J. MARCH.

STEAM ENGINE.

APPLICATION FILED MAR. 3, 1906.

962,907.

Patented June 28, 1910.

2 SHEETS—SHEET 1.

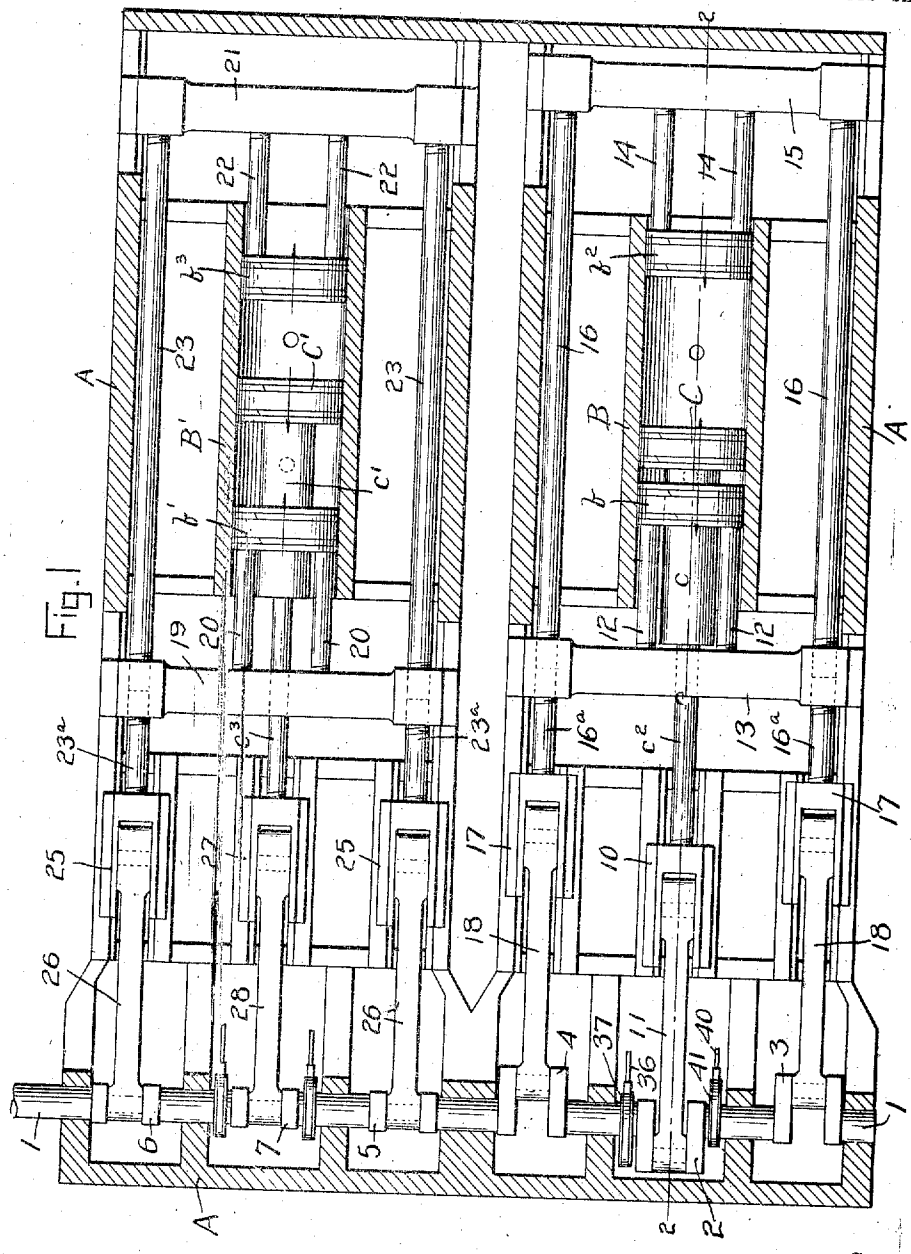

Fig. 1

Witnesses

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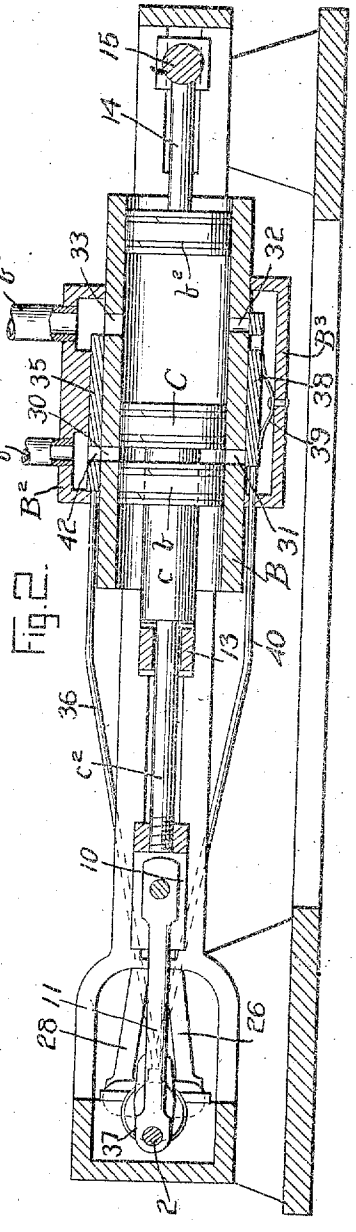

Fig. 2.

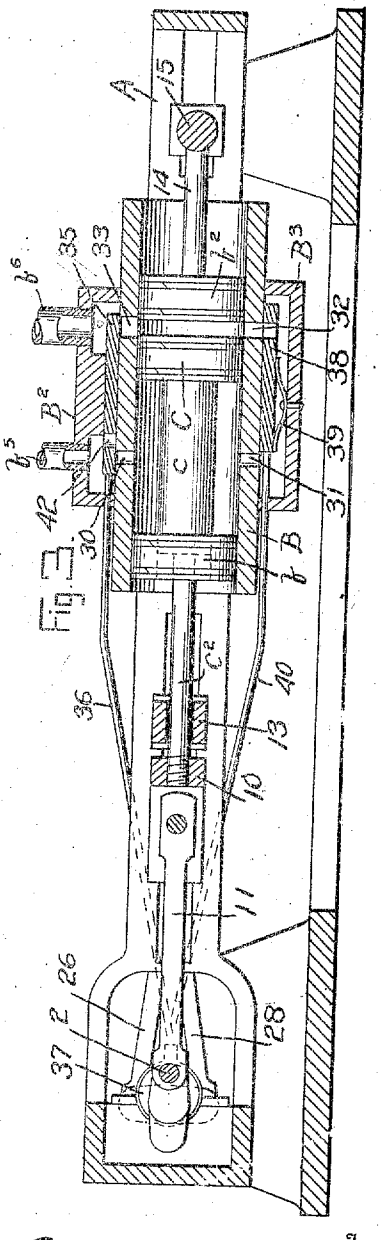

Fig. 3.

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UNITED STATES PATENT OFFICE.

JOHN MARCH, OF DILLON, MONTANA.

STEAM-ENGINE.

962,907. Specification of Letters Patent. Patented June 28, 1910.

Application filed March 3, 1909. Serial No. 481,163.

To all whom it may concern:

Be it known that I, JOHN MARCH, a citizen of the United States, residing at Dillon, in the county of Beaverhead and State of Montana, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My said invention consists in certain improvements in the construction and arrangement of parts of steam engines of that particular type wherein the expansion takes place between two movable heads or pistons contained within the steam cylinder, and in two separate expansion chambers of different areas, whereby such an engine is provided in which a double expansion of the steam is secured in the same cylinder, a perfect balancing of the expansive force provided for, all the power of the steam utilized to the best advantage in the work, and the maximum amount of steam power with the minimum amount of fuel is obtained, all as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts, Figure 1 is a central horizontal section through an engine embodying my said improvements, Fig. 2 a central vertical section through the same on the dotted line 2—2 in Fig. 1, and Fig. 3 a similar view showing the pistons and other moving parts in a position the reverse of that shown in Fig. 2.

In said drawings the portions marked A represent the bed or frame of the engine, B, B′ the steam cylinders and C, C′ the pistons. The frame A is preferably a casting and of suitable form and dimensions to support the cylinders, crank-shaft, and other parts of the mechanism and needs no special description.

As will be noted by reference to Fig. 1, the engine is a compound double expansion engine, comprising two cylinders B and B′ located on opposite sides of the frame. Said cylinders are of equal diameter and of a uniform bore throughout. The cylinder B is provided with sliding heads b, b^2 and the cylinder B′ is provided with similar sliding heads b', b^3.

The piston C is of a common construction mounted between the heads b and b^2 of cylinder B and the piston C′ is of similar construction mounted between the heads b' and b^3 in the cylinder B′. Said pistons and sliding heads are each shown provided with metal packing rings in the periphery, as is common.

