No. 833,582. PATENTED OCT. 16, 1906.

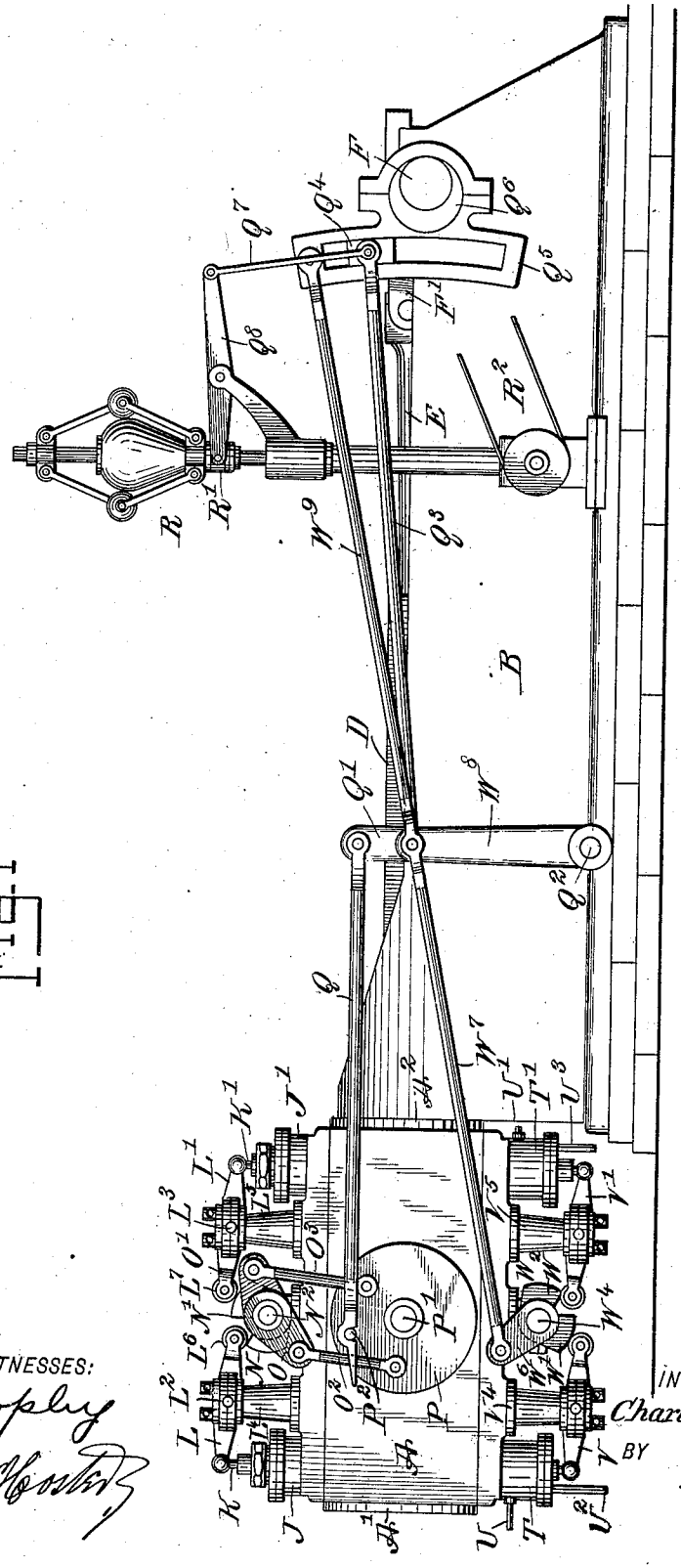
C. W. CRAWFORD.

VALVE GEAR FOR STEAM ENGINES.

