C. BENSON.

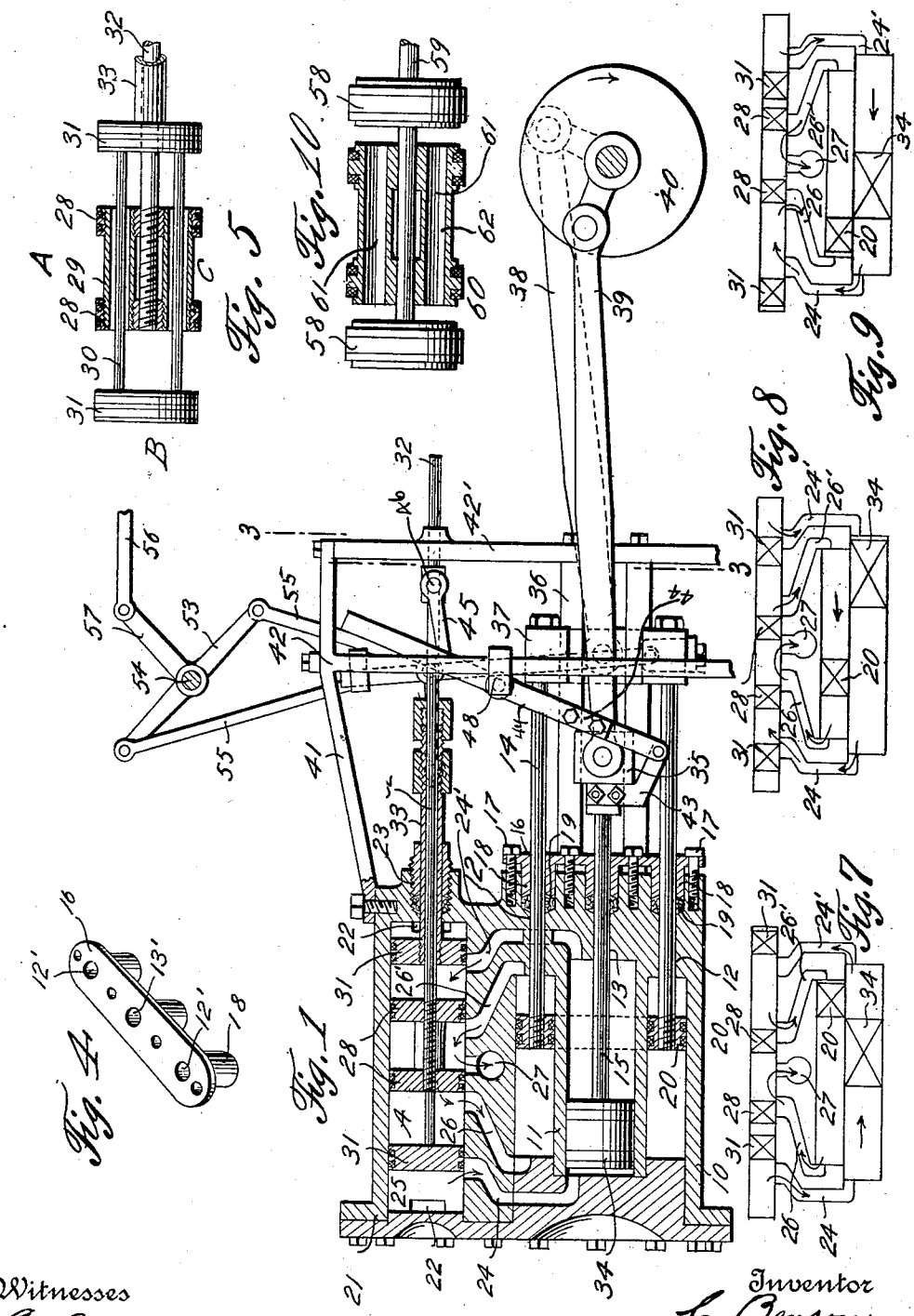
COMPOUND ENGINE.

APPLICATION FILED NOV. 12, 1909.

969,027.

