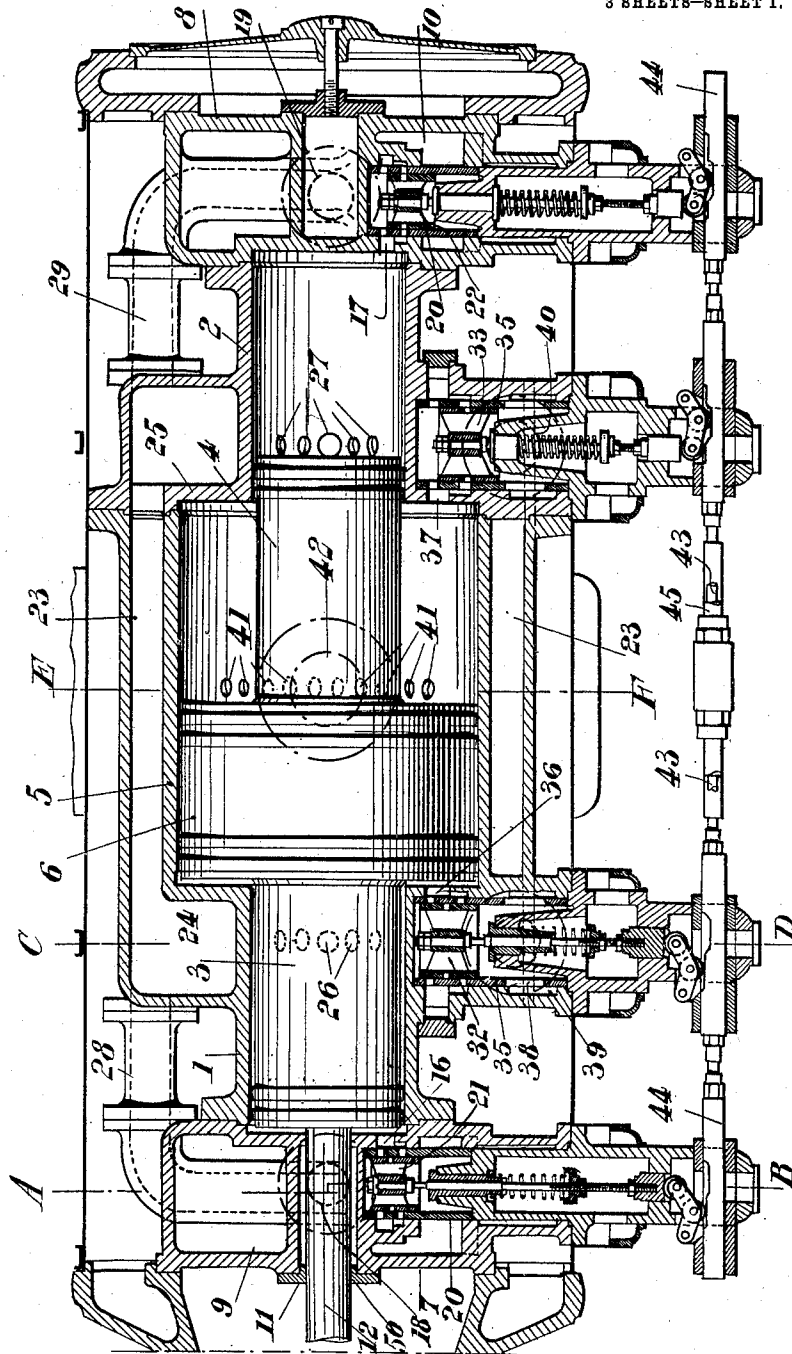


1,044,392.

Patented Nov. 12, 1912.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
F. M. Meyer
W. B. Stern.

