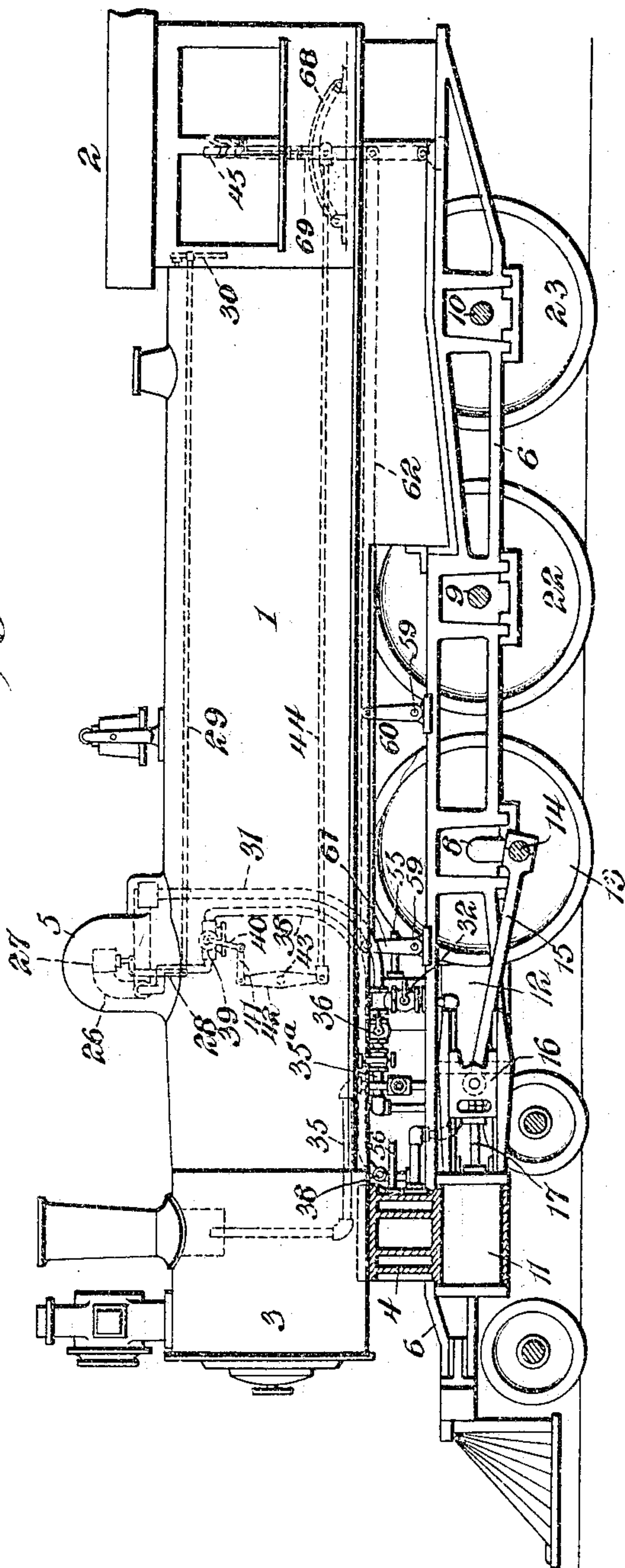
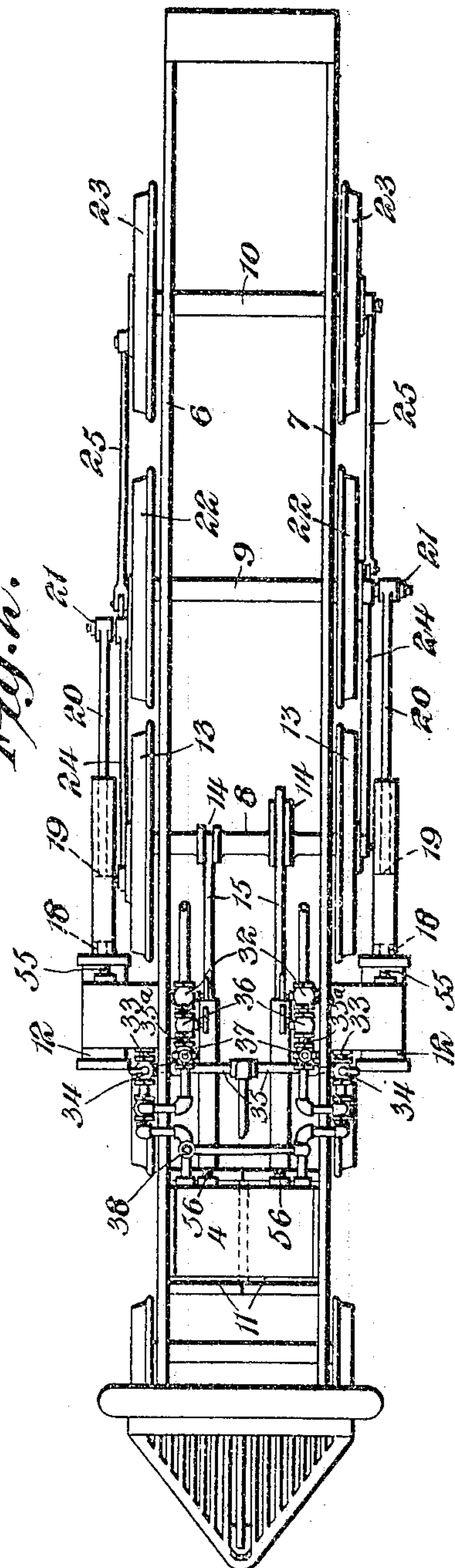