The piston C has a piston-rod rigidly secured thereto which is of two diameters. The large part c extends through a stuffing box in the sliding head b and is adapted to extend to the end of the cylinders while the small part c^2 extends from the large part and is connected to a sliding head 10 mounted in suitable ways in a part of the frame A, which in turn is connected by a pitman rod 11 to a crank 2 of the main crank-shaft 1. The piston rod at the point of its connection with the piston C, and for that portion of its length which will at all periods of the operation be within the sliding piston head b, is of a diameter which will occupy approximately one-third to one-half the area of the cylinder between the piston C and the piston head b, for a purpose to be presently described, while for the remainder of its length it is of only such dimension as may be necessary to secure the required strength for the work. The large part, c, may be either hollow or solid as preferred. The sliding piston head b is connected by rods 12 at each side thereof with a cross-head 13 which is mounted at each end to slide in suitable ways provided in the sides of the frame A. Said cross-head 13 is formed with a perforation through which the smaller portion c^2 of the piston rod extends. The sliding piston head b^2 is also connected by connecting rods 14 with a cross-head 15 mounted at each end to slide in longitudinal ways in the frame A and connected at each end by connecting rods 16 to cross-head 13, which is connected to sliding heads 17 by rods 16^a and said sliding piston heads, in turn, are connected by pitmen 18 to cranks 3 and 4, respectively, of the crank-shaft 1. In a like manner the sliding piston head b' in cylinder B′ is connected to a sliding cross-head 19 by connecting rods 20 and the sliding piston head b^3 is connected to a similar sliding cross-head 21 by connecting rods 22, the sliding cross-heads 19 and 21 being connected together near each end by rods 23. The cross-head 19 is connected by connecting rods 23^a with sliding heads 25, which are connected by pitman-rods 26 with the cranks 5 and 6, respectively, of the main crank-shaft 1. The piston C′ in cylinder B′ is likewise provided with a piston rod with a

large part c' of large diameter to extend through the sliding piston head b' and with a small part c^3 extending to the sliding head 27, which is connected by the pitman-rod 28 with the crank 7 on the main crank-shaft 1. The piston c^3 extends through a perforation in cross-head 19, and the piston rod c^2 through a like perforation in cross-head 13.

Each cylinder B and B′ is provided with a steam inlet port 30 leading into its high pressure chamber, an exhaust port 31 leading from said high pressure chamber, an inlet port 32 leading into the low pressure chamber and an exhaust port 33 leading from the low pressure chamber. A steam chest B^2 is mounted or formed on one side of the cylinder and another B^3 on its opposite side serves as a by-pass from one side of the piston to the other. Said steam chest B^2 is divided into two parts one of which has a live steam supply pipe b^5 connected therewith and the other an exhaust steam pipe b^6. A sliding valve 35 is mounted in said steam chest connected by a connecting rod 36 to an operating eccentric 37 on the main crank-shaft 1. Said sliding valve operates in a recess in the body of the metal composing the steam chest separating the live and exhaust steam chambers therein, resting on the side of the cylinder and adapted to cover and regulate the ports 30 and 33. A sliding valve 38 is mounted in steam chest B^3, being held against the face of the cylinder by a spring 39 and adapted to cover and regulate the ports 31 and 32. It is connected by a rod 40 with an operating eccentric 41 on the main crank-shaft 1.

In operation, the parts being in the position shown in Fig. 2 and in the lower half of Fig. 1, the steam from the live steam supply pipe b^5 comes through the port 42 in the sliding valve 35 to the narrow space between the piston C and the sliding piston head b in the cylinder B and expands, driving said piston and sliding head in opposite directions. It will be seen that as piston C is connected to the crank 2 of the main crank-shaft 1 through the piston rod c^2, the slide 10 and the pitman rod 11, and the sliding piston head b is connected to the cranks 3 and 4 respectively through the rods 12, cross heads 13, rods 16^a, sliding head 17 and pitman rods 18, and as the cranks 3 and 4 stand in a position opposite to the crank 2, that as the expansion takes place between the piston C and sliding piston head b its force is directed against said cranks of said crank-shaft to rotate it in its bearings, the two cranks pulling against each other and serving to balance the steam pressure, so that its force is exerted equally on opposite sides of the crank-shaft, one pitman 11 pushing on its crank while the other pitman 18 are pulling.

