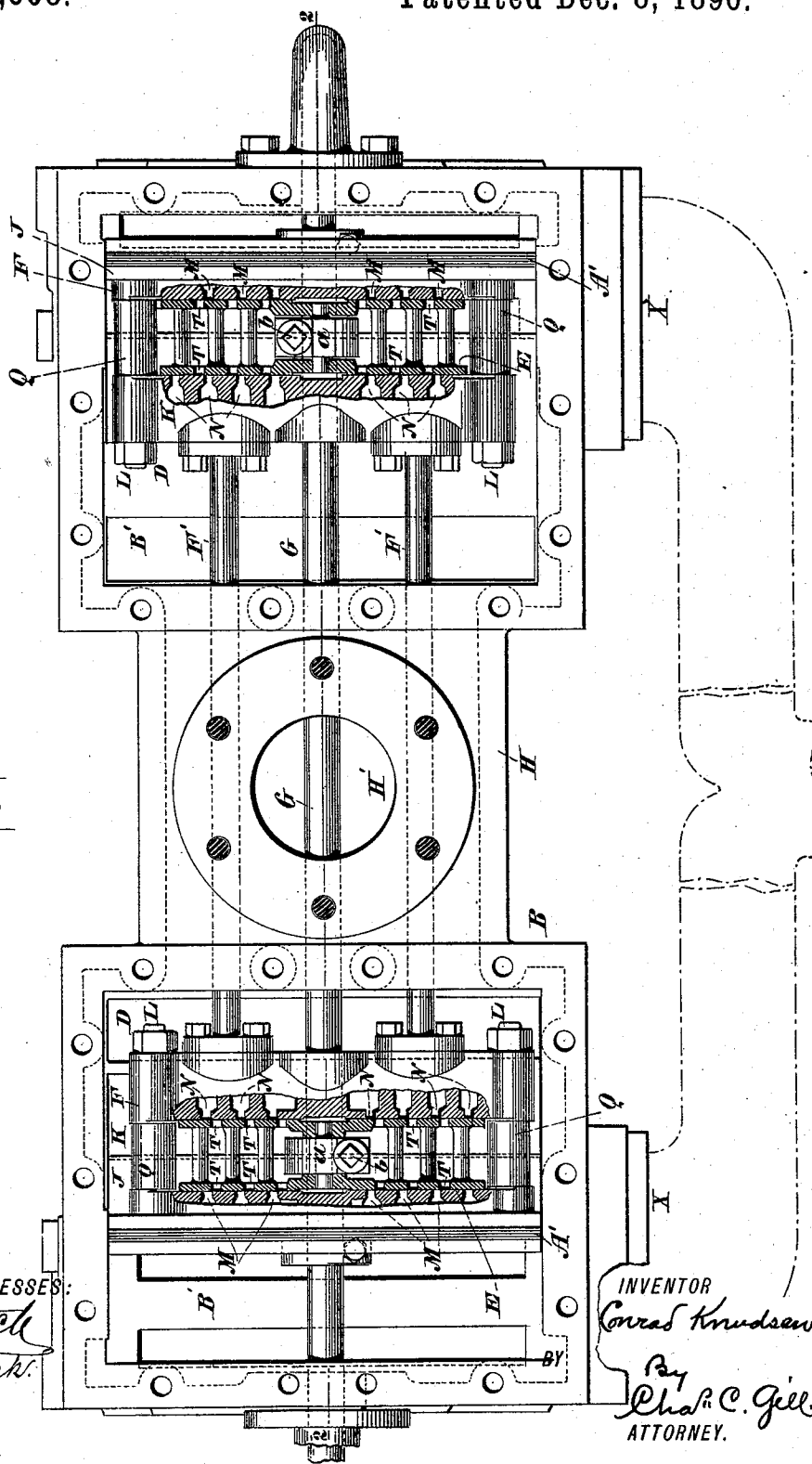


C. KNUDSEN.
VALVE FOR STEAM ENGINES.

No. 572,608.

Patented Dec. 8, 1896.

Fig. 1.



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(No Model.)

