March 6, 1928. 1,661,957

F. J. POWELL

STEAM ENGINE

Filed Aug. 13. 1924 3 Sheets-Sheet 1

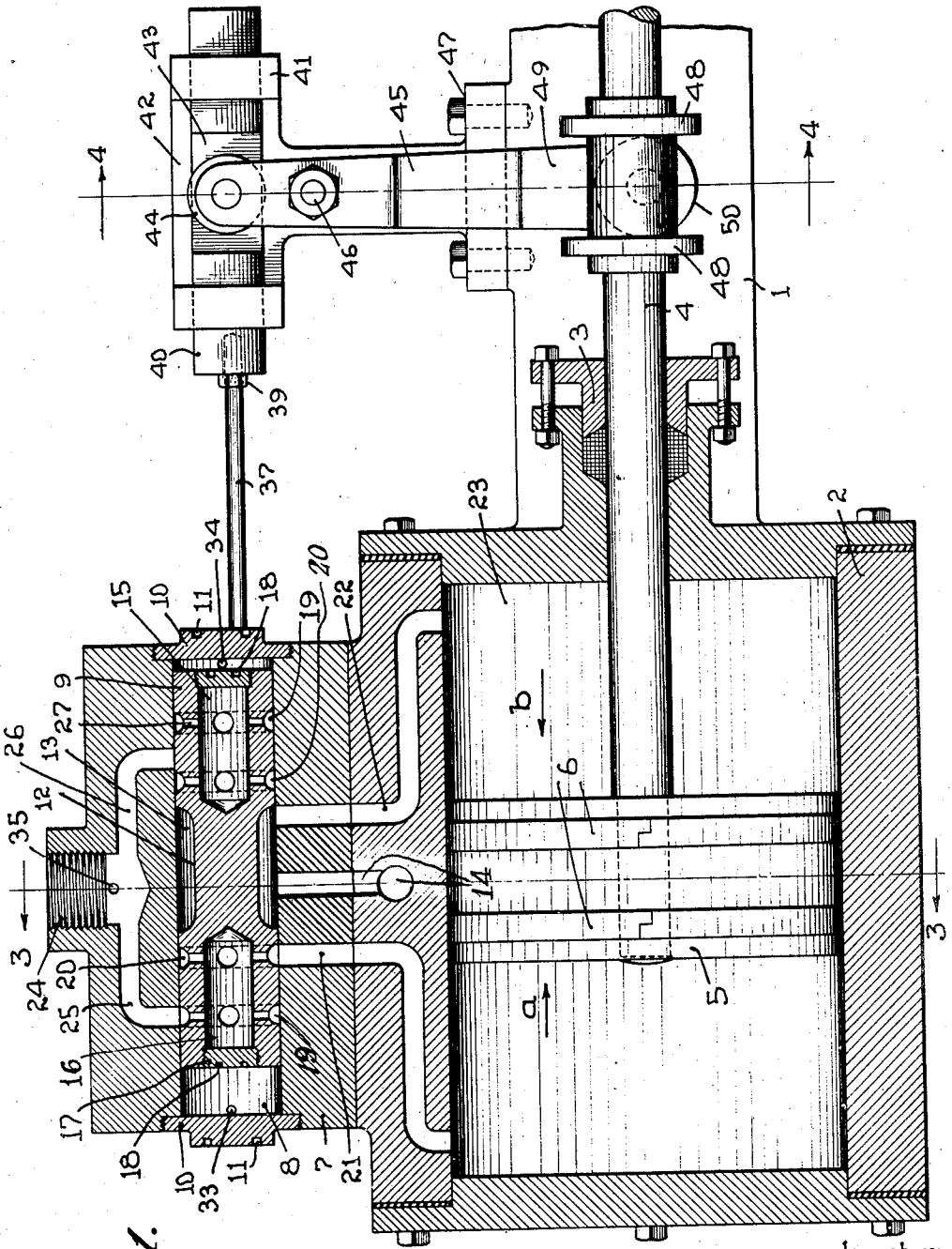


Fig. 1.

