(No Model.) 3 Sheets—Sheet 1.

E. F. SPAULDING.

VALVE FOR STEAM ENGINES.

No. 572,579. Patented Dec. 8. 1896.

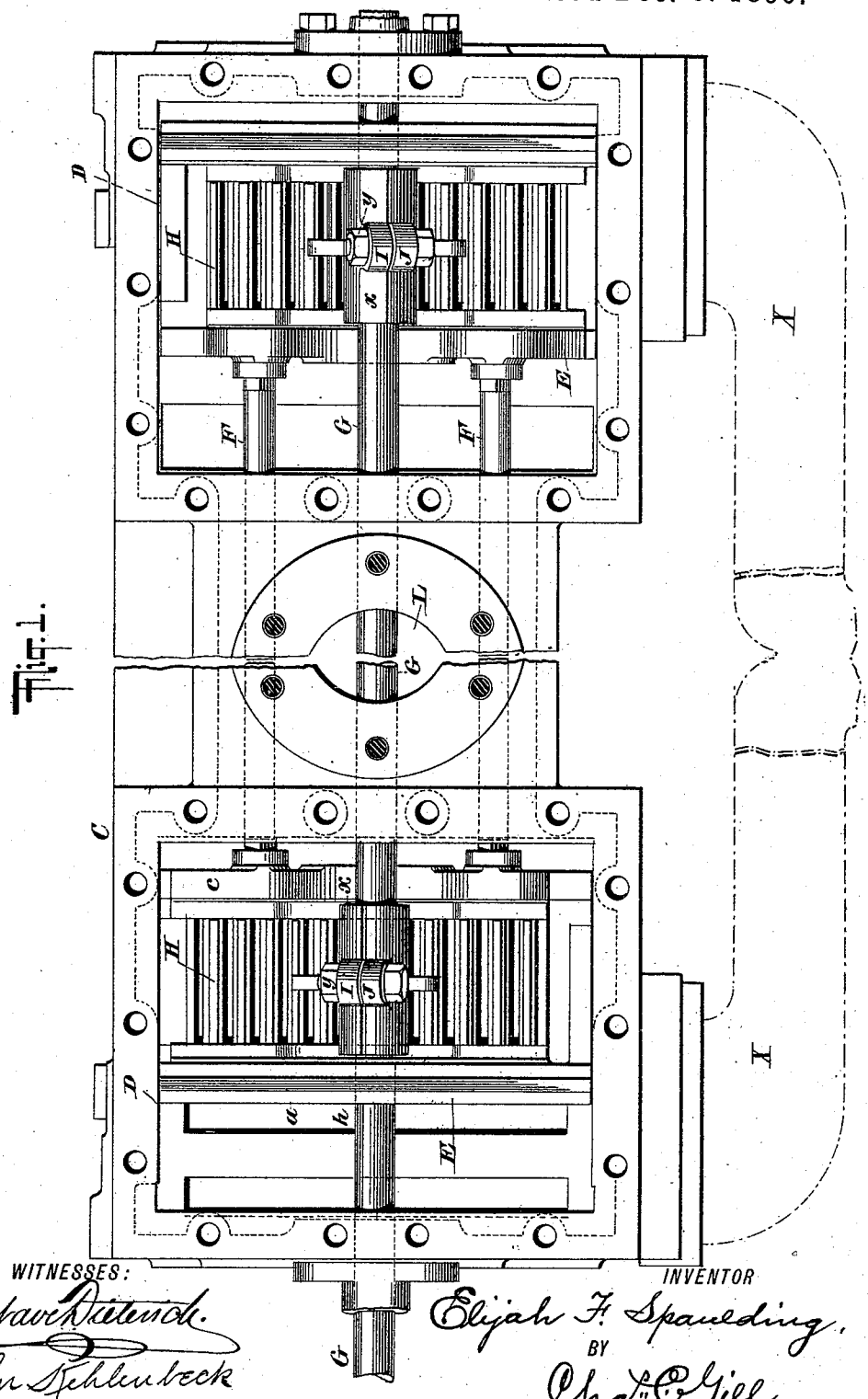

Fig. 1.

