(No Model.) 2 Sheets—Sheet 1.

J. PLAYER.

TANDEM COMPOUND ENGINE.

No. 499,584. Patented June 13, 1893.

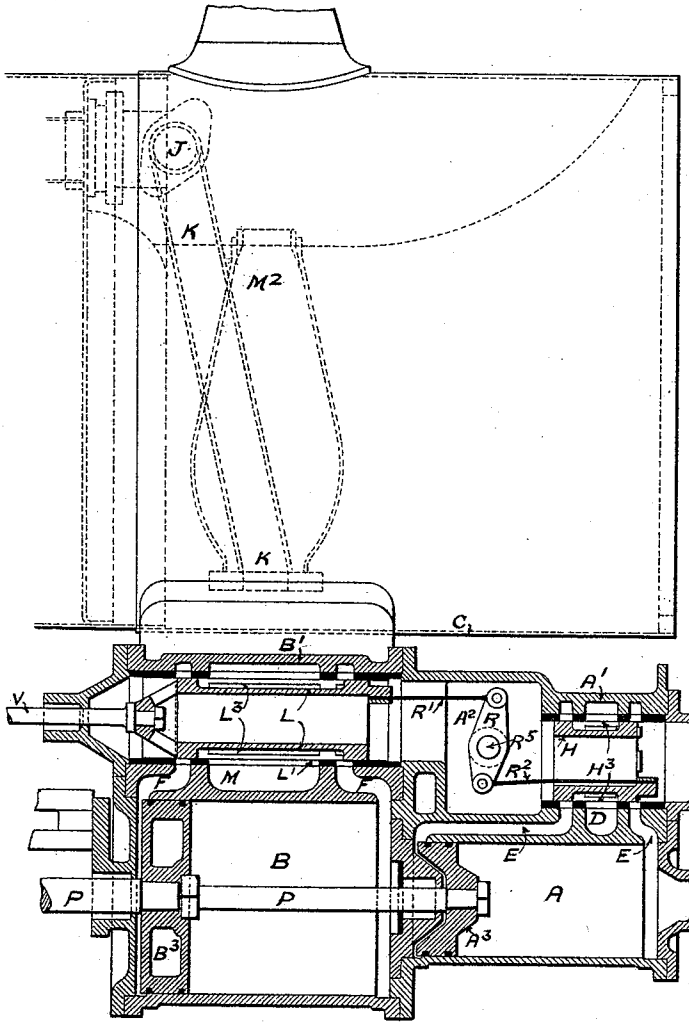

FIG. 1.

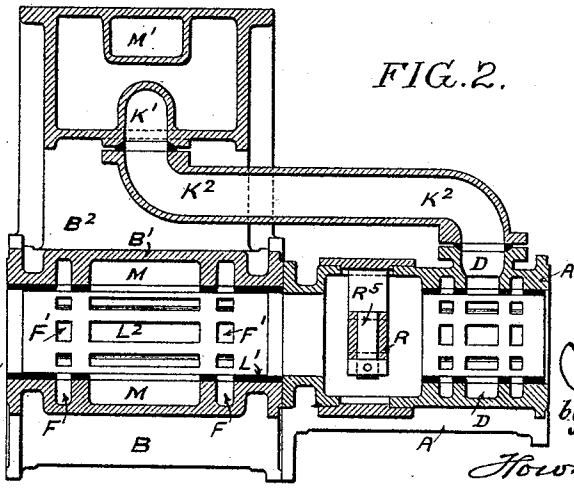

FIG. 2.

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FIG. 3.