APPLICATION FILED JAN. 24, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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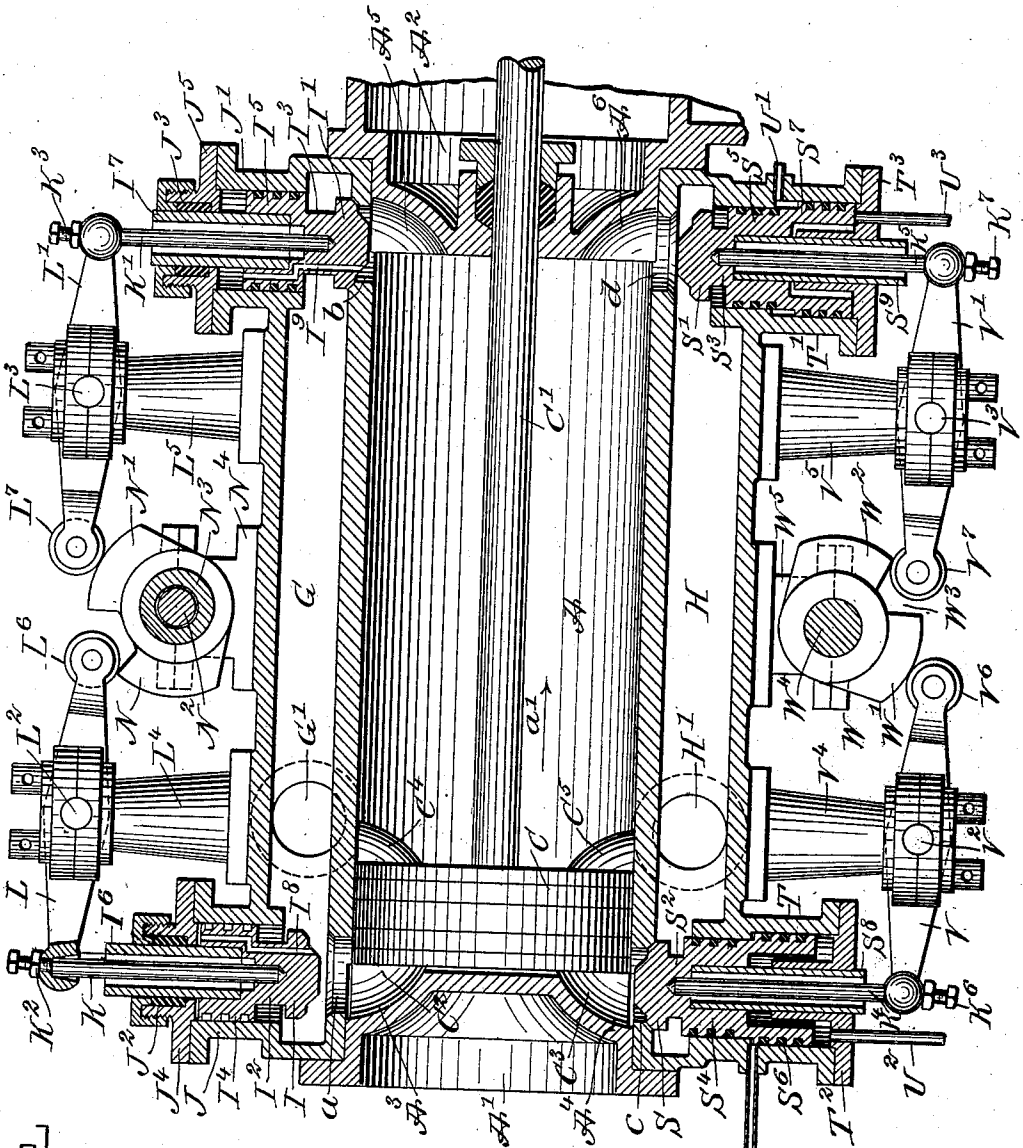


Fig. 2.

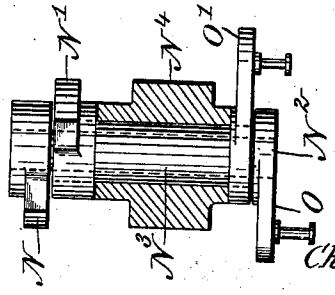


Fig. 3.