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Fig. 2.

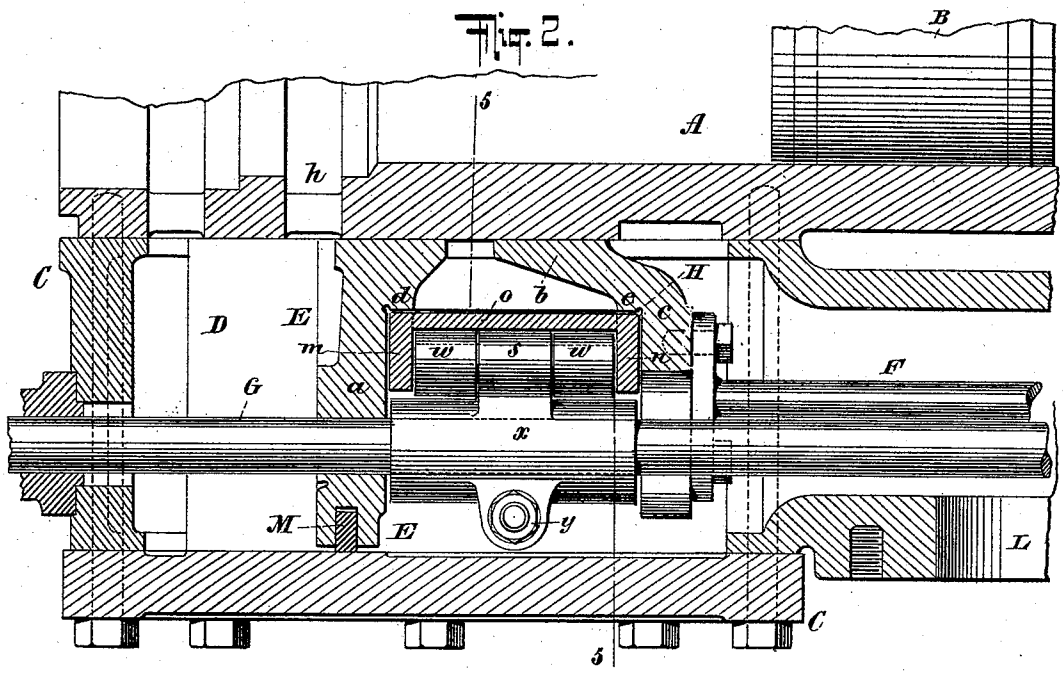

Fig. 3.

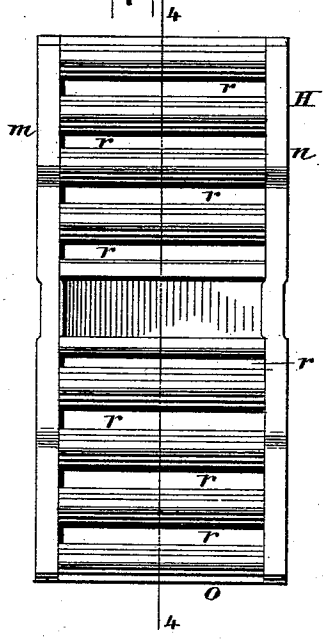

Fig. 4.

