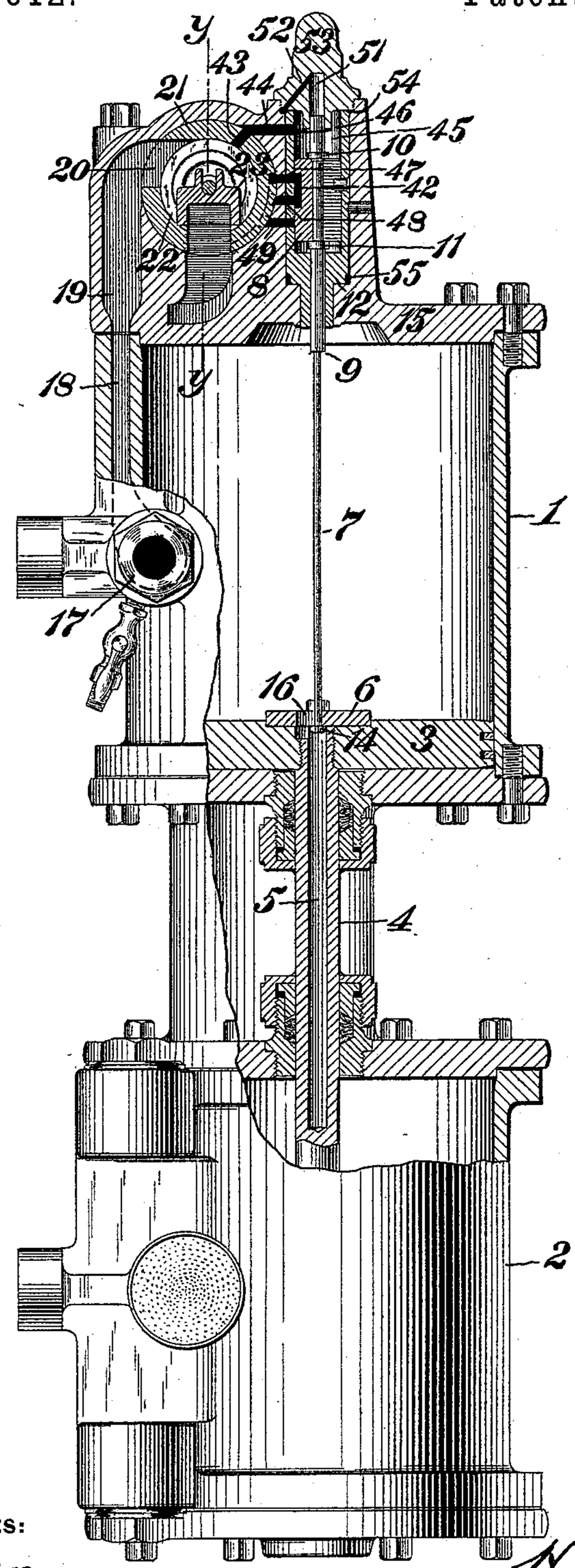
(No Model.) 3 Sheets—Sheet 1.

H. H. WESTINGHOUSE.

VALVE MECHANISM FOR STEAM PUMPS.

No. 494,612. Patented Apr. 4, 1893.

FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

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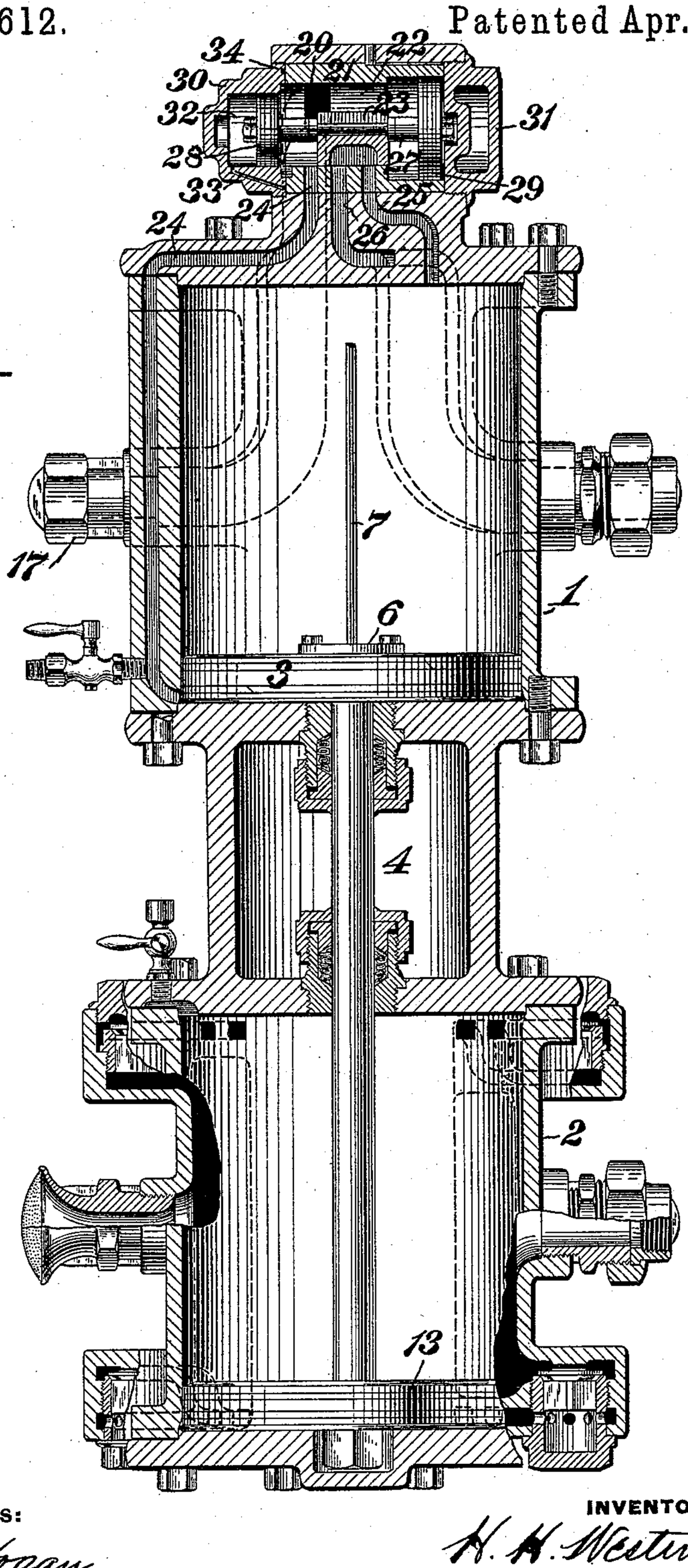
FIG. 2.



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(No Model.) 3 Sheets—Sheet 3.

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VALVE MECHANISM FOR STEAM PUMPS.

