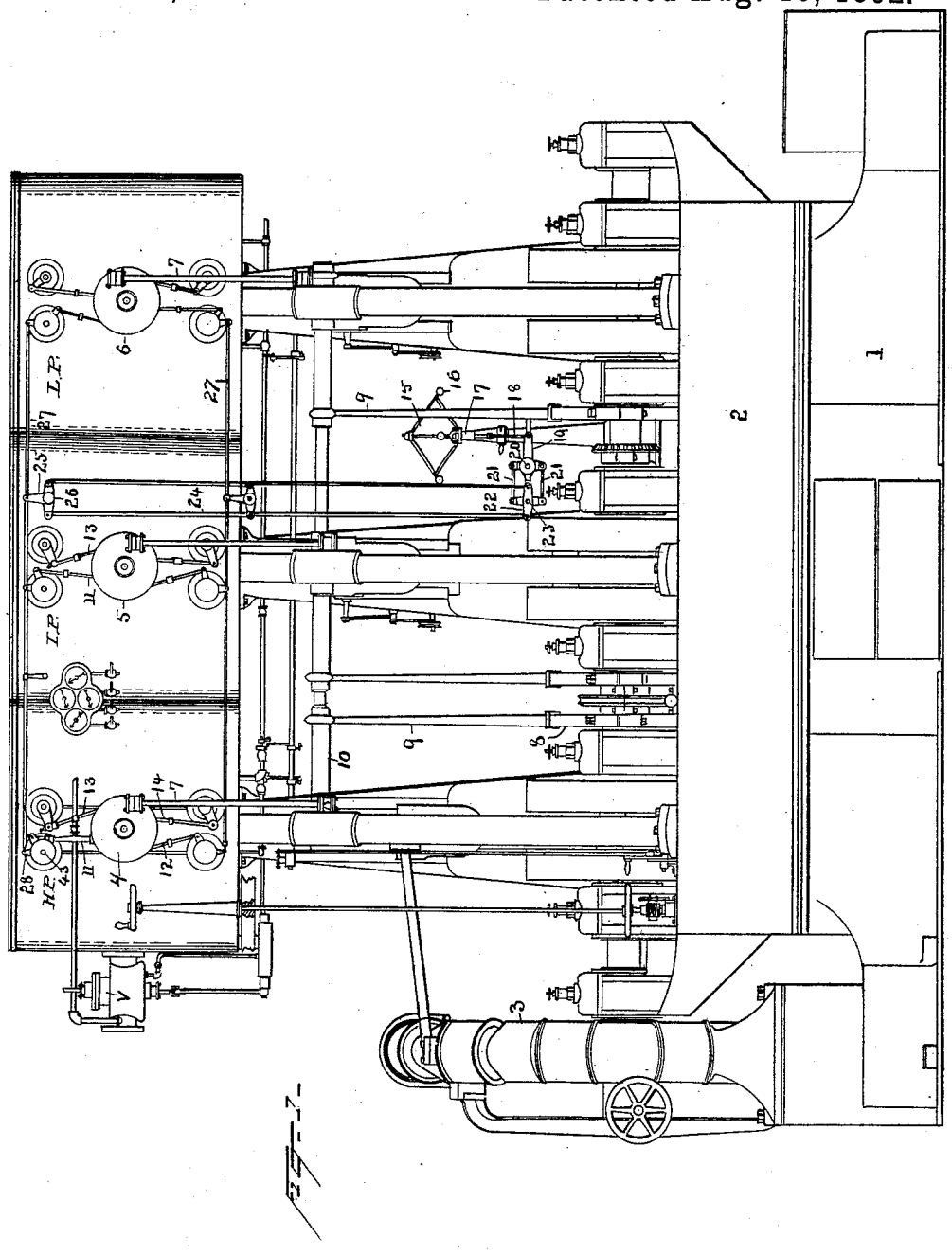
(No Model.) 4 Sheets—Sheet 1.

J. C. HENDERSON & F. A. PHELPS, Jr.

STEAM ENGINE.

No. 480,946. Patented Aug. 16, 1892.



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(No Model.) 4 Sheets—Sheet 2.

J. C. HENDERSON & F. A. PHELPS, Jr.

STEAM ENGINE.

