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J. H. EICKERSHOFF.

ENGINE.

No. 501,224. Patented July 11, 1893.

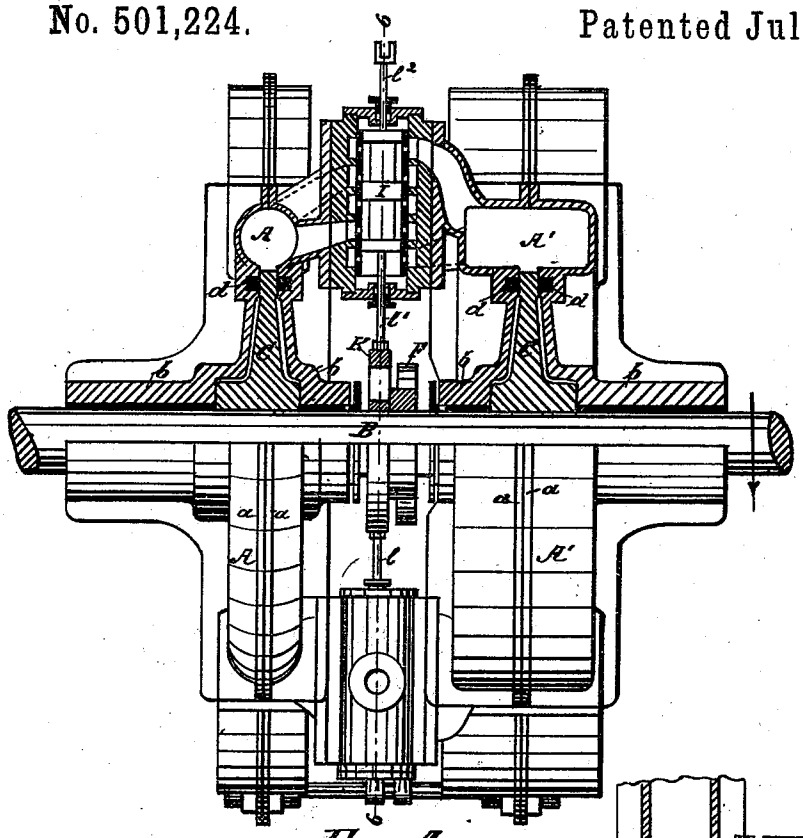

Fig. 1.

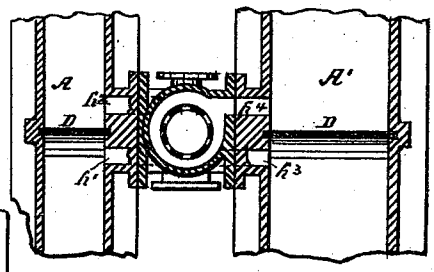

Fig. 3.

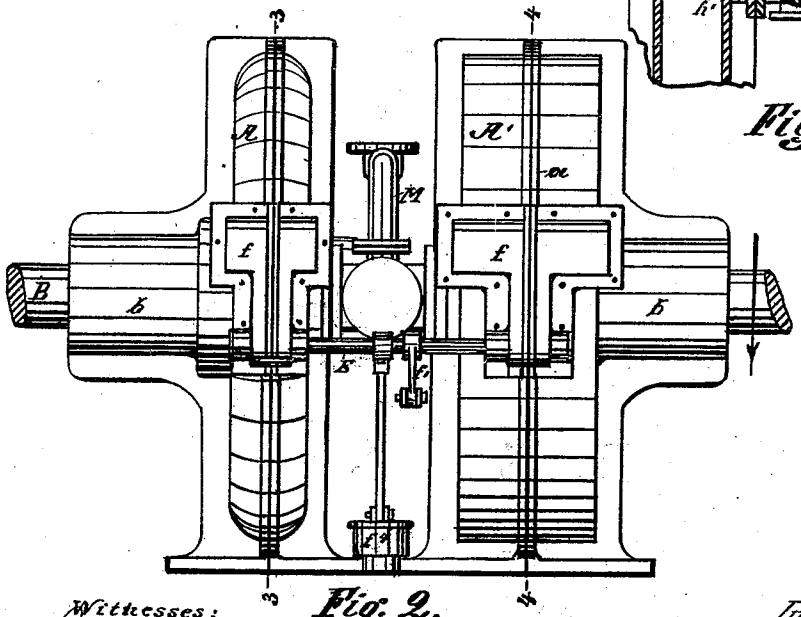

Fig. 2.

