

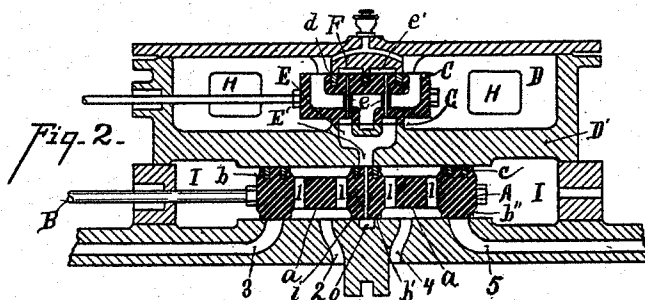
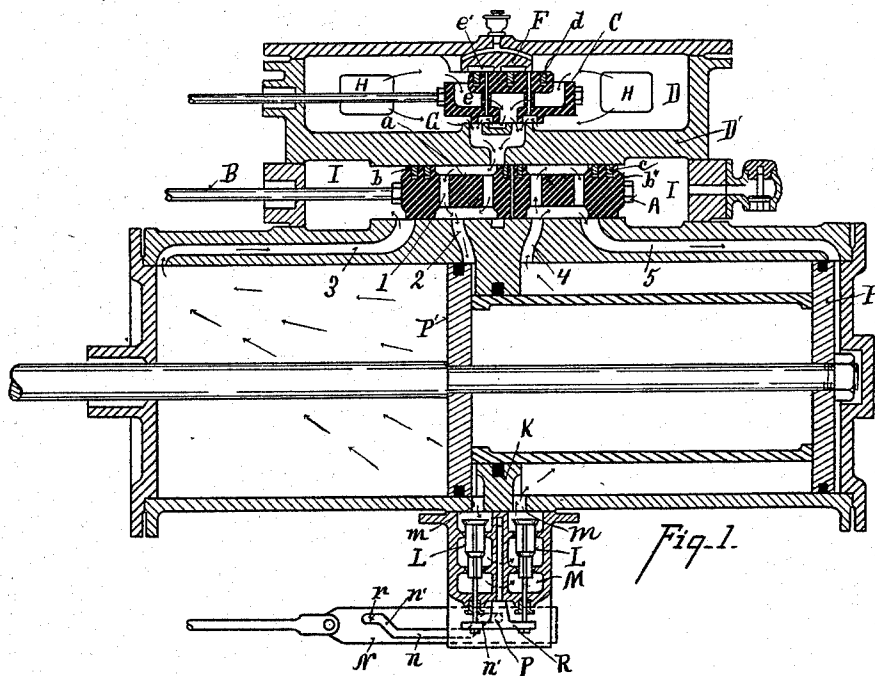
(No Model.)

2 Sheets—Sheet 1.

E. W. HARDEN.
STEAM CHEST FOR COMPOUND ENGINES.

No. 527,388.

Patented Oct. 9, 1894.



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attys

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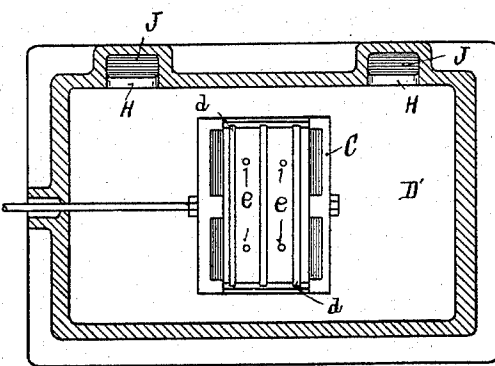
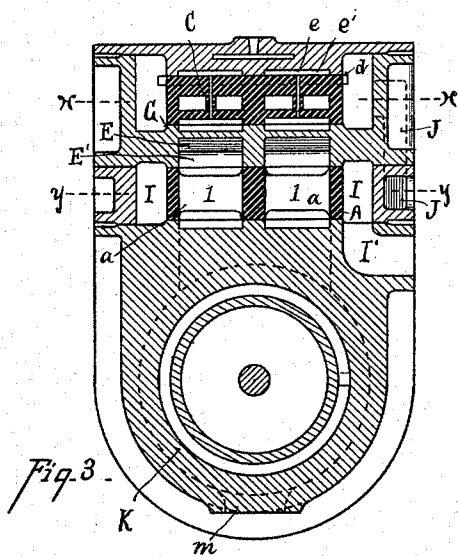


Fig. 4.