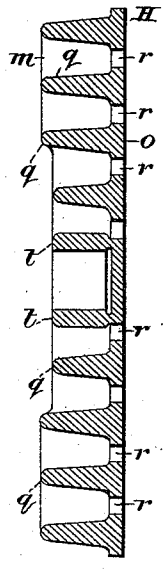

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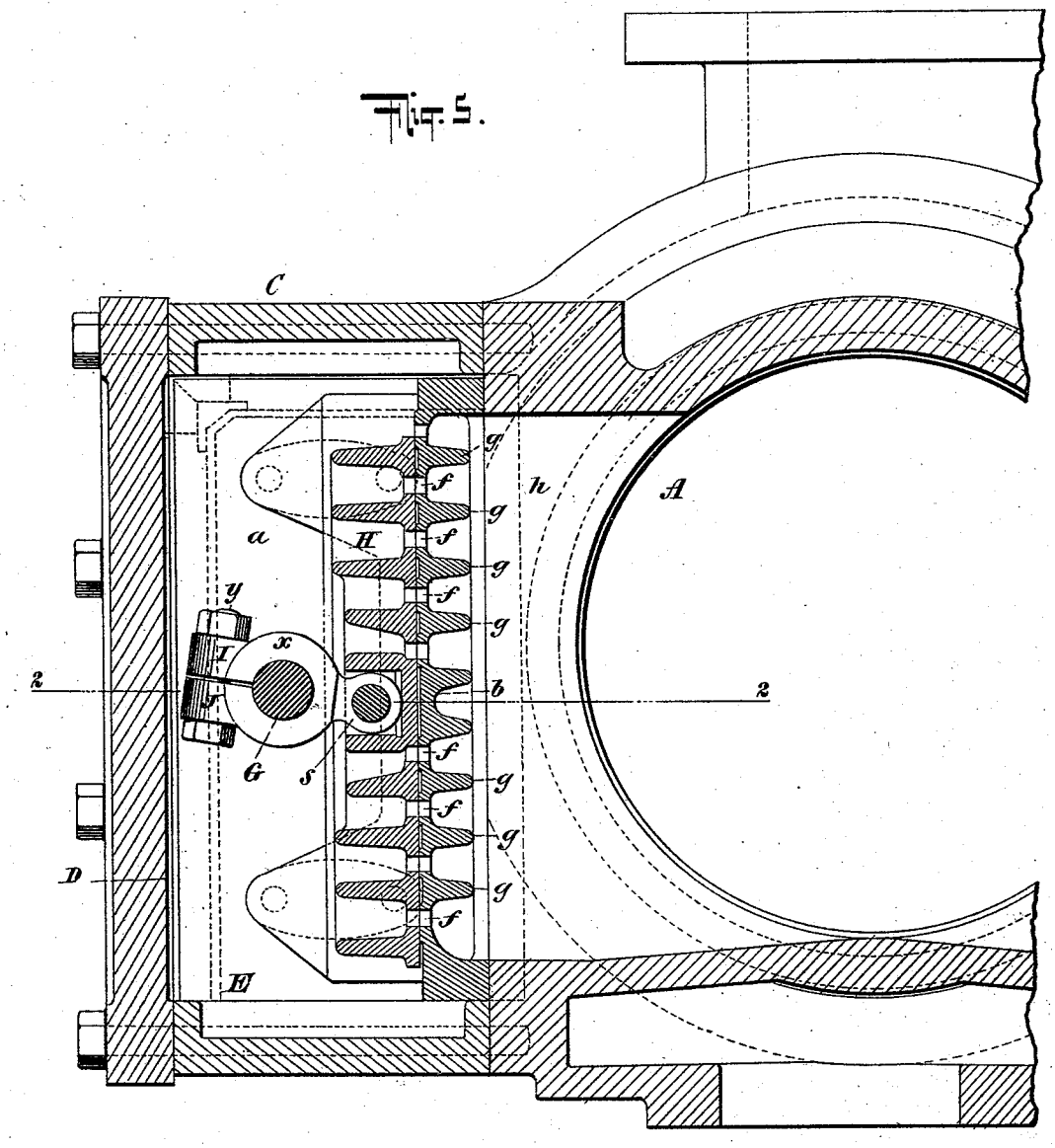
Fig. 5.



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UNITED STATES PATENT OFFICE.

ELIJAH F. SPAULDING, OF BOUND BROOK, NEW JERSEY, ASSIGNOR TO THE AMERICAN ENGINE COMPANY, OF SAME PLACE.

VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 572,579, dated December 8, 1896.

Application filed April 10, 1896. Serial No. 586,924. (No model.)

