

No. 725,935.

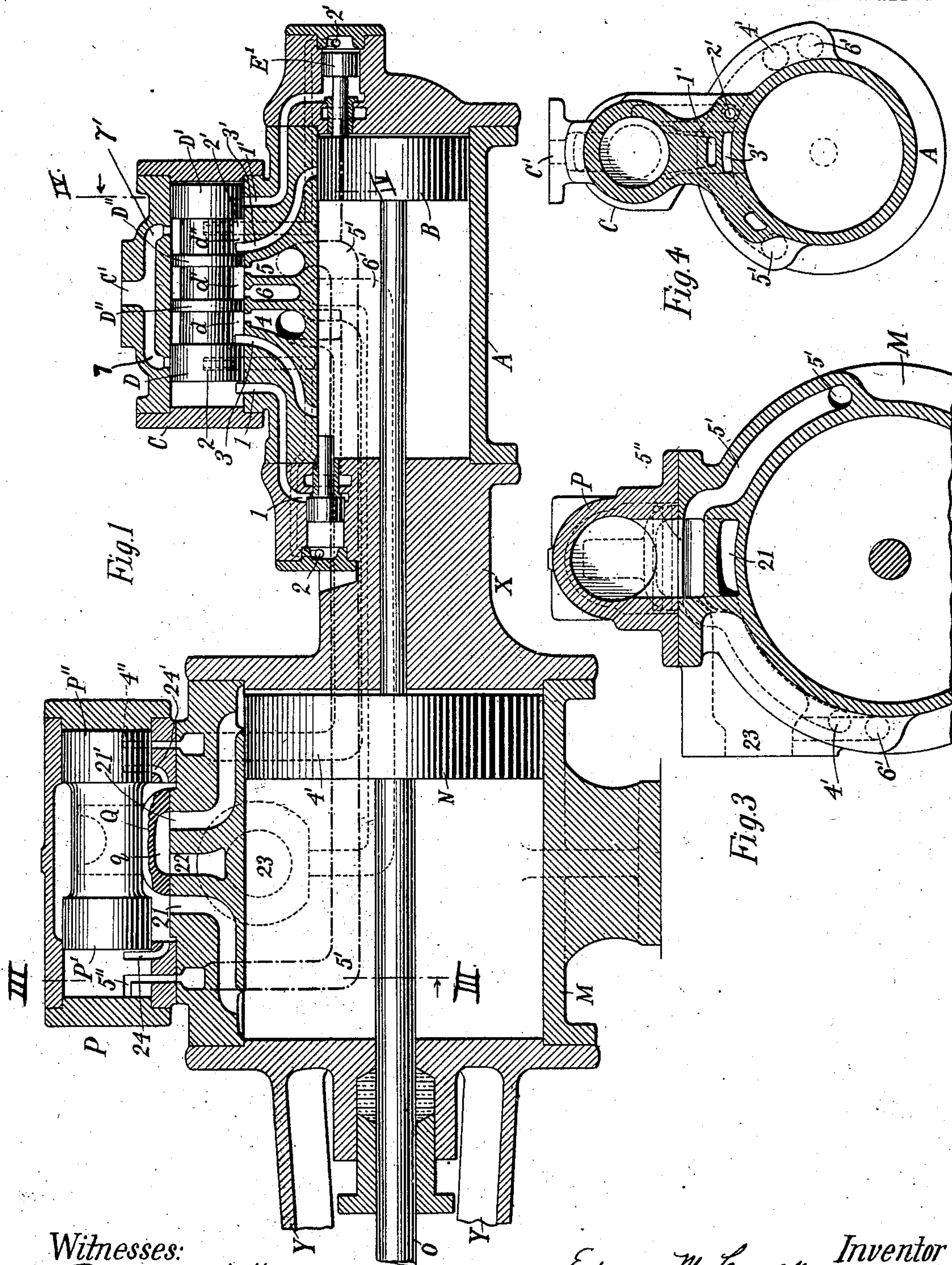
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E. M. CORYELL.  
COMPOUND ENGINE.

APPLICATION FILED AUG. 20, 1901.

NO MODEL.

2 SHEETS—SHEET 1.



*Witnesses:*

Rapphaël better

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# UNITED STATES PATENT OFFICE.

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## COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 725,935, dated April 21, 1903.

Application filed August 20, 1901. Serial No. 72,675. (No model.)

*To all whom it may concern:*

Be it known that I, EDWIN M. CORYELL, of the city and State of New York, have invented a new and useful Compound Engine, which invention is fully set forth in the following specification.

This invention relates to compound steam-engines; and it consists in arranging the high-pressure and low-pressure engines end to end, so that their two pistons are in tandem upon a common piston-rod.

More particularly the invention consists, further, in providing a single valve for the low-pressure engine that is itself actuated by the pressure of steam from the high-pressure engine and that controls the admission of steam to its own cylinder and also controls the final exhaust and another valve for the high-pressure engine that controls not only the admission of steam to its own cylinder and the discharge therefrom, but also the admission of such discharged steam to the low-pressure engine. Preferably the valve of the high-pressure engine is itself actuated by steam-pressure alone in the manner described in my Patent No. 688,598, granted December 10, 1901.