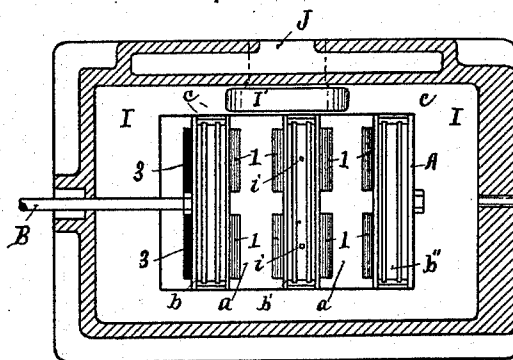
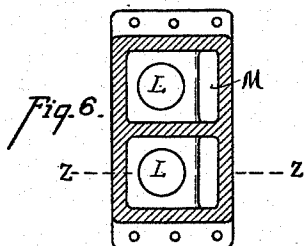
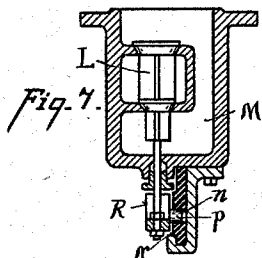


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD WILSON HARDEN, OF CINCINNATI, OHIO, ASSIGNOR TO FREDRIC CANDEE WEIR, OF SAME PLACE.

STEAM-CHEST FOR COMPOUND ENGINES.

SPECIFICATION forming part of Letters Patent No. 527,388, dated October 9, 1894.

Application filed May 12, 1894. Serial No. 511,048. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WILSON HARDEN, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Valves and Steam-Chests for Compound Engines, of which the following is a specification.

My invention relates to the compound class of engines.

One of the objects of my invention is to provide a balanced main valve located in the exhaust steam chest so constructed as to direct the flow of the live steam on to the smaller piston area, then to conduct the same on to the larger piston area and to finally exhaust over the ends of the valve directly into the exhaust chamber.

Another object of my invention is to combine the duplex main valve located in the exhaust chamber with an auxiliary valve located in the live steam chest.

Another object of my invention is to provide ready means for converting the engine from a compound to a simple acting engine and vice versa.

The features of my invention will be more fully set forth in the description of the accompanying drawings making a part of this specification, in which—

Figure 1, is a central longitudinal section of my improvement. Fig. 2, is a vertical section of the steam chest with the valves at cut-off. Fig. 3, is a central vertical cross section of Fig. 1. Fig. 4, is a section on line *x, x*, Fig. 3. Fig. 5, is a section on line *y, y*, Fig. 3. Fig. 6, is a top plan view of the converting valve and chamber. Fig. 7, is a section on line *z, z*, Fig. 6.

The construction of pistons and cylinders herein shown are similar to those shown in Letters Patent No. 507,433, granted October 24, 1893.

Port 2, in the cylinder directs live steam on to the annular area of piston *P'* and then on the return stroke the steam passes from port 2 through port 3, on to the larger area of said piston. This direction is controlled by the main valve *A*. This valve is shown of duplex form and likewise directs the flow of steam through ports 4, 5, alternately on to the piston *P*.

B represents the main valve stem. This

valve is of skeleton form and provided with three cut-off sections *b, b', b''*. *a* represents filling pieces between said sections and they are provided simply to lessen the size of the steam passages through the valve. 1, represents the steam passages through said valve for directing the steam into the different cylinder ports. *c* represents packing strips preferably on the upper face of said cut-off sections and they lie in grooves and are preferably supported on springs so as to form a steam joint and to assist in balancing the valve. Through the central section *b'* is pierced a steam passage *i* into recess *o* which is preferably employed in the lower seat valve. When the duplex skeleton valve is in the cut-off position shown in Fig. 2, said steam passage *i* connects the main supply port *E* with the seat of the valve or recess *o*. As the auxiliary valve *C* starts to move and admits steam into the port *E* this passage *i* passes the steam through the valve and balances it. Similar passages may be provided through the sections *b, b''*, but this is not material as the faces of these sections are at no time subjected to the direct pressure of the live steam.