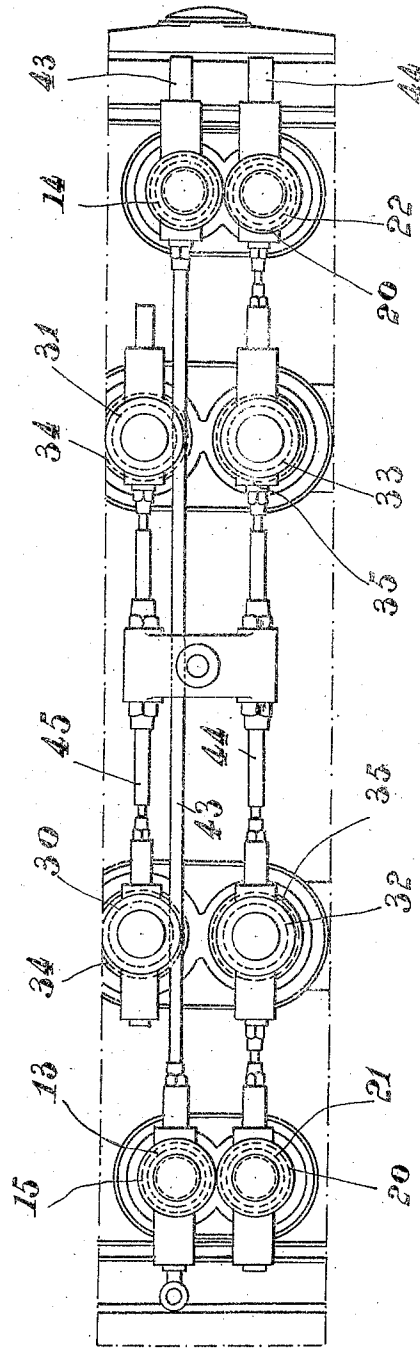
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1,044,392.

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COMPOUND ENGINE.
APPLICATION FILED FEB. 24, 1912.

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3 SHEETS—SHEET 2.

Fig. 2.



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APPLICATION FILED FEB. 24, 1912.

Patented Nov. 12, 1912.

3 SHEETS—SHEET 3.

Fig. 3.

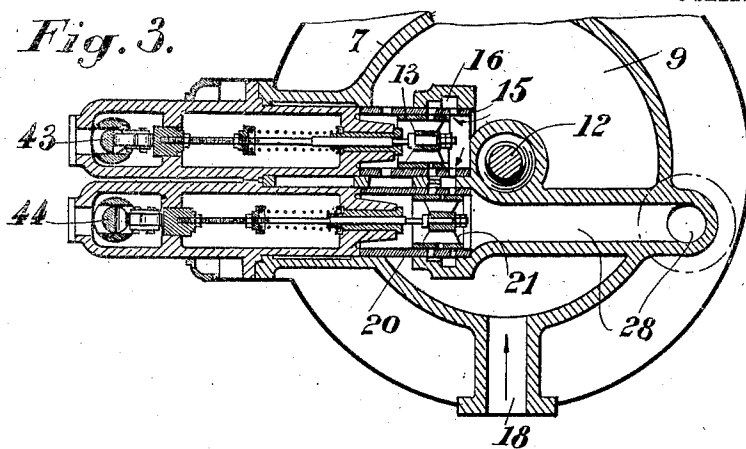


Fig. 4.

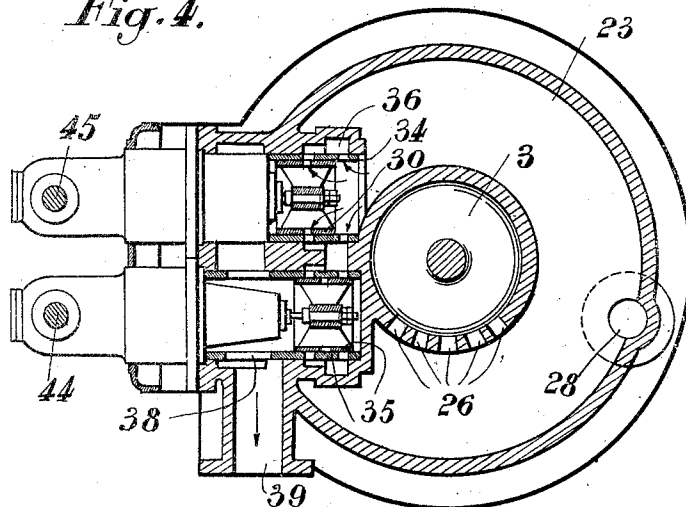
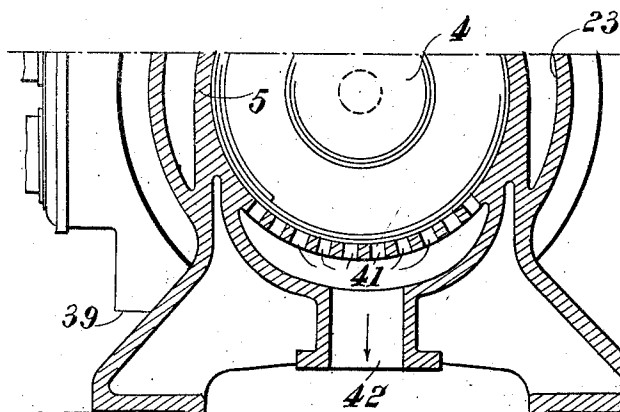


Fig. 5.