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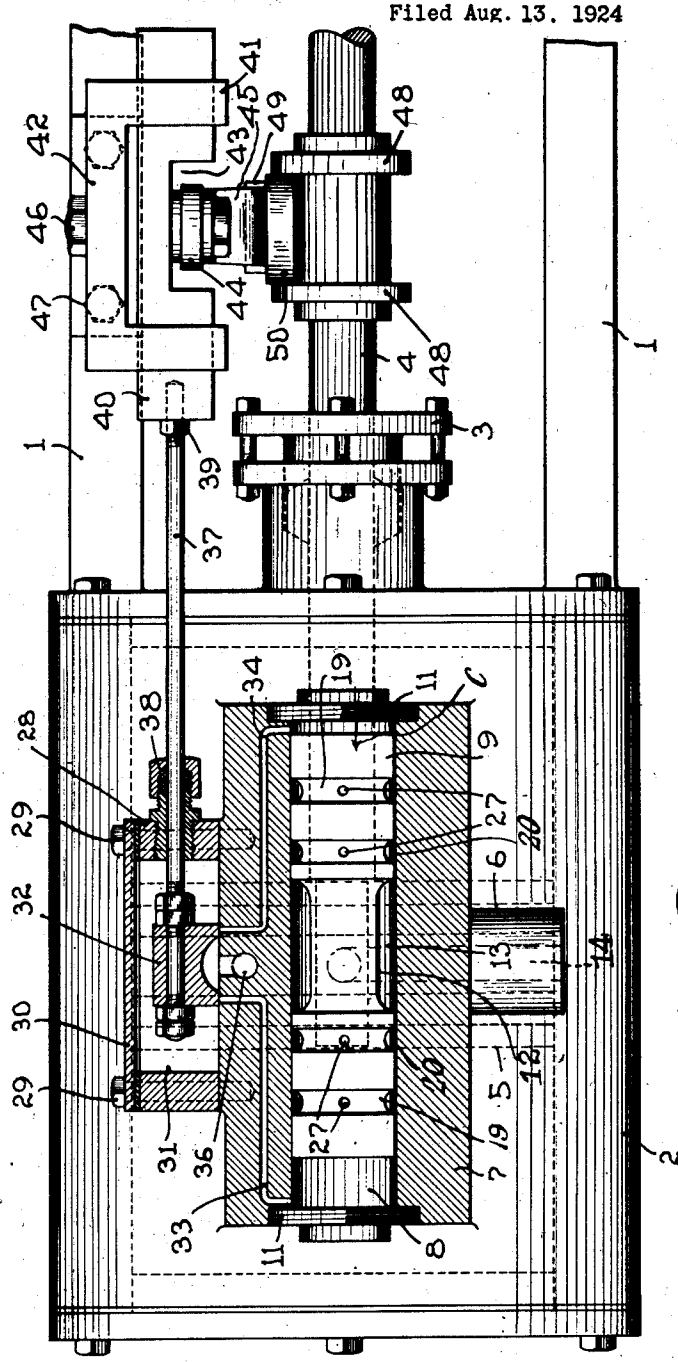


Fig. 2.

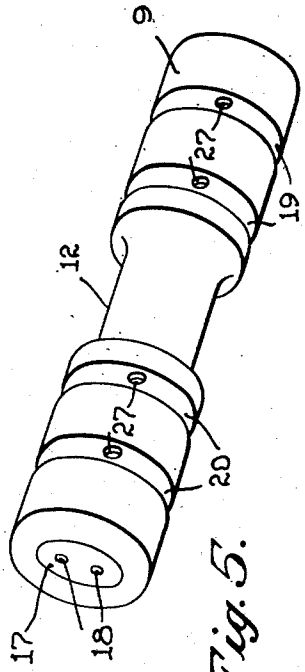


Fig. 5.

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STEAM ENGINE

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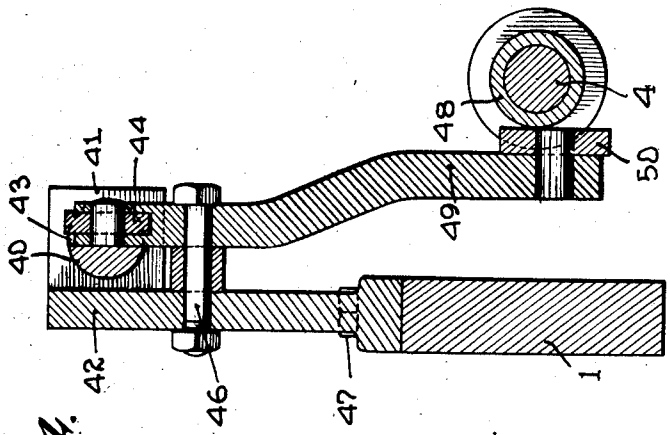


Fig. 4.