The auxiliary valve *C* is constructed in the same manner as shown and described in my application, Serial No. 511,047, filed of an even date herewith. This form of valve is preferably employed but a single auxiliary valve of the form shown in said Patent No. 507,433, might be employed with the main valve with the parts constructed as herein shown.

D represents the live steam chest. It is separated from the exhaust chest or chamber by the partition *D'*.

E represents the main supply port located in the partition *D'*. The ports are subdivided on the face of the valve and the valve seats.

E' represents the contracted end of the port which is cut off by the section *b'* of the main valve.

When the main valve is in the position shown in Fig. 1, live steam is being conducted through the port 2, on to the smaller area of piston *P'* and the steam is being exhausted through port 3 outside of the end of the section *b* directly into the exhaust chest or chamber *I* in which the main valve is located. This

exhaust chamber surrounds the main valve and is provided with a discharge I'. In the position shown in Fig. 1, port 4 conveys steam which has been used on the annular face of piston P back through port 5, on to the opposite face of said piston for compounding. Thus this duplex skeleton main valve is conveying live steam on to one piston and compounding steam upon the opposite piston at the same time and this takes place alternately on each side of the cylinder by the action of the main valve.

The live steam chest D is shown as supplied with steam through passages J formed in the sides of the steam chest. H represents the exit orifices of said passages into the steam chest.

It is often times desirable to convert a compound into a direct acting engine and especially when they are employed on locomotives or steam vessels. With the compound engine the auxiliary valve is frequently cut off as low as one eighth of the piston stroke. I have provided means for converting the engine from a simple to a compound and vice versa in the following manner:

M represents a valve chamber attached to the cylinder at any convenient position opposite the cylinder division ring K which supports the cylindrical piston.

m, m, represent ports leading into the chambers on each side of ring K.

L represents puppet valves which are preferably employed. When these valves are raised and steam is being admitted through port 2, on the face of the piston P' which is shown in Fig. 1, it will pass through ports *m* into the puppet valve chambers as shown by the arrows back into the opposite cylinder, thence around the cylindrical piston, thence through ports 4, 5, on to the opposite face of the piston P. Thus I employ the direct steam on to the larger piston area. Now it is necessary that both of these valves should be raised and closed at the same time, and it is also desirable to have this movement take place quickly. I have provided the following instrumentalities:

N represents a cam lever provided with a groove *n*. *n'* represents inclines near each end of said groove.

R represents a yoke attached to the stems of the puppet valves.

p represents a pin lying in the groove *n*.

When the lever N is retracted and the pin *p* has been raised by the forward incline *n'* the valves are open. When the lever is thrown forward to its furthest position the valves will be raised by the rear incline *n'* and the pin *p* will rest in a groove at the point *r* and the puppet valves will be likewise raised. This cam lever and the inclines near the ends of the groove it will be observed have the same throw as the cut off valve so that they may be operated in unison therewith, either by the same or independent lever as desired. As soon as the train or boat

is under way the lever would be pulled back and the engine would be converted by this movement into a compound engine. I obtain important advantages by making the main valve of skeleton form and locating it in the exhaust chest. The valve is constructed as herein shown. The valve is practically balanced under steam pressure when at rest, at starting, as well as, during the entire movement. By conducting the steam directly through the valve and using short cut-off sections the live steam being supplied freely, the time of exhausting is continued to the opposite end of the valve during the major portion of its travel, thus lessening the back pressure.