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UNITED STATES PATENT OFFICE.

CHARLES WESLEY CRAWFORD, OF BRAZIL, INDIANA.

VALVE-GEAR FOR STEAM-ENGINES.

No. 833,582. Specification of Letters Patent. Patented Oct. 16, 1906.

Application filed January 24, 1906. Serial No. 297,585.

To all whom it may concern:

Be it known that I, CHARLES WESLEY CRAWFORD, a citizen of the United States, and a resident of Brazil, in the county of Clay and State of Indiana, have invented a new and Improved Valve-Gear for Steam-Engines, of which the following is a full, clear, and exact description.

The invention relates to valve-gears for steam-engines, such as shown and described, for instance, in the application for Letters Patent of the United States, Serial No. 270,092, filed by me July 17, 1905.

The object of the present invention is to provide a new and improved valve-gear for steam-engines arranged for producing reduced clearance, silent action of the valve when running the engine at a high rate of speed, quick positive opening and closing of the valves, and keeping the same stationary when closed.

The invention consists of novel features and parts and combinations of the same, which will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the improvement. Fig. 2 is an enlarged longitudinal central section of the same, and Fig. 3 is a plan view of the rocking cams for the levers employed for holding the admission-valves to their seats against the pressure of the steam.

The cylinder A of the engine is mounted on the engine-bed B, and in the said cylinder A reciprocates a piston C, having its piston-rod C′ connected with a cross-head D, mounted to slide on suitable guideways arranged on the engine-bed B, and the said cross-head D is connected by a pitman E with the crank-arm F′ of the main driving-shaft F, journaled in suitable bearings carried by the engine-bed B. The cylinder A is provided at its ends with admission-ports *a* and *b* and with exhaust-ports *c* and *d*, of which the admission-ports *a* and *b* open into a steam-chest G, connected by a pipe G′ with a boiler or other steam-generator. The exhaust-ports *c* and *d* open into an exhaust-chest H, from which leads an exhaust-pipe H′ for conducting the exhaust-steam from the engine to a suitable place of discharge. The admission-ports *a* and *b* are adapted to be closed and opened by valves I and I′, arranged to be seated on the said ports from within the steam-chest G, and the stems I^2 and I^3 of the said valves I and I′ are connected with pistons I^4 and I^5, mounted to reciprocate in auxiliary cylinders J and J′, opening at their inner open ends into the steam-chest G, as plainly shown in Fig. 2, so that steam-pressure is at all times against the under side of the said pistons I^4 and I^5 to move the same outward, thus moving the valves I and I′ off their seats through the medium of the pressure of the motive agent, or, in other words, the valves I and I′ are moved into an open position by the pressure of the motive agent.

The valves I and I′ are provided with hollow trunks I^6 and I^7, extending through stuffing-boxes J^2 and J^3, held on the heads J^4 and J^5 of the cylinders J and J′ for closing the outer ends thereof. Through the trunks I^6 and I^7 extend pins K and K′, seated at their outer ends on set-screws K^2 and K^3, screwing in the ends of rocking levers L and L′, fulcrumed at L^2 and L^3 on brackets L^4 and L^5, attached to the steam-chest G. The rocking levers L and L′ are recessed at their outer ends for the reception of the outer ends of the pins K and K′, as indicated to the left of Fig. 2. The rocking levers L and L′ extend toward each other, and their inner or adjacent ends are provided with friction-rollers L^6 and L^7 in peripheral engagement with cams N and N′, of which the cam N is secured on a shaft N^2 and the cam N′ is secured on a sleeve N^3, held loosely on the shaft N^2. The sleeve N^3 is journaled in suitable bearings arranged on brackets N^4, attached to the steam-chest G, and on the forward ends of the shaft N^2 and the sleeve N^3 are secured arms O and O′, connected by links O^2 and O^3 with a wrist-plate P, mounted to turn on a stud P′, arranged on the cylinder A.