Fig. 2.



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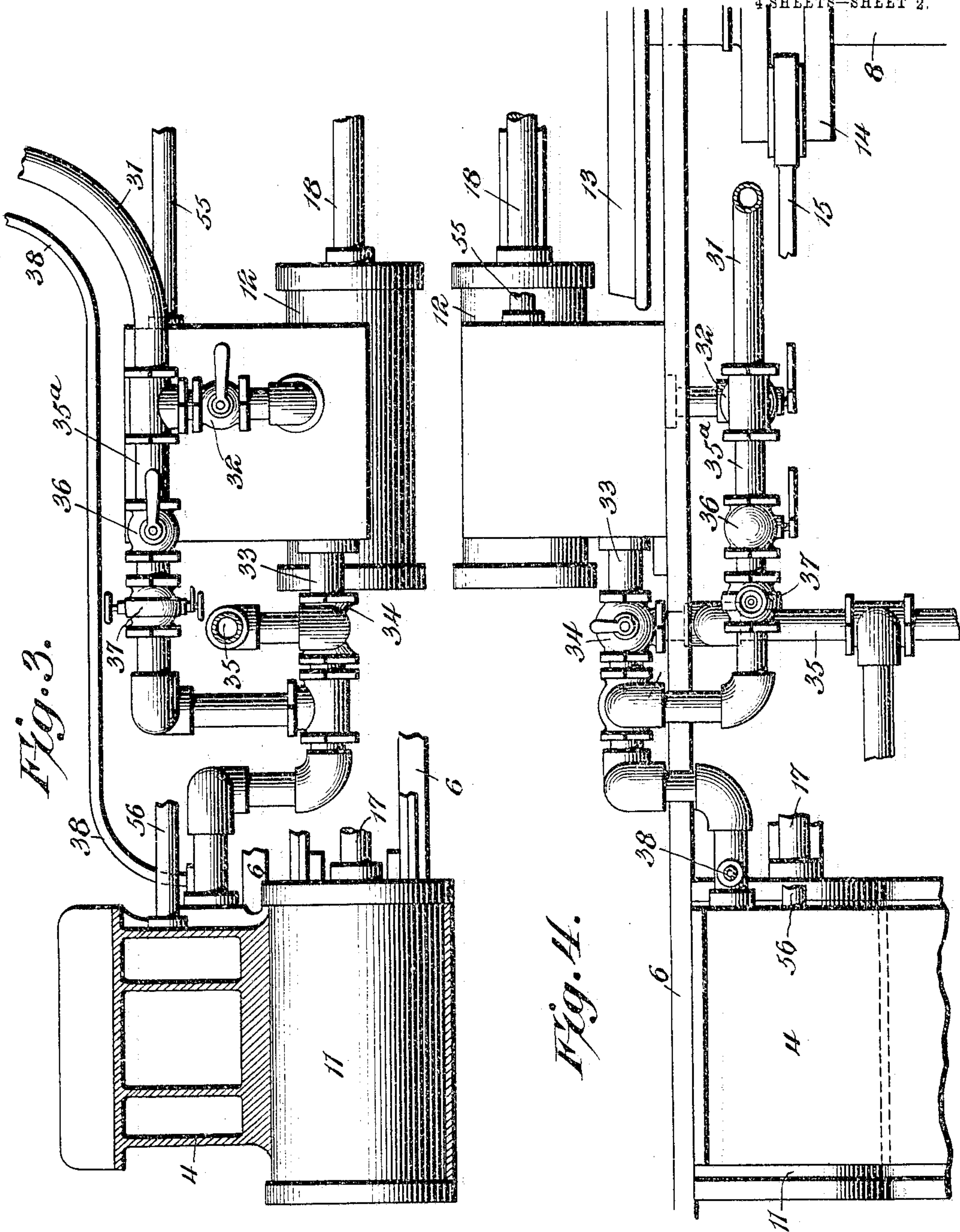
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