I claim—

1. In a compound engine having a duplex cylinder and piston, and a live steam port and an exhaust port in each cylinder, the combination with a live steam chest and an auxiliary valve located therein, of a separate exhaust chamber and a duplex skeleton main valve located in the exhaust chamber and provided with a central and two outside cut-off sections and having live steam passages between the cut-off sections communicating with one or more ports in the live steam chest, substantially as described.

2. In a compound engine employing a duplex cylinder and piston, and a live steam port and an exhaust port for each piston, the skeleton main valve located in the exhaust chamber provided with live steam passages extending through the valve and three or more cut-off sections formed in the seat of said valve and adapted and arranged to compound and exhaust on either side of its outside cut-off sections, substantially as specified.

3. In a compound engine provided with duplex cylinders and pistons and duplex supply and exhaust ports for each cylinder, the combination of an exhaust chamber mounted upon said cylinder, a duplex skeleton main valve located in the exhaust chamber and provided with two or more live steam ports leading through said valve and a central and two outside cut-off sections, a live steam chest mounted upon the exhaust chamber, and an auxiliary valve having a plurality of ports and cut-off sections for covering and uncovering a plurality of ports in the valve seat communicating with the through passages of the duplex skeleton main valve, substantially as described.

4. The duplex skeleton main valve provided with two or more live steam passages and three cut-off sections, in combination with an auxiliary valve and its seat having a central port E which is covered and uncovered by the central cut-off section of the main valve, substantially as specified.

5. The skeleton main valve provided with cut-off sections *b, b', b''*, and two or more live steam passages through it between said sections, the steam passage I pierced through the

central section and connecting with the supply port E, substantially as specified.

6. In a compound engine having duplex pistons and cylinders and a live steam and an exhaust passage for each cylinder, the combination with the live steam chest of the exhaust steam chest and a duplex skeleton main valve located in the exhaust chest and having a central cut-off section and two outside cut-off sections for covering and uncovering the steam ports and two or more live steam passages leading through the valve between the cut-off sections, substantially as described.

7. In combination with a compounding engine the skeleton main valve having two or more live steam passages between the cut-off sections located in the exhaust chamber, in combination with a live steam chest and auxiliary valve and its seat provided with a common supply port E adapted to be closed by the central cut-off section of the main valve, simultaneously with the closing of the outside cylinder ports by the end cut-off, substantially as specified.

8. In a compound engine the combination with the opposite cylinders of the converting valves provided with ports connecting said cylinders with each other through the valve chamber and mechanism operating said valves simultaneously whereby the engine is converted from a simple to a compound and vice versa, substantially as specified.

9. In a compound engine in combination with cylinders and pistons P, P', converting valves and valve chambers provided with ports and passages connecting said piston cylinders with each other through the valve chambers and the duplex skeleton main valve with cylinder ports for directing the steam simultaneously onto the face of pistons P, P', substantially as specified.

10. In a compound engine in combination with cylinders and pistons P, P', converting valves and valve chambers provided with ports and passages connecting said piston cylinders with each other through the valve chambers and the main valve and cylinder ports for directing the steam simultaneously on to the face of pistons, substantially as specified.

11. In combination with the converting valves L L connected to the cylinder of a compound engine, the cam lever N provided with one or more inclined grooves *n'* adapted to operate a pin *p* connected to a yoke which lifts the valve stems, whereby said valves are opened and closed simultaneously with the movement of said cam lever, substantially as described.

12. In a compound engine employing an auxiliary valve, a duplex cylinder and its division ring and pistons, converting valves P, P' applied to passages in the cylinder each side of the ring and their lever N for operating the converting valve at the extreme end of its movement, substantially as described.

13. In combination with the converting valves L, L, of a compound engine, the yoke R connected with the valve stems and operated by the cam lever N provided with an inclined slot *n'* at each end, said slots connected by a parallel slot *n* and adapted to engage a pin *p* on the yoke,—whereby said valves are raised or lowered near each end of the movement of the cam lever, substantially as specified.

In testimony whereof I have hereunto set my hand.

EDWARD WILSON HARDEN.

Witnesses:

W. R. WOOD,
C. W. MILES.