

(No Model.)

3 Sheets—Sheet 1.

W. D. HOOKER.
DOUBLE CYLINDER STEAM ENGINE.

No. 436,710.

Patented Sept. 16, 1890.

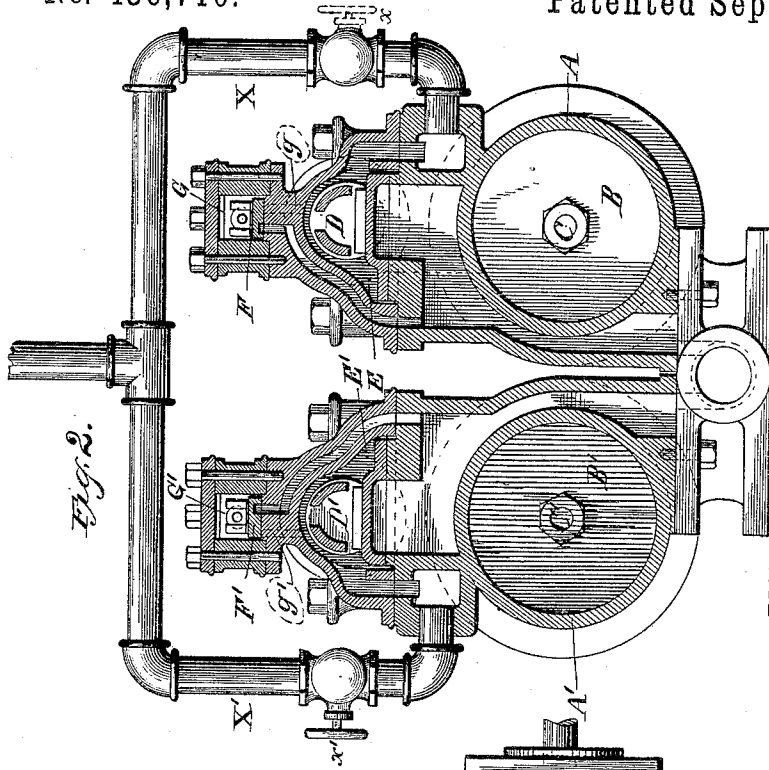


Fig. 2.

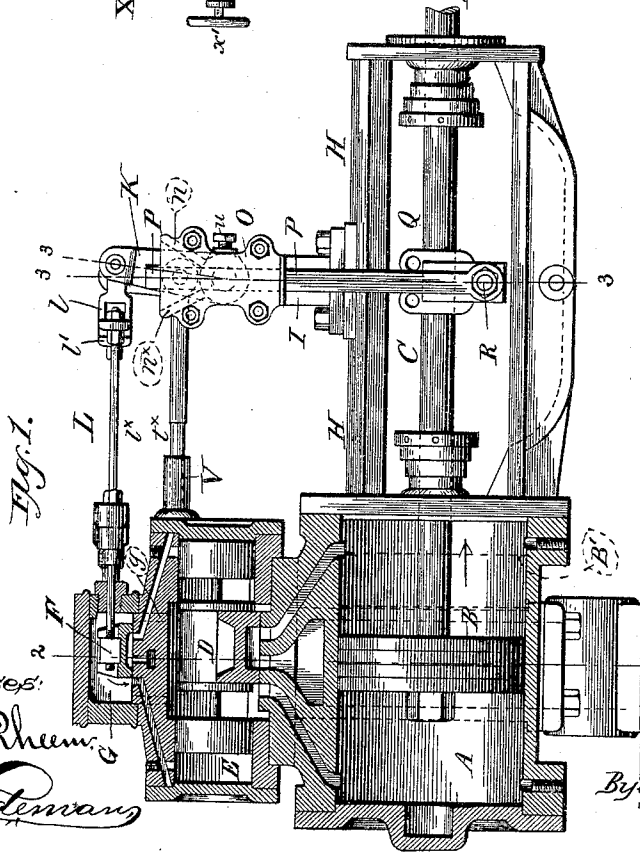


Fig. 1.