On the wrist-plate P is secured a wrist-pin P^2, engaged by a link Q, connected with a rocking lever Q′, fulcrumed at Q^2 on the engine-bed B, and the said rocking-lever Q′ is connected by a link Q^3 with the link-block Q^4 of a link-motion, having the usual link Q^5 engaged by an eccentric Q^6, secured to the main driving-shaft F of the engine. The link-block Q^4 is pivotally connected by a link Q^7 with a lever Q^8, connected with the up-and-down-sliding member R′ of a centrifugal governor R, connected by a suitable transmission R^2 with the main shaft F, so that when the en-

gine is running the governor R is actuated, and by the movable member R′ and the lever Q^8 and link Q^7 an up-and-down-sliding motion is given to the link-block Q^4, according to the speed of the engine to regulate the rocking movement of the wrist-plate P, which by the connection above described causes sooner or later closing of the valves I and I′.

When the engine is running, the wrist-plate P is caused to rock, so that a rocking motion is given to the shaft N^2 and sleeve N^3 to rock the cams N and N′, which by their connection with the friction-rollers L^6 and L^7 cause a rocking of the levers L and L′, so that the latter by the pins K and K′ forcibly move the valves I and I′ to their seats with a view to close the ports *a* and *b* as long as the friction-rollers L^6 and L^7 are in peripheral contact with the cams N and N′. The latter are so arranged that when it is desired to open the valves I and I′ then the friction-rollers L^6 and L^7 travel off the ends of the cams N and N′ to allow the pressure of the steam within the chest G to act on the corresponding pistons I^4 and I^5 to move the same outward with a view to unseat the valves I and I′—that is, to open the corresponding admission-port *a* or *b* for admission of steam from the chest G into the corresponding end of the cylinder A. Thus by the arrangement described the valves I and I′ are opened by pressure of the motive agent and are closed by mechanical contrivances under the control of the governor R. The valves I and I′, their stems I^2 and I^3, and pistons I^4 and I^5 are provided with by-passes I^8 and I^9 to allow steam to pass from the closed end of the cylinders J and J′ to the under sides of the valves I and I′, thus permitting proper working of the pistons I^4 and I^5 in the said cylinders J and J′.

The exhaust-ports *c* and *d* are adapted to be closed and opened by valves S and S′, connected by their stems S^2 and S^3 with pistons S^4 and S^5, having enlarged outer ends S^6 and S^7 and mounted to slide in auxiliary cylinders T and T′, attached to the exhaust-chest H and opening at their inner open ends into the said chest H. Live steam is admitted into the auxiliary cylinders T and T′ by pipes U and U′, connected with a boiler or other suitable source of steam-supply, so that the pressure of the steam, acting against the enlarged heads S^6 and S^7 of the pistons S^4 and S^5, forces the same outwardly to move the valves S and S′ off their seats, or, in other words, the exhaust-valves S and S′ are moved into open positions by pressure of live steam. The heads T^2 and T^3 for closing the outer ends of the auxiliary cylinders T and T′ are provided with drain-pipes U^2 and U^3 for carrying off any water of condensation in the lower outer ends of the auxiliary cylinders T and T′.

The exhaust-valves S and S′ are provided with hollow trunks S^8 and S^9, extending through the heads T^2 and T^3, and through the said trunks extend the pins K^4 and K^5, seated at their inner ends on the valves S and S′ and at their outer ends on set-screws K^6 and K^7, held on rocking levers V and V′, fulcrumed at V^2 and V^3 on brackets V^4 and V^5, attached to the exhaust-chest H. The inner or adjacent ends of the levers V and V′ are provided with friction-rollers V^6 and V^7 in peripheral contact with the arms W′ and W^2 of a cam W, secured on a shaft W^4, journaled in brackets W^5, attached to the exhaust-chest H.

