

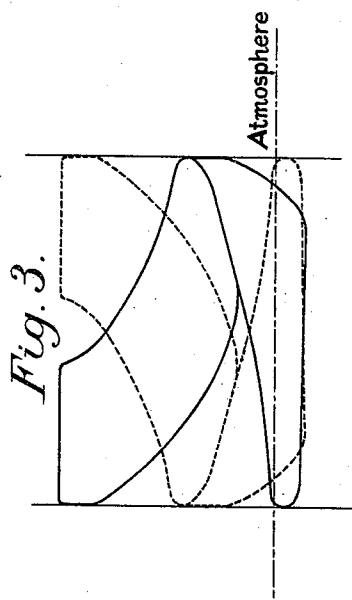
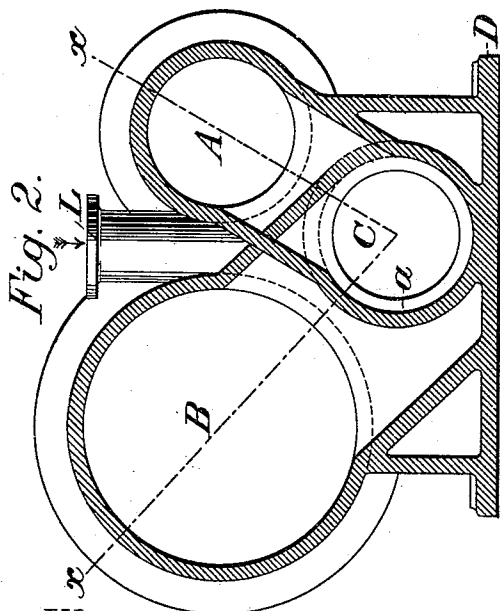
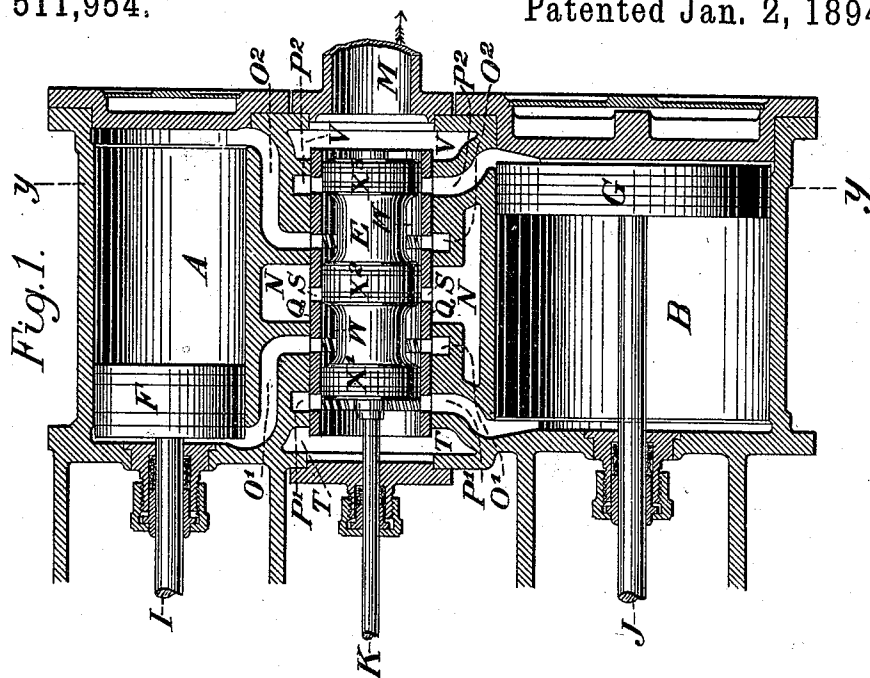
(No Model.)

2 Sheets—Sheet 1.

B. JACKSON.
STEAM ENGINE.

No. 511,954.

Patented Jan. 2, 1894.