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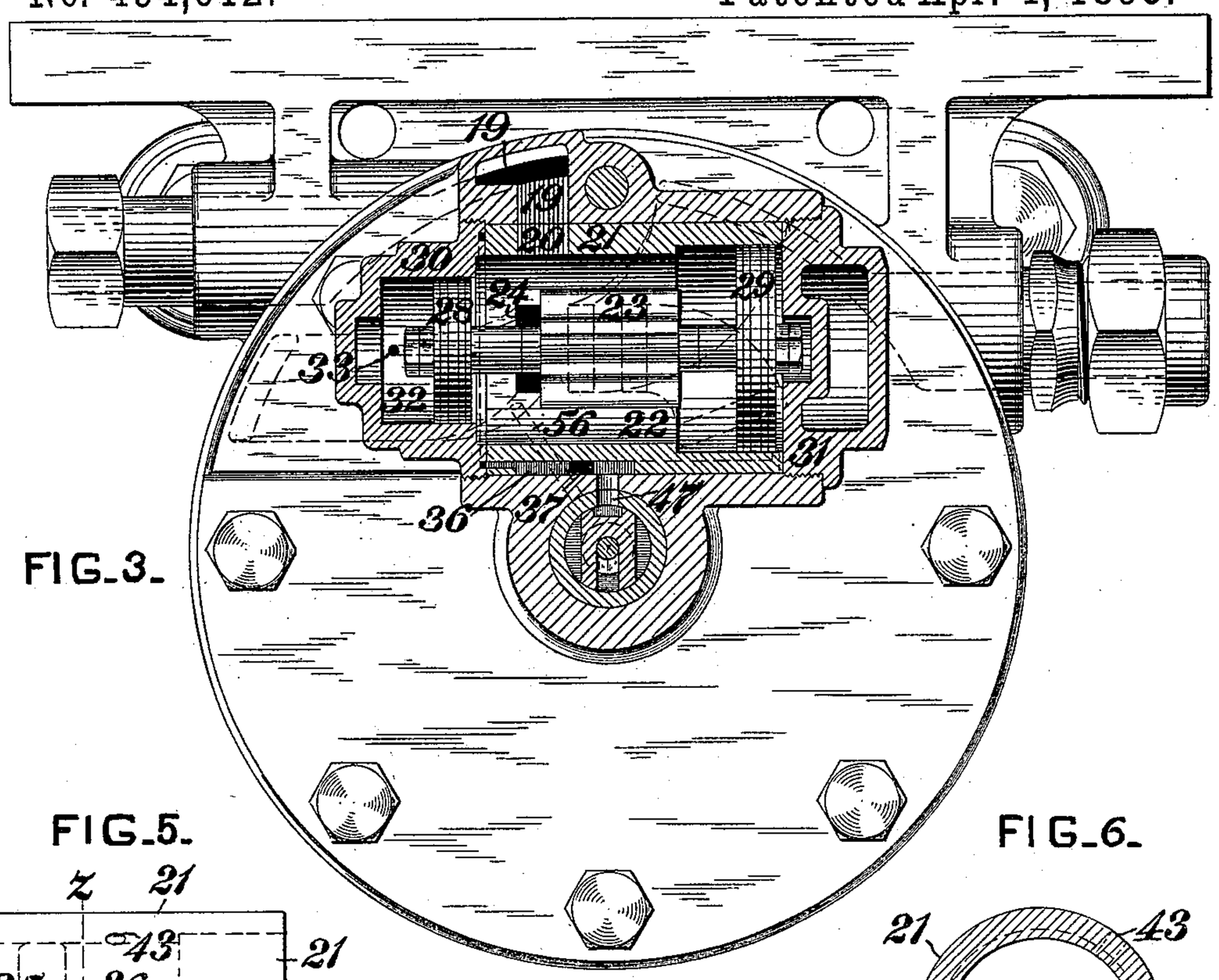

FIG. 3.

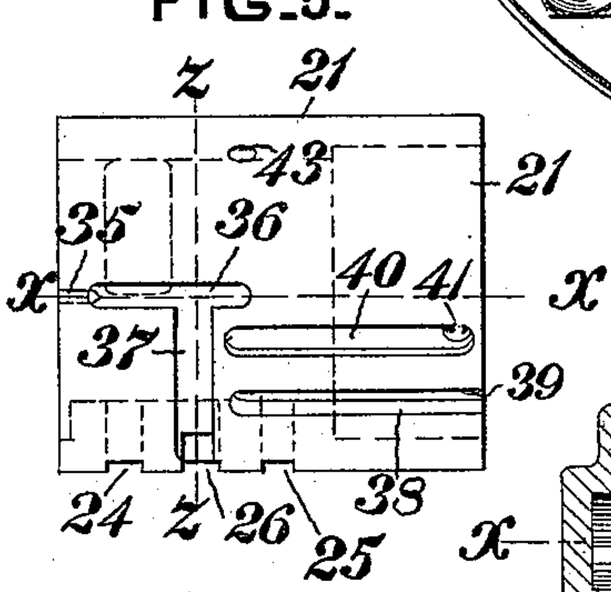

FIG. 5.