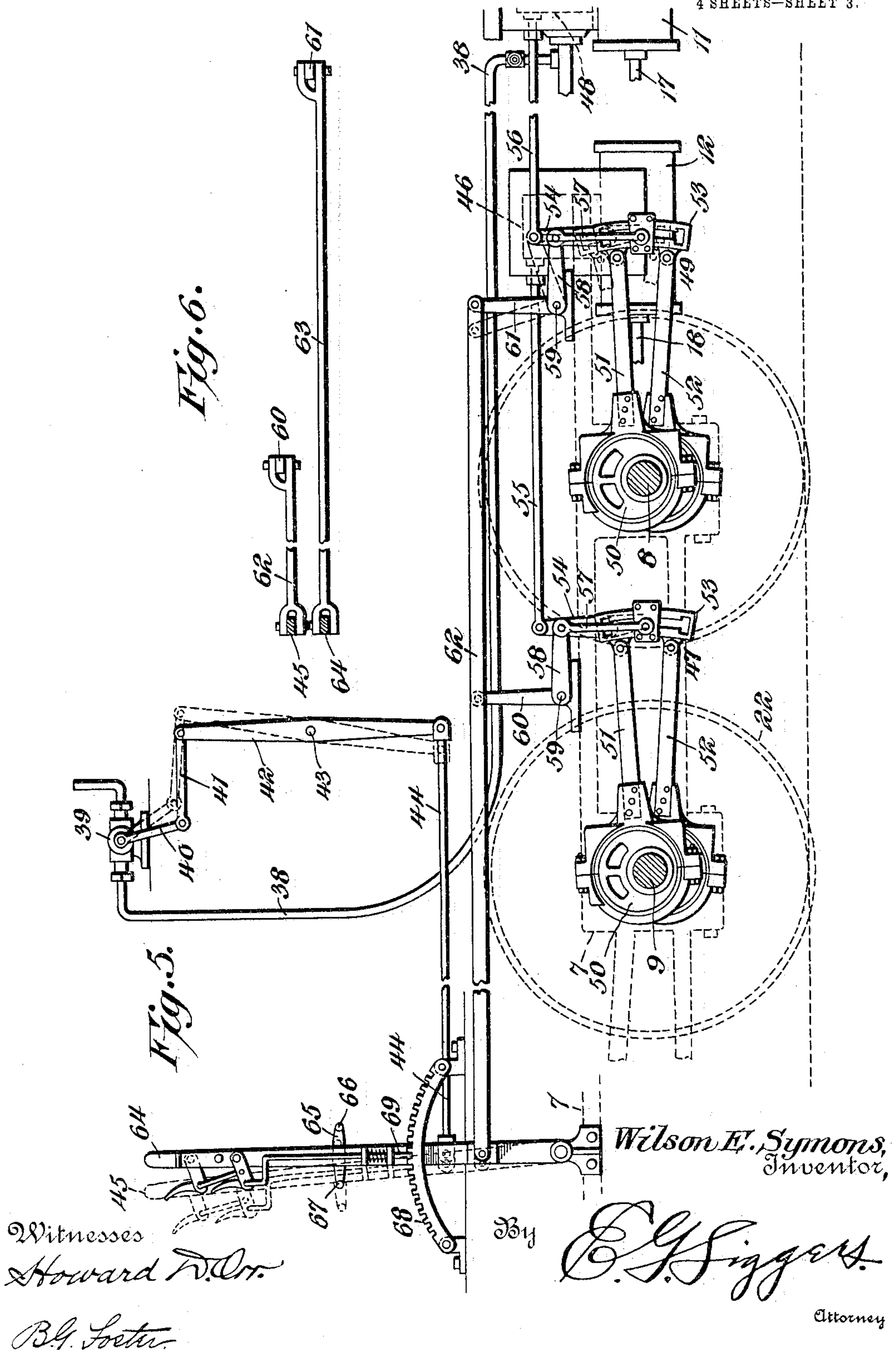
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4 SHEETS—SHEET 3.