On the forward end of a shaft W^4 is secured a crank-arm W^6, connected by a link W^7 with a rocking lever W^8, fulcrumed on the pin Q^2, previously mentioned, and the said rocking lever W^8 is connected by a link W^9 with the upper end of the link Q^5 of the link-motion above referred to. Thus when the engine is running and the link Q^5 is rocked it imparts a rocking motion to the lever W^8, which by the link W^7 and crank-arm W^6 rocks the shaft W^4 and the cam W so that the arms W′ and W^2 thereof act on the friction-rollers V^6 and V^7 to rock the levers V and V′ to cause the pins K^4 and K^5 to move the exhaust-valves S and S′ inwardly into a closed position and to hold the same in a closed position for the proper length of time—that is, the exhaust-valves S and S′ are positively closed by mechanical means, but are opened by pressure of live steam, as before mentioned. It is understood that when the cam W is rocked and the friction-roller V^6 or V^7 passes over the end of its corresponding arm W′ or W^2 into a notch W^3 between the adjacent cam-arms W′ and W^2, then the exhaust-valve S or S′ is released of the pressure by the mechanical means to allow the live steam acting on the pistons S^6 and S^7 to move the exhaust-valves S and S′ into an open position. As the link Q^5 is uniformly rocked by the eccentric Q^6 of the main shaft F, it is evident that a regular closing and opening of the exhaust-valves S and S′ takes place, while the closing of the admission-valves I and I′ takes place sooner or later, according to the speed of the engine and owing to the action of the governor R on the link-motion, as previously explained.

The operation is as follows: When the several parts are in the positions illustrated in Fig. 2, then the valves I′ and S are held in a closed position by the mechanical means previously described, while the valves I and S′ are held in an open position by the action of the motive agent on the pistons I^4 and S^5, as above explained. The motive agent from the steam-chest G now passes by way of the port *a* into the outer end of the cylinder A and acts on the piston C therein to push the latter on its inward stroke in the direction of the arrow *a*′, it being understood that during this movement of the piston C the link-motion causes the cams N and N′ to rock, so that the valve I is positively closed, to cut off the steam at the desired length in the stroke

of the piston C. In a like manner the valve S′ is closed when the piston C reaches the end of its stroke, and then the valve I′ is opened by the pressure of the steam from within the steam-chest G, while the valve S is opened by pressure of the live steam on the piston S^4. The motive agent in the steam-chest G now passes by way of the port *b* into the inner end of the cylinder A to act on the piston C therein with a view to send the piston on the return or outward stroke in the reverse direction of the arrow *a′*. The cylinder-heads A′ and A^2 of the cylinder A are provided adjacent to the ports *a c* and *b d* with recesses or cut-out portions A^3 A^4 and A^5 A^6, respectively, of which the recesses A^3 and A^4 are adapted to be engaged by offsets C^2 and C^3, formed on the outer face of the piston C, and the recesses A^5 and A^6 are adapted to be engaged by offsets C^4 and C^5, formed on the inner face of the piston C. By the arrangement described the piston C when moving into an outermost position, as shown in Fig. 2, moves, with its offsets C^2 and C^3, into the recesses A^3 and A^4, thus reducing the clearance-space between the piston C and the cylinder-head A′ to a minimum, and in a like manner when the piston C moves to the end of its inward stroke then the offsets C^4 and C^5 pass into the recesses A^5 and A^6. Thus in either case the clearance between the piston C and the corresponding head A′ or A^2 is reduced to a minimum, and at the same time full provision is had for a full passage of the steam into the cylinder A by way of the ports *a* and *b* and the corresponding recesses A^3 and A^5. In a like manner a complete unobstructed exhaust is had from the cylinder A by way of the recesses A^4 and A^6 and the ports *c* and *d* whenever the valves S and S′ are opened.