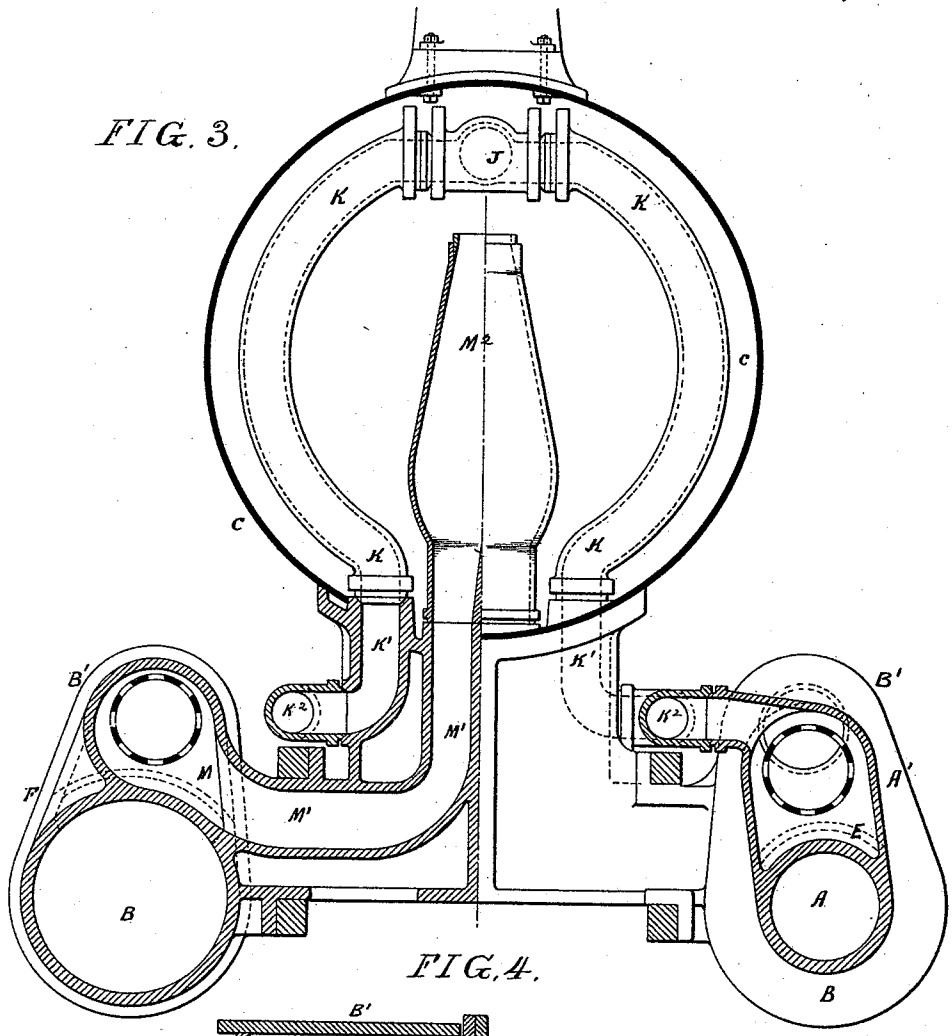
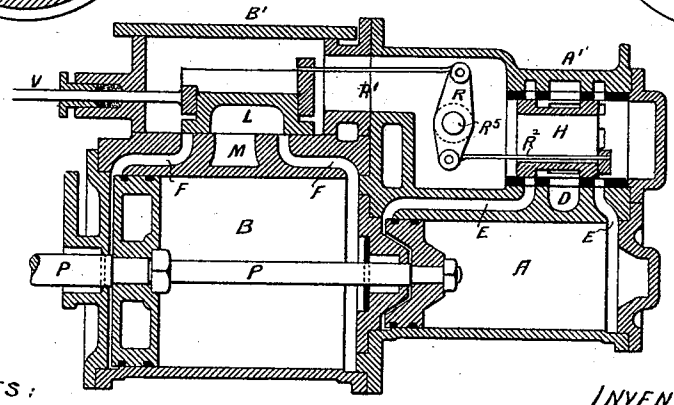


FIG. 4.



WITNESSES:
R. Schleicher.
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INVENTOR:
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UNITED STATES PATENT OFFICE.

JOHN PLAYER, OF DUNKIRK, NEW YORK, ASSIGNOR TO THE BROOKS LOCOMOTIVE WORKS, OF SAME PLACE.

TANDEM COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 499,584, dated June 13, 1893.