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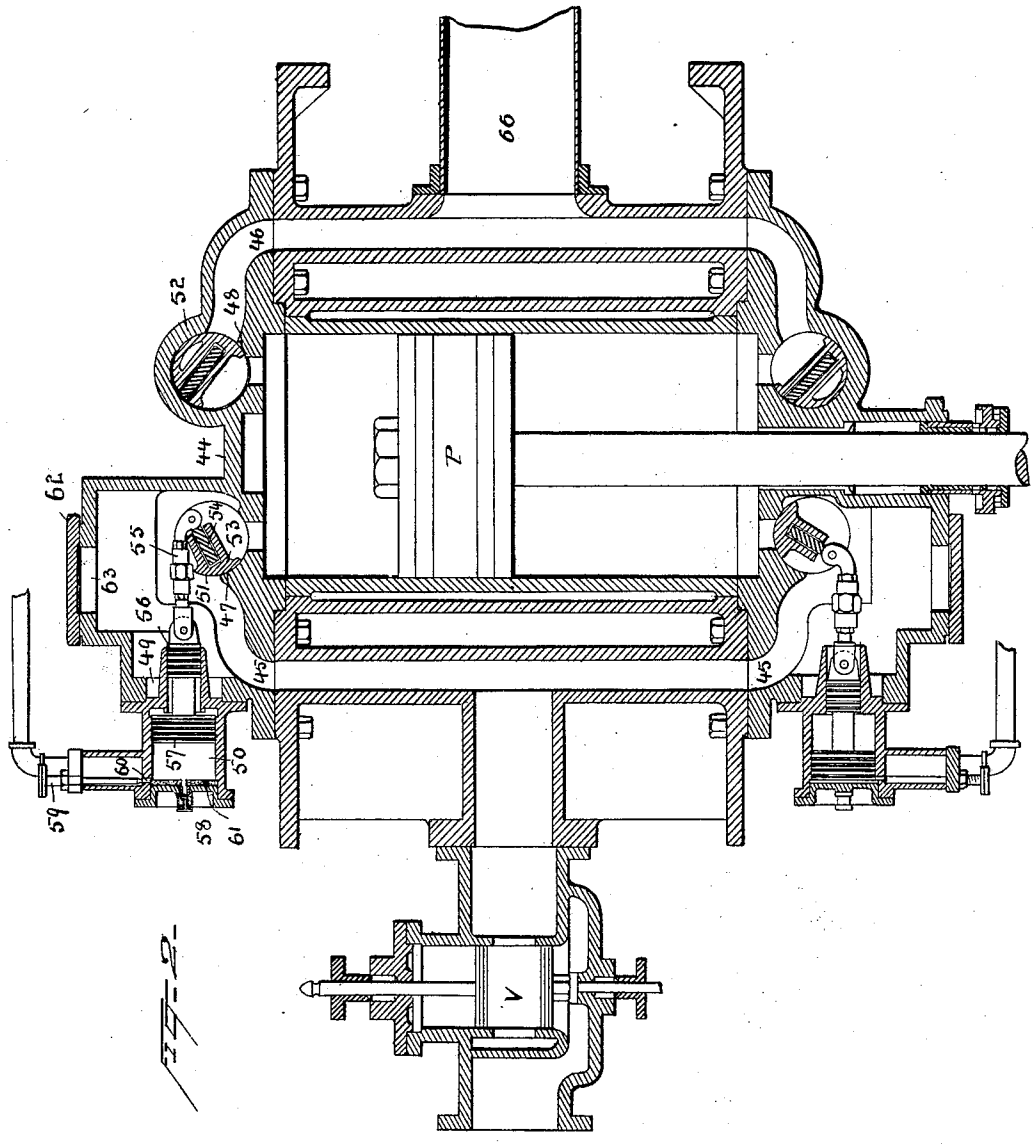

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(No Model.) 4 Sheets—Sheet 3.

J. C. HENDERSON & F. A. PHELPS, Jr.

STEAM ENGINE.

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Fig. 3.