Patented Aug. 30, 1910.

2 SHEETS—SHEET 1.



Witnesses

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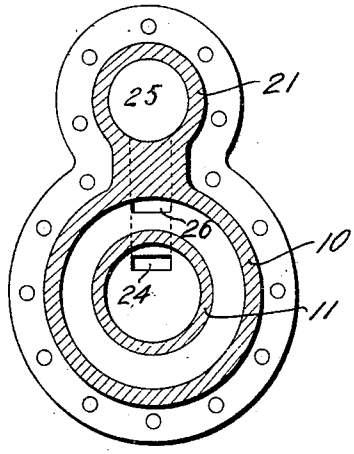

Fig. 2

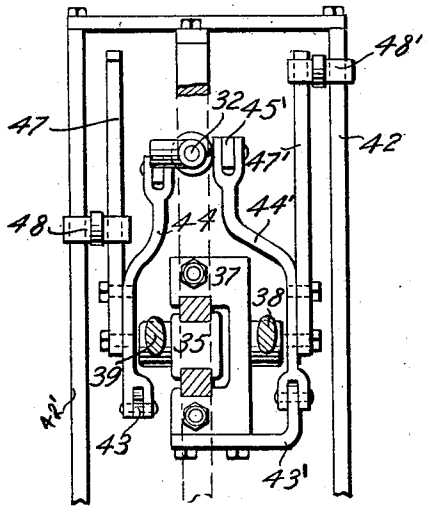

Fig. 3

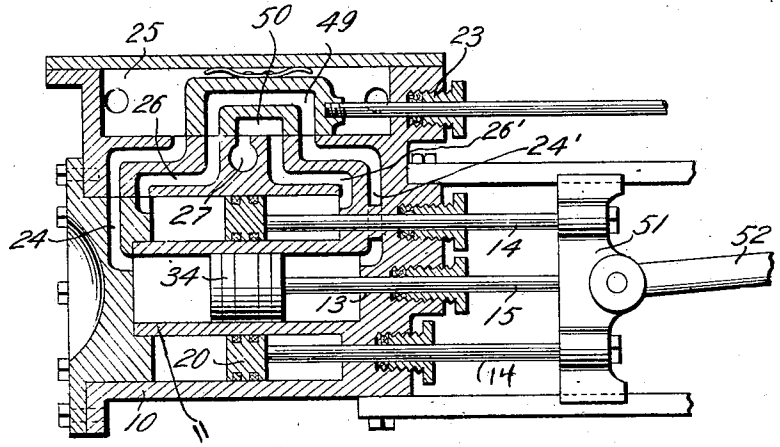

Fig. 6

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UNITED STATES PATENT OFFICE.

CHARLES BENSON, OF LAKE CITY, MINNESOTA.

COMPOUND ENGINE.

969,027. Specification of Letters Patent. **Patented Aug. 30, 1910.**

Application filed November 12, 1909. Serial No. 527,702.

To all whom it may concern:

Be it known that I, CHARLES BENSON, a citizen of the Kingdom of Sweden, residing at Lake City, in the county of Wabasha and State of Minnesota, have invented certain new and useful Improvements in Compound Engines, of which the following is a specification.

This invention relates to compound engines adapted for maritime use as well as locomotives, and more particularly to the construction of the cylinder and slide valves.

With the above and other objects in view this invention relates to the construction, combination and arrangement of parts all as hereinafter more fully described, claimed, and illustrated in the annexed drawings, wherein:—

Figure 1 is a longitudinal section of the cylinders and slide valves of an engine constructed in accordance with the present invention, illustrating the link mechanism for use of the same; Fig. 2 is a vertical transverse section of the cylinder and valve casing; Fig. 3 is a section taken along line 3—3 of Fig. 1, illustrating the link mechanism; Fig. 4 is a perspective view of the stuffing box for piston rods; Fig. 5 is a top plan view partly in section of the slide valve adapted for use in the type of engine set forth in Fig. 1; Fig. 6, is a central longitudinal section of a modification of the cylinder and slide valve; Figs. 7, 8, and 9, are diagrammatic views illustrating the course of the steam through the second, third, and fourth quadrants of the crank shaft; Fig. 10 is a side elevation partly in section of a modification of the valves.