Witnesses:

C. A. Brandau.
Wilson D. Bent, Jr.

Inventor:

Byron Jackson
John B. Richards
M.H.

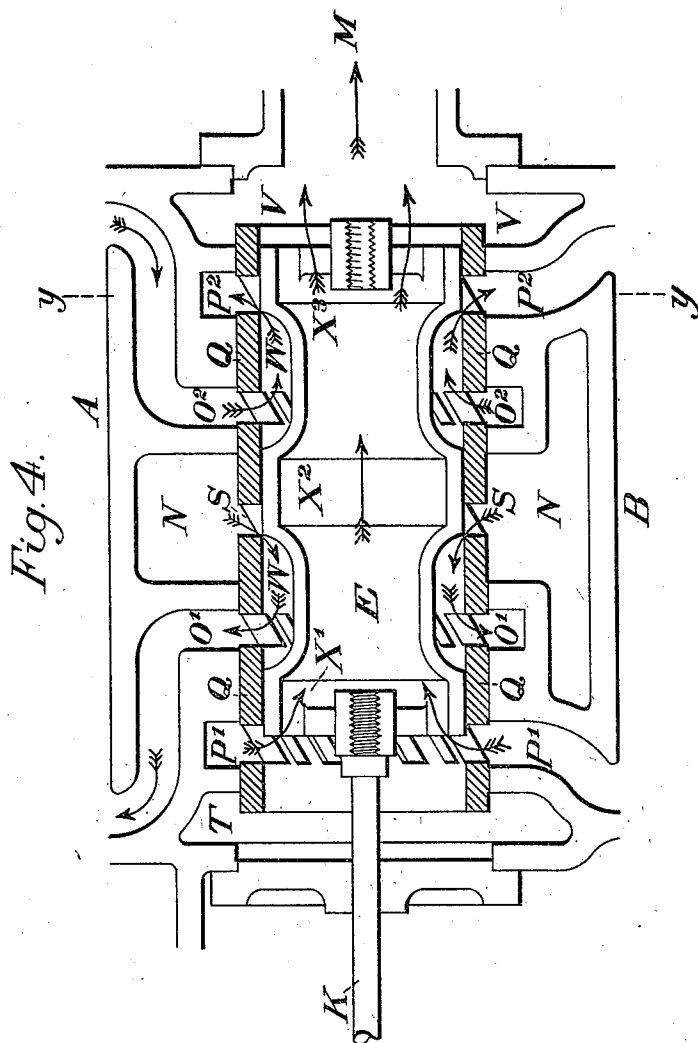
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UNITED STATES PATENT OFFICE.

BYRON JACKSON, OF SAN FRANCISCO, CALIFORNIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 511,954, dated January 2, 1894.

Application filed April 13, 1893. Serial No. 470,197. (No model.)

To all whom it may concern:

Be it known that I, BYRON JACKSON, a citizen of the United States, and a resident of the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Double-Acting Cross-Compound Steam-Engines; and I hereby declare the following specification and the drawings therewith to be a full, clear, and exact description of my invention and the manner of constructing and operating the same.

My invention relates to that class of double-acting steam engines called cross compound, where the steam pressure is applied successively on two pistons and in two cylinders, passing from one to the other, the pistons moving in opposite directions, and connected to cranks set one hundred and eighty degrees apart or opposite, and especially to the valve and valve chamber and ports of such engine.

My invention consists in arranging such engines as close together as practicable, and in the intersecting curves of the cylinders placing a piston valve of peculiar construction as near to, or as near in the plane, of the cylinders as is most convenient, and in so constructing the piston valves that the central piston thereof will perform the function of admission for both ends of the high-pressure cylinder, and so the two end sections thereof will perform the release of steam from the high-pressure cylinder, and both admission and release for the low-pressure cylinder.

