No. 668,130. Patented Feb. 12, 1901.

# J. W. KINCAID.

## MECHANICAL STOKER.

(Application filed Jan. 8, 1900.)

(No Model.) 3 Sheets—Sheet 1.

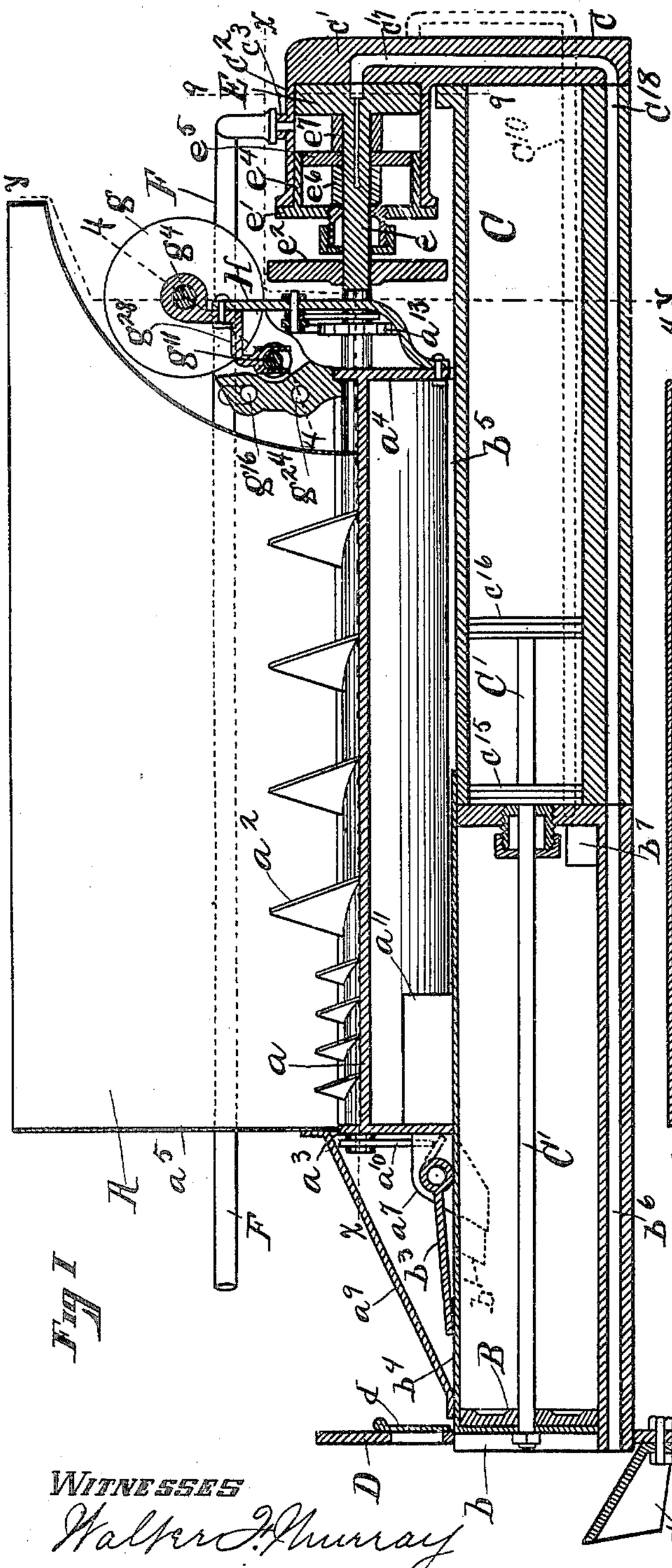