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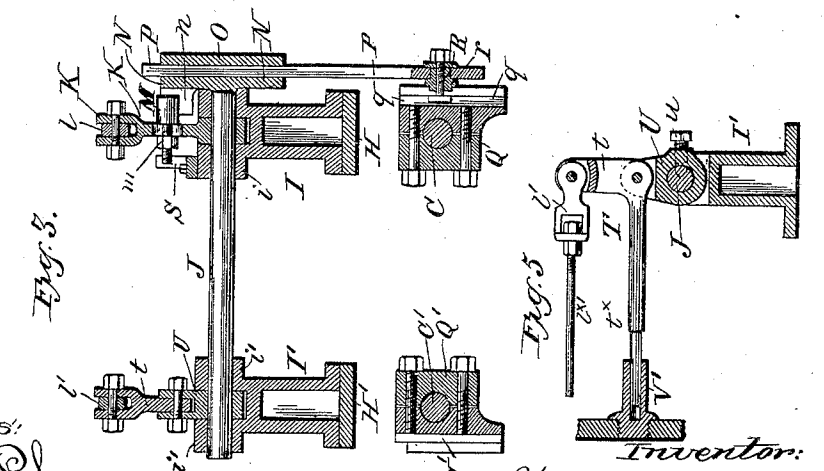
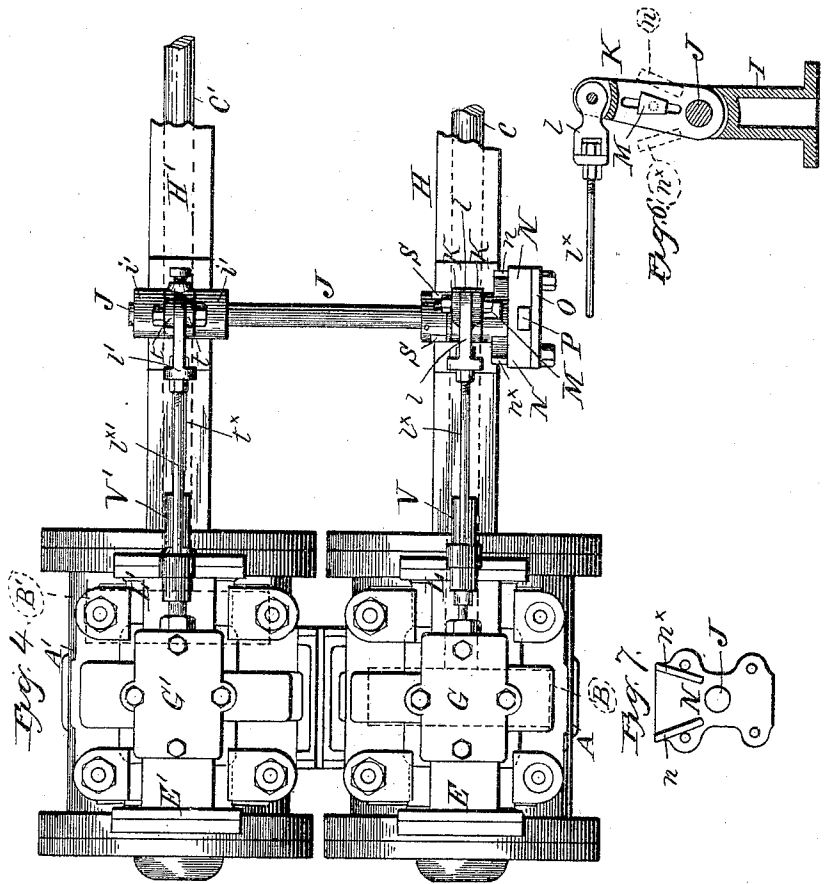
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UNITED STATES PATENT OFFICE.

WILLIAM D. HOOKER, OF CHICAGO, ILLINOIS.