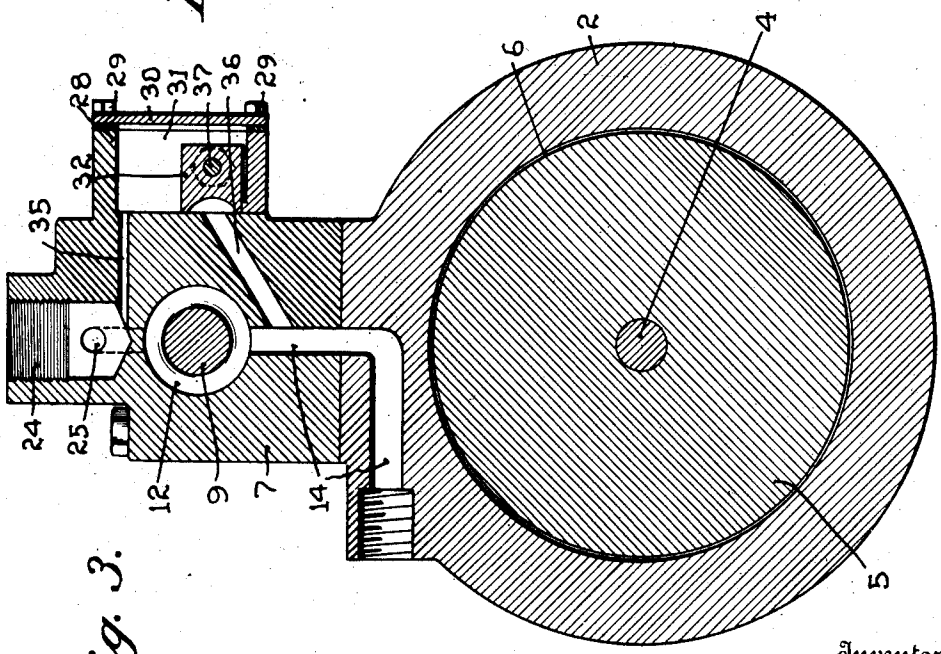


Fig. 3.

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Patented Mar. 6, 1928. 1,661,957

UNITED STATES PATENT OFFICE.

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STEAM ENGINE.

Application filed August 13, 1924. Serial No. 731,811.

The present invention has for its purpose to provide, in a steam engine construction, means for operating a slide valve which in turn controls the actions of a balance valve and the feed of the steam to opposite sides of the piston.

Another purpose is to provide a steam engine including a piston steam cylinder with a piston therein and a balanced valve for controlling the entrance of steam upon opposite sides of the piston, together with a slide valve (which includes a steam chest) for controlling the steam to opposite ends of the balanced valve, in conjunction with a rocker mechanism with a looseness of play in said mechanism for operating the slide valve through the medium of the piston rod, it being obvious that any suitable device (not shown) may be connected to the piston rod for the purpose of receiving power therefrom.

It is to be understood that the particulars herein given are in no way limitative and that, while still keeping within the scope of the invention, any desired modifications of detail and desired proportions may be made in the apparatus according to the circumstances.

The invention comprises further features and combinations of parts to be hereinafter set forth, shown in the drawings and claimed.

In the drawings:

Figure 1 is a view in section showing the improved steam engine constructed in accordance with the invention.

Figure 2 is a plan view showing the balanced valve and slide valve casings in section with the valves in elevation and partly in section, illustrating the piston in dotted lines.

Figure 3 is a sectional view on line 3—3 of Figure 1.

Figure 4 is an enlarged perspective view of the rocker connections between the piston rod and the slide valve rod, taken on line 4—4 of Figure 1.

Figure 5 is a perspective view of the balanced valve removed from the casing.

Referring to the drawings, 1 designates a frame and 2 denotes a steam cylinder, the frame 1 being connected in a conventional manner to one of the heads of the cylinder. Mounted in the cylinder and operable through the stuffing box 3 of a conventional construction is a piston rod 4 including a piston 5 which operates in the cylinder 2. The piston is supplied with the usual packing rings 6.

A balance valve casing 7 is mounted upon the cylinder casing and secured thereto in any conventional manner. This casing has a chamber 8 preferably cylindrical and mounted therein for reciprocating movements is a balance valve 9. In constructing the casing 7, the bore is made normally open ended. However, after placing the balance valve 9 in position in the chamber 8, the ends of the chamber are closed by the heads 10. In fact, the open ends of the chamber are counterbored and tapped whereby the heads 10 may be threaded in place by using a suitable spanner wrench or other device (not shown). The opposite notches 11 of the heads 10 act to receive the jaws of the spanner wrench to turn the heads home.