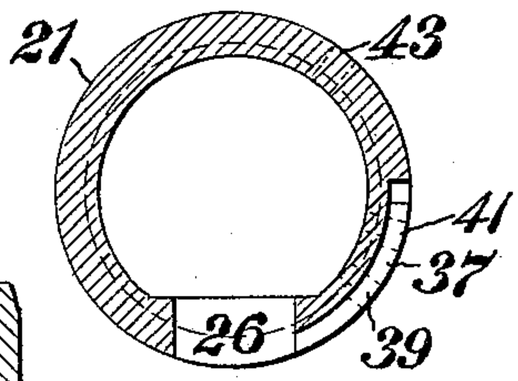

FIG. 6.

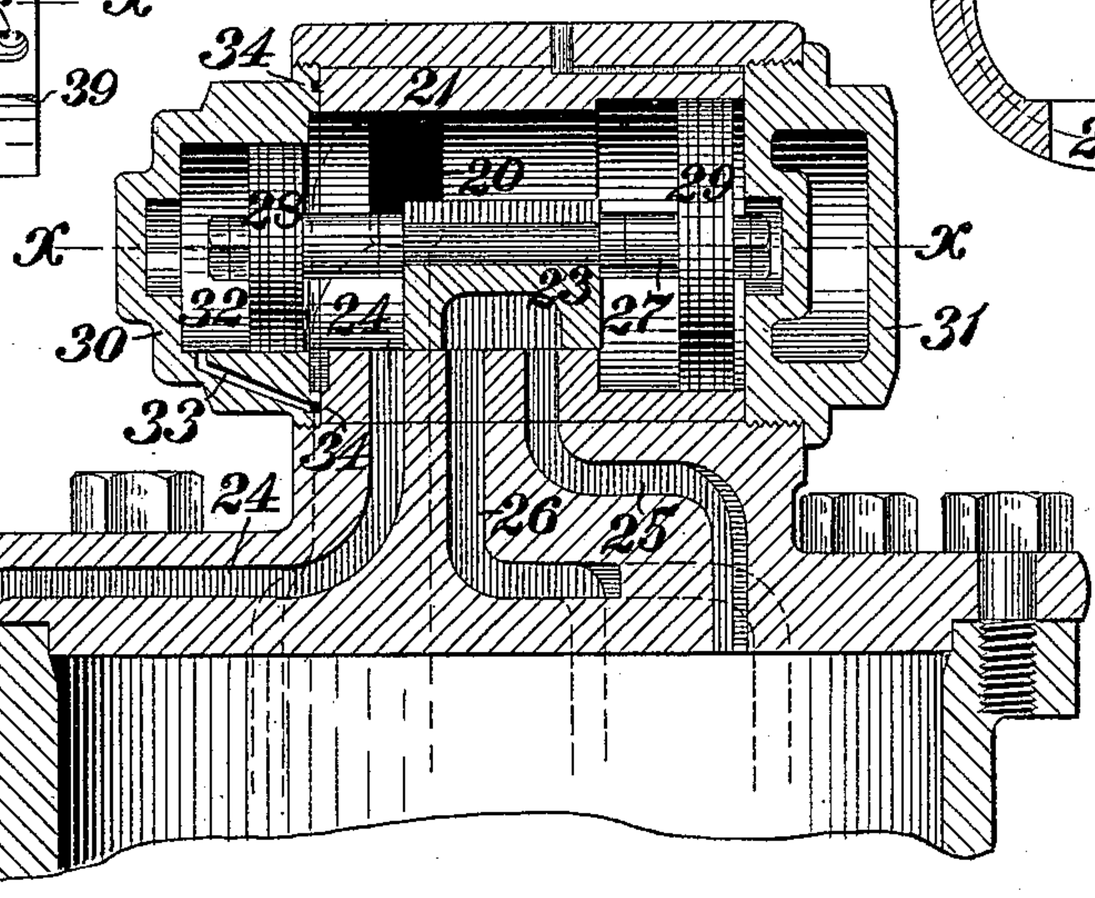

FIG. 4.

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UNITED STATES PATENT OFFICE.

HENRY HERMAN WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA.

VALVE MECHANISM FOR STEAM-PUMPS.