DOUBLE-CYLINDER STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 436,710, dated September 16, 1890.

Application filed May 17, 1890. Serial No. 352,243. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. HOOKER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Double-Cylinder Steam-Engines, of which the following is a specification.

The present invention relates to double-cylinder steam-engines in which the valves and parts of both engines are so constructed and said valves are so operated by mechanism which derives its motion from the piston of one of said engines that one engine will commence its stroke before the stroke of the other engine is completed.

The object of the said invention is to so improve the construction of such engines that both shall operate precisely alike, to the end that the operation of the pumps shall be alike, and consequently smooth and noiseless, even when running at the highest attainable speed.

The invention consists in certain features of novelty that are particularly pointed out in the claims hereinafter, an engine embodying said invention being first fully described with reference to the accompanying drawings, which form a part of this specification, and of which—

Figure 1 is a sectional elevation of the improved engine, the near steam-cylinder, its valves, valve-chests, and other accessories being shown in vertical longitudinal section, while the yoke, the valve mechanism, and its accessories are shown in side elevation. Fig. 2 is a vertical transverse section thereof on the line 2 2, Fig. 1. Fig. 3 is a vertical transverse section of the valve-actuating mechanism on the line 3 3, Fig. 1. Fig. 4 is a plan view of the improved engine. Fig. 5 is a sectional elevation of the valve mechanism of the auxiliary engine. Fig. 6 is a sectional elevation of the valve mechanism of the main engine. Fig. 7 is an elevation of the parts hereinafter described. Fig. 8 is a plan view, partly in section, showing the relative positions of the pistons.

A represents a steam-cylinder; B, a piston therein; C, the piston-rod, and D the valve for controlling the admission of steam to and

its exhaust from the cylinder. This valve is contained within a suitable chest E and is itself actuated by steam which is admitted to and exhausted from the opposite ends of said chest under the control of a supplemental valve F, contained in a suitable chest G, supplied with steam through a duct *g*. So far as the present invention is concerned, these valves may be of any desired construction, and the ports may be arranged in any desired manner, so long as the construction and arrangement are such that steam will be admitted to one cylinder so that the piston commences its stroke when the piston of the other cylinder is at or near the center of its stroke, so that one engine shall lag about half a stroke behind the other, as presently described. The construction and arrangement shown in the drawings are so very simple that very little description of them is necessary, as they will be readily understood from the drawings by those skilled in the art. The supplemental valve F is of the \square type. It is of such length that the ports *ff*, through which steam is supplied to and exhausted from the opposite ends of the valve-chest E, open into its chest G at such distances apart that when it is at the center of its stroke both of said ports are closed; but the instant it is moved beyond its central position one or the other of said ports is uncovered, thereby admitting steam to one end and exhausting it from the other end of the valve-chest E for shifting the valve D and permitting steam to enter one and exhaust from the other end of the cylinder A for producing the stroke of the piston B.

H is a yoke, from the top side of which rises a standard I, having at its upper end a bearing *i*, in which is journaled a horizontal shaft J.

K, Fig. 6, is a lever whose lower end is loosely fulcrumed upon the shaft J, and whose upper end is bifurcated and embraces one end of a short link *l*, to which it is pivotally connected. This link forms a part of a valve-rod L, which enters chest G through a suitable stuffing-box, and is connected to the valve F for operating it. The adjacent part *l'* of this valve-rod has its end screw-threaded and passed loosely through a perforation in the

end of the link l . A pair of nuts situated upon opposite sides of the end of the link serve to hold the parts l and l^x together and enable their adjustment longitudinally with respect to each other for lengthening or shortening the valve-rod L.

M is a lug, the contracted stem of which passes through a longitudinal slot through the lever K and is screw-threaded for the reception of a nut m , whereby said lug may be adjusted toward or from the center of oscillation of said lever.