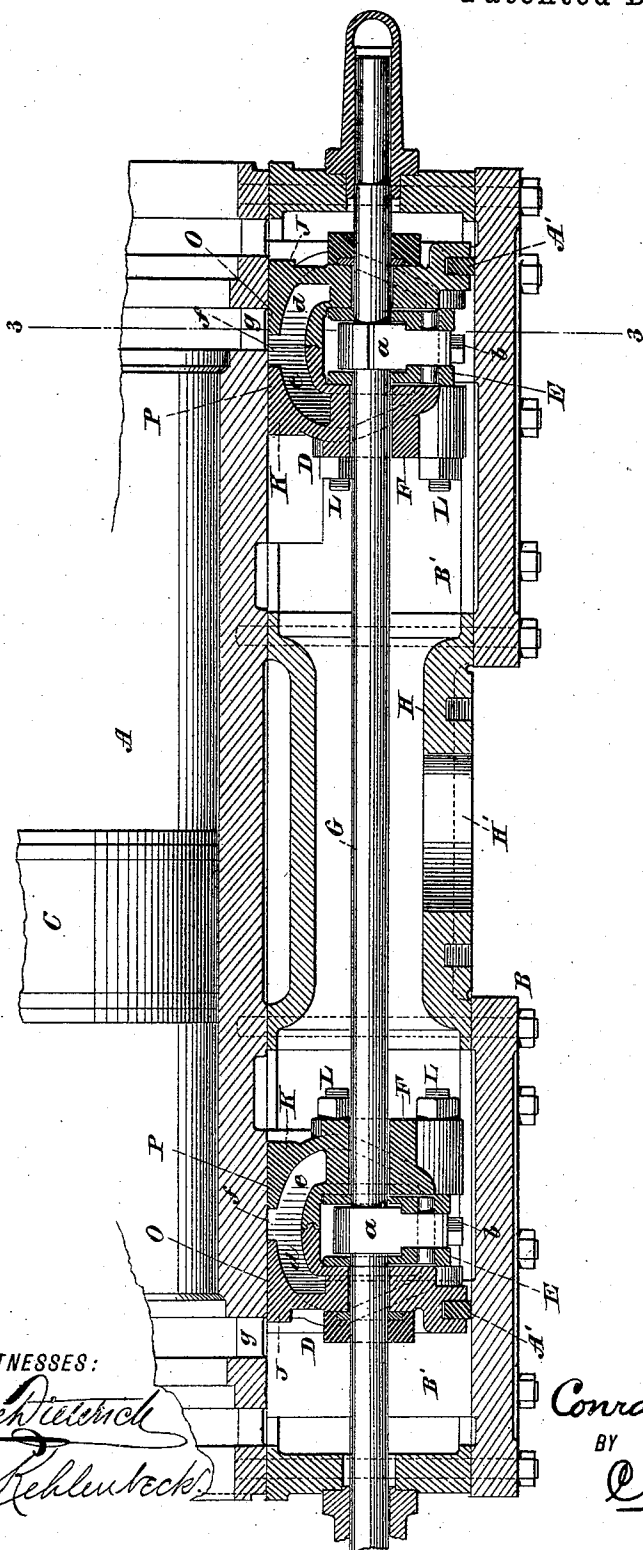
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Fig. 2.