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UNITED STATES PATENT OFFICE.

ROBERT JUNG, OF OSNABRÜCK, GERMANY.

COMPOUND ENGINE.

1,044,392.

Specification of Letters Patent.

Patented Nov. 12, 1912.

Application filed February 24, 1912. Serial No. 679,672.

To all whom it may concern:

Be it known that I, ROBERT JUNG, a subject of the German Emperor, and resident of Osnabrück, Germany, have invented certain new and useful Improvements in Double-Acting Tandem Compound Engines with Stage-Piston, of which the following is a specification.

The invention is shown in the accompanying drawing, in which:

Figure 1 is a horizontal section of the engine. Fig. 2 is a partial side view of the engine. Fig. 3 is a section on line A—B of Fig. 1. Fig. 4 is a partial section on line C—D of Fig. 1. Fig. 5 is a partial cross section of the engine on line E—F of Fig. 1.

In this compound engine two single acting high pressure cylinders 1 and 2, the pistons of which 3 and 4 and a double acting low pressure cylinder 5 are provided, a double acting piston 6 working in said cylinder 5. The cylinders are arranged as in a tandem engine, the low pressure cylinder 5 being directly interposed between both high pressure cylinders. The high pressure cylinder 1 and the low pressure cylinder 5 are made integral with each other and the high pressure cylinder 2 is connected with the low pressure cylinder. The pistons 3, 4 and 6 are connected so as to form a staged piston in which the pistons 3 and 4 are the end portions and the piston 6 the middle portion.

At the free ends of the high pressure cylinders 1 and 2 are provided covers 7, 8, steam jackets 9 and 10 being mounted by any known means on said covers (Figs. 1 and 3). The stage piston rod penetrates one of the covers 7 through a stuffing box 50. On the covers 7 and 8, are mounted the inlet means for the live steam, which are shown as piston valves 13, 14. Said piston valves are arranged to move in a tube shaped housing 15 (Figs. 2 and 3) having ducts 16, 17, which ducts 16, 17 open into the high pressure cylinders 1 and 2. The live steam is conveyed to the engine through connecting branches 18, 19 which open into the corresponding steam jackets 9 and 10 of the covers. Into the ducts 16 and 17 are also projecting the tube shaped housings 20 of the auxiliary outlet valves 21, 22.

The steam jacket 23 of the low pressure cylinder 5 serves as a receiver. Ports 26, 27 are provided at the end portions of the high pressure cylinders 1 and 2. The steam

jacket 23 extends over the inner ends of the high pressure cylinders 1 and 2 to such an extent, that the ports 26 and 27 open direct into the receiver 23. The receiver 23 is connected with the auxiliary outlet valves 21 and 22 by means of short ducts 28, 29 through the steam jackets 9 and 10.

Between the walls 24 and 25 of the low pressure cylinder and the end walls of the receiver 23 are provided the inlet means 30, 31 and the auxiliary outlet means 32 and 33. Said means respectively are also formed by piston valves and disposed in such a manner that the valve housings 34 and 35 are connected with the interior of the low pressure cylinder 5 by means of corresponding common ducts 36, 37. The free end of the housing 34 opens into the receiver 23 while the housing 35 is connected through an opening 38 and branches 39 and 40 with the condenser or exhaust piping (Fig. 1).

Outlet ports 41 are provided in the intermediate part of the cylinder 5, said ports opening in an exhaust duct connected with an exhaust pipe 42 (Fig. 5).

The inlet means 13 and 14 of the high pressure cylinders 1 and 2 are controlled by the connecting rod 43, the auxiliary outlet valves 21 and 22 of the high pressure cylinder and the auxiliary valves 32 and 33 of the low pressure cylinder 5 being controlled by means of a connecting rod 44 and the inlet valves 30 and 31 of the low pressure cylinder being controlled by means of a rod 45 connected with the connecting rod 44.