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Fig. 4.

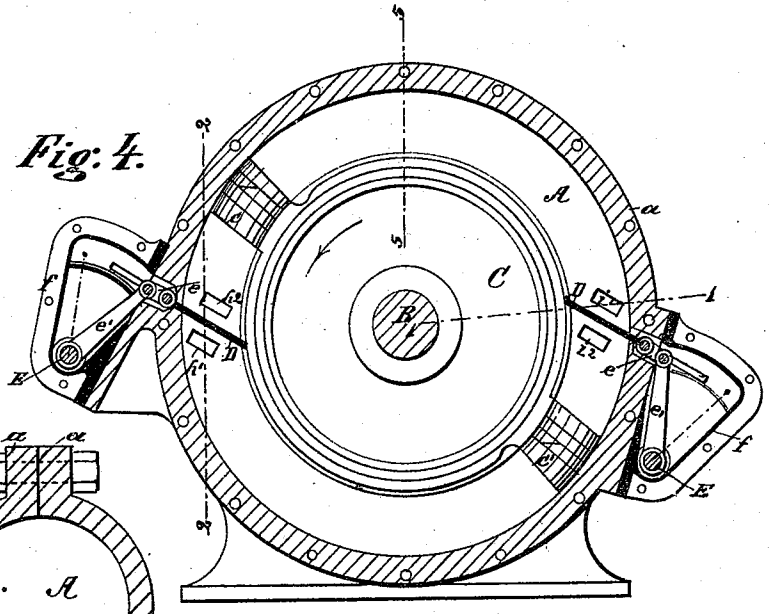


Fig. 6.

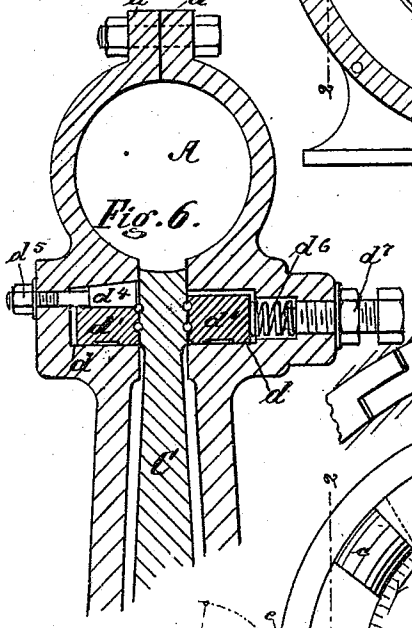


Fig. 7.

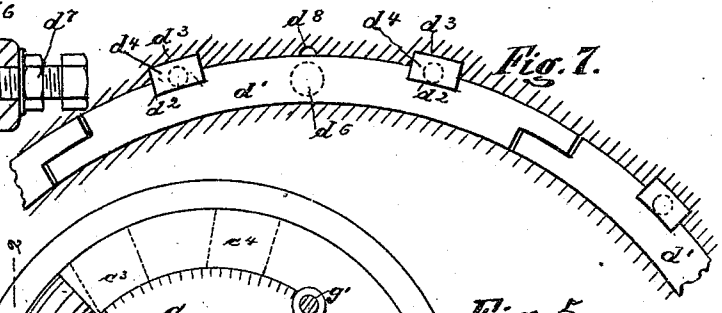
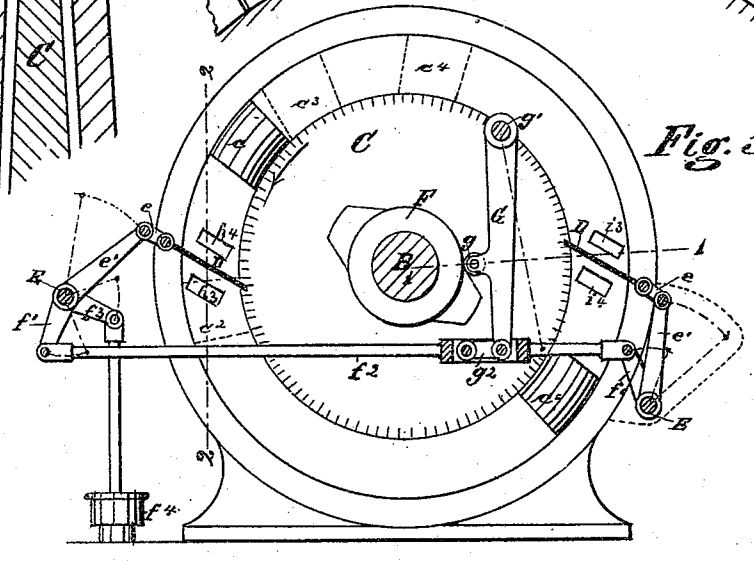