FIG 1

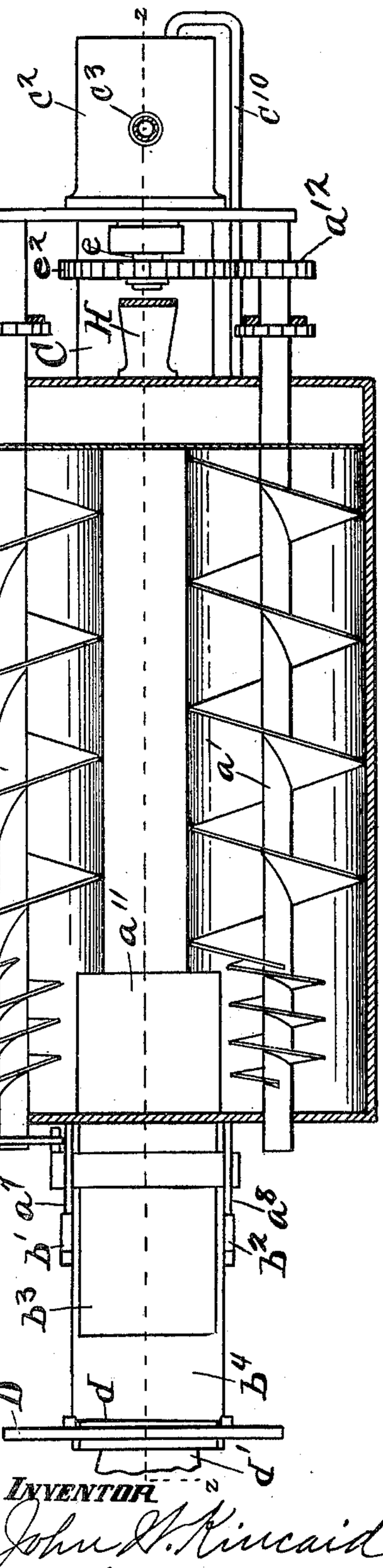

FIG 2

WITNESSES

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Fig 3

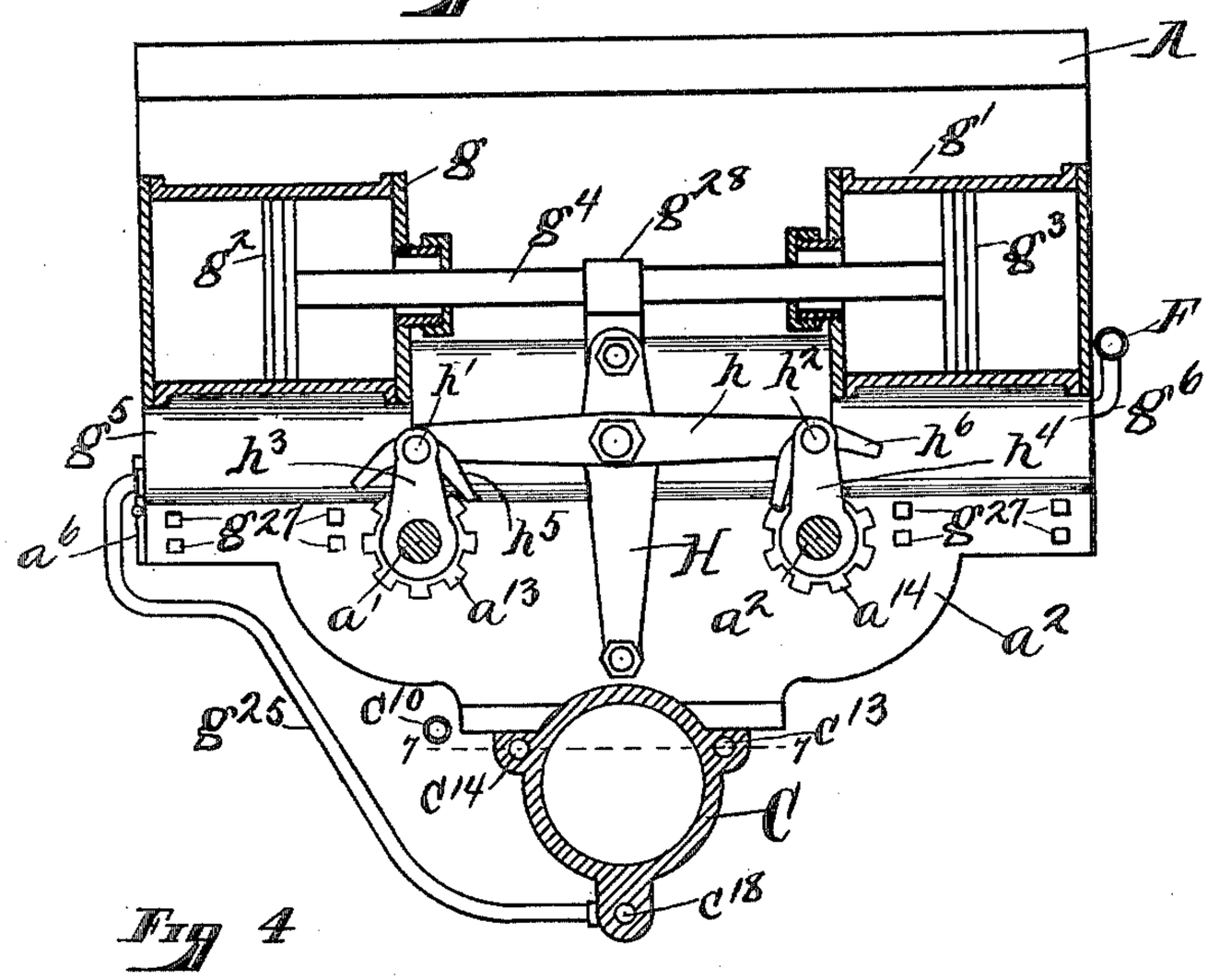



Fig 4