Application filed February 23, 1892. Serial No. 422,533. (No model.)

To all whom it may concern:

Be it known that I, JOHN PLAYER, a resident of Dunkirk, Chautauqua county, New York, have invented certain Improvements in Tandem Compound Engines, of which the following is a specification.

My invention relates to compound locomotives or other engines of that type in which both the high and low pressure cylinders are arranged on the same side of the locomotive, and on the same center line or "tandem," and in which both the high and low pressure pistons are attached to the same piston rod and connected to the same cross-head, so that the work done on both sides of the engine is equalized.

The objects of my invention are, first, to construct a compound locomotive in which the high and low pressure cylinders are on the same side of the engine and arranged on the same center line, having their pistons connected to a piston rod common to both cylinders, so that the total effort of both cylinders may be transmitted centrally to the cross-head, in which the cylinders and parts connected thereto may be absolutely interchangeable with like parts of a single expansion engine of similar capacity; second, to construct a compound locomotive in which the initial high pressure steam is exposed to the least possible amount of condensing surface, due to coming in contact with parts surrounded with either the exhaust steam from the high pressure cylinder or the exhaust steam from the low pressure cylinder; third, to so construct the valve gear for a compound locomotive of the above type that the high pressure valve is arranged to cut off steam at points of the piston stroke varying from those of the low pressure valve, both said valves being actuated by the same valve stem. These objects I attain as hereinafter specifically designated, and as clearly set forth in the accompanying drawings, which show so much of a locomotive engine embodying my improvements as is necessary to illustrate the subject matter thereof.

Some of these improvements may be used without the others, and on machines differing somewhat in their details of construction from those herein shown, and they are equally as applicable to stationary and marine engines as to a locomotive.

Figure 1, is a longitudinal section taken through the high and low pressure cylinders, with their steam chests, valves and connected parts. Fig. 2, is a sectional plan taken through the low pressure cylinder saddle, the high and low pressure steam chests and the connecting pipe from the cylinder saddle to the high pressure steam chest. Fig. 3, is a transverse sectional view, one half being a section through the high pressure cylinder and the other half being a section through the low pressure cylinder. Fig. 4, is a longitudinal sectional view through the high and low pressure cylinders, their steam chests, valves and connected parts showing a modification of the valve gear.

Parts not specifically described herein are of ordinary and well known construction.

My improvements in a compound locomotive or other engine of the "tandem" type consists in the combination of a structure containing the low pressure cylinder and saddle, the low pressure steam chest, the final exhaust passage and the live steam passage communicating with the boiler; and another structure containing the high pressure cylinder and steam chest, a live steam chamber communicating with the live steam passage of the low pressure cylinder saddle by a connecting pipe attached thereto, said high pressure cylinder structure being arranged so that it is attached to the tail end of the low pressure cylinder and having its steam chest communicating with the steam chest of said low pressure cylinder; with an annular balanced valve for the low pressure cylinder having its admission edges at its extremities and its final exhaust cavity in the center and also having a passage through the center through which the exhaust steam from the high pressure cylinder passes, said valve being connected direct to the valve stem and having another connection for actuating the rocker arm, reversing lever or other device which is connected to the high pressure valve in such a manner as to reverse the motion thereof from that of the low pressure valve, said high

pressure valve having an internal admission cavity and external exhaust edges, said rocker arm being further arranged so that the travel of the high pressure valve is different from that of the low pressure valve and consequently the different points of cut-off are caused to vary from those of the low pressure valve, securing thereby a better distribution of steam in the high and low pressure cylinders.

A is the high pressure cylinder. B is the low pressure cylinder. The high pressure cylinder is arranged directly back of and in line with the low pressure cylinder, but is made independent of the low pressure cylinder. I preferably so shape the castings of the low pressure cylinders that they can be substituted for the ordinary cylinder castings of a single expansion locomotive.

A′ is the valve chest of the high pressure cylinder, and B′ is the valve chest of the low pressure cylinder. In the present instance these chests are integral with their respective cylinder castings.