Fig. 5.



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ENGINE.

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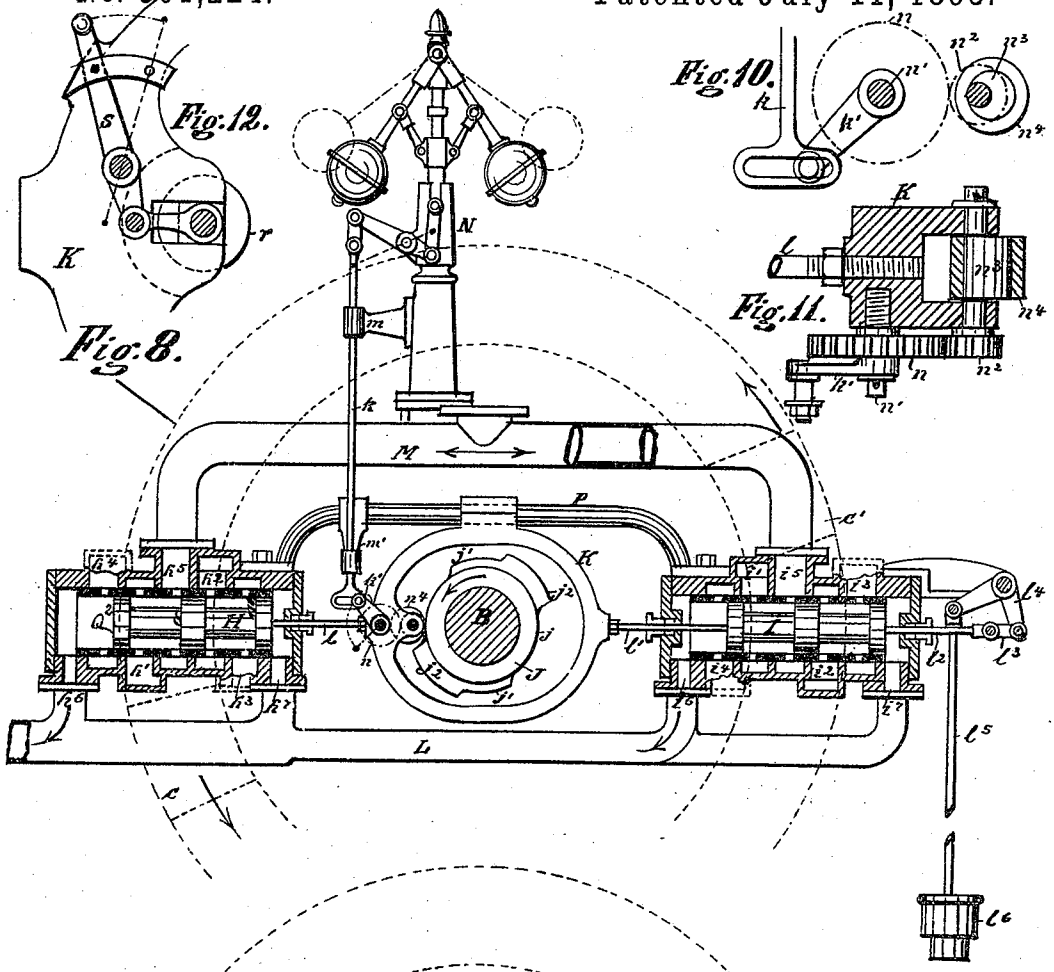

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UNITED STATES PATENT OFFICE.

JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO, ASSIGNOR TO THE UNITED STATES ENGINE COMPANY, OF SAME PLACE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 501,224, dated July 11, 1893.

Application filed February 4, 1893. Serial No. 461,058. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. EICKERSHOFF, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Engines, of which the following is a specification.

My invention relates more especially to continuous cylinder engines, but some of its features are applicable to other type of engines.

The primary object of my invention is to produce an improved engine of the continuous cylinder type, which, while possessing all the advantages incident to this general method of construction, may be operated as an automatic or as a reversible engine at will and operate equally well in both directions.

My invention consists in means for balancing the pressure on the resistance plates to relieve them from pressure against their seats or bearings at the moment they are to be actuated; in improved means for actuating the distribution valves; in a construction and arrangement of parts whereby the engine may be reversed by changing the relative position of a single bearing; in provisions for automatic adjustment of the distribution valves and automatic reversal of the engine, and in the parts and construction and arrangement of parts hereinafter described and claimed.

My invention may be embodied in simple or compound in expansion or non expansion engines having one or more pistons, and one or more resistance plates.

In the drawings: Figure 1 is a top view of a compound engine embodying my invention, one half being shown in section on the lines 1—1 of Figs. 4 and 5. Fig. 2. is an end view of the same. Fig. 3. is a vertical section through the high and low pressure cylinder on line 2—2 of Figs. 4 and 5. Fig. 4. is a longitudinal vertical section through the high pressure cylinder on line 3—3 of Fig. 2. Fig. 5. is a diagrammatic view of the parts shown in Fig. 4 showing also the operating mechanism for the resistance slides. Fig. 6. is an enlarged sectional view of the high pressure cylinder and piston carrying plates on line 5—5 of Fig. 4, showing the packing for the piston plates. Fig. 7. is a side view of the packing shown in Fig. 6. Fig. 8. is a longitudinal section through the distribution valve chambers on line 6—6 of Fig. 1, showing the governor, the distribution valves and the operating mechanism. Fig. 9. is a longitudinal section upon the same line as that of Fig. 8 but showing the valves in reverse position and omitting the governor. Fig. 10. is an enlarged side view of the governor connection with the cut-off mechanism. Fig. 11. is a horizontal section through the mechanism shown in Fig. 10. Fig. 12. is a detail showing one means for adjusting the position of the distribution valves.

Referring now to the drawings, in which I have selected for illustration a two cylinder compound engine, A designates the high pressure cylinder and A′ the low pressure cylinder. Both cylinders are made of sections and provided at their points of contact with flanges by means of which, they are bolted together; the sections are also provided with hubs *b* which take over the main shaft B but leave the latter free to revolve therein.

C C are the piston carrying plates, keyed to the shaft and revolving in the space between the cylinder sections, and each carrying a pair of pistons *c* and *c′* corresponding in cross section to the interior of the cylinders. The pistons are provided with self-acting packings to prevent any blowing through of steam. To avoid leakage of steam from the cylinder, between the revolving piston carrying plate C and the cylinder sections, I have provided on each face of the plate C, near the periphery, a packing which operates by the steam pressure itself and is secured by wedges and set screws as most clearly shown in Figs. 6 and 7.

In the shank portion of each of the cylinder sections, near the piston chamber, is an annular groove *d* adapted to receive a ring *d′* composed of segments, which are jointed with each other by being overlapped or interlocked. Each segment has at its outside periphery cross grooves d^2 corresponding with similar grooves d^3 in the cylinder sections, which, when brought together, form openings for wedges d^4 having set screws d^5. Back of the groove *d* are socket holes arranged at suitable intervals, at least one to each segment, and adapted to receive spiral springs d^6, the

tension of which may be regulated by set screws d^7. The segments d' and the grooves d are scraped on the inside periphery, so that when united by the pressure of the wedges they make a steam tight joint. The wedges d^4 are tapered at the outside periphery, so that the segments are between two parallel surfaces, between which they may move in the direction toward the revolving plate C. The spiral springs d^6 and the set screws d^7 are merely for the purpose of holding the segments against the circular plate C when no steam is at the engine. It will be seen, that the steam from the cylinder gets between the piston carrying plates and the cylinder sections and, through groove d^8, between the segments d' and the back of groove d, being confined there, because the segments have on this inside periphery a steam tight joint, and forcing the segments against the piston plate C, with substantially the same pressure which is in the cylinder thereby making a perfect steam joint. The grooves d^3 with wedges d^4 prevent the segments from following the revolving piston plate.

