No. 878,159. PATENTED FEB. 4, 1908.

J. C. SMITH.

PUMPING ENGINE.

APPLICATION FILED JAN. 18, 1905.

2 SHEETS—SHEET 1.

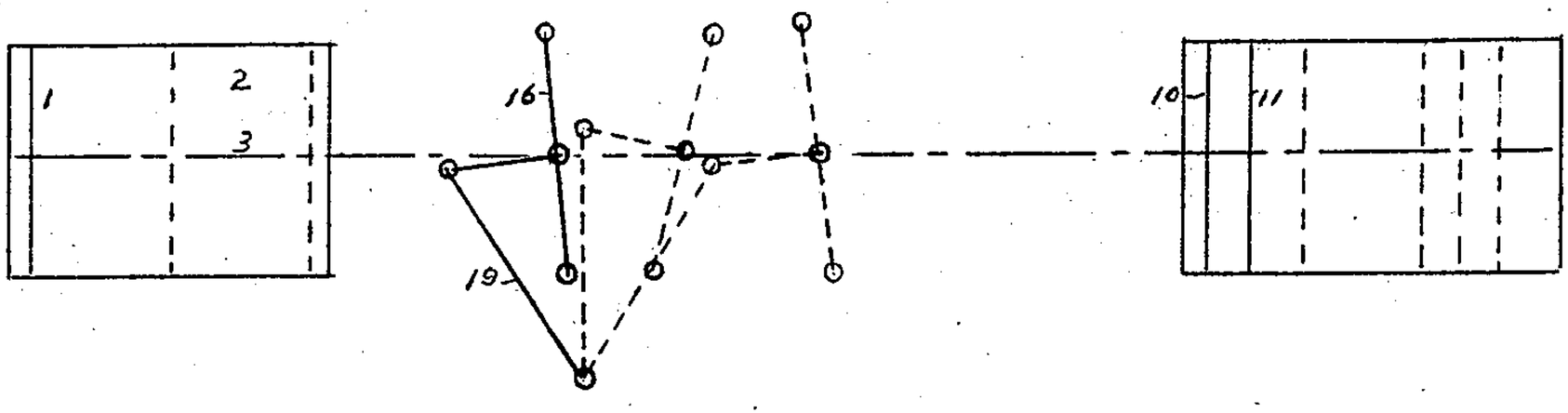

Fig. 1