Reference being had more particularly to the drawings, 10 indicates in general the outer or lower pressure cylinder in which is formed the inner or high pressure cylinder 11, said cylinders being constructed in the standard manner and are cast together in one piece at the rear terminals thereof. The rear or integral heads of the cylinders are provided with a central opening 13, surrounded by the extreme opening 12 in which the central and extreme piston rods 15 and 14 respectively operate, said extreme rods 14 being operated by the low pressure piston contained in the outer cylinder 10, while the central rod 15 is operated by the high pressure piston adapted to reciprocate in the inner cylinder 11. A plate 16 is detachably secured by the bolts 17, the exterior of the cylinder head having the openings 12 and 13 therein and is provided with the openings 12′ and 13′ which register with the openings 12 and 13, each of said openings being surrounded by the collar 18 which securely clamps the packing 19 about the piston rods.

The outer or low pressure piston 20 is detachably carried by the piston rods 14 and snugly fits in the spaces between the cylinder 11 and the cylinder 10, said piston encircling the inner cylinder 11. The piston rod 15 similarly carries the piston 34.

Superposed above the cylinders and formed integral therewith is the valve casing 21, said casing having the steam supply openinges 22 at each extremity thereof and the valve rod opening 23 in the end thereof adjacent to the link motion. A passage 24 extends from one extremity of the valve chamber 25 to the forward terminal of the inner cylinder 11, while a similar passage 24′ connects the opposite extremities of the valve chamber 25 and the cylinder 11. An exhaust port 27 is centrally disposed below the valve chamber 25 with respect to the longitudinal dimension thereof, and is connected by a passage with said chamber. Disposed on each side of said exhaust port and between the latter and the passages 24 and 24′ are the passages 26 and 26′ which connect the valve chamber 25 with the terminals of the outer cylinder 10.

Within the chamber 25 reciprocates the valve indicated in general as A, which is circular in formation and comprises two separate and distinct slides B and C. The slide C is constructed having the heads 28 between which are interposed the pipes or tubes 29, said pipes forming a housing for the rods 30 which connect the heads 31 of the slide B and also a passage for the steam when the same is being conducted from the high pressure cylinder to the low pressure cylinder. The valve rod 32 is connected directly with the inner slide C and is operated by a link connection from the high pressure cylinder, hereinafter more fully described; while the outer slide B is operated by a tubular casing 33, reciprocating about the valve rod 32 and in the opening 23, which is connected to the rear head 31 of

the slide B and is operated by a link connection with the cross head to which the low pressure piston is secured.

The high pressure piston 34 is constructed in the usual manner and operates a cross head 35 reciprocating between the guide rods 36. The low pressure piston 20 is constructed similar to a circular ring and incases the cylinder 11 of the high pressure piston and reciprocates a cross head 37 slidably mounted on the exterior of the guide rods 36. The cross heads 35 and 37 are connected to the main driving links 38 and 39, which operate on an eccentric 40 and are connected thereto at right angles as is illustrated in Fig. 1. A framework comprising the horizontal bars 41 supported by the vertical bars 42 and 42′ in any usual manner, are carried by the cylinders and slide valve casing and form a means of support for the guide rods, valve rods, and the valve operating links.

The cross head 35 operated by the high pressure piston 34 has secured thereon the arm 43 to which is pivoted a link 44, said link forming a connection between the cross head 35 and the operating link 45 which is pivoted between said link 44 and the outwardly projecting shoulder 46 formed on the valve rod 32. A rod 47 is rigidly bolted to the link 44 and is adapted to reciprocate in the jointed sleeve 48 slidable vertically on one of the rods 42. A similar connection is formed between the cross head 37 of the low pressure piston and the tubular casing 33 which operates the outer slide B, comprising an arm 43′ rigidly carried by said cross head to which is pivoted a link 44′, said link 44′ forming a pivotal connection between the link 45′ which is pivotally secured to the casing 33 and the cross head 37. A bar 47′ is rigidly bolted to the link 44′ and is adapted to reciprocate in the jointed sleeve 48′ slidable vertically on the rod 42′.