My invention consists, further, in certain details of construction to be pointed out. The invention will be best understood by reference to the annexed drawings, in which one embodiment is illustrated.

In the drawings, Figure 1 is a longitudinal sectional view, the passage-ways connecting the high-pressure and low-pressure members being indicated by dotted lines. Fig. 2 is a plan view of Fig. 1. Fig. 3 is a transverse sectional view through line III III, and Fig. 4 is a similar view through line IV IV of Fig. 1.

At the right hand of the figures is shown the primary or main or high-pressure engine, and at the left the larger or secondary or low-pressure engine. They are arranged end to end and united by the integral casting X, while at Y Y are indicated arms for connecting the compound engine to a pump or the like. The two pistons B and N are in tandem and are fast on the common piston-rod O. In the secondary is a single valve Q, actuated by the exhaust-steam from the primary, and in the latter is a single valve preferably

actuated by live steam and which itself serves to control both the inlet and the outlet of the main cylinder as well as of the secondary cylinder and also the final exhaust, all as will be more particularly described.

In the primary or high-pressure engine A is the steam-cylinder, and B the main piston. C is the valve-chest, containing what I shall designate the "spool-valve," that comprises the two piston-heads D D' and the two flanges or belts D'' D'', which define the three annular spaces  $d$   $d'$   $d''$ . At each end of the steam-cylinder A is a tappet-valve E E', operated alternately by the piston B. These valves E E' control the outlets 1 1', leading from each end of the valve-chest, and they are normally held closed by the pressure of steam admitted through ports 2 2'. Ports 3 and 3' lead from the valve-chest to the steam-cylinder, and ports 4 and 5 communicate with passages leading to the secondary or low-pressure engine. A port 6 leads through channel 6' to the final exhaust and is connected alternately (through space  $d'$ ) with ports 4 and 5.

C' is the inlet-port for live steam, and it branches to ports 7 and 7'. Small apertures (not shown) lead longitudinally through piston-heads D and D' from spaces  $d$  and  $d''$ , respectively.

The various parts of the spool-valve and the various ports are so arranged that when the spool is at one end of its chest (say the right end in Fig. 1) inlet 7 is cut off, inlet 7' is open, annular space  $d''$  affords communication from inlet 7' to inlet-ports 3' and 2', annular space  $d$  affords communication between outlet-port 3 and port 4, while annular space  $d'$  connects port 5 with port 6. When the spool is at the other (left) end, these relations are reversed.

The operation of this high-pressure engine is substantially as in my said patent. In Fig. 1 the piston B has just completed its downstroke (to the right) and has unseated tappet E', thus opening the outlet for passage 1' and exhausting the steam behind piston-head D'. Thereupon the pressure on the other head, D, has immediately shifted the spool to the right, cutting off inlet-port 7, opening passage-way 7'  $d''$  2', and opening



the communication 3 d 4 for the exhaust from the main or high-pressure cylinder, (behind piston B.) Steam is now admitted against valve E', tending to close it and start the main piston B on its back stroke, while the exhaust-steam passing out both relieves the opposing pressure on the rear of piston B and (operating in the low-pressure engine in a manner to be described) coacts with valve E' in moving piston B back until the mouth of passage 3' is uncovered, when the live steam passes directly from inlet C' through passage-way 7' d'' 3' into the steam-cylinder behind piston B. The movement of the piston continues until it unseats tappet-valve E at the other end of the stroke, when the proceedings are reversed. The pressure behind piston-head D is at once reduced and the spool immediately flies to the left, inlet 7' is cut off, and inlet 7 opened and put into communication with port 2, (and 3 also,) while port 3' is put into communication with port 5 (through space d'') and the piston B once more starts down to the right, and so on.

Referring now to the secondary or low-pressure engine, M is the main steam-cylinder, and N is the main piston on rod O, common also to piston B. P is the valve-chest, in which the slide-valve Q is operated by the double-headed piston P' P''. Ports 21 and 21' lead from valve-chest P to steam-cylinder M, each passage terminating in a (shallow) groove that extends very nearly to the adjacent head of the steam-cylinder. A port 22 leads to the exhaust 23. The ports 21 and 21' and 22, the piston-heads P' and P'', and valve Q are all so arranged that in one position the space q beneath valve Q connects passage 21 with port 22, and in the other position the same valve-space q affords communication between passage 21' and port 22. From port 4 in the primary engine leads a passage-way 4' 4', (indicated in Figs. 1 and 2 by heavy dotted lines,) that communicates with the adjacent end of valve-chest P, terminating in a groove 4'' just clear of the face of piston-head P'', and in like manner a passage-way 5' 5' leads from port 5 in the primary engine into the farther end of valve-chest P, terminating in a groove 5''. (This passage is indicated in Fig. 1 by dots and dashes; see also Fig. 2.) Passages 24 and 24' lead, respectively, from the ends of valve-chest P into the valve-seat for alternate communication with valve-ports 21 and 21'. The operation of this low-pressure member (considered apart from the primary engine) is also obvious. Steam from the exhaust of the primary engine is admitted by passage 4' and through the groove 4'' into the valve-chest P behind piston-head P'', which tends to slide valve Q to the left. At the same time the other end of the valve-chest has been cut off (in the primary) from its supply of steam and connected with the exhaust, so that the space at the left of piston-head P' being exhausted while steam is entering at the right the piston itself slides to