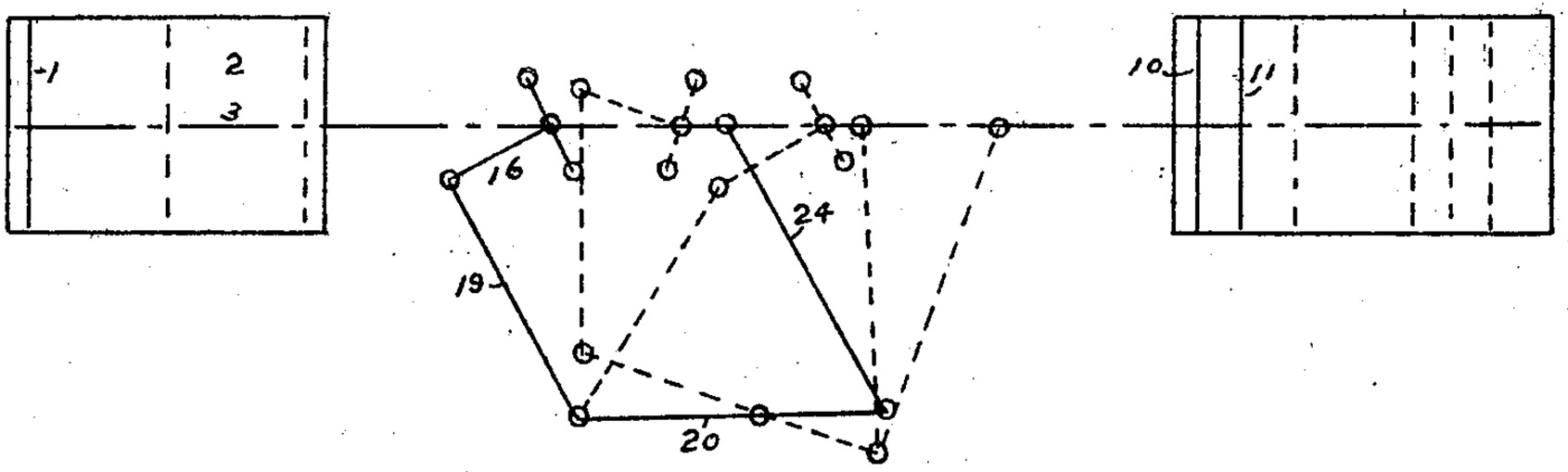

Fig. 2

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Fig. 3

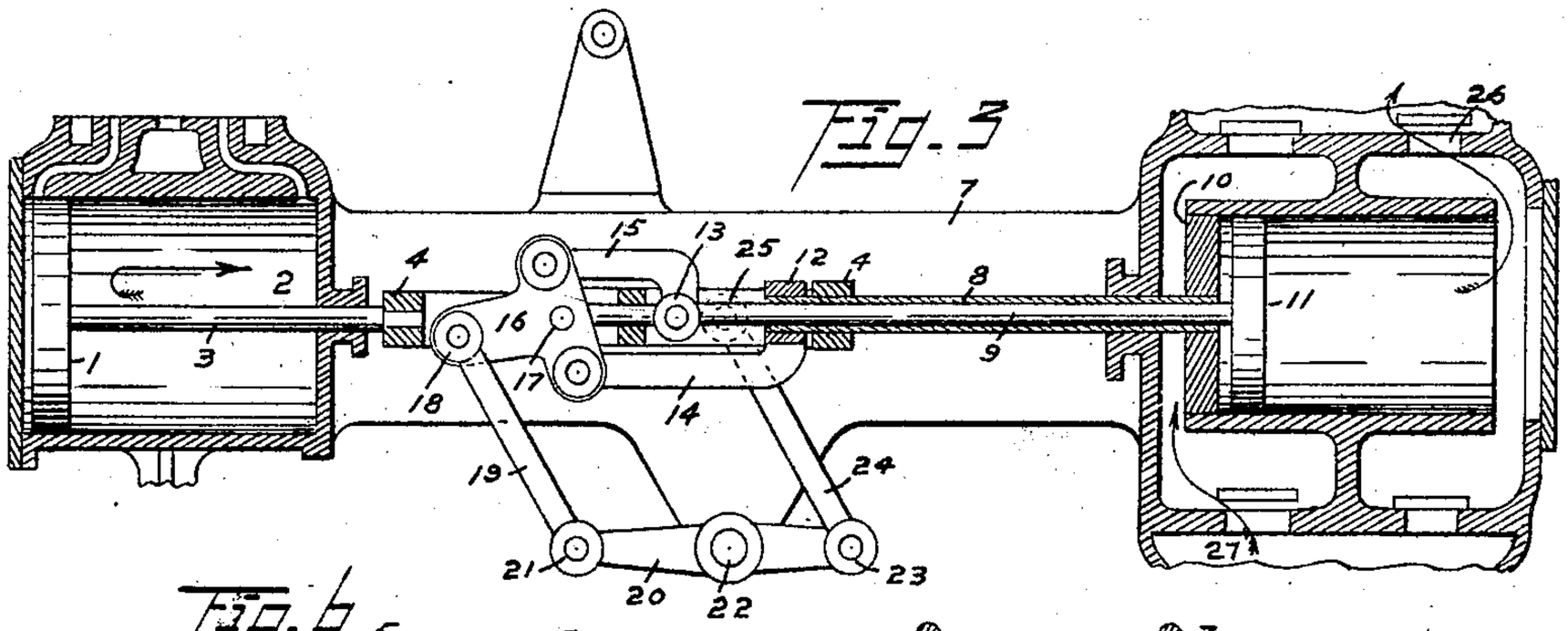
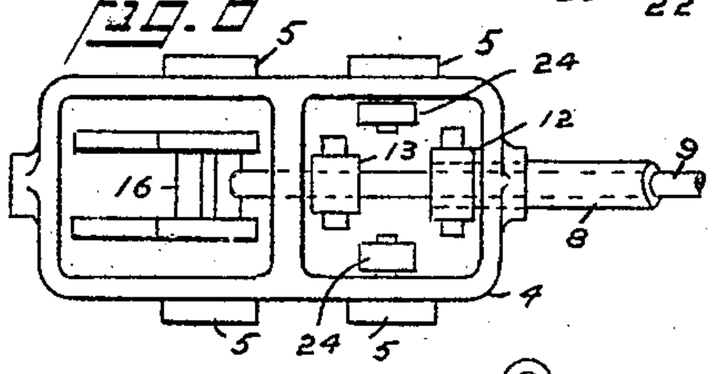