It is understood that the valves I and I′ are in the form of puppet-valves having pistons rigidly attached thereto to balance the valves, and the latter are also provided with a trunk or auxiliary piston open at the outer ends to the atmosphere for the purpose of providing an upward pressure when the valves are open. It will also be noticed that, owing to this upward pressure after the valve is opened the latter is perfectly balanced, and it requires but the trunk area to gain sufficient pressure to hold the valve open forcibly against its lever and cam to prevent noise.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A valve-gear for steam-engines, comprising a cylinder, a steam-chest connected by admission-ports with the ends of the said cylinder, admission-valves adapted to be seated on the said ports and each having a reduced trunk extending to the outside of the said steam-chest, admission-valve pistons connected and moving with the said admission-valves, auxiliary cylinders opening at their inner ends into the said steam-chest and in which reciprocate the said admission-valve pistons, the pressure of the steam exerted against the said admission-valve pistons causing the latter to move to open the admission-valves by the pressure of the steam, rocking levers having loose connections with the said valves by way of the said trunks, independent rocking cams in engagement with the said levers to move the admission-valves to their seats and to allow the valves to open by pressure of the steam against the said pistons, a wrist-plate connected with the said cams, and a link-motion connected with the said wrist-plate for rocking the same.

2. A valve-gear for steam-engines, comprising a cylinder, a steam-chest connected by admission-ports with the ends of the said cylinder, admission-valves adapted to be seated on the said ports and each having a reduced trunk extending to the outside of the said steam-chest, admission-valve pistons connected and moving with the said admission-valves, auxiliary cylinders opening at their inner ends into the said steam-chest and in which reciprocate the said admission-valve pistons, the pressure of the steam exerted against the said admission-valve pistons causing the latter to move to open the admission-valves by the pressure of the steam, rocking levers having loose connections with the said valves by way of the said trunks, independent rocking cams in engagement with the said levers to move the admission-valves to their seats and to allow the valves to open by pressure of the steam against the said pistons, a wrist-plate connected with the said cams, a link-motion connected with the said wrist-plate for rocking the same, and a governor controlling the said link-motion.

3. A valve-gear for steam-engines, comprising a cylinder, an exhaust-chest connected by exhaust-ports with the ends of the said cylinder, exhaust-valves adapted to be seated on the said ports and having trunks extending to the outside of the said exhaust-chest, exhaust-valve pistons connected and moving with the said exhaust-valves, auxiliary cylinders containing the said exhaust-valve pistons and connected with a source of live steam for the latter to move the pistons to open the said exhaust-valve by steam-pressure, and mechanical means engaging the said valves by way of the said trunks to move the pistons and the exhaust-valves inward against the pressure of the live steam and to seat the said exhaust-valves.

4. A valve-gear for steam-engines, comprising a cylinder, an exhaust-chest connected by exhaust-ports with the ends of the said cylinder, exhaust-valves adapted to be seated on the said ports and having trunks extending to the outside of the said exhaust-

chest, exhaust-valve pistons connected and moving with the said exhaust-valves, auxiliary cylinders containing the said exhaust-valve pistons and connected with a source of live steam for the latter to move the pistons to open the said exhaust-valve by steam-pressure, levers having a loose connection with the said valves by way of the said trunks, and a rocking cam in engagement with the said levers to move the said exhaust-valves to their seats and to allow the said exhaust-valves to open by pressure of the steam exerted against the said exhaust-valve pistons.

5. A valve-gear for steam-engines, comprising a cylinder, an exhaust-chest connected by exhaust-ports with the ends of the said cylinder, exhaust-valves adapted to be seated on the said ports and having trunks extending to the outside of the said exhaust-chest, exhaust-valve pistons connected and moving with the said exhaust-valves, auxiliary cylinders containing the said exhaust-valve pistons and connected with a source of live steam for the latter to move the pistons to open the said exhaust-valve by steam-pressure, levers having a loose connection with the said valves by way of the said trunks, a rocking cam having arms, and a recess between the said arms for engagement by the said levers to move the said exhaust-valves alternately to their seats and to allow the said exhaust-valves to open alternately by the pressure of the steam exerted against the said pistons.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES WESLEY CRAWFORD.

Witnesses:

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A. C. LANAGAN.