June 23, 1925. 1,543,431

P. FREIBERG

COMBINED COMPOUND AND DIRECT ACTING STEAM ENGINE

Filed May 19, 1923

Fig. 1

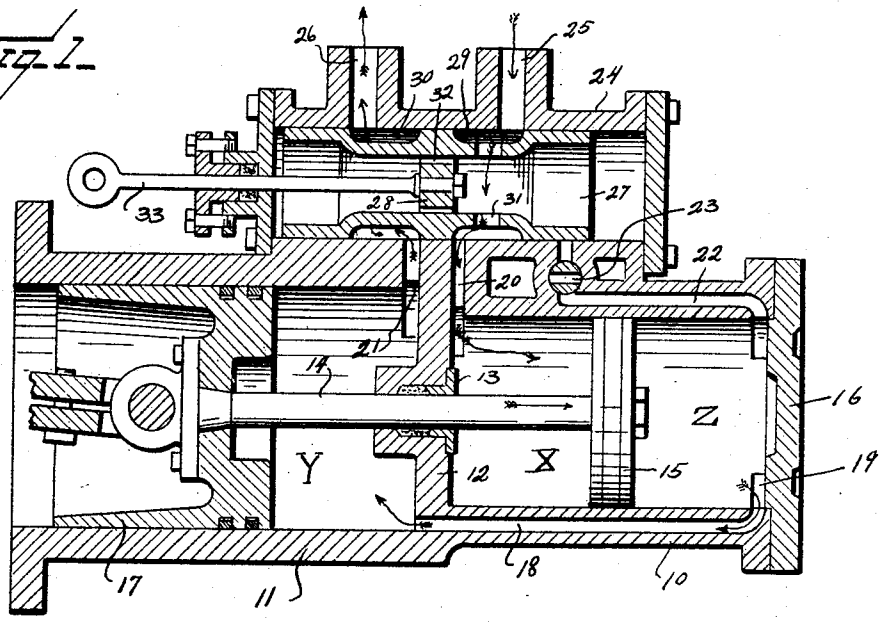
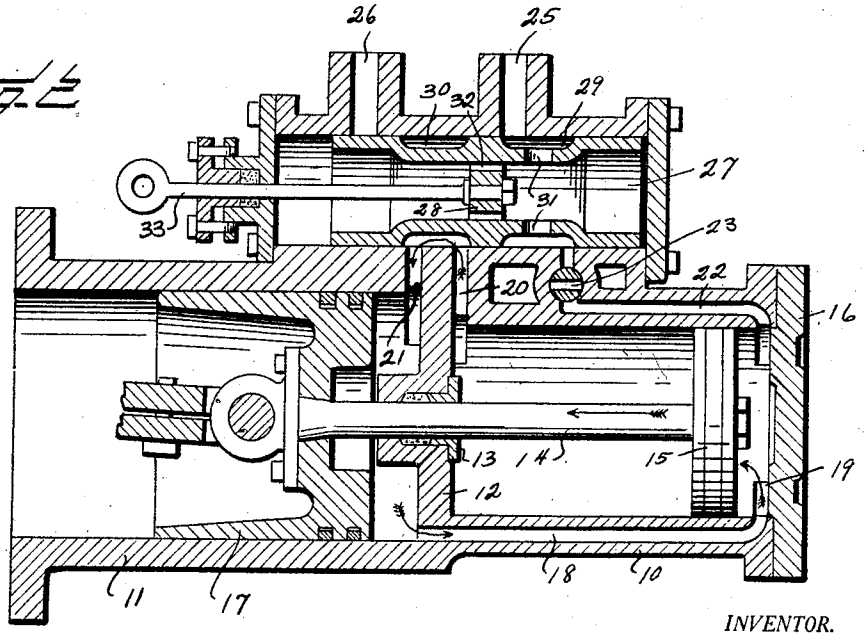


Fig. 2



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UNITED STATES PATENT OFFICE.

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COMBINED COMPOUND AND DIRECT-ACTING STEAM ENGINE.

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To all whom it may concern:

Be it known that I, PETER FREIBERG, a citizen of the United States, residing at Lithonia, in the county of Dekalb and State of Georgia, have invented certain new and useful Improvements in Combined Compound and Direct-Acting Steam Engines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to compound steam engines, and the general object of the invention is to provide a steam engine which will either work as a direct acting engine or as a compound engine.