SPECIFICATION forming part of Letters Patent No. 494,612, dated April 4, 1893.

Application filed October 19, 1892. Serial No. 449,372. (No model.)

To all whom it may concern:

Be it known that I, HENRY HERMAN WESTINGHOUSE, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Valve Mechanism for Steam Pumping-Engines, of which improvement the following is a specification.

The object of my invention is to provide a new and improved steam pumping engine; and to this end it consists of certain novel combinations of devices by which the construction is simplified, the parts are made readily accessible for examination or repair, and a high operative efficiency of operation is secured.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a view, partly in elevation and partly in vertical central section, of a steam pumping engine embodying my invention; Fig. 2, a vertical central section taken at right angles to Fig. 1; Fig. 3, a plan view and horizontal section, on a larger scale, on the line x, x, of Figs. 4 and 5; Fig. 4, a vertical section, on the same scale as Fig. 3, on the line y, y, of Fig. 1; Fig. 5, a side elevation of the bushing which lines the main valve chamber, and Fig. 6, a transverse section, on the line z, z, of the bushing shown in Fig. 5.

My present invention is an improvement in steam pumping engines of the class or type exemplified in Patent No. 159,782, to George Westinghouse, Jr., February 16, 1875, in which the operation of the main steam distribution valve is controlled by a valve operated by the movement of the main steam piston of the engine, or some member having a movement co-incident with that of the main steam piston.

As herein shown, my improved steam pumping engine includes a main slide distribution valve which controls the supply and exhaust of steam to and from the main steam cylinder and which is operated by a differential piston, whose movement is controlled by a single auxiliary valve operated by the movement of the main steam piston.

The construction and arrangement of the valve mechanism is exceedingly simple and compact, being formed entirely within a single casing which also forms the cover or bonnet for the main steam cylinder. This construction, by reason of its simplicity, is comparatively inexpensive, and permits the removal or examination of any or all of the parts without removing the cylinder head; and, in case it becomes necessary to remove the cylinder head this may be done without disturbing or removing the valve gear from the cylinder head. The employment of a single auxiliary valve for controlling the main valve, and the relative arrangement of these parts, as embodied in my improved construction admits of the employment of short and direct passages from the auxiliary valve to the differential piston. The relation of the parts to one another and their arrangement entirely within a single casing, which also forms a cover for the main steam cylinder, is such that there are no outside connections from one part to another requiring the employment of stuffing boxes or other packing or joints. The form of the main steam cylinder is much simplified, and, in case it becomes necessary to make repairs to the valve devices, or to the parts within which they operate, it is not necessary to remove the main steam cylinder, but only the cylinder head, for example, in case it becomes necessary to refit or repair a bushing.

When used on a locomotive for application to which my improved engine is specially designed, a new head, with its contained valve device, may be quickly substituted for one needing repair, and thus a locomotive which is otherwise in good condition need not be put out of service, or substantially delayed for repairs to the valve mechanism of its pump.

Figs. 1 and 2 of the drawings show the main steam cylinder, 1, placed above the air cylinder, 2, and the main steam piston, 3, connected, by means of the piston rod 4, with the pump piston, 13, the latter, however, being shown only in Fig. 2. The piston rod 4 has formed within it a central bore, 5, to receive the valve stem 7, which is connected to an auxiliary valve 8, which may be termed the reversing valve. This reversing valve, 8, is fitted in a bushing 12, which bushing is fitted in a central chamber formed in an upward extension of the head 15, of the main steam

cylinder. The reversing valve is connected to the stem 7, being fitted between the shoulders 10 and 11 thereon so that the valve and stem move together. The stem 7 extends into the steam cylinder and through the opening 16 in the plate 6 into the bore 5 of the piston rod 14. When the main steam piston 3 moves upward, the reversing plate 6 comes in contact with the shoulder 9 formed on the stem 7, and moves the valve 8 in one direction, and when the main steam piston moves back and approaches the opposite end of its stroke, the plate 6 comes in contact with a collar 14, formed on the end of the stem 7, and moves the reversing valve in the opposite direction.