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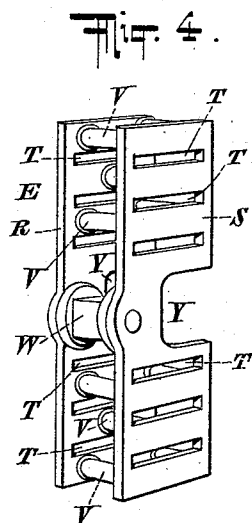
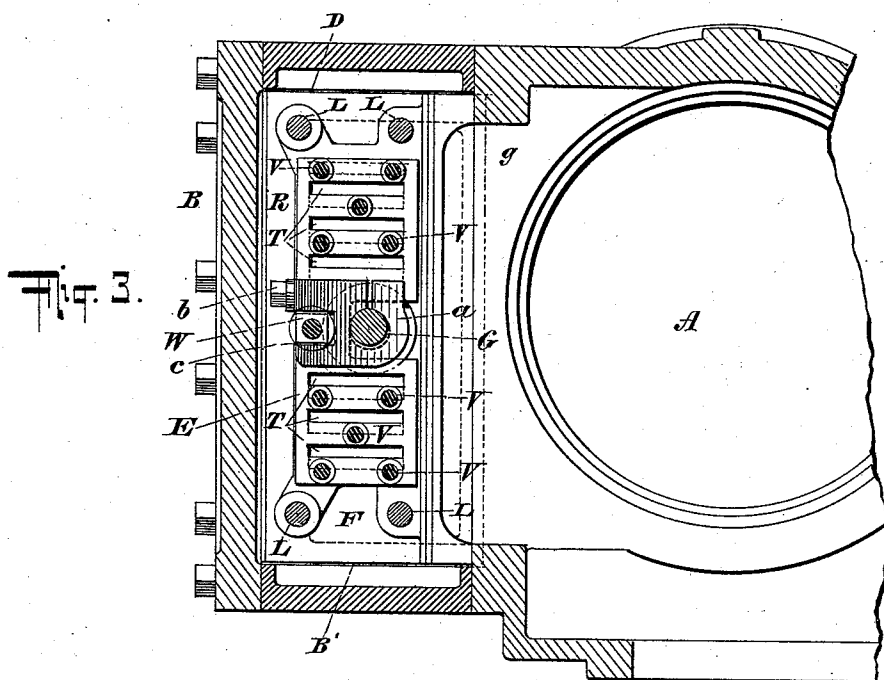
(No Model.)

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VALVE FOR STEAM ENGINES.

No. 572,608.

Patented Dec. 8, 1896.



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UNITED STATES PATENT OFFICE.

CONRAD KNUDSEN, 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. 572,608, dated December 8, 1896.

Application filed April 10, 1896. Serial No. 586,905. (No model.)

To all whom it may concern:

Be it known that I, CONRAD KNUDSEN, 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 longitudinal reciprocation, but simply at the proper time a vertical transverse 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 a part of the present invention, which in its broader scope is not limited to details of construction except as hereinafter described, and 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 a steam-chest containing slide and cut-off valves constructed in accordance with and embodying the invention, the outer face of the steam-chest being removed and the outer portions of the slide and cut-off valves being partly broken away and in section for clearness of illustration. Fig. 2 is a central horizontal longitudinal section of same on the dotted line 2 2 of Fig. 1. Fig. 3 is a vertical transverse section through a portion of same on the dotted line 3 3 of Fig. 2; and Fig. 4 is a detached perspective view of one of the cut-off valves.

In the drawings, A designates the steam-cylinder, B the steam-chest, and C the customary piston.

The longitudinally-reciprocating slide-valve within the steam-chest B is designated by the letter D, and the cut-off valves within the opposite heads F F of the slide-valve D

are indicated by the letters E E. The valve D is composed of the corresponding heads F F, which are connected by the rods F' and valve-rod G and are located at opposite ends of the steam-chest B.

The form of the steam-chest B and the relation of the heads F F, composing the reciprocating valve D, are clearly illustrated in Figs. 1 and 2, in which it will be seen that the valve-chest is provided with a chamber B' at each end for the respective heads F F, and that these chambers are connected by the cylindrical casting H, in which is provided the inlet H' for steam. The steam entirely fills the chamber formed by the casting H and also that portion of the chambers B' between the heads F F. The outer ends of the chambers B' connect with the usual exhaust X. The heads F F, being connected together and also to the valve-rod G, have a simultaneous movement in line with the length of the valve-chest, and each of said heads has within it a cut-off valve E, which travels with its head F, but has at the proper time an operation independent of said head under the axial rotation of the valve-rod G. The head F, with its cut-off valve E, at one end of the valve-chest is a duplicate of the head F and cut-off valve E at the other end of the valve-chest.