Each cylinder has a pair of retractible resistance plates D adapted, to, divide the annular cylinder into compartments and to be withdrawn or retracted as the pistons approach them. The plates D, which may be seated and guided in grooves of the cylinder sections, preferably extend diagonally across the cylinder so that the packing rings of the pistons will not be opposite the entire groove at the same time, thereby preventing the rings from slipping into the grooves.

Each slide is connected by links e to crank arms e' mounted upon suitable rock shafts E. I prefer to inclose the links and crank arms in suitable housings f. This arrangement permits the slides to lie perfectly against their seats and insures a practically steam tight joint by the steam pressure upon the slides, as no binding or twisting can occur. Upon rock shaft E are mounted arms or levers f' which are connected with each other, by rod f^2. A cam F, for the operation of the resistance plates, is mounted upon main shaft B. A lever or pendulum G is pivoted at g' and carries near its middle a roller g. At the lower end, the lever is connected by link g^2 to connecting rod f^2. A lever arm f^3 is also mounted upon rock shaft E and carries a dash pot f^4. The dash pot f^4 is for the purpose of closing the resistance plates after they are released by cam F. I have made the shape, in cross section, of the low pressure cylinder different from that of the high pressure, so that both resistance plates may have the same movement and be operated from the same rock shaft.

H and I are distribution piston valves mounted in a direct line opposite each other and rigidly connected with each other, so that they act as one valve. These valves are operated by the cam J, yoke k, the valve rods l, l', l^2, the link l^3 the rocker-arm l^4, the connecting rod l^5 and the dash pot l^6.

h', h^2, and i', i^2 are steam ports, connecting the high pressure cylinder compartments.

h^3, h^4 and i^3, i^4, are steam ports connecting the low pressure cylinder compartments.

M is the main steam pipe from the boiler.

h^5 and i^5, are the steam inlet ports to the valve chambers.

h^6, h^7 and i^6, i^7 are exhaust ports from the valve chamber, combined in one main exhaust pipe L.

A governor N is connected by levers and slide rod k to lever k'.

m and m' are slide bearings or guides for the governor rod k.

P is a slide for the support of yoke k.

Lever k' is fastened to cog wheel n, which latter is loosely mounted upon bolt n'. A second cog wheel n^2, somewhat smaller than the first, is keyed to an eccentric n^3 which carries a roller n^4. The connection of the governor rod k with lever k' is made by a bolt fastened into lever k' and sliding in a slot in rod k in order that the normal reciprocation of the valves, may not effect the operation of the governor but permitting the operation of the valves to be effected by the action of the governor.

The action of the governor upon the valves H and I will be seen, by referring to Fig. 8 in which the dotted lines show the governor balls in the higher position. Lever k' and eccentric n^3 will then be in the position indicated by dotted lines. The connection between the eccentric, the governor lever and the valves is such that a smaller amount of steam is admitted to the cylinder when the parts are in the position shown by the dotted lines and that a larger amount is admitted, when the governor balls are lowered. The cam J has at its periphery j, projections j' j^2, of different height; for the purpose more fully described hereinafter.

I have shown in Fig. 5 in dotted lines different positions of the piston c. Position c^4 is about the point of cutting off live steam; position c^3 is about the point for the beginning of the compression and position c^2 the point where the resistance plates commence closing.