In operation let it be assumed that the valves are in a position shown in Fig. 1, that is, driving the first quadrant of the rotation of the crank shaft. The steam will then enter the supply pipe 22, pass through the passage 24, and operate against the piston 34, as a result driving the same toward the crank shaft and forcing the steam contained in the cylinder 11 through the passage 24′ and tubes 29 and the passage 26 into the low pressure cylinder 10 where it operates against the forward face of the piston 20, forcing the same in a similar direction as the high pressure piston 34. The steam in the cylinder 10 of the opposite side of the valve 20 is by this motion forced out through the passage 26′, through the space between the valve heads 28, and out the exhaust port 27. By this motion the valve heads 28 and 31 are shifted to the positions diagrammatically set forth in Fig. 7. The pistons 20 and 34 likewise take positions diagrammatically set forth in Fig. 7. The steam will continue to enter the high pressure cylinder directly through the port 24 and operate against the high pressure piston 34, while the steam exhausts from the high pressure cylinder 11, passes through the passage 24′ into the passage 26′, and operates against the rear face of the piston 20, this motion forces the steam between the forward face of the piston 20 and the passage 26, through said passage and out the exhaust port. This motion shifts the valve and pistons to the positions set forth diagrammatically in Fig. 8. When the valves and pistons are in this position, the steam will enter directly from the supply opening 22 into the passage 24′ and operate directly against the rear face of the high pressure piston 34, forcing the same forwardly, which motion will cause the steam between the forward head of the cylinder 11 and the forward face of the piston 34 to exhaust through the passage 24, through the tubes 29, and the passage 26′ into the low pressure cylinder 10 operating against the rear face of the piston 20 causing the steam bearing against the forward face of said piston to be exhausted out through the passage 26 and the space between the valves 28 out the exhaust opening 27. By this motion the valves are caused to change to the position diagrammatically set forth in Fig. 9. In this position the steam continues to enter through the passage 24′ and operate against the rear face of the piston 34, causing the steam to be exhausted through the passage 24 and pass into the low pressure cylinder 10 through the passage 26, thus causing the steam already contained in the low pressure cylinder to be exhausted through the passage 26′ and out the exhaust 27. This motion will cause the valves and piston to change their positions to the positions set forth in Fig. 1, after which the operation is repeated.

In the modification illustrated in Fig. 6 the slide valve is rectangular in formation and is provided with the central depression 50 which operates between and at times over the passages 26 and 26′ of the cylinder and the exhaust 27, the passages 26 and 26′ leading into each end of the low pressure cylinder. The cylinders 10, 11, and the valve casing 12 are constructed exactly similar to the form set forth in Fig. 1. The pistons 20 and 34, however, operate simultaneously due to the fact that they are connected directly to the cross head 51 by the rods 14 and 15. During one complete revolution of the crank shaft, the steam will pass through the supply opening 25, through the passage 24 into the high pressure cylinder 11 operating against the forward face of the

high pressure piston 34, causing the steam contained in the rear end of said cylinder to be exhausted through the passage 24′, the passage 49 of the valve into the passage 26 and the forward extremity of the low pressure cylinder 10 operating against the forward face of the low pressure piston 20. After this the valve will shift causing the steam to enter the high pressure cylinder through the passage 24′, causing the steam in the forward end of the high pressure cylinder to exhaust through the passage 24 passing through the passage 49, passage 26′, and into the rear end of the low pressure cylinder exhausting the steam in the forward end of the cylinder out the passage 26 through the depression 50 and out the exhaust 27.