N is a plate cast in one with or secured to the end of the shaft J and forming a T-head. Upon the side of this plate adjacent to the shaft are a pair of lugs or tappets n n^x , between which the lug M projects. Against the other side of this plate is secured by bolts a second plate O, of corresponding shape, one or both of said plates being grooved to form a bearing in which a lever P fits snugly, so as to be capable of only an endwise movement therein.

Q is a two-part block, which is secured to the piston-rod C and has in one of its sides a vertical undercut groove q , and R is a bolt, the head of which fits in said groove, while its stem passes through a wrist-pin r and receives a nut, whereby said wrist-pin may be adjusted transversely with respect to the piston-rod, or, in other words, toward or from the rock-shaft J. The wrist-pin fits an eye at the lower end of the lever P, the latter being held in place thereon by a washer beneath the nut on bolt R.

This completes the description of the various parts of what is called in this specification (for the sake of convenience) the "main" engine, the operation of which will be described presently.

The auxiliary engine is situated beside the main engine and may be constructed as follows: A' is a cylinder in which works a piston B', having a rod C'. D' is a steam-actuated valve for controlling the admission of steam to and its exhaust from the cylinder A', and E' is the chest in which said valve is contained. Steam for actuating the valve D' is admitted to and exhausted from the ends of the chest E through ports f' f' , under the control of a supplemental valve F', situated in a suitable chest G', to which steam is supplied by a duct g' . The valve F' is fixed to one end of a valve-rod L', formed of two parts l' l'^x , secured together by a pair of nuts so as to be longitudinally adjustable. The other end of the valve-rod is secured by a pivot-pin to the bifurcated extremity of the vertical arm t of a part T, hereinafter called a "slide." This slide T is of L shape, and at its angle is secured by a pivot-pin to the upper extremity of a short arm U, which is fixed rigidly to the shaft J by a set-screw u . The arm t^x of the slide T is horizontal, and at its extremity fits loosely into a sleeve or socket V', secured to the end of the valve-chest E'. H' is a yoke to which is secured a standard

L', having a bearing i' , in which the shaft J is journaled.

Similar parts in the two engines are indicated by similar letters of reference, the prime (') mark being added to distinguish the parts of the auxiliary engine.

As the piston-rod C moves back and forth it carries with it the lower end of the lever P, and thereby causes the shaft J to rock or oscillate about its center. As the lever K is loose upon the shaft J, it will not be affected by the movement of said shaft until one or other of the tappets n or n^x comes in contact with the lug M, and this does not take place until the main engine is about to complete its stroke in one direction or the other. As shown in the drawings, the piston of the main engine is moving to the right. When it is about to complete this stroke, the tappet n will come in contact with the lug M and throw the lever K to the left, which shifts the valve F to the left, thereby permitting steam to enter the right-hand end of the valve-chest E and force valve D to the left, thereby permitting steam to exhaust from the left-hand end and enter the right-hand end of cylinder A, forcing the piston B to the left. When it is about to complete this stroke to the left, the tappet n^x comes in contact with lug M, and operations the reverse of the foregoing take place.

Upon the top side of the standard I are cast or secured a pair of lugs S, between which the nut m on the stem of the lug M projects, thereby forming a stop for limiting the movement of the lever K and preventing the valve F from being thrown too far when the engine is running at high speed.

Since the arm U is rigidly fixed to the shaft J and the connections between it and the supplemental valve F' of the auxiliary engine do not permit of any lost motion, it follows that the said supplemental valve F' must move in unison with the piston-rod C of the main engine, and that when said engine is at the center of its stroke the said valve will be at the center of its stroke. This valve is so constructed (in the instance given in the drawing it is exactly like the valve F of the main engine) that when it is at the center of its stroke the ports f' f' , through which steam passes to the respective ends of the valve-chest E', are both closed, and the instant it passes the center one or the other of the said ports is opened. As the parts are shown in the drawings, the main engine is at the center of its stroke in the direction of the arrow (to the right) and the supplemental valve F' of the auxiliary engine is in the center of its stroke in the opposite direction, (to the left,) the piston of the auxiliary engine having completed its stroke to the right. As soon as these parts pass these positions the valve F' will uncover the port that admits steam to the right-hand end of the chest E', whereby the valve D' will be forced to the left, uncovering the port through which the steam is

admitted to the right-hand end of the cylinder A'. Thus the stroke of the auxiliary engine is reversed when the main engine is at or near the center of its stroke and the valves of both engines are controlled by the main engine.