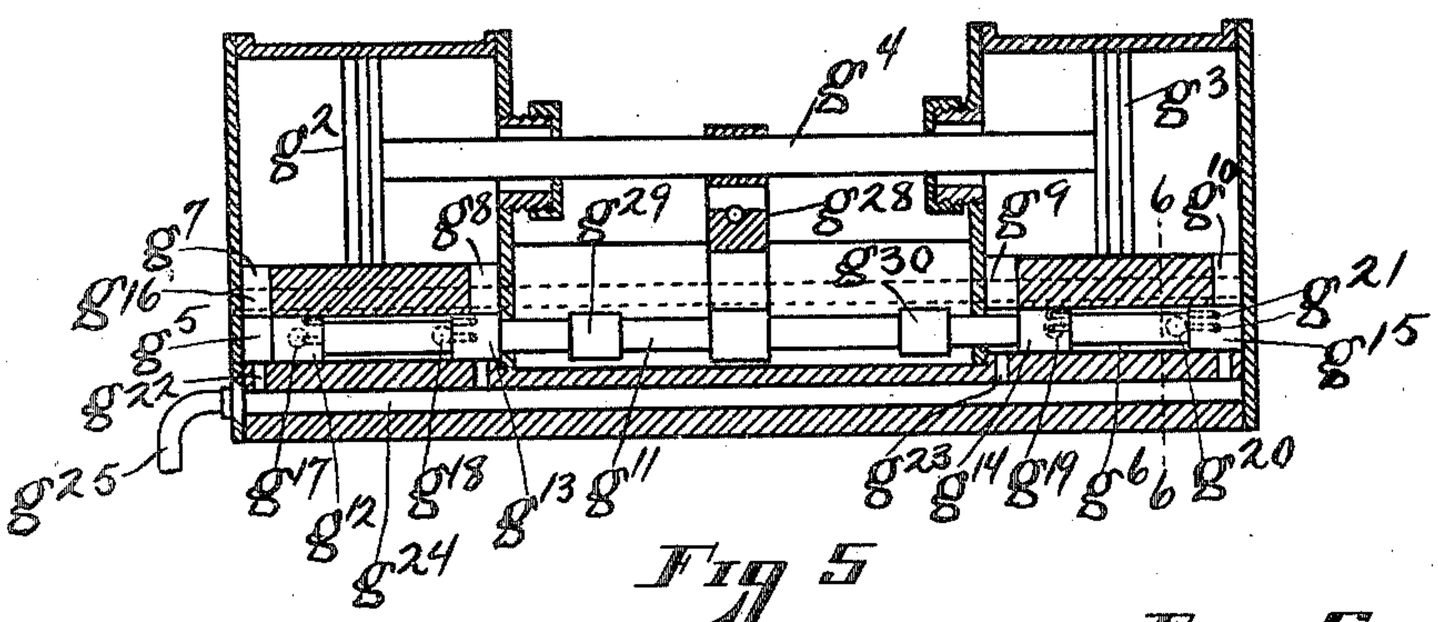
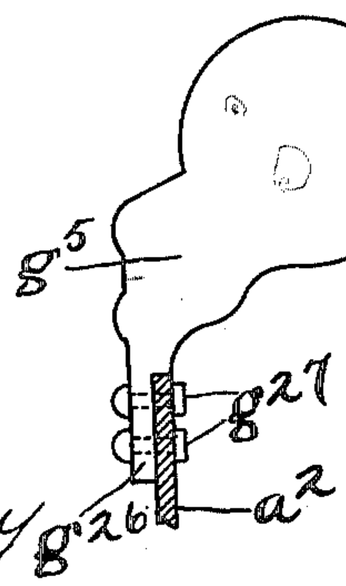



Fig 5

Fig 6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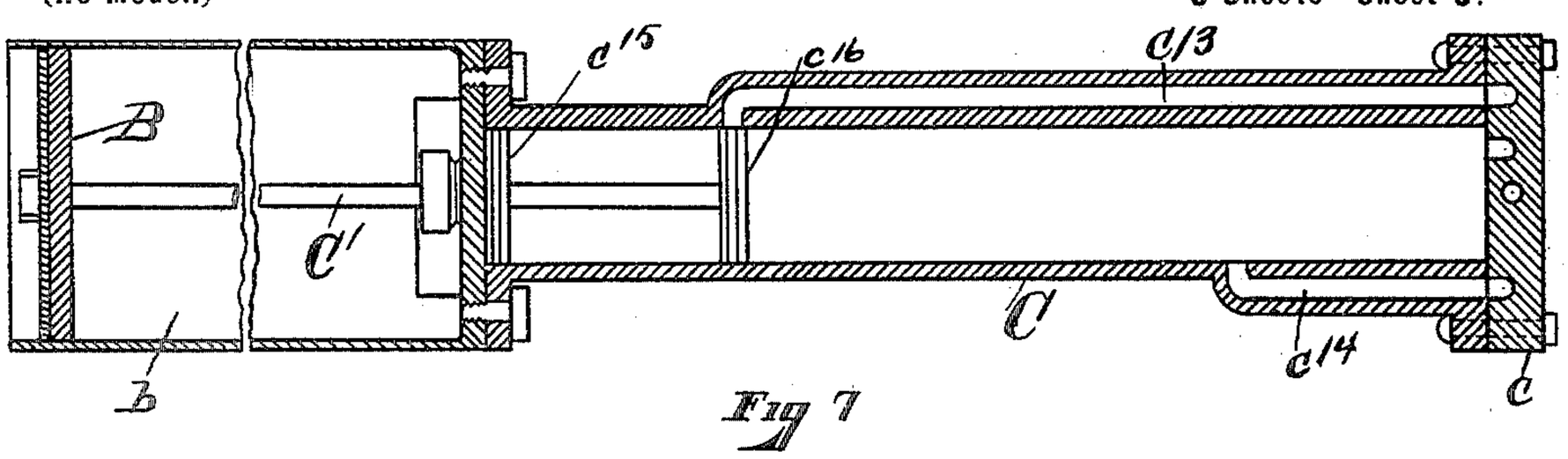