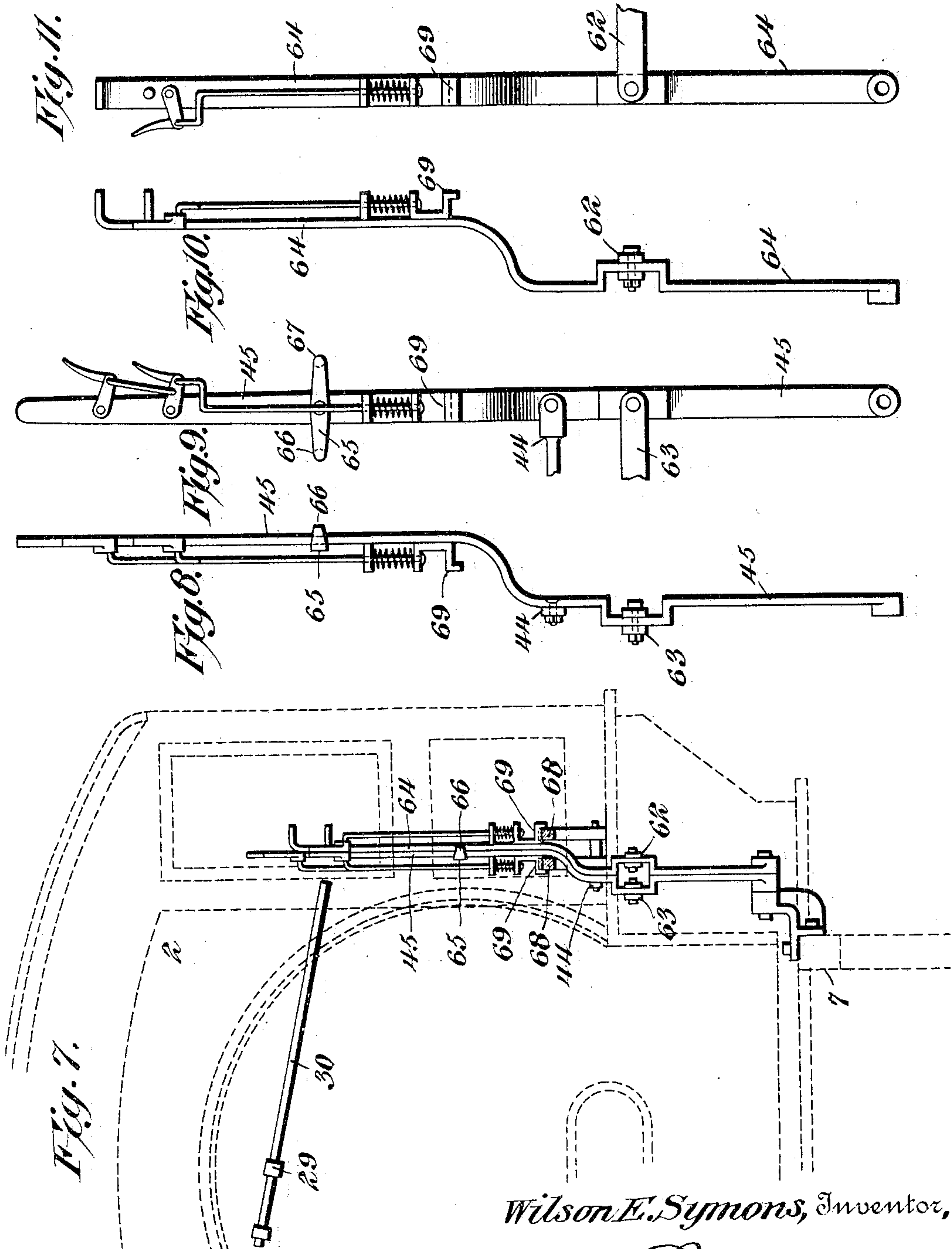
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