A^3 is the piston of the high pressure cylinder and B^3 is the piston of the low pressure cylinder. These two pistons are arranged on the same piston rod P. The rod is adapted to suitable packing in the heads of the cylinders, as clearly shown in the drawings.

D is the live steam port in the valve chest A′.

E E are the ports connecting each end of the high pressure cylinder with the valve chests.

H is an annular valve having a cavity H^3 which forms a communication between the live steam port D and the ports E, E, alternately.

F F are the induction and eduction ports forming communication between the valve chest B′ and the low pressure cylinder B.

M is the final exhaust port.

L is the low pressure annular balanced valve attached to the valve chest B′ and has a passage L^3 forming a communication between the ports F and the final exhaust port M. This valve is attached to the valve stem V, and through this stem a reciprocating motion of the proper length is given to the said valve.

As shown in Fig. 1, I form between the high and low pressure valve chests a chamber A^3, its shell being preferably cast with a high pressure cylinder casting. On a suitable stud R^5 in this chamber is pivoted a two armed lever R which has a rocking motion; I preferably make one arm of this lever longer than the other arm, and I attach to the long arm of the lever a rod R′ which is secured to the end of the low pressure valve, and to the short arm of the lever I attach a rod R′ which, in the present instance, is attached to the high pressure valve, and I prefer to make these rods in the form of flat bars having sufficient strength to impart movement to the lever and the high pressure valve, but being sufficiently flexible to allow for the swing of the lever as clearly shown in Fig. 1. The bars are connected to their respective valves by clamp plates and bolts. The object of this construction is to cause the high pressure valve H to travel in the opposite direction to that of the valve L. At the same time the two arms of this rocker being of unequal length, the high pressure valve must have a different travel from that of the low pressure valve. This enables me to simplify the valve ports in each chest and the valves. It will also be seen that the valve mechanism situated within the receiving chamber, is surrounded by steam of an even temperature so that these parts will not be subject to unequal expansion, which might otherwise occur if they were differently located.

The chamber A^2 forms a communication between the high pressure exhaust chamber and the low pressure steam chamber.

It will be noticed that in Fig. 1, the high pressure valve chest is out of line with the low pressure valve chest. This arrangement not only enables me to obtain the proper movement of the lever, but also brings the high pressure valve chest closer to the high pressure cylinder. Thus the travel of steam to and from the cylinder is shortened.

The ordinary bushings are used in both valve chests.

I will now refer to Fig. 3. C is the smoke box. J is the T-head connecting with the steam supply pipes K, K, located in the smoke box. These steam supply pipes are attached to the cylinder castings and communicate with the live steam passages K′, therein, which in turn communicate with the connecting pipes K^2, communicating with the live steam ports D, of the high pressure cylinders on each side of the engine. M′ is the exhaust passage forming a continuation of the exhaust port M of the low pressure cylinder, and this passage communicates with the exhaust nozzle M^2. It will be seen that the live steam passage does not adjoin the exhaust passage but is entirely independent of the said passage.

It will be understood that the high pressure valve chest need not necessarily be situated above its cylinder, but may be situated underneath or at the side of its cylinder, and would be connected to the low pressure valve by either the lever shown in Fig. 1, or the mechanism shown in Fig. 4.

The low pressure valve L may be an ordinary slide valve, having external admission edges and internal exhaust edges as shown in Fig. 4. In this case the high pressure exhaust steam instead of passing through the valve, as previously described for the annular valve, passes over the valve and is admitted to the low pressure cylinder by its external edges, the high pressure valve and valve reversing gear, however, being substantially the same as hereinbefore described.