The term "main engine" is employed in this specification to designate the one of the engines which controls the operation of the other. Either of the two engines may be used as the main engine.

The engine above described as the "auxiliary engine" may be made the main engine by turning the shaft J end for end, connecting the lever P to the piston-rod C', and transposing parts K and T U.

Steam is supplied to the main and auxiliary engines through separate pipes X and X', having valves x and x' , respectively. While both engines are running, by closing the valve x' steam will be shut off from the auxiliary engine, and said engine will stop, while the main engine will run on alone as a single engine.

Since the supplemental valve of the auxiliary engine and the piston of the main engine move synchronously, the mechanism connecting them must be such as to materially reduce the extent of the movement, so as to move the supplemental valve the proper stroke. It is to this end that the arm U is made so short. The slide T neither augments nor reduces the extent of the movement, it being an expedient for connecting the end of the arm U with the end of the valve-rod L', the latter being considerably above the former. On the other hand, since the piston of the main engine moves nearly its whole stroke without affecting the supplemental valve of the main engine, and said valve must be shifted while the said piston is completing the last inch or so of its stroke, it is manifest that its movement must be a quick one. This quick movement for this valve, as well as the slow movement for the valve F', is also derived from the rock-shaft J. It is accomplished by making the lever K of sufficient length and connecting the valve-rod to it at a sufficient distance from its fulcrum. This movement may be regulated by adjusting the lug M (which is the point at which the power is applied) toward or from the fulcrum, thereby increasing or decreasing the length of the "load-arm" of the lever.

The amplitude of the movement of the rock-shaft itself may be regulated by moving the block r toward it or from it, accordingly as it is desired to increase or decrease it.

I desire to have it understood that my invention is not limited to the precise construction of valve mechanism shown and described, as said mechanism may be varied within wide limits without departing from the spirit or sacrificing the advantages of my invention.

I am aware that it has been proposed to operate the supplemental valves of two similarly-constructed direct-acting engines having steam-actuated main valves under the

control of said supplemental valves by mechanism which derives its motion from the piston-rod of one of said engines, the valves and ports of both engines being so constructed and arranged that both engines commence and end their strokes at the same time, their pistons moving always in opposite directions.

I am also aware that it has been proposed in a duplex engine to connect the main valve of the auxiliary engine to the piston-rod of the main engine, so that said valve shall move synchronously with said rod, the main ports of said auxiliary engine being so arranged that said valve will open them to steam and exhaust when the main engine is at about the center of its stroke, while the main valve of the main engine is steam-actuated and under the control of a supplemental valve, which is operated by connections which derive their motion from the piston-rod of the main engine. With such an arrangement steam will not be admitted to and exhausted from the two cylinders under like conditions, and consequently the movements of the pistons will be unlike and the action of the pump jerky and unsteady.

The ultimate object of the present invention is to produce a double-cylinder engine whose action shall be uniform, steady, and constant. In order to accomplish this result, it is essential that the operations of the two pistons be precisely alike, and that each shall commence its stroke before the stroke of the other is completed. In order that the pistons shall operate alike, it is not only necessary that they be the same size, but it is also necessary that the steam by which they are driven be admitted to and exhausted from the cylinders of both under precisely similar conditions. This latter can be accomplished only by providing both engines with valves of similar construction under the control of mechanism which shall insure their similar operation.

A duplex engine in which the main valve of the auxiliary engine is driven by direct connections with the piston-rod of the main engine, without the intervention of a supplemental valve, is not the equivalent of my invention.