A further object is to provide a structure of this character having means whereby the steam may be admitted alternately to one end or the other of a cylinder to thereby cause the pistons to be directly acted on by the steam or in which, when the valve is closed, the steam used in acting directly upon a piston may be used expansively in the low pressure cylinder of the engine.

Other objects have to do with the details of construction and arrangement of parts as will appear more fully hereinafter.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is a longitudinal sectional view of a convertible compound and direct acting steam engine constructed in accordance with my invention, the parts being shown in the position taken when live steam is entering the high pressure cylinder;

Figure 2 is a like view to Figure 1, but showing the parts in the position taken when the steam in the high pressure cylinder is expanding into the low pressure cylinders;

Referring to these drawings, it will be seen that I have illustrated a high pressure cylinder 10 coacting with a low pressure cylinder 11, the high pressure cylinder having a diameter less than the low pressure cylinder but being concentric thereto and there being a partition 12 dividing the low pressure cylinder from the high pressure cylinder. This partition 12 has a stuffing box 13 for the passage of a piston rod 14 which extends through the high and low pressure cylinders both. This piston rod at that end which extends into the high pressure cylinder carries upon it a piston 15 and the high pressure cylinder is closed at one end, as at 16. The opposite end of the piston rod 14 carries upon it the trunk piston 17 which is of any suitable character, as is the piston 15.

The space between the partition 12 and the trunk piston 17 I have designated Y. This space Y constitutes the low pressure chamber. The space between the partition 12 and the piston 15 I have designed X and this constitutes the high pressure chamber, while the space between the head 16 and the piston 15 constitutes a supplemental low pressure chamber and is designated Z. The wall of the cylinder 10 is formed with a longitudinally extending passage 18 which opens by a port 19 into the chamber Z at one end and at the other end opens into the chamber Y.

Adjacent the partition 12 and opening into the high pressure chamber X is a port 20 and adjacent the partition 12 and opening into the chamber Y is a port 21. Extending from the exterior face of the high pressure cylinder 10 is a passage 22 which opens into the supplemental low pressure chamber Z adjacent the head 16. In this passage there is disposed the valve 23 which, when rotated in one direction, permits communication through this passage and when turned in the other direction closes communication through the passage.

Formed in conjunction with the conjoined cylinders 10 and 11 is a valve chest 24. This chest has an inlet port 25 and an exhaust port 26, and operating within the chest is a piston valve, designated generally 27. This valve is hollow and has an intermediate partition 28 midway of its length and on one side of this partition 28 there is formed the annular channel 29 and on the opposite side the annular channel 30. The floor of the channel 29 has ports 31 opening into the interior of this side of the valve. The partition 28 is apertured, as at 32, to permit steam to pass from one side of the partition to the other and thus balance the valve. The valve is shifted by means of the valve rod 33 which is connected to any suitable valve operating mechanism not necessary to be shown.

The operation of this mechanism is as follows: With the parts as in the position shown in Figure 1, steam will enter through the port 25, traverse the annular passage 29, pass through the port 20 into the high pressure chamber X, and will act upon the piston to drive it in the direction of the arrow toward the right hand end of the cylin-

der. The exhaust steam which is in the chamber Z will be forced out through the port 19 and duct 18 into the low pressure chamber Y and the steam which is in the low pressure chamber Y will be forced out through the port 21 into the channel 30 and out through the exhaust port 26. When the pistons 15 and 17 have completed their stroke toward the right, the valve 27 will be shifted to the position shown in Figure 2. Under these circumstances the valve 27 will close communication between the port 25 and the port 20. The channel 30 will open communication between the port 20 and the port 21. Therefore, the steam which is in the chamber X, that is to the left hand side of the piston 15, will expand and pass into the chamber Y and will expand within this chamber Y, urging the piston 17 to the left. At the same time this steam will expand through the duct 18 and into the supplemental low pressure chamber and will expand therein so that the expansion of the low pressure steam will act upon the inside face of the piston 17 to force it to the left and upon the outside face of the piston 15 to force it to the left. When the pistons 15 and 17 have completed their stroke, the valve 27 is again shifted to the position shown in Figure 1 and again communication will be established between the steam port 25 and the chamber X to force the piston 15 to the right. Under these circumstances, of course, the steam in the supplemental low pressure chamber Z and the low pressure chamber Y will be forced out through the port 21 and through the exhaust port 26. The engine thus operates as a compound engine.