To all whom it may concern:

Be it known that I, ELIJAH F. SPAULDING, a citizen of the United States, and a resident of Bound Brook, in the county of Somerset and State of New Jersey, have invented certain new and useful Improvements in Valves for Steam-Engines, of which the following is a specification.

The invention relates to improvements in valves for steam-engines, and pertains particularly to valves located within the steam-chest.

In accordance with my invention I provide within the steam-chest a slide-valve which has a uniform longitudinal reciprocation, and within this valve is located an inner or cut-off valve which has no independent longitudinal reciprocation, but simply at the proper time a vertical reciprocation, the exact time at which this cut-off valve is to act being variable and under the control of the governing devices.

The form and construction of both the slide-valve and the cut-off valve are new and constitute the present invention, as hereinafter described and particularly pointed out in the claims.

The invention will be more fully understood from the detailed description hereinafter presented, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of the valve-chest of a steam-engine containing the slide and cut-off valves constructed in accordance with and embodying the invention, the outer face of the valve-chest being removed to expose the valves located within the said chest. Fig. 2 is an enlarged horizontal longitudinal section of one end of the valve-chest and the valves therein on the dotted line 2 2 of Fig. 5. Fig. 3 is an enlarged detached face view of the outer side of the cut-off valve removed from the valve-chest. Fig. 4 is a vertical section of same on the dotted line 4 4 of Fig. 3, and Fig. 5 is an enlarged vertical transverse section on the dotted line 5 5 of Fig. 2.

In the drawings, A designates the steam-cylinder, B the customary piston therein, and C the valve-chest. At opposite ends of the valve-chest C are formed the chambers D, within which the corresponding heads E E, constituting the slide-valve, have their longitudinal reciprocating movement. The heads E, constituting the slide-valve, are connected together by the rods F and are mounted upon the valve-rod G, the longitudinal motion of which is imparted to the slide-valve and the axial motion of which operates the cut-off valves to have their transverse reciprocation. The heads E E, constituting the slide-valve, move together and correspond with one another, and hence in Figs. 2 to 5, inclusive, but one of said heads is illustrated.

Each head E is formed of the three sides *a b c*, the sides *a c* being at substantially right angles to the longitudinal line of the cylinder A and the side *b* being parallel with said cylinder. The outer surface of the side *b* is provided adjacent to the sides *a c* with the shoulders *d e*, between which said side *b* is formed with the openings *f* and ribs *g*, the said openings and ribs being more clearly illustrated in Fig. 5. The purpose of the openings *f* through the side *b* is to permit, at the proper time, steam to enter the cylinder A through the usual ports *h* at the ends thereof.

Between the sides *a c* of the heads E and arranged in face-contact with the outer surface of the side *b* of said heads are placed the cut-off valves H, the form and construction of which are clearly illustrated in Figs. 3, 4, and 5, in which it will be seen that each cut-off valve H is composed of the three sides *m n o*, the sides *m n* being connected by the ribs *q*, and the side *o* being provided with the series of slots or openings *r*, which, when the cut-off valve is in position in the head E, may be brought into alinement with the openings *f* in said head for the purpose of permitting a clear passage of the steam through the cut-off valve and said openings *f* to the port *h* and cylinder A. At the longitudinal center of the cut-off valve H are the partitions *t*, between which are placed the outer end of the sleeve *s* and the sleeves *w w*, which latter sleeves are mounted upon the ends of a pin passing through said sleeve *s*, as illustrated more clearly in Figs. 2 and 5. The sleeve *s* is integral with and constitutes in effect an arm projecting inward from the split sleeve *x*, which is mounted upon the valve-

rod G between the sides *a c* of the head E, being there secured by the bolt *y* passing through the ears I J, which are integral with the opposite parts of said sleeve *x*. The sleeve *x* by means of the ears I J and bolt *y* may be adjustably secured upon the valve-rod G, and the purpose of said sleeve *x*, with its parts engaging the partitions *t t* of the cut-off valve H, is to enable the rod G when having an axial motion to impart to the cut-off valve H a vertical reciprocating motion against the outer face of the side *b* of the head E.