The object of my invention is to simplify the construction of such engine, and also to secure a more perfect steam distribution to both cylinders, and to dispense with a steam pipe or receiver between them by a single valve, as shown in the accompanying drawings, in which—

Figure 1 is a central section through the cylinders and valve of a compound, double-acting steam engine constructed according to my invention, taken on the line *xx x* of Fig. 2. Fig. 2 is a transverse section on the line *y y* of Fig. 1, with the valve removed, and showing the relative position of the two cylinders and single piston valve for steam distribution. Fig. 3 is a steam indicator diagram illustrating the degree of pressure in the two cylinders throughout one complete revolution, and the nature of the steam distribution at-

tained by my improved multiple piston valve. Fig. 4 is a diagram to illustrate the method of the valve's operation more clearly than is possible in the shaded figures of the drawings.

Similar letters of reference are employed to designate like parts in the different figures of the drawings.

Referring first to Figs. 1 and 2, I preferably form the two steam cylinders A and B with the valve chamber C, and the base-plate D, all in one casting, the valve E being placed as near to the cylinders A and B as practicable; yet the two cylinders and valve chamber might be in separate castings if desired. The high-pressure piston F, and the low-pressure piston G, being connected by the piston rods I and J to cranks set opposite, or one hundred and eighty degrees apart, the pistons assume the position shown in Fig. 1, at the extreme of one stroke. The piston valve E is connected by the rod K to an eccentric on the engine shaft, and is adjusted by a centrifugal governor to cut off steam admission to both cylinders at various points of the stroke as the speed and power required may demand. Steam enters at the nozzle L and is discharged at M. Its course through the steam cylinders can best be explained by reference to the diagram, Fig. 4, where the valve E is shown in corresponding relation to the position of the pistons F and G in Fig. 1, or at the beginning of one stroke. The central chamber N is in connection with the inlet nozzle L, and is constantly filled with steam at boiler pressure.

O' and O² are passages leading to the ends of the high-pressure cylinder A, and P' and P² are ports leading to the ends of the low-pressure cylinder B. All these passages or ports extend around the valve bushing Q, as shown at *a* in Fig. 2.

For the purpose of convenience in construction, and accuracy of fitting the valve and ports, I insert in the valve chamber a bushing, through the sides of which are ports, as shown, accurately spaced to correspond with the steam ports in the cylinder, and in accordance with the working edges of the valve. Across these ports are diagonal bars, so that the packing rings in the valve will pass over the ports without obstruction or danger of catching. These diagonal bars

cause the wear to be uniform on the valves and packing rings.

Referring now to the course of steam: When the pistons A and B and the valve E are in the position shown in Figs. 1 and 4, steam from the chamber N passes through the ports S and O' into the front end of the high-pressure cylinder A to begin the stroke. At the same time the port O² leading from the back end of the high-pressure cylinder A is open and steam passes from this port, as indicated by arrows, into the port P² into the back end of the low-pressure cylinder B; at the same time the port P' of the front end of the low-pressure cylinder B is practically wide open, permitting the waste steam from that port to escape into the chamber T, and through the interior of the valve E to the exhaust outlet M. This lead or early opening of the exhaust port P being at the point of fastest travel of the valve, causes a free exhaust. The valve E moves on to complete its stroke, fully opening the ports S and P², as will be understood. The exhaust steam from the port P', and from the low-pressure cylinder B, flows into the chamber T, and through the interior of the valve E to the chamber V, and from there out at M to the open air, or to a condenser, commonly the latter, as is indicated in the pressure diagram, Fig. 3. At the opposite strokes of the engine all these operations are reversed in like relation, as will be understood; the exhaust steam from the port P² passing directly out through the chamber T and discharge-way M.