WILSON E. SYMONS, OF PITTSBURG, KANSAS.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 793,328, dated June 27, 1905.

Original application filed February 10, 1904, Serial No. 192,996. Divided and this application filed December 22, 1904. Serial No. 237,996.

To all whom it may concern:

Be it known that I, WILSON E. SYMONS, a citizen of the United States, residing at Pittsburg, in the county of Crawford and State of Kansas, have invented a new and useful Valve-Gear, of which the following is a specification.

The present invention relates to improvements in valve-gear mechanism, particularly of the type employed in connection with the compound engines of locomotives, though perhaps useful on other types, and this application is a division of one filed by me on February 10, 1904, Serial No. 192,996.

Broadly stated, the object in the present case is to obtain the highest economic efficiency of the engine by providing the high and low pressure cylinders with independent controlling-valves and valve-gears equipped with operating mechanism common to both gears, but including provision for the relative adjustment of the gears to regulate the travel of the valves for effecting the cut-off of steam from the high and low pressure cylinders at such points as may be most economical under given conditions; furthermore, to provide in connection with the above means controlled by the said operating mechanism for admitting live steam to the low-pressure cylinders upon the opening of the throttle when the reversing-lever is in full gear for either forward or backward motion in order to facilitate the starting of the engine.

To the accomplishment of the recited objects and others subordinate thereto, as will more fully appear, the invention in its preferred embodiment resides in that construction and arrangement of parts to be hereinafter described, illustrated in the accompanying drawings, and succinctly defined in the appended claims.

In the accompanying drawings, Figure 1 is a side elevation of a compound locomotive of the ten-wheel type constructed in accordance with my invention. Fig. 2 is a plan view with the boiler and appurtenant parts removed. Fig. 3 is a side elevation on a somewhat enlarged scale, showing the high and low pressure cylinders at one side of the engine and

the arrangement of pipes and valves for leading the steam to and from said cylinders. Fig. 4 is a plan view of the subject-matter of Fig. 3, more clearly illustrating the relation of parts with respect to the locomotive-frame. Fig. 5 is a side elevation showing the connections between the valve-gears and the reversing-lever and also the connection between the reversing-lever and the auxiliary or starting valve, certain of the parts being indicated in dotted lines and a portion of the supporting structure being similarly represented. Fig. 6 is a plan view of the connecting-rods. Fig. 7 is a diagrammatic representation of a locomotive-cab in dotted lines and showing in elevation the reversing and throttle levers. Figs. 8 and 9 are detail views of the main reversing-lever, and Figs. 10 and 11 are similar views of the auxiliary reversing-lever.

Like numerals of reference are employed to designate corresponding parts throughout the several views.

1 indicates the boiler, 2 the cab, 3 the smoke-box, 4 the saddle, 5 the dome, 6 and 7 the engine-frames, and 8, 9, and 10 the driving-axes, of a locomotive of the ten-wheel type, although it should be understood that my invention in its various aspects is capable of application to any type of engine—for instance, the mogul, eight-wheel, ten-wheel, consolidation, twelve-wheel, Atlantic, trailer, American, or other type.