If it be desired that the engine shall operate as a direct acting engine, the valve 23 is turned so as to establish communication through the passage 22. In this case when the parts are in the position shown in Figure 1, steam enters, as before, through the port 20 and acts upon the piston 15 to shift the piston toward the right, the steam within the chamber Z exhausting through the port 19 into the chamber Y and thence out through the exhaust port 26. Upon the completion of the movement of the piston 15 to the right, the valve 27 will be shifted to the right, as in Fgure 2, establishing communication between the inlet port 25 and the duct 22, causing the live steam to pass into the chamber Z and this live steam acting directly upon the piston 15. The live steam also passes through the port 19 and duct 18 into the chamber Y and acts upon the piston 17 and the live steam passes from the chamber Y through the port 21 and annular port 29 to the port 20 and thus into the chamber X. Thus the live steam successively flows into the chambers Z, Y and X. The pressure in the chamber X would, of course, counterbalance the pressure in the chamber Z but the steam acting on the relatively large piston 17 will cause the pistons to move to the left in Figure 2 until the parts have returned to their original position.

An engine of this character is very simple in construction, has been found very economical in practice, and it will be seen that the steam may be used directly or expansively as desired and that the engine may operate as a direct acting engine for any desired number of reciprocations and then be changed so as to act as a compound engine thereafter, or vice versa.

I claim:—

1. In a steam engine, a pair of aligned cylinders, one smaller than the other and separated by a partition, connected pistons operating in the cylinders, said pistons defining movable walls for a high pressure chamber and two low pressure chambers, means for causing the steam to enter the high pressure chamber and act directly on the small piston therein and including a valve and a duct leading into the high pressure chamber and for exhausting the steam from the high pressure chamber into the low pressure chambers and including said valve, and ducts operatively connecting the high pressure chamber with the low pressure chambers, said means then acting at the end of the stroke of the pistons in one direction to cut off the inlet and exhaust of steam and permit steam in the low pressure chambers to act expansively, and manually controlled means whereby live steam may be admitted to the high pressure and the low pressure chambers when the stroke of the piston under the direct action of steam in the high pressure chamber has been completed.

2. In a steam engine, aligned small and large cylinders separated by a partition, connected pistons operating therein, and forming movable walls for a high pressure chamber and two low pressure chambers, a valve chamber and a reciprocating valve therein in one position causing steam to enter the high pressure chamber and act directly on the small piston and permitting the exhaust of steam from the high pressure chamber into the low pressure chambers and including ducts operatively connecting the high pressure chamber with the low pressure chambers and controlled by said valve and in the other position acting to cut off the inlet and exhaust of steam and permit steam in the low pressure chambers to act expansively, a duct extending from the valve chamber to one of the low pressure chambers behind the smaller piston, and a manually controlled valve in said duct adapted in one position to permit passage through said duct and in the other position to cut off passage through said duct.

3. In a steam engine, two aligned cylinders, one of smaller diameter than the other,

a partition separating the cylinders, the cylinder of smaller diameter having a head at the end remote from the partition, a piston rod passing through the partition and carrying a pair of pistons, one for each cylinder, the smaller piston defining a high pressure chamber between it and the partition and the large piston defining the movable wall of a low pressure chamber, there being a supplemental low pressure chamber between the small piston and the head, the supplemental low pressure chamber communicating with the other low pressure chamber by a duct, a valve chest, the high and low pressure chambers having each a port communicating with the valve chest and there being a passage connecting the head end of the supplemental low pressure chamber with said valve chamber, a manually operable valve in said passage adapted to cut off or permit communication through said passage, the valve chamber having a steam inlet port and an exhaust port, a valve reciprocating therein and in one position opening communication between the inlet port and the high pressure chamber and between the exhaust port and the low pressure chamber and in the other position acting to cut off the exhaust and inlet ports and open communication between the ports of the low pressure and high pressure chamber.

In testimony whereof I hereunto affix my signature.

PETER FREIBERG.