Each head F is composed of the vertical frames lettered J K, respectively, which are connected together by the bolts L, and are respectively provided with the transverse ports M N. The edges of the frames J K adjacent to the steam-cylinder are formed with the flanges O P, which, when said frames are brought together, meet each other, and the whole then forms a head or frame having three sides which receive the cut-off valve E. The open side of the frame or head formed by the castings J K has its opposite edges properly separated by the sleeves Q on the bolts L. The cut-off valve E is in one piece and formed of the opposite sides R S, provided with the slots or ports T and connected by the lugs V and bar W, the purpose of the latter being to receive the crank by which the cut-off valve E is given a vertical transverse motion within the head F for the purpose of throwing the ports or slots T of said cut-off valve into or out of alinement with the

like ports M N, formed in the side frames J K of said head F. The side frames J K of the head F are provided with the central apertures to receive the valve-rod G, and at its inner edges the cut-off valve E has its sides cut away to form the recess Y through which the said valve-rod passes. Within the space formed between the opposite sides of the cut-off valve E in each head F there is provided upon the valve-rod G the crank *a*, the form of which is more clearly illustrated in Fig. 3, in which it will be seen that this crank is composed of a block of metal slit at one side leading to the valve-rod G in order that it may be clamped upon the said rod by means of a bolt or screw *b*, and that said crank at its outer end is bifurcated or provided with the recess *c*, which passes upon and engages the bar W, formed between the opposite sides of the said cut-off valve E. The crank *a* when adjusted and secured upon the valve-rod G is rigid thereon, and hence when the valve-rod is given an axial movement the crank *a*, acting through the said bar W, will elevate or depress the cut-off valve E and thereby throw the ports or slots T therein into or out of alinement with the like ports M N in the opposite sides of the head F. The crank *a* snugly fits between the inner surfaces of the sides of the cut-off valve E, as illustrated in Fig. 1, and hence when the valve-rod G is given a direct reciprocating motion it will move with it the heads F and cut-off valve E.

The ports or slots T in the cut-off valve E extend entirely through the opposite sides of said cut-off valve, as shown in Figs. 1 and 4, but the ports M N in the opposite sides of the head F do not extend entirely through the said sides, but, as illustrated in Fig. 2, lead into inner chambers *d e*, formed within the opposite sides of the head F, and which at their meeting ends merge into the outlet-port *f*, which at the proper time is brought into alinement with or removed from the port *g*, leading directly into the steam-cylinder A.

When the two sides J K of the head F are brought together and secured by the bolts L, they form a rigid head F, whose exterior opposite sides have closed solid surfaces, but whose inner opposite sides contain the ports M N, which lead to the chambers *d e*, and thence through the port *f* into the port *g*, communicating directly with the steam-cylinder. The live steam which completely fills the steam-chest between the heads F F freely passes into the spaces between the opposite sides of the cut-off valves E E and around the cranks *a*, and hence when the port *f* of one head F is in communication with a port *g* at the end of the steam-cylinder the steam will enter said cylinder so long only as the ports or slots T in the cut-off valve E are in register with the slots M N in said head F, and when said cut-off valve is either raised or lowered to throw its ports or slots T out of

alinement with the ports M N in the head F the live steam will be prevented from reaching the port *f* and hence will be excluded from the cylinder A. The direct reciprocating motion of the valve-rod G brings the port *f* into communication with the port *g*, or cuts off such communication, while the axial movement of said rod G determines the point at which the valve E shall cut off the steam from the cylinder A, as above described. The head F at the right-hand end of the steam-chest is a counterpart of the head F at the left-hand end of said chest, and the cut-off valves E are duplicates of one another. The cranks *a* are also duplicates of one another, but will be arranged upon the valve-rod G at an angle to one another, as indicated in Fig. 1, in order that when one cut-off valve E is moving downward the other cut-off valve E will move upward. It has been described above that the axial motion of the valve-rod acts, through the cranks *a*, to operate the cut-off valves E. When the cut-off valve E at the left-hand end of the steam-chest is moving downward to close the ports M N in its head F, the valve E at the right-hand end of the steam-chest will move upward to open the ports M N in its head F, and hence it will be understood that when one cut-off valve is in position to admit steam into the ports M N of its head the other cut-off valve will close the ports M N of its head. The heads F F, composing the slide-valve, have a simultaneous and uniform longitudinal reciprocation, while the cut-off valves E E have simply, with respect to their seats and cooperating ports, a vertical reciprocation. The vertical reciprocation of the cut-off valves E E is variable as to time of action under the control of the governing devices, while the traverse of the heads F F, composing the slide-valve, is invariable.