The low-pressure cylinders 11 are carried side by side between the engine-frames and under the smoke-box 3 by the saddle 4, while the high-pressure cylinders 12 are secured to the outer sides of the engine-frames 6 and 7 at a point just in advance of the front drivers 13, as clearly shown in Figs. 2 and 4. It should be noted in this connection that the four cylinders are not grouped in or about the saddle as in ordinary constructions, but that, on the contrary, they are separated and distributed in a manner to equalize the strains on the supporting structure and to thus reduce to a minimum the liability of failure or derangement.

The front driving-axle 8 is provided with a pair of quartering-cranks 14, connected by

the main rods or pitmen 15 to cross-heads 16, which are in turn connected to the piston-rods 17 of the pistons in the low-pressure cylinders 11. The piston-rods 18 of the pistons in the high-pressure cylinders 12 are likewise connected to cross-heads 19, which are in turn connected by the pitmen 20 with quartering crank-pins 21, projecting outwardly from the second drivers 22, the front drivers 13, second drivers 22, and the rear drivers 23 being coupled or connected by the parallel bars 24 and 25 in a manner well understood in the art. It will now be seen that the weight of the cylinders is not only distributed upon the engine-frame in a manner to equalize the incidental strains, but that in addition the power is applied to a plurality of driving-axles, the four crank connections being set in quartering relation or at intervals of ninety degrees to obtain a substantially constant application of power, thus reducing the fiber stress on the various parts of the structure and avoiding the necessity for the use of massive counterbalances and the incidental hammer-blow which has a very injurious effect on the tracks, bridges, and superstructures in general.

No claim is herein made to the above structure, the same being covered by a copending divisional application, Serial No. 239,796.

Having now described the arrangement of the cylinders and the connections between the high and low pressure pistons and the drivers, it is next in order to describe the arrangement of pipes and valves for supplying steam to the cylinders. It will of course be understood that the opposite sides of the locomotive are duplicates, and I will therefore describe one side or compound engine and will direct attention to any variation from the general rule of duplication.

Within the dome 5 is located, as usual, the angular dry pipe 26, equipped with a throttle-valve 27, operated by a bell-crank 28, connected, by means of a connecting-rod 29, to a throttle-lever 30, located in the cab 2. From the dry pipe 26 steam is led to the steam-chest of each high-pressure cylinder by a steam-pipe 31, in which adjacent to the chest is located a high-pressure cut-out valve 32, employed for cutting out the adjacent high-pressure cylinder when necessary, as will be more fully described. From the chest of the high-pressure cylinder to the chest of the low-pressure cylinder is led what may be termed the "normal high-pressure exhaust-pipe" 33, designed to convey the exhaust-steam from the high-pressure cylinder to the low-pressure cylinder for compounding. Within the pipe 33 is located what may be termed a "low-pressure cut-out valve" 34, to the casing of which is connected an emergency exhaust-pipe 35, leading to the stack. Normally the valve 34 closes the emergency exhaust-pipe 35 and permits the passage of exhaust-steam from the

high-pressure cylinder to the low-pressure cylinder. When, however, it is desired to cut out the low-pressure cylinder, the valve 34 is turned to close the communication between the cylinders and to permit the high-pressure cylinder to exhaust directly to the stack.

Since it is designed to permit the independent use of either the high-pressure or the low-pressure cylinder in the event of either one or the other being put out of service, provision must be made for supplying the low-pressure cylinder with live steam when its supply of motive fluid from the high-pressure cylinder is discontinued. I therefore provide the steam-pipe 31 at a point above the cut-out valve 32 with an emergency extension or branch 35^a, leading to and communicating with the pipe 33 at a point between the valve 34 and the low-pressure cylinder. (See Fig. 3.) When the valve 32 is closed to cut out the high-pressure cylinder, live steam is led from the pipe 31 direct to the low-pressure cylinder by way of the emergency branch 35^a and the pipe 33, the branch 35^a being equipped with a normally closed cut-out cock 36, beyond which is a pressure-reducing valve 37 of ordinary construction for reducing the pressure of the live steam for use in the low-pressure cylinder.