The purpose of imparting the vertical reciprocating motion to the cut-off valve H may be fully understood when reference is made to Fig. 5, in which it will be seen that the cut-off valve H is in its lower position and that the openings *r* thereof are in alinement with the openings *f* in the said side *b* of the head E. When the cut-off valve is in the position shown in Fig. 5, the steam which enters the valve-chest through the opening L may pass directly through the openings *r f* in the cut-off valve H and head E. The axial movement of the valve-rod G will cause the cut-off valve H to ascend and at the proper time the solid portions of its side *o* will cover the openings *f* in the head E and cut off the steam from passing through said openings *f* to the cylinder A. The valve H while moving with the head E is adapted to have a vertical reciprocating motion for the purpose of opening or closing the openings *f*. When the openings *f* are permitted to be open, the steam may pass through them, and when said openings are closed by the valve H the steam will be cut off from the cylinder. The valve-rod G has a uniform reciprocating motion and imparts this motion to the heads E, and at the same time the said valve-rod G has a variable axial motion for the purpose of cutting off the steam from the cylinder A by means of the cut-off valves H at the proper time and under the influence of the governing devices.

When the head E at the left on the valve-rod G is in position to admit steam through the port *h* to the cylinder A, the head E at the right hand on said valve-rod will be removed from its port *h*, and at such time the steam at the right-hand end of the cylinder may exhaust into the outer end of the chamber D at the right-hand end of the valve-chest, which chamber connects with the usual exhaust H, and when the head E at the right-hand end of the valve-rod has its ports *f* uncovered and in position to admit steam through the port *h* at the right-hand end of the cylinder A the head E at the left hand will be removed from the port *h* at the left-hand end of the cylinder A, and at such time the steam at the left-hand end of the cylinder A may exhaust into the outer end of the chamber D at the left-hand end of the valve-chest, which, as customary, is connected with the usual exhaust. The live steam completely fills the valve-chest between the heads E E of the slide-valve and enters between the sides *a c* of said heads, and hence, whenever the openings *f* of the heads E are uncovered and in line with the ports *h* at the ends of the cylinder A the live steam will pass directly into the cylinder. The heads E are provided with the packing-strips M, which prevent the live steam from passing around said heads to the exhaust.

Upon reference to Fig. 5 it will be seen that the upper half of the head E at the left-hand portion of the valve-chest contains in its side *b* one more opening or port *f* than the lower half of said head. The head E at the right-hand end of the valve-rod G will contain in its lower half one more opening *f* than in its upper half, and hence it is that both of the cut-off valves H may be operated from the one valve-rod G. When the cut-off valve H at the left-hand end of the valve-chest is in its lower position, as shown in Fig. 5, admitting steam through the openings or ports *r f* to the port *h*, leading into the left-hand end of the cylinder A, the cut-off valve H at the right-hand portion of the valve-chest will be in its upper position, closing the ports *f* in the right-hand head E. Thus it will be understood that when one cut-off valve H is descending to open the ports *f* in line with it the other cut-off valve H will be closing the ports *f* in its head. The cut-off valves H do not, preferably, have a sudden movement, but have a gradual vertical reciprocation during the longitudinal reciprocation of the heads E.

As above described, the action of the cut-off valves H is variable in order that the steam may be cut off from the cylinder A at the desired moment under the control of the governing devices.

The valve-rod G may be connected with the heads E, so as to reciprocate the same, by any suitable means, and in the present instance the sleeve *x* on said valve-rod fitting between the sides *a c* of said heads enables the valve-rod to effect the longitudinal reciprocating movement of said heads. The means of connection between the heads E and valve-rod G must also be such as to enable said rod to have an axial movement in order that it may at the proper time, regulated by the governing apparatus, move the cut-off valves H to open and close the ports to the cylinder. The valve-gear for operating the slide-valve (composed of the heads E E) and cut-off valves H will be of any suitable character, and as disclosing an example of satisfactory gear for this purpose attention is called to Letters Patent of the United States No. 385,533, granted to me on July 3, 1888. The present invention is not confined, however, to any special form or construction of valve-gear.