Fig 7

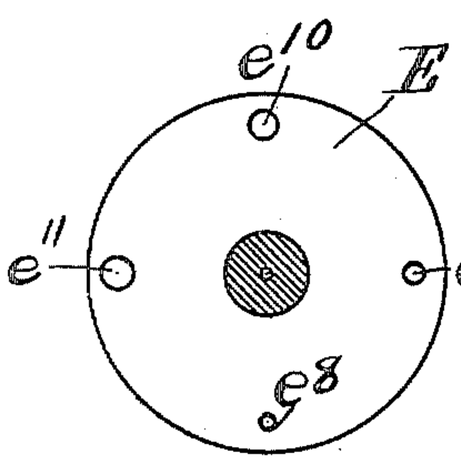


Fig 8

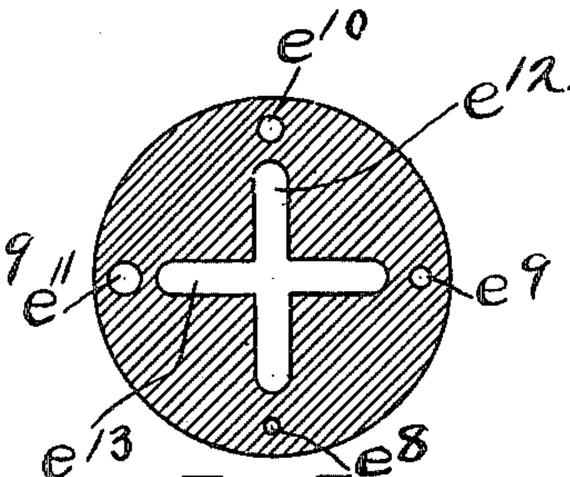


Fig 9

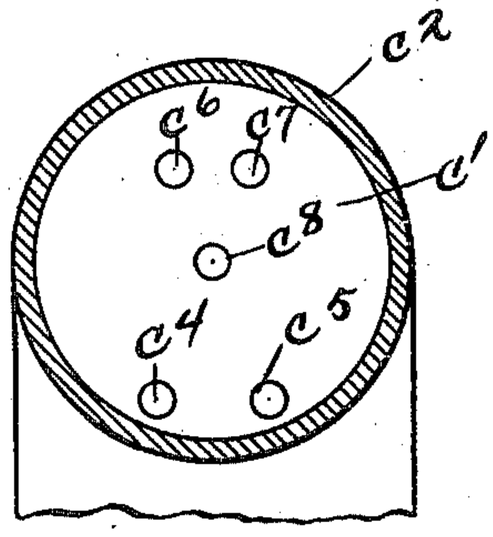


Fig 10

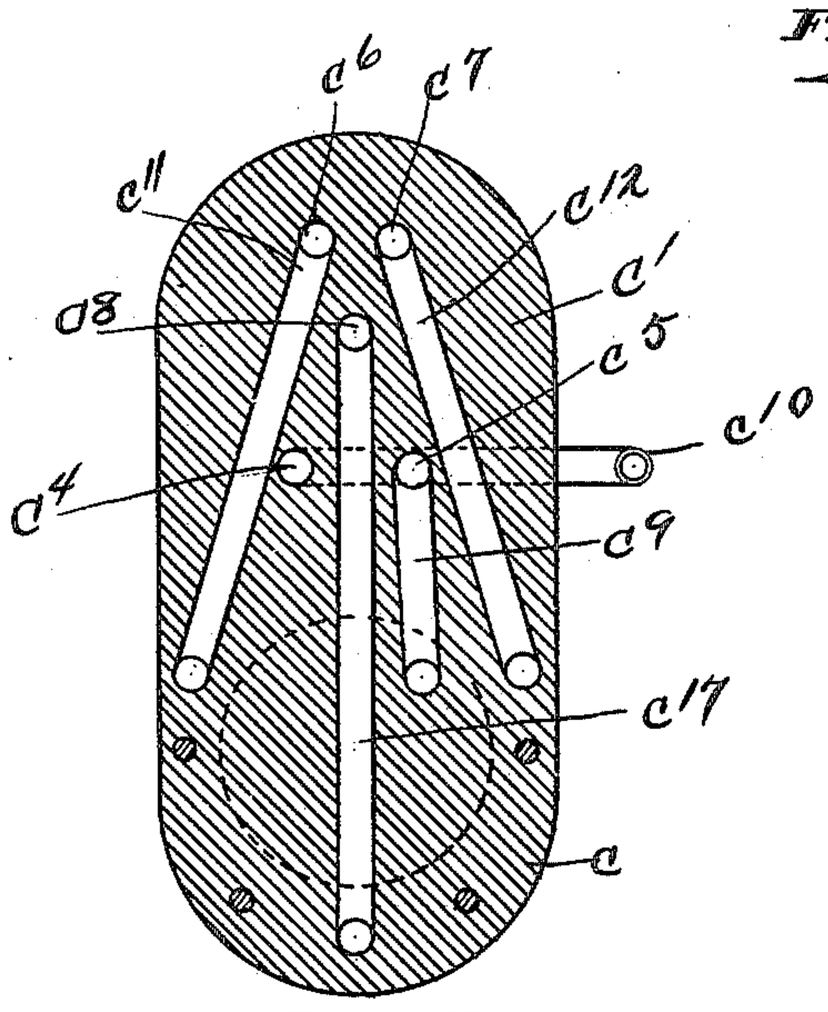


Fig 11

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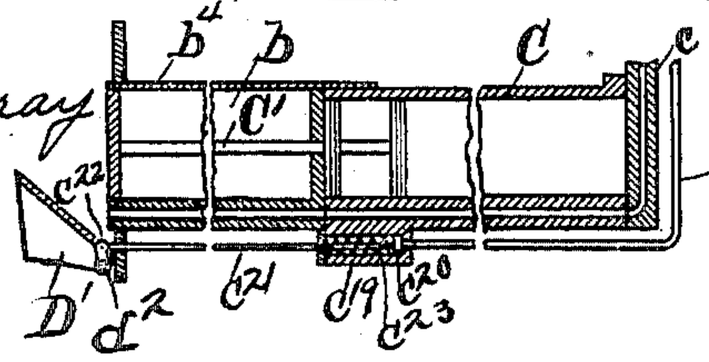


Fig 12

# UNITED STATES PATENT OFFICE.

JOHN W. KINCAID, OF COVINGTON, KENTUCKY, ASSIGNOR OF ONE-THIRD TO CHARLES A. KINCAID, OF COVINGTON, VIRGINIA.

## MECHANICAL STOKER.

SPECIFICATION forming part of Letters Patent No. 668,130, dated February 12, 1901.

Application filed January 8, 1900. Serial No. 691. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN W. KINCAID, a citizen of the United States, and a resident of Covington, in the county of Kenton and State of Kentucky, have invented certain new and useful Improvements in Mechanical Stokers, of which the following is a specification.

My invention relates to improvements in mechanical stokers. Its object is a mechanical stoker for feeding fuel into furnaces, especially those of locomotive-engines, over the grate-bars, in which the fuel is fed from a hopper to the fire in quantities and at a rate which are readily changed as desired and is distributed evenly over the fire by a reciprocating plunger which is operated by an engine whose piston does not strike the heads of its cylinder, in which the furnace walls and flues are protected from the inrushing of the outside air, in which the upper part of the hopper can be swung back readily when it is desired to poke the fire, and in which the whole machine can be detached from the furnace and moved out of the way to avoid delay in case of accident. This object is attained by the means described in the annexed specification and illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal central vertical sectional view of a mechanical stoker embodying my invention, taken upon line *z z* of Fig. 2, the plunger being shown in its forward position. Fig. 2 is a sectional plan view of the same, taken upon irregular line *x x*, Fig. 1, the hood shown extending from the hopper to the furnace-door over the swinging door in Fig. 1 being removed to expose the swinging door and the apron attached to the plunger. Fig. 3 is a vertical transverse sectional view taken upon *y y* of Fig. 1. Fig. 4 is a sectional detail view taken upon irregular line 4 4 of Fig. 1, showing the duplex engine for operating the conveyers and the valve-stem for controlling the admission to and the exhaust of steam from each of its cylinders and the manner of coupling the valve-stem to the piston-rod of the cylinders. Fig. 5 is a detail side elevation of the duplex engine, showing the manner of attaching it to the rear end of the lower part of the hopper. Fig. 6 is a detail transverse sectional view of the valve-stem, taken upon line 6 6 of Fig. 4, upon a somewhat enlarged scale, showing the ports shown in the piston-valve in dotted lines, Fig. 4, for admitting steam to the ends of the cylinders. Fig. 7 is a horizontal sectional view taken upon line 7 7 of Fig 3, part of the plunger trough or channel being broken out and the ends brought together to economize space. Fig. 8 is a detail view, upon an enlarged scale, of the valve for controlling the admission and the exhaust of steam to and from the cylinder of the main engine—namely, the engine that actuates the plunger—the valve-stem being shown in section. Fig. 9 is a sectional view of the valve, taken upon line 9 9 of Fig. 1. Fig. 10 is a detail view of the valve-seat, taken also upon line 9 9 of Fig. 1. Fig. 11 is a central sectional view of the casting that forms the head of the rear end of the main cylinder and the valve-seat and case of the valve which controls the admission and exhaust of steam to and from it, showing the channels leading to the admission and exhaust ports. Fig. 12 is a detail view, upon a somewhat reduced scale, similar to Fig. 1, of a modification, parts of the cylinder of the main engine and the trough of the plunger being broken out and the ends brought together to economize space.