The operation is as follows: The resistance plates being in their operative position, steam being admitted from steam pipe M (Fig. 8.) through ports h^5 and h' to the lower compartment of the high pressure cylinder A, forces the resistance plates against their seats and drives the piston c in the direction indicated by arrows. The live steam is cut off at the port h^5 by the edge o of the piston valve H, when the projection j', of cam J reaches and actuates roller n^4. The steam is expanding in the cylinder as long as roller n^4 is on the projection j' and till the projection j^2 reaches and actuates roller n^4. During the admission and expansion of steam in the high pressure

cylinder, the steam, which has previously actuated the same, but in the other compartment, being now in front of piston c', between same and resistance slide D, has been expanding through ports h^2 and h^3 to one compartment of the low pressure cylinder A′ and driving the piston in said compartment in the same direction as the one in the high pressure cylinder. The edges o' and o^2 of the piston valve cover the ports h^3 and h^4 as soon as projection j^2 reaches and actuates roller n^4 and the steam remaining in both cylinders in front of pistons c' is compressed as the pistons approach the resistance plates thereby equalizing the pressure on both sides of the resistance plates, so that the plates are balanced, at the moment the slides are to be withdrawn by the operation of cam F and the connecting mechanism. The resistance plates are now withdrawn, and before the pistons are entirely over the grooves of the slides, the cam F releases the roller g of lever G and the slides are quickly closed by the action of dash pot f^4, and the distribution valves are again ready for admission of steam. The operation of piston valve I is identical with that of H; except, that the steam is admitted to the upper compartments and exhausted from the lower compartments of the cylinder, as they appear in the drawings. When desired the connection of the governor to roller n^4 may be such that the engine will receive counter steam or be reversed, when the load is suddenly removed by accident or otherwise. Such an arrangement is illustrated in Fig. 9; where the eccentric n^3 and roller n^4 are shown in positions opposite to those shown in Fig. 8. When in this position the live steam port h^5 is connected through h^2 to the high pressure cylinder and the ports h' and h^4 from the high to low pressure, and h^3 with h^7 from which is the exhaust from the low pressure cylinder, and the operation is the reverse of that shown in Fig. 8.

It will be seen, that the cam J works perfectly in both directions and that the projection j^2, serving in Fig. 8 for compression, serves in Fig. 9 for the admission of steam and the periphery j', serving in Fig. 8 for the admission of steam, serves in Fig. 9 for the compression of steam in the cylinders.

In Fig. 12 I have shown a roller r mounted in a sliding bearing in yoke k and connected by a link to a lever s by means of which its position in the bearing may be adjusted. The lever may be locked in position by any convenient means. This roller may be used in place of the eccentric n^3 and roller n^4 shown in Figs. 10 and 11.

In my application, Serial No. 448,272, filed October 8, 1892, and allowed March 28, 1893, I have described and claimed:

In a steam engine, a continuous cylinder having a slot in its periphery; a plate mounted upon the shaft taking into the slot and carrying a pair of pistons; a pair of resistance slides taking diagonally across the section of the cylinder, and balanced piston valves controlling the distribution of steam.

In a steam engine a continuous cylinder having a slot in its periphery; a plate mounted upon the shaft, taking into the slot and carrying a pair of pistons, a pair of self-seating resistance slides and link connection between the parts of the slides and the operating mechanism, and balanced piston valves controlling the admission and exhaust of steam.

In a steam engine a continuous cylinder having a slot in its periphery; a plate mounted upon the shaft taking into the slot and carrying a pair of pistons; a pair of resistance slides taking diagonally across the cylinder; a rock shaft operated from the main shaft, levers and links connecting the rock shaft and the resistance slides and steam tight housings inclosing the bearings for the rock shaft, the resistance slides, the links and the levers.

In a compound engine two continuous cylinders having slots in their peripheries; plates mounted upon the shafts taking into the slots, and each carrying a pair of pistons; a pair of resistance slides taking diagonally across the cylinders, and balanced piston valves each controlling the admission of steam to the two cylinders and the exhaust therefrom.

In a compound engine two continuous cylinders having slots in their peripheries, plates mounted upon the shafts, taking into the slots and each carrying a pair of pistons; a pair of resistance slides in each of the cylinders taking diagonally across the cylinder, and balanced piston valves each controlling the admission, expansion and exhaust of steam.

In a steam engine a continuous cylinder having a slot in its periphery, a plate mounted upon the shaft, taking into the slot and carrying a pair of pistons mounted opposite each other a pair of resistance slides taking diagonally across the cylinder and mounted opposite each other.

While I have described my invention as embodied in a two cylinder compound engine with continuous cylinders, I do not wish to be understood as confining myself to that construction. Nor do I wish to confine my invention to steam alone, as it is equally applicable to the use of liquids or gases under pressure.