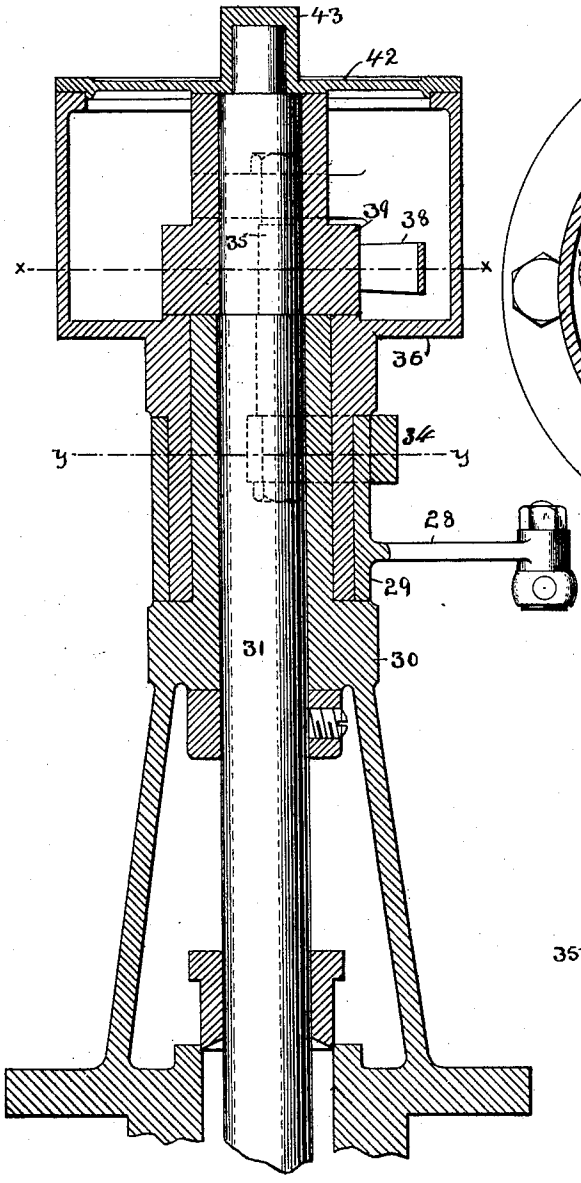


Fig. 4.

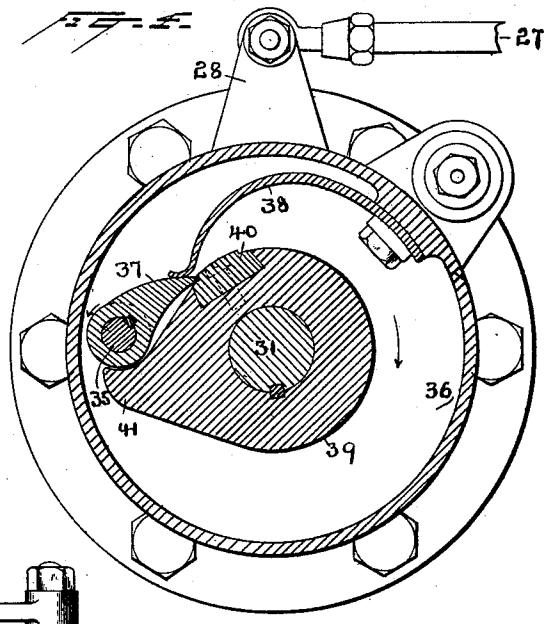
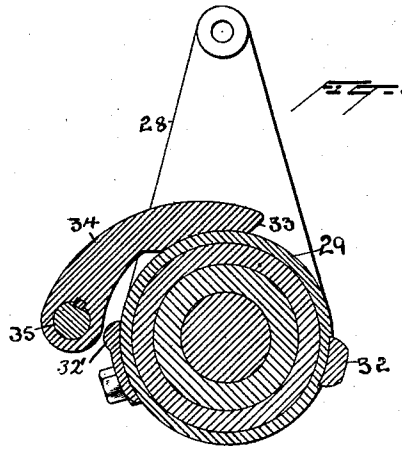


Fig. 5.



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(No Model.) 4 Sheets—Sheet 4.

J. C. HENDERSON & F. A. PHELPS, Jr.

STEAM ENGINE.

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Fig. 6.

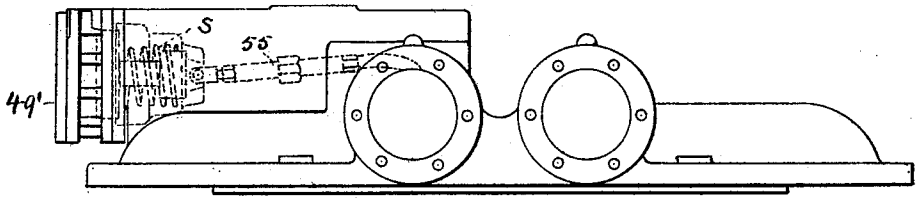


Fig. 7.