By examining the diagram of the pressure in the two cylinders A and B, as indicated in Fig. 3, it will be seen that the back-pressure line of the high-pressure diagram is an expansion line, and corresponds with the low-pressure diagram until the cut-off takes place (which is coincident in the two cylinders), when the curve in the expansion line changes to correspond to the reduced volume of steam in the low-pressure cylinder, and the back-pressure line of the high-pressure diagram changes to a compression line, the curve of which corresponds to the volume of steam trapped into the clearance space of the high-pressure cylinder and ports. There being no pipes or receivers between the two cylinders, the expansion commences at the cut-off in the high-pressure cylinder, and continues without interruption until its release from the low-pressure cylinder, doing work all the time, except the slight drop caused by the clearance between the valve and the low-pressure cylinder, as is indicated by the diagram, Fig. 3, which is taken from actual performance of engines made according to my invention. It will be observed that there is a single inlet port S opening into the bushing Q, and that the initial steam passes first on one side and then on the other side of the middle piston X² of the valve E, and that the two end pistons X' and X³ of the valve E perform the functions of release for the high-pressure cyl-

inder A, and both admission and release for the low-pressure cylinder B, and that the ports O' and O² are not covered at any time by either piston of the valve E. The space between the middle and end pistons of the valve E forms a portion of the clearance space of the high-pressure cylinder, and notwithstanding the steam pressure is variable, and not the same in both ends of the cylinder, yet the valve is always in perfect balance.

It will be seen that all the parts, including the cylinders, valve and valve chamber, are symmetrical in construction each way from their center longitudinally, and that the valve E can be inserted from either end, and that either end of the valve chamber can become an exhaust way as the convenience of erection may demand.

Having thus explained the nature and objects of my invention, also the manner of constructing and operating the same, what I claim as new, and desire to secure by Letters Patent, is—

1. In a double-acting, cross-compound steam engine, as herein described, a multiple piston valve composed of three pistons, the center piston acting, as an admission valve for both ends of the first or initial cylinder, covering or uncovering alternately to the back and front end, a single inlet for steam, and the two end pistons of the valve performing the functions of release for the initial or first cylinder, and both admission and release for the second or low-pressure cylinder, substantially in the manner and for the purposes described.

2. In a double-acting, cross-compound steam engine, having a three-piston valve in one piece, connected to one valve stem; a single valve chamber with five ports, one of which ports is covered by the center piston, and uncovered alternately, admitting live steam from the boiler to the front and back of the initial or high-pressure cylinder through the ports connecting the valve chamber with the initial cylinder (these ports never being covered by any of the three pistons), and the ports leading to the low-pressure or second cylinder being covered and uncovered by the two end pistons, and alternately releasing the steam from the initial cylinder into the second cylinder, and from the second cylinder to the atmosphere or to the condenser, substantially in the manner and for the purposes described.

3. In a double-acting, cross-compound steam engine, the single three-piston valve made in one piece, performing the admission and release of steam for both cylinders, and made hollow so as to pass the exhaust steam from either end of the cylinder to the other so that it can be conducted away from the engine at either end of the valve chamber, requiring no other steam passages or outlets made in the cylinder or valve chest casting than the one made to contain the single valve; a single valve chamber with five ports, having diagonal bars across the ports to prevent the packing rings from catching or wearing unequal,

made substantially in the manner and for the purposes described.

4. In a double-acting, compound steam engine having one valve having three pistons; 5 a valve chamber with five ports, as herein described; a central port covered by a central piston of the valve, opened alternately right and left thereby admitting steam to the ends of the high-pressure cylinder the low-pressure 10 cylinders and the ports leading thereto; ports O' and O² leading from the valve chamber to the ends of the high-pressure cylinder, so arranged as to be not covered by the valve in any position of its stroke, in the manner substantially as described. 15

5. In a double-acting, compound engine, as herein described, high and low-pressure cylinders combined, and steam admitted and released in both cylinders by a single valve,

which is composed of three pistons, the center of which acts as an admission valve for 20 both ends of the first cylinder, while the two end ones perform the functions of release for the first cylinder and both admission and release for the second cylinder the valve chamber placed parallel to the cylinders, and symmetrical each way from its longitudinal center so the valve can be inserted from either 25 end of the valve chamber, and either end of the latter become a discharge way for exhaust steam, in the manner substantially and for 30 the purposes described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

BYRON JACKSON.

Witnesses:

JAMES MASON,

WILSON D. BENT, Jr.