Referring to the parts, the hopper A consists of a lower part *a*, which consists of two semicylindrical channels, in each of which is a spiral conveyer, whose shaft $a'$ and $a^2$, respectively, is journaled in its front and rear ends $a^3$ and $a^4$, and an upper part $a^5$, which rests upon the lower part $a^2$ and is hinged to it upon one side by hinges $a^6$, so that it may be swung back for convenience in stirring the fire through door *d*, attached to the furnace D. The hopper rests upon cylinder C of the main engine and trough *b* of the reciprocating plunger B and has at its forward end lugs $a^7$ and $a^8$ upon its sides to fit under the lugs $b'$ and $b^2$ upon the sides of the trough *b*, as shown in dotted lines, Fig. 1. Journaled in lugs $a^7$ and $a^8$ is a door $b^3$ to swing down into the trough *b* when the plunger is retracted. Secured to the forward end of the hopper and resting upon trough *b*, near the furnace-door D, is a hood $a^9$ for excluding the air from the furnace. Door $b^3$ is raised by a cam $a^{10}$ upon the end of conveyer-shaft $a'$ when the plunger is advanced. The twin spiral conveyers keep

feeding the fuel to the forward end of the hopper, whence it passes through an opening $a^{11}$ in its bottom to rest upon an apron $b^4$, which is attached to the plunger B and reciprocates in ways $b^5$ between the hopper and the cylinder C of the main engine, whose piston-rod C′ is connected to the plunger, until the plunger is retracted, when it drops into the trough or channel $b$ of the plunger, to be carried forward through the furnace-door D by the plunger on its next stroke. The trough has a small opening $b^7$ in its bottom near the cylinder C, through which the dust which may accumulate between the plunger and the cylinder is discharged.

The rear head $c$ of the cylinder C is formed integral with the valve-seat $c'$ and the cylindrical valve-case $c^2$ of the valve E, which is formed integral with its stem $e$, which passes through the cap $e'$ of the valve-chamber, and has secured upon its end a cog-wheel $e^2$, which meshes with a cog-wheel $a^{12}$ upon the end of conveyer-shaft $a'$. Cap $e'$ has an annular bushing $e^4$ extending into the valve-chamber. Upon the valve-stem is a loose disk or piston $e^5$, which bears against the inner walls of the bushing and is held in place on the stem between a rigid and a loose collar $e^6$ and $e^7$. Steam enters the valve-chamber from steam-pipe F through opening $c^3$ in the valve-case between disk $e^5$ and the valve, making it a balanced valve.

Valve E has four port-openinge $e^8$, $e^9$, $e^{10}$, and $e^{11}$ upon a common circumference and equidistant from each other and gradually increasing in size from the smallest $e^8$ to the largest $e^{11}$. Into the under side of the valve are cut grooves $e^{12}$ and $e^{13}$ upon the diameters connecting ports $e^8$ and $e^{10}$ and $e^9$ and $e^{11}$, respectively, but terminating upon a circle within that upon which the ports lie. Valve-seat $c'$ has two admission-ports $c^4$ and $c^5$ to register with the port-openings in the valve, two exhaust-ports $c^6$ and $c^7$ to register with the grooves in the under side of the valve, and a central exhaust-port $c^8$. Admission-port $c^5$ is connected by a channel $c^9$ to the rear end of the cylinder to admit steam for advancing the plunger. Steam from admission-port $c^4$ is conveyed to the forward end of cylinder C by a pipe $c^{10}$ for retracting the plunger.

The purpose of making the ports $e^8$ to $e^{11}$ vary in size is to vary the amount of steam admitted to the cylinder for advancing the plunger each time, so that the forward strokes of the plunger will vary in rapidity from one that would deposit the fuel in front of the door to one that would throw it to the back of the furnace. Pipe $c^{10}$ is made of an interior diameter equal to that of the smallest port $e^8$ in order that the return stroke of the plunger may not vary in speed.

Exhaust-ports $c^6$ and $c^7$ are connected by channels $c^{11}$ and $c^{12}$ in the cylinder-head $c$ with channels $c^{13}$ and $c^{14}$ upon the side of the cylinder C, channel $c^{13}$ entering the cylinder at a distance from the front head of the cylinder equal to or slightly less than the distance between the two pistons $c^{15}$ and $c^{16}$, which are secured upon the piston-rod C′ within cylinder C. The object of this arrangement is that on the forward stroke of the piston the steam left in the cylinder after piston $c^{15}$ has reached the exhaust-port $c^{13}$ acts as a cushion between the piston and the front end of the cylinder and that on the return stroke the steam left in the cylinder after piston $c^{16}$ has passed exhaust-port $c^{14}$ acts as a cushion between it and rear head $c$ of the cylinder. A channel $c^{17}$ in the head $c$ conveys the exhaust-steam of the front and the rear of cylinder C from the central exhaust $c^8$ of the valve-seat through channels $c^{18}$ and $b^6$, which are underneath cylinder C and the plunger-trough $b$, against a cone-shaped deflector $d'$, attached to the furnace-door centrally in front of the forward end of the trough to spread the coal. The purpose of this arrangement is both to keep the deflector swept clean of coal and to aid in combustion of the blue flames on top of the fire.