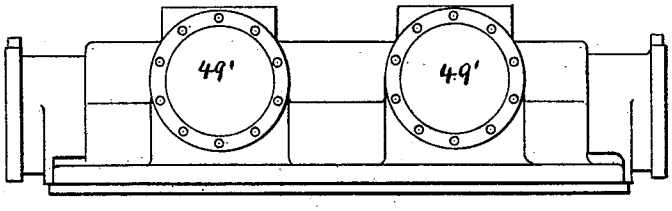
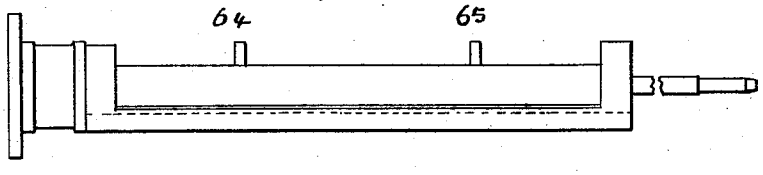


Fig. 8.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JOHN C. HENDERSON, OF NEW YORK, AND FREDERICK A. PHELPS, JR., OF SCHENECTADY, ASSIGNORS TO THE EDISON GENERAL ELECTRIC COMPANY, OF NEW YORK, N. Y.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 480,946, dated August 16, 1892.

Application filed October 26, 1891. Serial No. 409,905. (No model.)

To all whom it may concern:

Be it known that we, JOHN C. HENDERSON, residing at New York city, in the county of New York, and FREDERICK A. PHELPS, Jr., residing at Schenectady, in the county of Schenectaday, State of New York, citizens of the United States, have invented a certain new and useful Improvement in Steam-Engines, of which the following is a specification.

The present invention relates to means for controlling the valves of a steam-engine and to the arrangement of the valves and dash-pots.

One object of the invention is to provide an improved connection between the speed-governor of the engine and the valve or valves adjusted thereby, and especially in engines having several steam-valves all of which are controlled by a single governor.

Another object is to provide an improved arrangement of the valves whereby a shorter clearance of the piston is obtained, and whereby the construction of the valve-seats is simplified.

Another object is to furnish an improved tripping mechanism for releasing the valve at a proper point of the stroke of the engine.

A further object is to so arrange the valves and dash-pots relatively as to simplify the construction and improve the operation of said parts.

The invention consists in the several features and combinations hereinafter named.

In the drawing, Figure 1 is a general view of an engine having our improved devices thereon. Fig. 2 is a central section of the high-pressure cylinder, showing the improved arrangement of the valves and dash-pots. Fig. 3 shows one end of a valve-stem and the devices surrounding the same in section. Fig. 4 is a section on line $x\,x$ of Fig. 3. Fig. 5 is a section on line $y\,y$ of Fig. 3. Figs. 6 and 7 are side views at right angles to each other of the upper cover of the low-pressure cylinder, and Fig. 8 is a view of one of the steam-valves of the low-pressure cylinder.

The foundation-box 1, the bed-plate 2, and the arrangement of the dynamo or dynamos 3 need not be described in detail.

On the bed-plate is supported a three-cylinder engine, the positions of the high-pressure, intermediate-pressure, and low-pressure cylinders being indicated by the letters H P, I P, and L P, respectively.

V is the throttle-valve of the engine.

Suitably pivoted or journaled in front of the vertical faces of the cylinders are wrist-plates 4 5 6, which are oscillated or turned back and forth through a certain arc by the connecting-rods 7, which, in turn, are operated by the eccentrics 8, the eccentric-rods 9, and suitable rocker-arms extending from the shaft 10, and to the ends of which the eccentric-rods 9 are connected in the usual manner. From the wrist-plates extend connecting-rods 11 to the upper steam-valves, similar rods 12 to the lower steam-valves, and rods 13 14 to the upper and lower exhaust-valves, the connections between said rods and valves being shown more fully in Figs. 3, 4, and 5, hereinafter described.

15 is a speed-governor, preferably provided with four weights 16 and having a sliding collar 17 connected to the rod 18, the lower end of which is connected to the T-lever 19, pivoted at 20. From the ends of the cross-head of this lever extend connecting-rods 21 to the vertical arm of a +-shaped lever 22, pivoted at 23. From the opposite ends of the horizontal arm of this lever extend two rods or connecting devices 24, the upper ends being connected to the opposite ends of one or more T-shaped levers 25, each of which is centrally pivoted, as indicated at 26.