The balance valve 9 is preferably cylindrical and has a central contracted neck 12, the provision of which causes a space 13 to be formed for the purpose of taking care of the exhaust steam whereby it may pass out through the exhaust passage 14. The opposite ends of the balance valve have chambers 15 and 16, the ends of which are closed by the threaded plugs 17 which are also turned home by means of a spanner wrench, the jaws of which engage with the notches or depressions 18. The opposite ends of the balance valve also have annular grooves 19 and 20 arranged in pairs. The grooves of each pair are spaced to insure proper register with the steam passages or ports 21 and 22 which communicate the chamber 8 with the interior 23 of the steam cylinder. The ends of the passages terminate at positions adjacent the heads of the cylinder whereby steam may be allowed to enter the cylinder and cooperate with the piston.

The casing 7 which contains the balance valve has a steam intake passage or port 24, branches 25 and 26 of which communicate with the chamber 8. The ends of the branches 25 and 26 are diagonally opposite where the ends of the passages 21 and 22 communicate with the chamber 8. In fact, the ends of the passages 25 and 26 are offset from the inlet ends of the passages 21 and 22 a distance equal to the spacing of the annular grooves 19 and 20 so that when one of the grooves 20 of the balance valve registers with the passage 21, one of the grooves 19

will register with the passage 25, in which case certain of the grooves 19 and 20 are entirely out of registration with the passages 22 and 26 and thereby permit steam to enter the left hand end of the cylinder 2 for the purpose of operating the piston in the direction of the arrow *a*. When one of the grooves 20 registers with the passage 22 and one of the grooves 19 with the passage 26, the other of said grooves 19 and 20 are out of registration with passages 21 and 25. In this case, steam is permitted to pass through the passage 22 and into the right hand end of the cylinder 2 where the steam may act upon the opposite side and move the piston in the direction of the arrow *b*.

The grooves 19 have openings or ports 27 which permit the steam to enter the chambers 15 and 16, so that it, in turn, may pass alternately through the passages 21 and 22, when the grooves 20 alternately register with the branches 25 and 26. The grooves 20 also have openings or ports 27 communicating the grooves with the chambers 15 and 16. It will be noted that the steam alternately acts upon opposite sides of the piston 5, the steam having been alternately transmitted to and through the passages 21 and 22 through the medium of the opposite ends of the balance valve.

The balance valve is steam actuated due to the provision of a steam chest 28 being connected in a conventional manner to one side of the casing 7, as shown in the plan view, there being bolts 29 passing through the steam chest 28 and into the casing 7 to not only secure the two together but also to retain the cover or head 30 in position. The steam chest has a steam chamber 31 including a slide valve 32 of conventional design and connecting the steam chamber 31 and the chamber 8 of the casing 7 are passages 33 and 34. The passages 33 and 34 communicate with the chamber 8 of the casing 7 adjacent its remote ends whereby steam is permitted to co-operate with the opposite ends of the balance valve. The ends of the passages 33 and 34 where they communicate with the chamber 31 are so spaced as to permit the slide valve 32 to alternately uncover them and connect each with the chamber 31 alternately. A port or passage 35 communicates the passage 24 with the chamber 31 of the steam chest 28, there being an exhaust port 36 communicating the chamber 31 and the main exhaust 14, thereby permitting the steam from the passages 33 and 34 to exhaust through the same exhaust port as the steam which exhausts from the cylinder 2.

The slide valve 32 has a slide valve rod 37 which passes through a conventional stuffing box 38 and is, in turn, connected adjustably at 39 to a slide 40 which is mounted for reciprocating movement in guides 41 of a bracket 42. The slide 40 is recessed centrally and engaging with this recess 43 is a roller 44 which is carried upon the upper end of a rocker arm 45 which is fulcrumed at 46 to the bracket 42. The roller 44 is of such a diameter as to remain out of contact with the end walls or shoulders of the recess 43 as long as the rocker arm remains in a perpendicular position. This permits the roller 44 to engage with the end walls of the shoulders of the recess 43 as the rocker arm 45 approaches the end of its rocking movement.