The engine is connected with the live steam supply pipe by the nozzle or connection 17; and live steam passes through the passage 18 formed in the wall of the steam cylinder, the passage 19 formed in the cylinder head, and the port 20 in the bushing 21, into the chamber 22 in which the main slide valve 23 is located. The main slide valve, 23, controls the ports 24, 25, and 26, through which steam is admitted to and exhausted from the two ends of the main steam cylinder for the purpose of moving the main piston. The main slide valve, 23, is fitted between two shoulders on the stem 27 of the differential pistons 28 and 29, so that the pistons and the main valve move together.

As shown in the drawings the piston 29, which is the larger of the two differential pistons, is fitted in one end of the bushing 21, and the other piston, 28, is fitted in the cap 30 which closes one end of the chamber 22; but both pistons may be fitted in the bushing 21, or in a chamber 22 without a bushing; or, the piston 29 may be fitted in the cap 31 in the same manner as the piston 28 is fitted in the cap 30. The outer end of the chamber 32, in the cap 30, is in open communication at all times with the exhaust passage 26 by means of the passage 33 formed in the cap 30, the annular passage 34 formed in the inner end of the cap 30, the passage 35 in the bushing 21, (see Fig. 5) and the passages 36 and 37, which open into the exhaust passage 26. The outer side of the smaller piston 28 is exposed at all times to the pressure in the exhaust passage 26; the space between the two pistons 28 and 29 is at all times exposed to the pressure in the live steam passages 18 and 19; and the outer end of the larger piston 29 is exposed to the pressure of steam which is admitted to and released from it by the reversing valve 8, as hereinafter explained.

The main valve chamber 22 is always in open communication with the reversing-valve chamber 45 by means of the port 43 in the bushing 21, the passage 44, and the port 46 in the bushing 12.

The reversing valve 8 controls the three ports 47, 48, and 49 formed in the bushing 12, said ports connecting, respectively, with the passages 36, 40, and 38 formed in the outer side of the bushing 21. The passage 36 in the bushing 21 communicates with the exhaust passage 26 by means of the passage 37. The passages 38 and 40 both communicate, by means of the ports 39 and 41, with the space at that end of the chamber 22 which is closed by the cap 31. When the reversing valve is in the position shown in Fig. 1, the port 49 is closed and the cavity 42 in the face of the reversing valve by connecting the port 48 with the port 47 connects the passage 40 with the passage 36, and thereby opens communication from the outer end of the piston 29 to the exhaust passage 26. The outer face of each piston is then exposed to the pressure in the exhaust passage 26, and their inner faces are exposed to the live steam in the chamber 22 between the pistons, therefore, since the piston 29 has a larger area exposed to the action of the live steam than the piston 28 has, the two pistons 28 and 29 and the main slide valve 23 will be moved to the right, as shown in Figs. 2 and 3, or toward the cap 31. Before reaching the outer end of its stroke the piston 29 closes the port 41 and thereby confines a portion of the exhausting steam between the piston 29 and the cap 31. The port 41 is purposely formed a short distance from the end of the bushing 21, so that it will be closed by the piston before all of the steam has been exhausted from the end of the chamber, in order that the portion of steam thus confined may act as a cushion to the piston 29 as it approaches the end of its stroke. The movement of the piston 29 to the outer end of its stroke moves the main slide valve in the same direction, and opens the port 24, thereby admitting live steam to the under side of the main steam piston 3 and exhausting the steam from the upper side of the main piston through the passage 25, the cavity, 50, in the main valve, and the exhaust passage 26, thereby causing the main steam piston to move upward. When the main steam piston approaches the upper end of its stroke, the plate 6 comes in contact with the shoulder 9 on the stem 7, and effects the upward movement of the reversing valve, in which movement the reversing valve first closes the port 48 and cuts off communication between the port 41 and the exhaust passage 36, and as the valve moves farther upward, it opens the port 49 through which live steam passes into the passage 38 in the bushing 21, and through the port 39 into the space at the outer side of the piston 29. The steam thus admitted to the piston 29 overbalances the steam pressure on the inner side of the same piston, and the pressure of the live steam on the inner side of the smaller piston 28 being opposed only by the pressure in the exhaust passage 26 acting on the outer side of piston 28, causes the pistons and the valve 23 to move toward the head 30 and put the passage 24 from the lower end of the main steam cylinder in communication with the exhaust passage 26 through the cavity 50 in the valve 23. At the same time the port 25 is opened and permits