The working of the compound engine is as follows: When the pistons 3, 6 and 4 are at the left (see Fig. 1) the live steam enters through the tube 18 into the steam jacket 9 of the cover 7 (Fig. 3) and through the slide valve 13 and the duct 16 into the high pressure cylinder 1. Just before the pistons reach the right hand position, the high pressure piston 3 uncovers the outlet ports 26, so that the greatest part of the steam flows into the receiver 23. When the pistons move back the steam in the cylinder 1 is expelled through the duct 16, the sliding valve 21 and the tube 28 and is forced into the receiver 23 until the compression, controlled by the sliding valve 21, begins in said cylinder. This steam, expelled in alternate manner is heated when it passes the steam jacket 9. At the end of the piston stroke the exhaust steam of the high pressure cylinder 2, which enters at the end of the receiver through the

ports 27, is joining the foregoing steam. This exhaust steam contacts the end 25, of the low pressure cylinder 5, then the peripheral surface of said cylinder and after having struck the opposed end 24 it flows together, with the exhaust steam of the second high pressure cylinder, through the sliding valve 30 and the duct 36 to the low pressure cylinder 5 (Fig. 4).

Most of the exhaust steam flows through the exhaust ports 41, uncovered by the low pressure piston 6, into the outlet piping 42. The steam which does not flow through the outlet ports 41 is directed through the duct 36 and through the outlet sliding valve 32, which serves as regulating means for the compression in the low pressure cylinder 5.

The live steam entering the high pressure cylinder 2 through the piping 19, the sliding valve 14 and the duct 17, flows through the engine in the same manner as the live steam entering the high pressure cylinder 1, but in an opposite direction, and, after having flowed around the low pressure cylinder 5, it unites with the exhaust steam from the high pressure cylinder 1. The exhaust steam from the high pressure cylinder 2, enters the receiver 23 through the duct 29, during the back stroke of the piston 4. During the following forward stroke of the piston 4 it flows through the inlet valve 31 into the low pressure cylinder 5 and leaves the engine through the ports 41 and the piping 42.

The condensation of the live steam, while entering in the high pressure cylinders 1 and 2, is very small in the above compound engine. The condensation in the low pressure cylinder 5 is also very small, because said cylinder is heated all around by means of moving steam, the steam from the outlet ports controlled by the high pressure pistons 3 and 4 being made to flow in alternate currents along the ends and the peripheral surface of the low pressure cylinder.

The losses of heat while the steam is passing from the high pressure cylinders 1 and 2 into the low pressure cylinder 5 are very low, because the large part of the exhaust steam of the high pressure cylinder passes directly into the receiver 23.

Having now fully described my said invention, what I claim and desire to secure by Letters Patent, is:

1. A compound steam engine comprising a low pressure cylinder and high pressure cylinders connected with the ends thereof, said cylinders being arranged in tandem, the high pressure cylinders having in the vicinity of their inner ends outlet ports and the low pressure cylinder being provided approximately midway between its ends with outlet ports, a jacket surrounding the low pressure cylinder and overlapping the inner ends of the high pressure cylinders and inclosing the outlet ports of the last mentioned cylinders, connected pistons arranged for simultaneous movement in the cylinders, means for admitting steam into the outer ends of the high pressure cylinders, means for permitting steam to flow from the jacket into the ends of the low pressure cylinder and means for partially exhausting steam from the jacket.

2. A compound steam engine comprising a low pressure cylinder and high pressure cylinders connected with its ends, said cylinders being arranged in tandem, outlet ports located in the vicinity of the inner ends of the high pressure cylinders, said low pressure cylinder being provided with ports located between its ends, hollow covers closing the outer ends of the high pressure cylinders, connected pistons arranged for simultaneous movement in the cylinders, a jacket surrounding the low pressure cylinder and overlapping the inner ends of the high pressure cylinders and inclosing the outlet ports thereof, means for admitting steam from the covers into the outer ends of the high pressure cylinders, ducts connecting the jacket with the covers, means for admitting steam from the jacket to the ends of the low pressure cylinder and means for partially exhausting the steam from the jacket.

In testimony whereof I have hereunto set my hand in presence of two witnesses.

ROBERT JUNG.

Witnesses:

GUSTAV TRÖBEL,
ERICH SCHRADER.