The twin spiral conveyers $a'$ and $a^2$ are rotated toward each other by the duplex engine G, which consists of two cylinders $g$ and $g'$, within which are pistons $g^2$ and $g^3$, respectively, connected by a piston-rod $g^4$, to reciprocate which steam is admitted alternately to the opposite ends of the cylinders from chambers $g^5$ and $g^6$ beneath cylinders $g$ and $g'$, respectively, through ports $g^7$, $g^8$, $g^9$, and $g^{10}$, Fig. 4, the opening and closing of which are controlled by a common valve-stem $g^{11}$, which has two piston-valves $g^{12}$ and $g^{13}$, and $g^{14}$ and $g^{15}$ within the chambers $g^5$ and $g^6$, respectively. Steam is admitted to the chambers $g^5$ and $g^6$ between piston-valves $g^{12}$ and $g^{13}$ and $g^{14}$ and $g^{15}$, respectively, from the steam-chamber $g^{16}$, which is in communication with steam-pipe F through ports $g^{17}$ and $g^{18}$ and $g^{19}$ and $g^{20}$, (shown in dotted lines in Fig. 4,) in which position ports $g^{17}$ and $g^{19}$ are closed, steam is being admitted to the right-hand ends of the cylinders through channels $g^{21}$, cut in the piston-valve (shown in Fig. 6 and in dotted lines, Fig. 4,) and steam from the left-hand ends is exhausting through ports $g^{22}$ and $g^{23}$ into the exhaust-chamber $g^{24}$, whence it is conveyed through exhaust-pipe $g^{25}$ into the exhaust-channel $c^{18}$. Cylinders $g$ and $g'$, chambers $g^5$ and $g^6$ beneath them, steam-chamber $g^{16}$, and exhaust-chamber $g^{24}$ are formed integral in a casting, a detail side view of which is shown in Fig. 5, which rests upon the rear end of the lower part $a^2$ of the hopper and has a downwardly-projecting flange $g^{26}$, which is secured to the hopper by bolts or rivets $g^{27}$. Valve-stem $g^{11}$ is actuated by piston-rod $g^4$, which has an arm $g^{28}$ secured to it and projecting down to straddle stem $g^{11}$, upon which are collars $g^{29}$ and $g^{30}$, which are struck by arm $g^{28}$ near the limits of its stroke in either direction. Pivoted to arm $g^{28}$ at one end and to the end of the hopper $a^2$ at the other is a vertical lever H, centrally

pivoted to which is a horizontal arm $h$. Upon pivots $h'$ and $h^2$ at the opposite ends of arm $h$ are links $h^3$ and $h^4$, which also are rotatably secured to conveyer-shafts $a'$ and $a^2$ and pawls $h^5$ and $h^6$ to engage cog-wheels $a^{13}$ and $a^{14}$. Now when piston-rod $g^4$ moves toward the right, Fig. 3, pawl $h^5$ engages cog-wheel $a^{13}$ and rotates spiral conveyer $a'$ to the right, and when rod $g^4$ moves toward the left pawl $h^6$ engages cog-wheel $a^{14}$ and rotates conveyer $a^2$ to the left.

In operation when steam from the boiler has been turned on in pipe F it enters both engine G and valve-case $c^2$ of valve E and starts up duplex engine G, the reciprocation of whose piston $g$ is conveyed by rod H alternately to spiral conveyers $a'$ $a^2$, which keep carrying the fuel in hopper A toward its end that is toward the furnace, where its rests on apron $b^4$ until the apron is retracted by the plunger. The rotation of shaft $a$ rotates valve E to admit steam alternately to the ends of cylinder C to reciprocate piston-rod C' and plunger B. When the plunger is retracted, the coal from opening $a^{11}$ falls into the trough in front of it. The speeds with which the conveyers carry the coal to the forward end of the hopper to fall in front of the plunger through opening $a^{11}$ and the rapidity with which the plunger carries it forward to the furnace are thus interdependent, since the faster the conveyer-shaft rotates the more coal is carried forward and, since the rotation of the conveyer-shaft determines the rotation of valve E, the greater the number of strokes of the plunger in a given time. Cam $a^{10}$ upon the end of shaft $a$ opens door $b^3$, as shown in Fig. 1, when the plunger advances to throw the fuel upon the fire.

In the modification shown in Fig. 12 is a chamber $c^{19}$, within which is a piston-head $c^{20}$, connected to a piston-rod $c^{21}$, which projects horizontally forward through the front head of the chamber $c^{19}$, beneath trough $b$, and is pivoted at its forward end to a crank $c^{22}$, which is connected to the deflector D', which is pivoted upon a pivot $d^2$ upon the furnace-door. About piston-rod $c^{21}$, within chamber $c^{19}$ and bearing against piston-head $c^{20}$, is a coiled spring $c^{23}$. A steam-pipe $c^{24}$ is tapped through head $c$ of the cylinder C into channel $c^9$ to convey steam thence beneath cylinder C into chamber $c^{19}$, against piston-head $c^{20}$. When a strong pressure of steam enters channel $c^9$, it compresses spring $c^{23}$, carries piston-rod $c^{21}$ forward, and lowers deflector D', and the stronger the pressure the more is the deflector lowered, so that the fuel is not spread so much upon the strokes which are intended to carry the fuel near the rear of the furnace. The purpose of this is obvious in view of the fact that the farther the fuel is thrown the more it spreads of itself.

While I have described my stoker as run by steam, it is obvious that in place of steam other compressed fluids might be substituted for it.