The bracket 42 is mounted at 47 upon the frame 1. The piston rod is, in turn, provided with a flanged sleeve 48 which is made fast to the piston rod in any conventional way. The lower end of the long arm of the rocker 45 terminates in an offset 49 which interposes between the two flanges of the sleeve 48, there being a roller 50 carried by the offset end and cooperating with the end flanges.

Upon movement of the piston 5 in the cylinder 2, movement is transmitted to the piston rod 4 which imparts an oscillatory movement to the rocker 45. At the end of the movement of the rocker 45, the roller 44 engages with one of the shoulders or walls of the recess 43 and thereby imparts movement to the slide valve rod, thereby shifting the slide valve 32 to permit steam to enter one or the other of the passages 33 and 34. Should steam be admitted through the passage 34, it cooperates with the right hand end of the balance valve, imparting movement to it in the direction of the arrow *c* which will cause a shifting of the balance valve to move certain of the grooves 19 and 20 out of register with the passages 25 and 21 and move certain other of the grooves 19 and 20 in register with the passages 26 and 22 to permit steam to enter the cylinder 2 and cooperate with the right hand face of the piston 5. A reverse of the steam through the passage 33 will cause a reverse movement of the balance valve and a reverse admission of steam through the passage 21. These cycles of operation coordinately repeat and thereby impart movement to the piston rod.

The bracket 42 constitutes a guide for the slide valve rod 37. The rocker arm which receives motion from the piston rod moves the slide 40 and in turn imparts movement to the slide valve as the piston approaches the end of its stroke. The steam enters the steam chest through the port or passage 35. The steam from the main port passes through the balance valve and enters the cylinder.

The invention having been set forth, what is claimed is:

1. A steam engine comprising a steam cylinder with a piston operable therein, the piston including a piston rod, a steam chamber, a balance valve controlling communication between the steam chamber and the steam

cylinder, a casing for the balance valve and having ports of communication with the steam chamber and the steam cylinder, a slide valve in the steam chamber for controlling the steam passing through the ports of communication with the balance valve casing, the balance valve acting to control the steam passing through the ports communicating with the steam cylinder, a rod carried by the slide valve, a slide carried by the slide valve rod with a substantial elongated recess on one side, a guide frame for the slide, a pair of spaced annular shoulders on the piston rod, a lever pivoted on the guide frame, the lower end thereof carrying a wheel operating between said annular shoulders, and a wheel on the upper end of the lever, and of a diameter less than the length of said recess so as to be normally spaced from the shoulders defining the ends of the recess.

2. In a steam engine, the combination with a steam cylinder and a steam chamber, of a balance valve casing connecting the steam chamber and the cylinder with ports of communication connecting the casing and the cylinder, ports connecting the steam chamber and the interior of the casing, a slide valve in the steam chamber, a steam intake with branch ports connecting with the interior of the balance valve casing, a balance valve with chambers in its opposite ends mounted in the balance valve casing, the balance valve having exterior annular grooves to register alternately with the branch ports and the ports leading to the steam cylinder, the balance valve having radial ports connecting the grooves and the end chambers, said steam cylinder having an exhaust port common to the steam chamber, said balance valve having a central reduced portion which cooperates with the ports leading to the steam cylinder and at all times registering with the exhaust port, and a piston operable in the steam cylinder and operatively connected to the slide valve.

3. A steam engine comprising a steam cylinder with a piston operable therein, the piston including a piston rod, a balance valve casing on the cylinder with ports communicating with the interior of the latter at the opposite ends thereof, a steam chamber on the side of the balance valve casing, which casing has a steam intake with branch ports communicating with the interior of the balance valve casing and a port of communication with the steam chamber, which steam chamber has passages of communication with the opposite ends of the balance valve casing to permit the entrance of steam for actuating the balance valve, a slide valve in the steam chamber to control the steam passing through the ports leading to the balance valve casing, a balance valve with chambers in its opposite ends mounted in the balance valve casing, the exterior of the balance valve having annular grooves to register alternately with the branch ports of the steam intake and the ports leading to the steam cylinder, the balance valve having radial ports connecting the grooves and the end chambers of the balance valve, said steam cylinder and casing having an exhaust port common to the steam chamber and the steam cylinder, said balance valve having a central reduced portion which cooperates with the ports leading to the steam cylinder and at all times registering with the exhaust port to permit the exhaust of utilized steam, a rod carried by the slide valve, and means operatively connecting the piston rod and the slide valve rod, whereby the latter is controlled by the former.

In testimony whereof he affixes his signature.

FRED J. POWELL.