Normally the opening of the throttle permits live steam to pass from the dry pipe to the high-pressure cylinders and thence by way of the pipes 33 to the low-pressure cylinders, where it is again used and from whence it is exhausted to the stack. In the event of a breakdown or derangement of either low-pressure cylinder its valve 34 is turned to permit the high-pressure cylinder at that side of the engine to exhaust directly to the stack instead of passing to the disabled low-pressure cylinder. If, on the other hand, one of the high-pressure cylinders or its associated mechanism is disabled, its cut-out valve 32 is closed and the adjacent emergency-valve 36 is opened. The high-pressure cylinder will thus be cut out, but the low-pressure cylinder will be supplied with live steam the pressure of which has been reduced by the reducing-valve 37. It will be obvious that by the described arrangement of steam connections at each side of the locomotive all of the cylinders may be utilized compoundly for the propulsion of the engine and that either or any of the cylinders may be utilized independently of any other or others which may be out of service.

No claim is herein made to the above-described structure, the same being covered by claims in the original or parent application, to which reference has already been made.

Another feature of the invention contemplates the provision of means for supplying both the high and low pressure cylinders with live steam when the throttle is opened to start the locomotive either forward or back with the reversing-lever in full gear. To obtain

this end, I provide an auxiliary steam-pipe 38, extending from the vertical arm of the dry pipe 26 and communicating with the valve-chests of the low-pressure cylinders—as, for instance, by having a branched lower end connected to the pipes 33 (see Figs. 2, 3, and 4) adjacent to said cylinders. In the pipe 38 is located a three-way auxiliary valve 39, the arm 40 of which is connected by a link 41 with one end of a lever 42, fulcrumed intermediate of its ends, as indicated at 43, (see Fig. 5,) and connected at its opposite extremity by a connecting-rod 44 with a primary reversing-lever 45, mounted as usual in the cab of the locomotive.

When the reversing-lever 45 is thrown in full gear, either forward or backward, the auxiliary valve 39 is opened, and therefore when the throttle 27 is opened by the manipulation of the throttle-lever 30 live steam will not only be supplied to the high-pressure cylinders, but will also be supplied directly to the low-pressure cylinders to increase the tractive power of the locomotive—as, for instance, in starting heavy trains. It will of course be understood that the primary reversing-lever will ordinarily be moved out of full gear as soon as the engine has made a half-revolution. This movement of the lever will cause the auxiliary valve to cut off the supply of live steam to the low-pressure cylinders, as the continuance of such supply is unnecessary after the exhaust from the high-pressure cylinders becomes effective for compounding.

Still another feature of the invention resides in the provision of novel means for controlling and regulating the supply of steam to the high and low pressure cylinders. For the valves 46 of the high-pressure cylinders I provide a link-motion valve-gear 47, operated from the second driving-axle 9, and for the valves 48 of the low-pressure cylinders I provide a separate link-motion valve-gear 49, operated from the front driving-axle 8. These valve-gears 47 and 49 are of ordinary construction, each comprising eccentrics 50, forward and back eccentric-rods 51 and 52, a link 53, and a rocker 54, connected at its lower end to the link and at its upper end to the high or low pressure valve-rods 55 or 56. Each of the valve-gears also comprehends a link-lifter 57, connected to a tumbling-shaft arm 58, extending from a tumbling-shaft 59. The tumbling-shaft of the high-pressure valve-gear 47 is provided with a tumbling-shaft lever 60, and the tumbling-shaft of the low-pressure valve-gear 49 is provided with a similar lever 61. The lever 61 is connected to the primary reversing-lever 45 by means of a reach-rod 62, and the tumbling-shaft lever 60 of the high-pressure valve-gear is similarly connected by a reach-rod 63 with what may be termed an "auxiliary reversing-lever" 64, associated and movable with the primary reversing-lever 45. The primary and auxiliary revers-

ing-levers may be considered as twin levers for the reason that while they are designed to have limited relative movement they are adapted to swing in unison for the major portion of their throw. They may also be viewed as sections of the same lever for the reasons just stated and for the further reason that they perform the same function, although in connection with different pairs of valves.