What I claim is—

1. In a mechanical stoker the combination of a main engine, a trough or channel leading from the cylinder of the main engine into a furnace above the grate-bars, a plunger reciprocated in the trough or channel by the main engine, an apron connected to the plunger, a hopper on the trough and the cylinder of the main engine leaving ways between it and them in which the apron slides, twin spiral conveyers journaled in the ends of the hopper for feeding fuel to the forward end thereof, a hole in the bottom of the hopper near the forward end through which the fuel passes into the trough when the plunger and apron are retracted, and an engine for rotating the conveyers, substantially as shown and described.

2. In a mechanical stoker the combination of a plunger reciprocating in a channel or trough, the channel leading into a furnace above the grate-bars, a hopper above the channel from which fuel is fed in front of the plunger when retracted, an engine for reciprocating the plunger and a revolving valve for controlling the admission of steam to the front and rear ends of the cylinder of the main engine for reciprocating the plunger whose admission-ports vary in size from a minimum to a maximum, whereby the plunger is advanced with a correspondingly-varying speed for throwing fuel to different parts of the furnace, substantially as shown.

3. In an engine for reciprocating a plunger the combination of a rotating valve for controlling the admission and exhaust of steam to and from the end of the cylinder of the engine having admission-ports varying in size from a minimum to a maximum upon the circumference of a circle, and channels cut in its under side upon the radii connecting the admission-ports and within their circle leading into an exhaust-port in the valve-seat, a valve-seat having two admission-ports to register with the admission-ports in the valve, two exhaust-ports upon the smaller circle of the exhaust-channel to register with the channels in the under side of the valve and a central exhaust-port, substantially as shown and described.

4. In an engine for reciprocating a plunger the combination of a cylinder, a piston reciprocating in the cylinder for actuating the plunger, the rear head of the cylinder the valve-seat and the valve-case formed integral, and a revolving valve in the case for controlling the admission and exhaust of steam to and from the cylinder to reciprocate the piston, substantially as shown and described.

5. In an engine for reciprocating a plunger the combination of a cylinder two pistons at a short distance apart upon a piston-rod, the piston-rod for actuating the plunger, ports for admitting steam into the ends of the cylinder and exhaust-ports in the cylinder at a distance from each end equal to or less than the distance between the pistons whereby a

small amount of steam is left in the cylinder after exhaust to act as a cushion between the piston and the head of cylinder, substantially as shown and described.

6. In a mechanical stoker the combination of a main engine for reciprocating a plunger, the plunger, a channel or trough in which the plunger reciprocates leading into a furnace, a hopper from the forward end of which fuel drops in front of the plunger when retracted, two spiral conveyers situated in the bottom of the hopper for feeding the fuel to the forward end thereof whose shafts are journaled in the hopper ends, a duplex engine having two cylinders within each of which is a piston, a rod connecting the pistons, means for admitting steam to the cylinder to reciprocate the rod, a lever coupled to the rod at one end and pivoted to the hopper at the other, an arm pivoted to the lever and terminating in pawls said pawls to engage ratchet or cog wheels upon the ends of the conveyer-shafts for revolving the shafts and said cog-wheels, substantially as shown and described.

7. In a duplex engine the combination of two cylinders, a piston within each of the cylinders, a rod connecting the pistons, a valve-chamber adjacent to each of the cylinders, piston-valves for controlling the admission and exhaust of steam to and from the cylinders within each of said chambers, a common valve-stem connecting the piston-valves and a rod coupling the piston-rod and the valve-stem for reciprocating the stem to open and close the admission and exhaust ports of the cylinders, substantially as shown and described.

8. In a mechanical stoker the combination of a main engine whose piston-rod is connected to a plunger for reciprocating it, a channel or trough in which the plunger reciprocates leading from the cylinder of the main engine into a furnace, a hopper above the cylinder and the trough leaving ways between it and them having an opening in the bottom near its forward end through which fuel passes into the channel when the plunger is retracted, an apron connected to the plunger and sliding in said ways, a spiral conveyer or conveyers situated in the bottom of the hopper whose shaft or shafts are journaled in the ends of the hopper for feeding fuel to the forward end thereof, a duplex engine for revolving the spiral conveyer, a revolving valve for controlling the admission and exhaust of steam to and from the cylinder of the main engine whose valve seat and case are formed integral with the rear head of the cylinder, and whose valve-stem has a cog-wheel secured upon it to mesh with a cog-wheel upon the shaft of the spiral conveyer whereby the valve is revolved to open and close the ports, and said cog-wheels, substantially as shown and described.

9. In a mechanical stoker the combination of a main engine whose piston is connected to a plunger for reciprocating it, a trough in which the plunger reciprocates leading from the cylinder of the main engine into a furnace, a valve for varying the amount of steam admitted to the rear end of the cylinder to advance the plunger at various speeds, a channel for conducting the steam into the rear end of the cylinder from the valve, a chamber beneath the cylinder, a spring-pressed piston in the chamber, a piston-rod connected to the piston and projecting forward and being pivoted to a lever, a deflector pivoted to the furnace-door in front of the channel and secured to the lever, said lever, the spring within the chamber for drawing the piston-rod backward, and a pipe connecting the rear end of said chamber with the channel for conveying steam into the chamber against the piston whereby the deflector is lowered in a degree proportioned to the rapidity of the forward stroke of the plunger, substantially as shown and described.

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Witnesses:
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EMMA LYFORD.