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

1. The combination, with the main and auxiliary engines, both having steam-actuated main valves and supplemental valves for controlling said main valves, of connections between the supplemental valves of both engines and the piston-rod of the main engine, whereby said valves are moved, the ports and valves of both engines being so constructed and arranged that each engine shall commence its stroke before the stroke of the other engine is completed, substantially as set forth.

2. The combination, with a supplemental-valved main engine and a supplemental-valved auxiliary engine, of connections between the supplemental valves of both en-

gines and the piston-rod of the main engine, whereby the main engine controls the operation of both engines, the ports controlled by the supplemental valves being so arranged
 5 that the supplemental valve of each engine uncovers its ports to steam and exhaust when the other engine is about at the center of its stroke, substantially as set forth.

3. The combination, with a main engine
 10 having a steam-actuated main valve and a supplemental valve for controlling said main valve and an auxiliary engine having a steam-actuated main valve and a supplemental valve for controlling said main valve, of connections between the supplemental valves of
 15 both engines and the piston-rod of the main engine, whereby both of said supplemental valves are actuated by the main engine, the valves and ports of both engines being of
 20 similar construction and so organized that the main valve of each engine will be shifted before the piston of the other engine completes its stroke, substantially as set forth.

4. The combination, with the main engine
 25 having a steam-actuated main valve and a supplemental valve for controlling said main valve and an auxiliary engine having a steam-actuated main valve and a supplemental valve for controlling said main valve, of positive connections between the supplemental
 30 valve of the auxiliary engine and the piston-rod of the main engine, the ports controlled by said supplemental valve being arranged to be opened to steam and exhaust when the
 35 piston of the main engine is near the center of its stroke, and mechanism also controlled by the main engine for operating its own supplemental valve, the ports controlled by said
 40 valve being arranged to be opened to steam and exhaust when the piston of the main engine is at or near the end of its stroke, substantially as set forth.

5. The main engine having a steam-actuated main valve, a supplemental valve for
 45 controlling said main valve, and tappets for shifting its supplemental valve at each end of its stroke, in combination with an auxiliary engine having a steam-actuated main valve, a supplemental valve for controlling
 50 the said main valve, and mechanism controlled by the main engine for moving said supplemental valve, the ports that it controls being arranged to be opened to steam and exhaust when the piston of the main engine

is near the center of its stroke, substantially as set forth.

6. The combination of a main supplemental-valved direct-acting engine with an auxiliary engine, a valve-movement controlled by the main engine for actuating the valves of both
 60 engines and opening the ports of the auxiliary engine to steam and exhaust when the main engine is at or near the center of its stroke, and independent steam-pipes having valves, whereby the steam may be cut off from the
 65 auxiliary engine and the main engine run alone, or the steam to both engines may be regulated, substantially as set forth.

7. The combination, with the two engines having valves, of a rock-shaft, a positive connection between said rock-shaft and the valve
 70 of one engine, tappets carried by said shaft, means for communicating the motion derived from said tappets to the valve of the other engine, and connections between said rock-
 75 shaft and the piston-rod of one of the engines, substantially as set forth.

8. The combination, with two engines having valves, of the rock-shaft J, connection between said rock-shaft and the piston of one
 80 of the engines, the short arm U, fixed to said shaft, connections between said arm and the valve of one engine, the lever K, connections between said lever and the valve of the other engine, and tappets carried by the rock-shaft
 85 for moving said lever K, substantially as set forth.

9. The combination, with the valve of an engine, the rock-shaft, and means for moving the latter, of the short arm U, the slide T,
 90 and the valve-rod L', substantially as set forth.

10. The combination, with the piston-rod and a lever connected thereto, of the rock-shaft J, having a plate N formed integral
 95 therewith, said plate having a bearing in which said lever fits, so as to be capable of sliding endwise, but incapable of lateral movement relatively thereto, tappets *n* and *n*^x on said plate, the lever K, fulcrumed loosely on
 100 said shaft and having the lug M projecting between said tappets, and connections between said lever and the engine-valve, substantially as set forth.

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