My improved engine operates as follows:—Steam is admitted to the high pressure steam chest A′ through the steam pipes K and pas-

sages K′ and K², through the port D into the admission cavity H³ of the high pressure valve H, thence through the induction port E into the high pressure cylinder A, operating upon the high pressure piston A³. The exhaust steam from the high pressure cylinder A passes through the eduction port E, into the end of the steam chest A′, thence through the hollow valve H and the chamber A² into the end of the low pressure steam chest B′, thence through or over the valve L, into the low pressure cylinder B through the induction port F. The exhaust steam from the low pressure cylinder B passes out through the eduction port F into the cavity L³ of the valve L into the final exhaust pipe M². As before stated, the rocker arm or reversing lever R is so proportioned that the travel of the valve H differs from the travel of the valve L, and may be adjusted in any proportion desired to give the best distribution of steam in the high and low pressure cylinders according to the work performed; the high pressure valve is arranged with an internal admission edge so as to expose the least possible surface to the live steam. The chamber A² of the high pressure steam chest A′, containing the rocker arm R and its neck connecting with the low pressure steam chest B′ are of sufficient area to prevent an excessive pressure at the point of admission of steam into the low pressure cylinder.

In the above description of my improvements I have only referred to an engine of the locomotive type. My improvements, however, are equally applicable to a marine or stationary engine, having the cylinders arranged on the "tandem" principle; in this case, however, the cylinder saddle and connecting pipes would be somewhat modified.

I claim—

1. The combination in a compound engine, of high and low pressure cylinders, an independent valve chest for each cylinder, a receiving chamber for the high pressure exhaust steam situated between the valve chests and connected thereto, independent valves in each chest, a lever pivoted in the receiving chamber, one arm of said lever being connected to one valve, and the other arm connected to the other valve, with mechanism for operating the valves, substantially as described.

2. The combination in a tandem engine, of the high and low pressure cylinders, the high and low pressure valve chests, hollow cylinder valves therein, a chamber situated between the two chests but communicating therewith so as to receive the high pressure exhaust steam, the valves being so arranged as to be balanced by said high pressure exhaust steam, a two armed lever pivoted in the chamber, one arm of said lever being connected to one valve, and the other arm being connected to the other valve, a valve rod attached to one of said valves, the other valve being actuated through the medium of the lever from the first valve, whereby a reverse motion is given to said valve, substantially as described.

3. The combination in a tandem engine, of the low pressure cylinder, a valve chest, a cylinder valve therein, a rod attached to said valve for giving it motion, a high pressure cylinder situated directly back of the low pressure cylinder, a valve chest situated above the rear end of the cylinder, a cylindrical valve therein, a receiving chamber for the high pressure exhaust steam situated between the high pressure valve chest and the low pressure valve chest, a lever pivoted in said chamber, having a long and short arm, the long arm being connected to the low pressure valve, and the short arm being connected to the high pressure valve, whereby a greater throw is given to the low pressure valve, than to the high pressure valve, substantially as described.

4. The combination in a tandem compound engine of the low pressure cylinder and its valve chest, situated between the low pressure cylinder and high pressure cylinder directly back of the low pressure cylinder, a high pressure valve chest and the receiving chamber for the exhaust steam from the high pressure cylinder, both situated above the high pressure cylinder, the said chamber communicating with the high pressure valve chest and the low pressure valve chest, the valves in said chest, and mechanism for operating said valves, substantially as described.

5. The combination in a tandem compound locomotive engine, of a low pressure cylinder, its valve chest formed of a single casting, with the saddle of the engine, a casting situated directly back of the low pressure cylinder, said casting containing the high pressure cylinder, the receiving chamber, and the high pressure valve chest and valve in the high pressure chest, and a valve in the low pressure chest, with mechanism for operating said valves, substantially as described.

6. The combination of the high and low pressure cylinders, the high pressure cylinder being in line with the low pressure cylinder, high and low pressure valves, one being out of line with the other, valve chests for each valve, a chamber between the two valve chests, a lever pivoted in said chamber, having a short and a long arm, a flexible rod connecting the long arm of the lever with the low pressure valve and a flexible rod connecting the short arm of the lever to the high pressure valve, with mechanism for operating one of said valves, the motion of the other valve being imparted through the medium of the lever and rod, substantially as described.

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

JOHN PLAYER.

Witnesses:
EUGENE ELTERICH,
HENRY HOWSON.