Connected with the outer end of the vertical extension of the T-lever or T-levers is a rod, or are rods, 27, extending to the arm or arms 28, through which the valve-trips are operated. Said arm 28 forms an extension from the sleeve 29, which is mounted upon and adapted to turn on a bearing formed by the valve-bracket 30, which surrounds the valve-stem 31. The sleeve 29 carries two cams or trips 32 32′, the former of which is adapted to ride under the beveled ends 33 of the trip-toe 34, which is secured to the shaft 35, which shaft extends through the wall 36 of the casing at the end of the valve-stem, and carries at its opposite end

a pawl 37, which pawl is pressed by spring 38, carried by the casing 36, against the periphery of the sleeve 39, which is keyed to the valve-stem. At one point in the sleeve 39 is firmly secured a hard-metal block 40, against which the pawl 37 engages when the extension 41 of the sleeve rests in the position shown. In this position of the several parts the valve carried by the stem 31 will be closed. 42 is an end cover for the casing 36, having a central bearing 43, in which the end of the valve-stem rests.

Referring now to Fig. 2, the arrangement of the valves and dash-pots will be specifically described. 44 is a head of the high-pressure cylinder, and in it are formed valve-ports 45 46, valve-seats 47 48, and an opening or seat 49 for a dash-pot 50. The valve-seats are adapted to receive Corliss or rotary valves. 51 is the steam-valve and 52 the exhaust-valve, said valves consisting of main bodies 53, having grooves for the reception of the blades 54, which blades are provided with circular stems 31, as indicated in Fig. 3. To the upper edge of the blade 54 of the steam-valve is secured the adjustable link 55, the outer end of which is pivoted to the dash-pot piston 56, which is always in communication with the steam-chamber, as shown. The piston 56 is connected with a larger air-piston 57, moving in the dash-pot cylinder, adapted to retard and regulate the movement of the valve. 58 is a small spring-controlled safety-valve, and 59 is a screw, the point of which extends into the opening 60 for the purpose of adjusting the opening through which air can escape. As shown, the seat for the dash-pot is cast integral with the cylinder-head and the dash-pot itself is bolted thereto. 61 is an elastic sheet of suitable material at the outer end of the dash-pot to receive the stroke of the piston should it for any reason strike the end of the cylinder. 62 is a cover over a hand-hole 63 to provide means for getting at and adjusting the length of the link 55 when necessary. No dash-pot is connected to the exhaust-valve. The arrangement of parts at the lower end of the cylinder will be practically the same as that above described, and the arrangement of the valves and dash-pots at the intermediate cylinder will be practically the same and need not be described in detail. At the low-pressure cylinder the heads will be of slightly-different form, as indicated in Figs. 6 and 7. Owing to the size of this cylinder, the heads will be large and the valves will be long, and in order to make their operation more certain and even we may provide one or more dash-pots for a single valve, one dash-pot being connected to the valve at the lug 64 and one being connected to the same stem at 65. The two dash-pots are placed side by side at 49′, as shown in Fig. 7. Between the high-pressure, intermediate-pressure, and low-pressure cylinders pipes 66 extend from the exhaust-passage of one cylinder to the steam-passage of the succeeding cylinder. These pipes and passages, which are quite large, form steam-reservoirs. When the throttle-valve is first opened, live steam is admitted to the steam-ports 45 of the first cylinder, moving the piston P down, the upper steam-valve being open. The movement of the engine caused by this movement of the piston will turn the wrist-plates 4, carrying sleeve 36 around toward the right, at the same time carrying the pawl 37 forward, turning the valve-stem 31 until the toe 33 at the opposite end of the shaft 35 from the pawl 37 rides up on cam 32. This turns the shaft 35 and raises pawl 37 out of engagement with the block 40. The steam-pressure on piston 56 is thus allowed to operate to move the piston toward the left, closing the valve. It will be understood that the steam-valve at the bottom of the cylinder is controlled in the same manner, but is closed when the upper valve is open. The two exhaust-valves are also controlled in accordance with the positions of the steam-valves. As the engine gets under way the speed-governor 15 will operate to turn the sleeve 29 to a greater or less extent, thereby varying the distance between the end 33 and the cam 32, and hence controlling the time at which steam will be cut off from the cylinder. If from any cause the governor should become defective or the means for driving it disarranged, the governor-balls would fall and would move trip 32′ around under pawl 34, and retain it there so that the cam on the valve-stem would not engage with block 40 and the valve would therefore not be moved to open position. The valves at the intermediate and low pressure cylinders will simultaneously be operated. The three pistons are preferably connected through suitable connecting-rods and pitmen to cranks at one hundred and twenty degrees apart on the engine-shaft. By using the double arrangement of rods 21 24, one of each of said rods acting as a push-rod and the other as a pull-rod, we find that we can transfer motion from the governor to the trip mechanism much better than by means heretofore used. When a single transmitting-rod is used it must be large enough to be rigid, so as not to bend when acting by thrust movement. In our present arrangement the transmitting device always acts with both a thrust and a pull, and there is no danger of lost motion. The trip herein described is easily controlled by the governor, since all the work necessary to be done thereby is that required to turn the sleeve 29 on the large cylindrical bearing provided for it. By mounting the valves in the heads of the cylinders the ports directly face the piston, instead of coming in at the side of the cylinder close to its end. Hence, as already indicated, the clearance of the piston can be reduced, and since the heads of the cylinder are comparatively small and easily-handled parts it is more convenient to form the valve-seats than when they are made in the cylinder itself. The valves are also more accessible