live steam to pass from the chamber 22 to the upper end of the main steam cylinder, thereby causing the main steam piston to move downward. When the main piston approaches the lower end of its stroke the plate 6 comes in contact with the collar or shoulder, 14, on the stem 7 and moves the reversing valve down into the position shown in Fig. 1. The supply of steam to the space at the outer side of the piston 29 is then cut off and that space is put in communication with the exhaust passage 26, which permits the pressure of the live steam on the inner face of the piston 29 to move the two pistons 28 and 29 and the valve 23 so as to first cut off the exhaust from the lower side of the main piston, and then open the port 24 to admit live steam to the lower side of the main piston, and at the same time connect the passages 25 and 26 through the cavity 50, so as to open the upper side of the main piston to the exhaust passage. The main piston 3 then moves upward as before.

In order to hold the reversing valve down in the position shown in Fig. 1 and prevent its being moved upward before the plate 6 strikes the shoulder 9 the upper end of the stem 7 is exposed to live steam pressure in the chamber 51 when the main piston 3 is moving upward. The chamber 51, which is formed in the cap 53, communicates by means of the passage 52 with an annular groove 54 formed around the outside of the upper edge of the bushing 12. This annular groove is connected by means of a longitudinal groove, not shown, formed in the outside of the bushing 12, within another annular groove 55, formed around the lower end of the bushing, and the annular groove 55 is connected with the passage 24 by means of a passage 56 formed in the cylinder head, see Fig. 3. The chamber 51 will, therefore, always be exposed to the pressure in the passage 24 and below the main piston 3, and, when the main piston 3 is moving upward the piston stem 7 will be held down by live steam pressure, in the chamber 51, acting on its upper end, against the pressure of the exhaust acting on the other end. When the main piston 3 is moving downward the chamber 51 and the under side of the main piston 3 are exposed to the pressure in the exhaust passages; the reversing valve is then in its upper position and is held up by the pressure in the space above the main steam piston acting on the lower end of the stem against the pressure of the exhaust to which the upper end of the stem 7 is then exposed.

I claim as my invention and desire to secure by Letters Patent—

1. In a steam pumping engine, the combination, with a main steam cylinder, of a cylinder head, a main distribution valve working in a chamber in the head, a differential piston in said chamber, consisting of two pistons of different areas, connected to the main valve, one of the pistons being exposed at all times on one side to the pressure in the exhaust passage of the engine, and the other piston being exposed alternately to live steam pressure and to pressure in the exhaust passage, and a reversing valve controlling the supply to and release of steam from the latter piston, through separate ports said reversing valve being connected to a stem which extends centrally into the main steam cylinder and is moved directly by the main steam piston at the extremity of its stroke in either direction, substantially as set forth.

2. In a steam pumping engine, the combination with a main distribution valve, of a reversing valve controlling the movements of the main valve, and a stem connected to the reversing valve and moved in either direction by the movement of the main piston, said stem being alternately exposed to the pressure of live steam or exhaust steam at its opposite ends, whereby it is held in its proper position by live steam pressure until moved by the main steam piston, substantially as set forth.

3. In a steam pumping engine, the combination of a main distribution valve, and a differential piston connected thereto for moving said valve, a reversing valve controlling the supply of steam to the larger end only of said piston through a port opening into the end of the piston chamber, and the exhaust of steam through a separate port located some distance from the end of the piston chamber, whereby the piston may close the exhaust port before reaching the end of its stroke and thereby cause the piston to be cushioned, substantially as set forth.

In testimony whereof I have hereunto set my hand.

HENRY HERMAN WESTINGHOUSE.

Witnesses:

JOHN F. MILLER,

J. SNOWDEN BELL.