I claim as my invention—

1. In an engine the combination of a continuous cylinder, one or more pistons adapted to travel therein, one or more retractible resistance plates, an exhaust normally open and means for closing the exhaust as the piston approaches a resistance plate thereby balancing the pressure upon the resistance plates, substantially as set forth.

2. The combination, in an engine, of distribution valves; a shaft; a cam revolving therewith and adapted to actuate the valves, the cam having one face adapted to hold the

valves in position for the admission of steam, a second adapted to hold them in place for the expansion and exhaust of steam, and a third adapted to hold them in position to shut off the exhaust, substantially as set forth.

3. The combination, in an engine, of distribution valves; a shaft; a cam revolving therewith having one face adapted to hold the valves in position for the admission of steam, a second adapted to hold them in place for the expansion and exhaust of steam and a third adapted to hold them in position to shut off the exhaust, and a yoke connecting the distribution valves and adapted to be actuated by the cam, substantially as and for the purpose specified.

4. The combination, in an engine, of distribution valves; a shaft; a cam revolving therewith having one face adapted to hold the valves in position for the admission of steam, a second adapted to hold them in place for the expansion and exhaust of steam and a third adapted to hold them in position to shut off the exhaust; a yoke connecting the distribution valves, embracing and adapted to be actuated by the cam; and a guide for the yoke, substantially as and for the purpose specified.

5. The combination, in an engine, of distribution valves; a shaft; a yoke revolving therewith having one face adapted to hold the valves in position for the admission of steam, a second adapted to hold them in place for the expansion and exhaust of steam and a third adapted to hold them in position to shut off the exhaust; a yoke connecting the distribution valves and adapted to be actuated by the cam; a movable bearing mounted on the yoke and adapted to engage with the cam; and means for adjusting the position of the bearing, substantially as and for the purpose specified.

6. The combination, in an engine, of distribution valves; a shaft; a cam; a sliding yoke connecting the distribution valves; a movable bearing mounted on the yoke and adapted to engage the cam; a governor and a connection between the governor and the movable bearing whereby the position of the bearing and the distribution valve may be controlled by the governor, substantially as and for the purpose specified.

7. The combination, in an engine, of distribution valves; a connection between the valves; a cam adapted to actuate the valves; a movable bearing adapted to engage with the cam; a lever adapted to adjust the position of the bearing; a governor; a connecting rod from the governor, and a slotted connection between the lever and the connecting rod, substantially as and for the purpose specified.

8. In an engine the combination of a cam; distribution valves normally operated thereby; a governor, and connections between the governor and the distribution valves whereby the engine may receive counter steam and be reversed, substantially as and for the purpose specified.

9. In a steam engine the combination of a continuous cylinder having a slot in its periphery; a plate mounted upon the shaft, taking into the slot, and carrying one or more pistons; one or more resistance plates; grooves in the shank portion of the cylinder sections; a packing in said grooves adapted to be operated by steam pressure, and composed of jointed segments, and regulating screws adapted to support the packing.

10. In a steam engine the combination of a continuous cylinder having a slot in its periphery, a plate mounted upon the shaft taking into the slot and carrying one or more pistons, gooves in the shank portion of the cylinder sections and a packing in the grooves composed of segments and operated in one direction by steam pressure, and wedges securing the segments and adapted to press the packing against its other bearing, substantially as and for the purpose specified.

11. In a steam engine the combination of a continuous cylinder having a slot in its periphery, a plate mounted upon the shaft taking into the slot and carrying one or more pistons, grooves d in the shank portion of the cylinder sections, a sectional packing d' in the grooves, grooves d^2 in the sections of the packing, grooves d^3 in the shank of the cylinder sections, wedges d^4 adapted to take into the grooves d^2 and d^3 and means for actuating the wedges, substantially as and for the purpose specified.

12. In a compound engine the combination of two or more continuous piston cylinders, of different form in cross section, having slots in their peripheries; plates mounted on the shaft, taking into the slots, and carrying one or more pistons; retractible resistance plates for each cylinder; and a rock shaft adapted to actuate the resistance plates, the form of the cylinders in cross section being such that the same movement operates the resistance plates in the high and low pressure cylinders, substantially as and for the purpose specified.

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