The valve-gear for operating the slide-valve and cut-off valves 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 Elijah F. Spaulding on July 3, 1888. The present invention is not confined, however, to any special form or construction of the valve-gear. It is essential, however, that the action of the cut-off valves in cutting off the steam from the cylinder A be variable, in order that the steam may be cut off from said cylinder at the desired moment under control of the governing devices. When, for illustration, the port *f* of the right-hand head F is in line with the port *g*, leading to the right-hand end of the cylinder A, the cut-off valve E of said head will have its slots or ports T in alinement with the ports M N of said head F, and at such time and during the desired period steam will pass through said slots or ports T and ports M N into the chambers *d e*, and thence to the said port *f* and port *g*, leading into the right-hand end of the cylinder A. At such time the steam at the left-hand end

of the cylinder A will be enabled to exhaust through its port *g* and the outer end of the left-hand compartment or chamber *d* into the usual exhaust X. After the proper quantity of steam has entered the right-hand end of the cylinder A the cut-off valve E at said end will move to bring its solid side portions over the ports M N of the right-hand head F, thus cutting off the steam, this being, as to time, variable under the control of the governing devices. The operation of the head F and cut-off valve E at the left-hand end of the steam-chest is the same as that of the head and cut-off valve at the right-hand end of said chest. The form of connection between the valve-rod G and the cut-off valves E E is such that the said rod may impart to the heads F the usual reciprocating motion and at the same time receive an axial oscillation by which it, the said valve-rod, is enabled, through the cranks *a*, to impart a vertical reciprocating motion to the cut-off valves. The cut-off valves do not preferably have a sudden movement, but a gradual vertical reciprocation during the longitudinal movement of the heads F F. The steam filling the central portions of the steam-chest is prevented from reaching the exhaust by the packing-strips A', secured in grooves in the frames J, composing the outer portions of the heads F F.

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

1. In a steam-engine the reciprocating slide-valve composed of the connected heads comprising the sections J, K, having at their inner facing sides the ports M, N, and provided with the interior chambers *d*, *e*, leading to the outlet-port *f*, combined with the cut-off valves located between said frames J, K, and provided in their opposite sides with the ports or slots T adapted to be brought into or out of alinement with the said ports M, N, and means for reciprocating said heads longitudinally and said cut-off valves transversely; substantially as set forth.

2. In a steam-engine the reciprocating slide-valve composed of the connected heads comprising the frame or sections J, K, having in their facing sides the ports M, N, and provided with the chambers *d*, *e*, leading to the outlet-port *f*, combined with the cut-off valves E composed of the opposite slotted sides connected together by lugs and adapted to move against the facing sides of said heads, the

valve-rod for reciprocating said heads, and the cranks on said valve-rod engaging said cut-off valves and adapted to impart to the same a transverse reciprocating motion; substantially as set forth.

3. In a steam-engine the reciprocating slide-valve composed of the connected heads comprising the frames or sections J, K, having the ports M, N, in their facing sides, and provided with the interior chambers *d*, *e*, leading to the outlet-port *f*, combined with the cut-off valves located between said facing sides and provided with the slots or ports T, the valve-rod connected with said heads, and the cranks *a* secured upon said valve-rod and engaging said cut-off valves, said cranks being slit in line with said valve-rod and provided with the tightening-bolt and also with the recesses which engage said cut-off valves; substantially as set forth.

4. In a steam-engine the reciprocating slide-valve composed of the connected heads comprising the frames or sections J, K, having the ports M, N, in their facing sides and provided with the interior chambers *d*, *e*, leading to the outlet-port *f*, combined with the cut-off valves E composed of the slotted sides having the recesses Y and connected together by the cross-bars W, the valve-rod passing through said heads and the recesses Y of said cut-off valves, and the cranks *a* secured upon said valve-rod and provided with recesses engaging said cross-bars; substantially as set forth.

5. In a steam-engine the reciprocating slide-valve composed of the connected heads containing in their facing sides the series of ports M, N, leading to an outlet-port *f*, combined with the cut-off valves located between said facing sides and having in their opposite sides the ports or slots T adapted to be brought into or out of alinement with said ports M, N, and means for longitudinally reciprocating said slide-valve and transversely reciprocating 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.

CONRAD KNUDSEN.

Witnesses:

CHAS. C. GILL,
E. JOS. BELKNAP.