the left, carrying valve Q with it. This uncovers ports 24' and 21' to admit steam behind main piston N, and the steam in front of the piston N is exhausted through port 21, space q, port 22, and exhaust 23. Piston N is thus carried to the left until by the operation in the primary this action is reversed, steam then coming in at 5'' 24 21 and exhausting from the other end of the cylinder through passage-way 21 q 22 23.

The operation of my compound engine as a whole may now be clearly set forth. The main piston B has just unseated tappet-valve E' and exhausted behind piston-head D', which last has just passed to the right. The fresh steam under high pressure enters at C' through 7' d'' 2' and tends to push piston B to the left, (by means of valve E'.) The exhaust-steam from the main steam-cylinder passes out through 3 d 4 4' 4'' and tends to push secondary valve Q to the left, the steam behind this secondary piston-head being now free to exhaust through 5'' 5' 5 d' 6 6' 23, whereby the secondary valve Q is moved to the left. The steam from 3 4 4' 4'' then passes through ports 24' 21' behind secondary piston N and starts the latter to the left. By this time the main piston B has uncovered port 3' and is itself being propelled to the left by steam from C' 7' d'' 3'. The exhaust from the secondary is through 21 q 22 23. At the end of the stroke of the pistons piston B unseats the tappet-valve at E, main valve D is shifted to the left, steam begins to push against tappet E and then against piston B, the exhaust behind piston B passes through 3' d'' 5 5' 5'' into the farther left-hand end of chest P, secondary valve Q is shifted back to the right, and steam is admitted to the left of secondary piston N, while its exhaust is through 21 q 22 23, all this being just the reverse of the former operation, and so on continuously.

It will be noted that the secondary valve-chest, except for the exhaust, has all its communications leading back to the primary, so that no packings or bearings, &c., are called for; that only a single valve is found in the secondary; that the single valve in the primary acts not only as the main valve for its high-pressure cylinder, but as well controls the admission into the secondary of steam discharged from the primary and also controls the final exhaust, and that the two pistons work simultaneously with a single piston-rod.

I do not limit myself to the exact arrangement described and shown, since changes may be made in the construction without departing from the spirit of my invention.

Having thus fully described my invention and the best mode in which I contemplate carrying it out, I claim—

1. In a compound steam-engine, the combination with a high-pressure cylinder and its valve-chamber communicating therewith by two ports, a low-pressure cylinder and its



valve-chamber communicating therewith by two ports, two passage-ways leading between said valve-chambers, and an exhaust-channel leading to each valve-chamber, of a valve in said low-pressure valve-chamber actuated through said passage-ways and controlling its two ports aforesaid and said exhaust, and a valve in said high-pressure valve-chamber that controls its two ports aforesaid and also said two passage-ways as well as said exhaust.

2. In a compound engine, the combination of a high-pressure cylinder and a low-pressure cylinder arranged end to end, a valve-chest and valve for each, and suitable ports and passages between said valve-chests and cylinders controlled by said two valves, with a piston in each cylinder, the two pistons being fast on a common piston-rod, but there being no mechanical connection between said valves.

3. In a compound engine, the high-pressure engine comprising a steam-cylinder and its piston, a valve-chest connected with said cylinder by two ports, and a spool-valve in said chest operated by steam-pressure which is controlled by tappet-valves actuated by said piston, in combination with two passage-ways and an exhaust-channel which lead from said valve-chest to the secondary engine and which are so arranged relatively with said spool-valve that one of said ports and one of said passage-ways are put into communication while simultaneously the other port is in communication with said exhaust-channel.

4. In a compound engine, the low-pressure engine comprising a steam-cylinder and a

valve-chest connected by two ports, two passage-ways leading from the high-pressure engine to said chest, and an exhaust-channel leading from said valve-chest, in combination with a valve in said chest that connects each of said ports alternately with said exhaust-channel, a double-headed piston carrying said valve and actuated alternately through each of said passage-ways, and means in the high-pressure engine for controlling said passage-ways.

5. In a compound engine, the combination with the high-pressure member consisting of the valve-chest with its valve and the steam-cylinder with its piston, and the low-pressure member consisting of its valve-chest with its valve and its steam-cylinder with its piston, of two passage-ways leading respectively from said high-pressure valve-chest to the opposite ends of said low-pressure valve-chest, the inlet of steam from said high-pressure steam-cylinder into said passage-ways alternately being controlled by said high-pressure valve, and the steam in said passage-ways alternately shifting said low-pressure piston, the other passage-way acting in turn as the exhaust for said low-pressure member, substantially as described.

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

EDWIN M. CORYELL.

Witnesses:

C. A. L. MASSIE,  
ELISHA K. CAMP.