As above described, the heads E E, composing the slide-valve, have a simultaneous and uniform longitudinal reciprocation, while the cut-off valves H have simply, with re-

spect to their seats and coöperating ports, a vertical reciprocation. The vertical reciprocation of the cut-off valve H is variable as to time of action under the control of the governing devices, while the traverse of the heads E E, composing the slide-valve, is invariable.

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

1. In a steam-engine, the valve-chest having the chambers at its opposite extreme ends connected with the exhaust, and the reciprocating slide-valve in said chest and composed of the connected heads each comprising the sides *a*, *c*, *b*, the latter having the series of openings *f*, and the former the packing-strips M, combined with the cut-off valves having the openings *r* and arranged in contact with said side *b* between the sides *a*, *c*, and adapted to have a transverse reciprocation, while said heads have a longitudinal reciprocation, and the valve-rod connected with said heads and said cut-off valves; substantially as set forth.

2. In a steam-engine, the valve-chest having the chambers at its opposite extreme ends connected with the exhaust and having also the central inlet for steam, the reciprocating slide-valve in said chest and composed of the heads E, E, located within the chambers at the opposite ends of said chest and each comprising the sides *a*, *b*, and the side *c* having the openings *f*, the rods F connecting said heads, and the packing-strips M in said sides *a*, combined with the cut-off valves having the openings *r* and arranged in contact with said side *b* between the sides *a*, *c*, and adapted to have a transverse reciprocation, while said heads have a longitudinal reciprocation, and the valve-rod connected with said heads and said cut-off valves; substantially as set forth.

3. In a steam-engine, the valve-chest having the chambers at its opposite extreme ends connected with the exhaust and having also the central inlet for steam, and the connected heads E, E, located in said chambers and leaving the space between them entirely open for live steam, said heads being provided with packing at their outer edges to prevent the live steam from reaching the exhaust, and with the series of ports adapted to communicate with the usual ports leading to the cylinder, and said heads being of a size to completely close said chambers in a transverse direction, combined with the cut-off valves having a transverse reciprocation and provided with ports which may be moved into alinement with or out of alinement from the ports in the said heads constituting the slide-valve, and the reciprocating valve-rod connected with said slide and cut-off valves and adapted to turn axially and thereby operate the latter; substantially as set forth.

4. In a steam-engine, the steam-chest having the chambers at its extreme ends connected with the exhaust and having also the central opening for steam, and the reciprocating slide-valve in said chest and composed of the connected heads each comprising the sides *a*, *c*, *b*, the latter having the series of openings *f* and the former extending entirely across between all the adjacent walls of said chest to cut off the live steam from the exhaust, while the sides *c* permit the live steam filling all the central part of the steam-chest to pass outward beyond them, combined with the cut-off valves having the openings *r* and arranged in contact with said side *b* between the sides *a*, *c*, and adapted to have a transverse reciprocation, while said heads have a longitudinal reciprocation, and the valve-rod connected with said heads and said cut-off valves; substantially as set forth.

5. In a steam-engine, the reciprocating slide-valve composed of the heads E, E, each comprising the sides *a*, *c*, *b*, the latter having the series of openings *f*, combined with the cut-off valves H having the ports or openings *r* and arranged against said side *b*, the reciprocating valve-rod G connected with said heads E, the sleeves *x* secured upon the said valve-rod between said sides *a*, *c*, and the sleeves *s* integral with said sleeves *x* and carrying the pins and sleeves *w*, said sleeves *s*, *s*, *w*, being seated in said slide-valves, and said valve-rod being adapted to reciprocate said slide-valve and also to impart a transverse reciprocating motion to said cut-off valves; substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 6th day of April, A. D. 1896.

ELIJAH F. SPAULDING.

Witnesses:
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E. JOS. BELKNAP.