and are more readily connected to their dash-pots. By connecting two dash-pots to the valve when it is long enough to require it all straining of the valve is avoided and sufficient power is obtained to close the valve promptly. In some cases it may be desirable to employ a spring S, Fig. 6, to aid in the operation of the low-pressure dash-pot in order to have the operation prompt when the engine is first started.

What we claim is—

1. The combination of a speed-governor, a valve the operation of which is controlled by said governor, and means for transferring motion from the governor to the valve mechanism, said means having a pivoted arm adapted to be tilted by the governor, two rods or connecting devices extending from the arm on opposite sides of its pivot, whereby one acts as a pull-rod and the other as a push-rod, a second pivoted arm, to which the two rods are connected on opposite sides of its pivot, and a working connection between the same and the valve mechanism, substantially as described.

2. The combination of a speed-governor, one or more valves the operations of which are controlled by said governor, and means for transferring motion from the governor to the valve mechanism, said means having a pivoted arm adapted to be tilted by the governor, the two rods extending from the arm on opposite sides of its pivot and one or more other pivoted arms, to which the two rods are connected, and working connections between said arm or arms and valve mechanism, substantially as described.

3. The combination of a steam-valve mechanism, a speed-governor, and means for transferring motion from the governor to the valve mechanism, said means having two pivoted arms connected by rods on opposite sides of the pivots, one of the arms being provided with two angular extensions, rods connected thereto and to a T-shaped lever, one arm of which is connected to the movable part of the governor, the other pivoted arm having an extension, and a rod connected thereto and to the controlling device of the valve mechanism, substantially as described.

4. The combination of a cylinder, a head therefor having in it a valve port and seat, a valve in said seat, and a dash-pot, also on the cylinder-head, connected to the valve, substantially as described.

5. The combination of a cylinder, a head therefor having in it a valve port and seat, a rotary valve in said seat, and a steam-operated dash-pot, also on the cylinder-head, connected to the valve, substantially as described.

6. The combination of a cylinder, a head therefor having in it a valve port and seat, a valve in said seat, and a dash-pot, also on the cylinder-head, connected to the valve, said cover being provided with a hand-hole, and a cover therefor, whereby access may be obtained to the valve and dash-pot connection, substantially as described.

7. The combination of a valve and stem, a pawl operatively connected to said stem, a sleeve on the stem, a connecting-rod for moving said sleeve, pawl, and valve in one direction, a second sleeve on the stem operatively connected to the governor, a cam on said sleeve, a trip-toe adjacent to said sleeve and adapted to be moved by the cam, the toe and pawl being connected by a shaft 35, so as to move together, and means for reversing movement of the valve when said trip is operated, substantially as described.

This specification signed and witnessed this 17th day of October, 1891.

JOHN C. HENDERSON.

Witnesses:
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ARPAD VON BARBER.

This specification signed and witnessed this 20th day of October, 1891.

FREDERICK A. PHELPS, JR.

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