The reason for the employment of separate valve-gears connected with reversing-levers or lever-sections capable of slight relative movement is that the greatest economic efficiency in compounding makes it essential to provide means for the independent adjustment of the cut-off of the high and low pressure cylinders. In other words, there is a certain ratio of steam volume to be maintained between the two cylinders, according to the speed at which the engine is running and the weight of the train being hauled, and by providing independent valve-gears and reversing-levers a variable adjustment of the valve-gears may be effected at the discretion of the engineer in charge. For the purpose of limiting the relative movement of the reversing-levers the primary lever 45 is preferably provided with a detachable stop-bar 65, provided with stops 66 and 67, projecting laterally therefrom to engage the lever 64. This stop device will determine the variation of movement of the levers under ordinary conditions, but may be quickly detached should it be desired to increase the range of positive movement of or to leave one of the levers located in a fixed position—as, for instance, should one pair of cylinders be out of service. Each of the reversing-levers 45 and 64 is provided with its individual toothed quadrant 68 and spring-latch 69. (See Fig. 7.)

Since the operation of the various constructions described has been fully recited, reiteration is deemed to be unnecessary.

From the foregoing it is thought that the construction, operation, and many advantages of the herein-described invention will be apparent to those skilled in the art without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

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

1. The combination with high and low pressure cylinders, valves therefor, and separate valve-gears for said valves, of separate means for independently driving the gears means for effecting the differential adjustment of said gears, and means for leading live steam to the high-pressure cylinder and exhaust-steam to the low-pressure cylinder.

2. The combination with high and low pres-

sure cylinders, of means for leading steam to the high-pressure cylinder and thence to the low-pressure cylinder, separate shafts driven from the cylinders independent valves and valve-gears for the cylinders actuating means for the valve-gears driven respectively from the different shafts, and means for effecting the independent adjustment of the valve-gears.

3. The combination with high and low pressure cylinders, of different wheel-shafts driven from the cylinders means for leading steam to the high-pressure cylinder and thence to the low-pressure cylinder, independent valves and valve-gears for the cylinders actuating means for valve-gears connected respectively to the different shafts, and a reversing-lever comprising relatively movable sections, each having operative connection with one of the valve-gears to adjust the same.

4. The combination with high and low pressure cylinders, means for leading steam to the high-pressure cylinder and thence to the low-pressure cylinder, independent valves and valve-gears for the cylinders, a reversing-lever comprising relatively movable sections, each having operative connection with one of the valve-gears to adjust the same, and means for compelling the sections of the reversing-lever to move in unison after predetermined relative movement thereof.

5. The combination with high and low pressure cylinders, means for leading steam to the high-pressure cylinder and thence to the low-pressure cylinder, independent valves and valve-gears for the cylinders, a reversing-lever comprising relatively movable sections, each having operative connection with one of the valve-gears to adjust the same, and a stop-bar detachably carried by one section of the lever and having stops disposed to be engaged by the other lever-section to limit the relative movement of said sections.

6. The combination with high and low pres-

sure cylinders, valves therefor, separate valve-gears for the valves, and a device having connections with the different valve-gears for effecting the differential adjustment of the same upon the movement of said device, of means for leading live steam to the high-pressure cylinders and exhaust-steam to the low-pressure cylinders, an auxiliary pipe for leading live steam to the low-pressure cylinders, and an auxiliary valve controlling the passage of steam through the auxiliary pipe and controlled by the means which effects the differential adjustment of the valve-gears.

7. The combination with a plurality of cylinders, of means for leading steam thereinto, independent valves, valve-gears for the cylinders, an actuating device, and means operated by said actuating device for effecting the differential adjustment of the valve-gears.

8. The combination with high and low pressure cylinders, of means for leading live steam to the high-pressure cylinder and the exhaust from the high-pressure cylinder to the low-pressure cylinder, independent valves and valve-gears for the cylinders, an actuating device, and means operated by said actuating device for effecting a differential adjustment of the valve-gears.

9. The combination with high and low pressure cylinders, of means for leading steam to the high and low pressure cylinders, independent valves and valve-gears for the cylinders, an actuating lever-section, and separate sets of devices operated by the lever-section upon its movement and connected to the valve-gears for differentially adjusting the same.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

WILSON E. SYMONS.

Witnesses:

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BEN E. JEEKYL.