Fig. 6



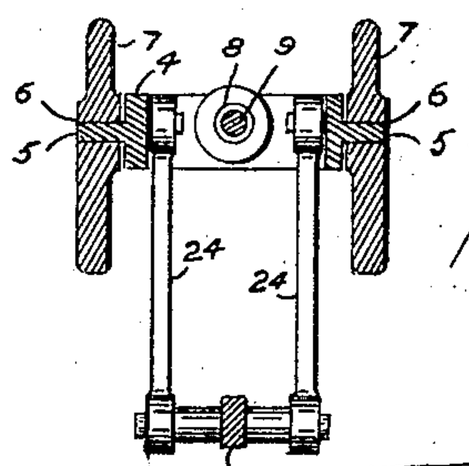
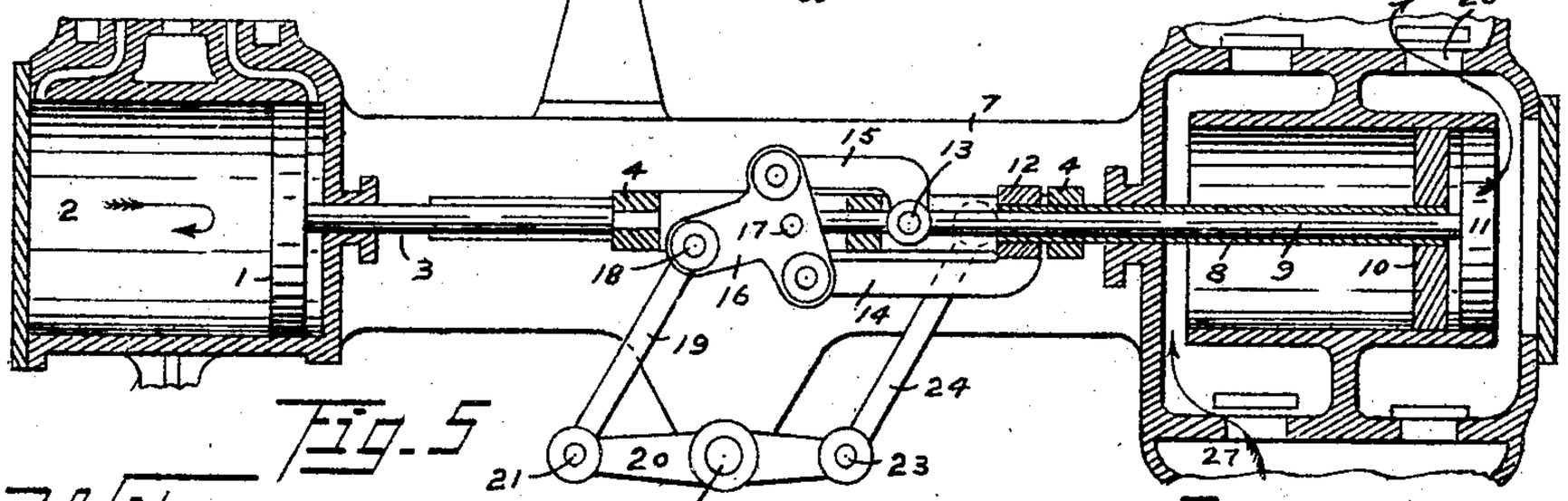


Fig. 7

Fig. 4

Fig. 5



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PUMPING-ENGINE.

No. 878,159. Specification of Letters Patent. Patented Feb. 4, 1908.

Application filed January 18, 1905. Serial No. 241,627.

To all whom it may concern:

Be it known that I, JOHN C. SMITH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Pumping and Similar Engines, of which the following is a full, clear, and complete specification.

My invention relates to non rotative and other engines, which act directly against a practically uniform resistance, and in which steam is used expansively, and my object is to move the pumping piston through its entire stroke with steam used expansively by means of a mechanism which shall equalize the work done between the steam and pumping pistons. In Letters Patent 628,419, granted to me on July 4th, 1899, the same was accomplished by means of a lever, interposed between the steam and pumping pistons, with a movable fulcrum which shifted to favor the decreasing pressure of the expanding steam, while in the improvement herein described, the same result is obtained by equalizing the work done between the steam and pumping pistons through the fractional parts of and consequently the entire stroke by means of the mechanism herein described. In other words, to satisfy the equation $F' S = F S'$ in which the first member $F' S$ represents the work done by steam piston with the variable force F'; and in the second member $F S'$ represents the work done on the pumping piston in which the space S' varies to equalize the first member for any fractional part of the stroke, S and S' being equal for the entire stroke. I attain this object by the construction and combination of the mechanism hereinafter described and pointed out definitely in the claims.

Similar characters of reference designate similar parts throughout the specification and drawings.

Figure 1 is a diagram representing the fundamental principle upon which the mechanism depends. Fig. 2 is a modification of Fig. 1 having more advantages from a constructional standpoint which will be hereinafter more fully explained, and is the one which is used in the mechanism employed in my invention. Figs. 3—4 and 5 are longitudinal sectional elevations showing the mechanism employed and the relative positions of the steam and pumping pistons at different parts of the stroke, and also an economical construction for, making the engine double acting, Fig. 6 is a plan view of the mechanism with a portion removed for clearness. Fig. 7 is a transverse section across the frames connecting the steam and pumping cylinders on line *a a* of Fig. 4.