Should it be desired at any time to reverse the direction in which the engine is being driven a pivotal arm 53 is mounted adjacent to the valves and pistons by the stationary pivot 54 and adjacent to the valve shifting mechanism. From each extremity of the radial arm 53 extends an arm 55 pivotally secured to said radial arm and likewise attached to the sleeve 48. A reach rod 56 is secured to the radial arm and is adapted to rotate the same through the instrumentality of the link 57, and as a result shift the position of the sleeve on the vertical rods 42 and 42′ imparting a lateral movement to the rods 44—44′. This movement of the rods 44—44′ has the same effect as the movement imparted thereto by the pistons and causes the valves B and C to shift and changes the course of the steam.

The slide valve shown in Fig. 10 is connected somewhat similarly to the valve shown in Fig. 5 and used in the preferred form. This valve comprises the heads 58 shrunk or connected rigidly in any suitable manner to the piston rod 59 and have interposed therebetween the cylindrical member 60 shrunk or otherwise received on said rod and provided with the longitudinally extending passages or tubes 61. This valve operates similarly to the valve shown in Fig. 5, the steam passing through the passages 61 from the high pressure cylinder to the low pressure cylinder and through the central groove 62 to the exhaust.

I claim—

1. In an engine of the class described, the combination with a low pressure cylinder, of a high pressure cylinder disposed therein, a low pressure piston surrounding said high pressure cylinder and operating in said low pressure cylinder, a high pressure piston adapted to reciprocate in said high pressure cylinder, a valve chamber disposed adjacent to said piston provided with a centrally disposed exhaust port, ducts connecting each extremity of said valve chamber with each extremity of said high pressure cylinder, and intermediate ducts disposed on each side of said exhaust port, connecting each extremity of said low pressure cylinder with said valve chamber, a valve adapted to operate over the ducts connecting the valve chamber with the high pressure cylinder and regulate the movement of the pressure piston, means whereby said valve may be shifted by the movement of said pistons, and a valve adapted to coöperate with the ducts forming the connection with the low pressure cylinder.

2. In an engine of the class described, the combination with a low pressure cylinder, of a high pressure cylinder disposed therein, a low pressure piston surrounding said high pressure cylinder and operating in said low pressure cylinder, a high pressure piston adapted to reciprocate in said high pressure cylinder, a valve chamber disposed adjacent to said piston provided with a centrally disposed exhaust port, ducts connecting each extremity of said valve chamber with each extremity of said high pressure cylinder, and intermediate ducts disposed on each side of said exhaust port, connecting each extremity of said low pressure cylinder with said valve chamber, a valve adapted to operate over the ducts connecting the valve chamber with said high pressure cylinder and regulate the movement of the high pressure piston, means whereby said valve may be shifted by the movement of said pistons, a valve adapted to coöperate with the ducts connecting the valve chamber with the low pressure cylinder and regulate the movement of the low pressure piston, and means whereby said valve may be shifted by the movement of the low pressure piston.

3. In an engine of the class described, the combination with a low pressure cylinder, of a high pressure cylinder disposed therein, a low pressure piston surrounding said high pressure cylinder adapted to reciprocate in said low pressure cylinder, a pair of piston rods carried by said low pressure piston, a cross head carried by said piston rods, a high pressure piston adapted to reciprocate in said high pressure cylinder, a piston rod carried by said high pressure piston, a cross head coöperating with said piston rod, a valve chamber disposed above said cylinders having a centrally disposed exhaust port, extreme supply pipes, ducts at each extremity thereof connecting said chamber with each extremity of said high pressure cylinder, and ducts on each side of said exhaust port connecting each chamber with each extremity of said low pressure cylinder, a valve adapted to coöperate with the ducts of the high pressure cylinder, comprising a pair of valve heads connected by a plurality of rods, each valve head adapted to coöperate with one of the ducts forming the connection between the valve chamber and the high pressure cyl-

inder, and a valve adapted to coöperate with the low pressure cylinder, comprising a pair of heads and connected by a plurality of tubular members, each valve head adapted to coöperate with one of the ducts connecting the valve chamber with the low pressure cylinder, and means whereby the valves may be shifted by the movement of the piston operating in the cylinder with which each valve coöperates.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES BENSON.

Witnesses:
W. C. WISE,
M. L. ERICHSON.