It will be noticed that the cranks 5 and 6 on the opposite end of the main crank-shaft 1 extend at an opposite direction from the crank 7 and that the cranks 5 and 6 are at right angles with the cranks 3 and 4, while the crank 7 is at right angles with the crank 2. Thus when the cranks 3 and 4 are in line with the crank 2 as shown in the drawings, which would bring the engine B on a dead center, the cranks 5, 6 and 7 will stand at right angles thereto in a position where their longest leverage is in play, thus bringing engine B′ into position of greatest power at the time needed to carry engine B over said dead center. It will thus be seen that throughout the entire revolution of crank-shaft 1 the several cranks stand in such relation to each other that one-half the full power of both cylinders is exerted on said shaft in one direction and the other half in the other direction, insuring an even and steady running of the engine with the strain perfectly balanced and the bearings of the shaft practically relieved of all unnecessary wear. As the steam expands in the chamber between piston C and sliding piston head b they are not only driven apart but the piston C and sliding piston head b^2 are drawn toward each other through the connection of said piston head b^2 with the frame, consisting of the cross-heads 13 and 15 and the rods 16, for as the piston head b is driven toward the end of the cylinder the piston head b^2 will be drawn toward the center of the cylinder, forcing the spent steam out through the exhaust pipe b^6 and bringing the parts to the position shown in Fig. 3. When the parts have reached said position the eccentrics 37 and 40 have shifted the position of the sliding valves 35 and 38 to close ports 30 and 33 and open the ports 31 and 32, when the steam from the chamber between piston C and piston head b will pass through the steam chest B^3 into the larger chamber between the piston C and the piston head b^2, where a second expansion will take place, returning the parts to the position shown in Fig. 2, thus securing a double expansion of steam in the same cylinder which is of a uniform diameter and bore throughout its length, the contracted area of the high expansion chamber being secured by the enlarged diameter of the section c of the piston rod within said chamber.

It will be understood that the operation just described for the cylinder B and parts connected therewith describes with equal accuracy the operation of the cylinder B′ and the parts connected therewith except as to the time of the inlet and exhaust of the steam to the respective high pressure and low pressure chambers, which takes place half way between like periods in the operation of engine B, as will be readily understood.

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

1. A steam engine comprising a frame, a compound crank-shaft having a series of cranks extending in right angular directions to each other, a plurality of cylinders each containing sliding piston heads with a piston between them, said piston heads connected to a sliding frame, said sliding frame connected by a pitman to cranks of said crank-shaft, said piston, and a piston rod connected therewith and connected to a crank of said crank-shaft extending oppositely from the cranks to which said frame is connected, the piston and piston heads of one cylinder being connected to cranks which extend at right angles to those to which the piston and piston heads of the other cylinder are connected, substantially as set forth.

2. An engine comprising a frame, a compound crank-shaft journaled in said frame with cranks extending at right angles to each other, a plurality of steam cylinders, sliding piston heads mounted in each of said steam cylinders, the piston heads of each cylinder being connected to a sliding frame, each of said frames connected by pitman-rods to cranks of said crank-shaft, the cranks to which one frame are connected extending at right angles to those to which the other frame are connected, a piston in each cylinder, a piston rod connected with each piston and connected to a crank on said crank-shaft, the crank to which one piston is thus connected extending at right angles to the crank to which the other piston is connected, the steam regulating valves and means for operating them, substantially as set forth.

3. In a steam engine, the combination of a frame, a compound crank-shaft journaled in bearings therein, a steam cylinder having a bore of uniform diameter throughout its length, a sliding piston-head in each end of said cylinder, a sliding frame connected to each of said sliding piston heads and to cranks of said crank-shaft, a piston between said sliding piston heads in said cylinder, a piston rod connected with said piston and formed for a distance of a diameter to occupy a considerable portion of and contract the area of the expansion chamber on one side of said piston as compared with the area on its opposite side, a connection from said piston rod to a crank of said crank-shaft, a steam chest, a valve therein for controlling the inlet and exhaust of the steam, another steam chest affording a by-pass from one side of the piston to the other, a valve therein, and means for operating said valves, substantially as set forth.

4. A steam engine comprising a frame, a compound crank-shaft, a steam cylinder, steam supply and regulating mechanism connected therewith, sliding piston heads in the opposite ends of said cylinder, a sliding piston between said piston heads, a cylinder connected to one side of said piston and extending through one of said piston heads of a sufficient diameter to make the chamber on one side of said piston of smaller area and therefore a high expansion chamber while the chamber on its opposite side is of a larger area and therefore becomes a low expansion chamber, a sliding frame connected with said piston heads, a connection between said sliding frame and the crank-shaft and another connection between said piston and said crank-shaft, substantially as set forth.

In witness whereof, I, have hereunto set my hand and seal at Washington, D. C. this 26th day of February, A. D. nineteen hundred and nine.

JOHN MARCH. [L. S.]

Witnesses:
E. W. Bradford,
L. A. Price.