The steam piston 1 moving to and fro in the steam cylinder 2 transmits the pressure of the steam through the steam piston rod 3 to the yoke 4 to which it is rigidly connected. The yoke 4 is constrained to move in the direction of the piston rod 3 only, preferably by means of the wings 5, sliding in the slots 6 which are contained in the connecting frame 7 between the steam and pumping cylinders. At the end of the yoke 4 farthest from the steam cylinder 2, bearings are made for the reception of the pumping piston rods 8 and 9, to resist any thrust other than that in the direction of motion. The rod 8 is tubular and secured to the pumping piston 10, while the rod 9 passes through rod 8 and is secured to its pumping piston 11, this construction enabling one pumping piston to be moved independently of the other.

Some means should be employed to prevent the formation of a vacuum between the two pistons, or the imprisonment of a fluid between them as otherwise the two pistons could not move toward and from each other as freely as is desirable. In the construction shown it is intended that the fit of rod 9 in rod 8 may be sufficiently loose to permit enough air to flow through it to prevent any substantial compression or rarefaction of the air between said pistons.

Sleeves 12 and 13 are respectively secured to rods 8 and 9 at or near their ends. These sleeves are secured to said rods between the bearings mentioned above, and are provided with trunnion bearings on each side for the reception of the connecting links 14 and 15, the other ends of which are pivotally connected with the opposed upper and lower arms of the rocker 16.

The rocker 16 which as shown is a three armed lever is housed within the yoke 4 and mounted on trunnions 17 secured to said yoke, thus permitting an oscillating motion to be given the rocker in addition to the motion of the yoke 4 to which it is attached.

In the end of the rocker 16 is the pin 18, upon which is pivoted the link 19, the other end of which is hinged to the rocker beam 20 by means of the pin 21, while the rocker beam 20 oscillates upon the fulcrum pin 22

which is housed in projecting bearings on the fixed connecting frame 7. In the other end of the rocker beam 20 is the pin 23 upon which are pivoted the links 24, the other ends of said links swinging upon the pins 25 which are housed within the yoke 4 and securely fastened thereto.

Having now described the salient features of construction, I will proceed to explain the operation of my improved pumping engine, in which Fig. 3 shows the relative position of the steam and pumping pistons and connecting mechanism at the beginning of the stroke. The steam piston 1 moving in the direction of the arrow transmits its motion through the rod 3 to the yoke 4 which carries the rocker 16 and pins 25 with it; as the pins 25 are constrained to move in a longitudinal line, the rocker beam 20 is, through the links 24, rocked on its fulcrum 22 approaching the position shown in Fig. 4 while the rocker 16, rocking on its fulcrum 17, because of its connection with rocker beam 20 through the connecting link 19, gradually approaches the middle position shown in Fig. 4 and motion from the rocker is transmitted through connecting links 14 and 15 to the pumping piston rods 8 and 9, thus giving to the pumping piston 11, a velocity equal to the sum of the velocity of the yoke 4, and the velocity due to the oscillation of the rocker 16, while the pumping piston 10 will have a velocity equal to the difference of these two.

Fig. 4 shows the relative positions of the steam piston, pumping pistons and connecting mechanism when the steam piston 1 has reached the middle of the stroke; the links 24 have assumed a vertical position forcing the rocker beam 20, to one extreme of its arc of oscillation; and, through the link 19 the rocker 16 has also reached one limit of its arc of oscillation. It is evident that the pumping piston 11 is acting to discharge the liquid from its end of the pump cylinder through the valve 26 while the pumping piston 10 is filling its end of said cylinder through 27, both currents being shown by the arrows.

In Fig. 5, which represents the end of the stroke, the relative position of the pistons 1, 10 and 11 are shown together with that of the mechanism employed; in advancing from the position shown in Fig. 4 to that assumed in Fig. 5, the links 24 form the continuance of the right line motion of yoke 4, and consequently pins 25 move from a vertical to the inclined position shown in Fig. 5. In doing so, the rocker beam 20 returns to the other extreme limit in its arc of oscillation, and, in consequence of the link 19, the rocker 16 is also returned to its other limit of oscillation as shown in Figs. 3 and 5, and when the rocker beam 20 and rocker 16 are proportioned as previously described, will be found to approximate closely in satisfying the equation previously mentioned. The pumping piston 10 through its connecting link 14 will have passed from the position shown in Fig. 4 to that assumed in Fig. 5. The pistons are now ready for the return stroke, and when steam is admitted on the other face of the steam piston 1, the pumping piston 10 then acts to discharge the liquid from its end of the pumping cylinder while the pumping piston 11 fills the other end thus making the pumping engine double acting. The pumping piston 10 will pass through the relative positions on the return as the piston 11 did on the advance stroke.

The required relative speeds of the stroke of the pumping piston 10 and 11 and the steam piston 1 in different parts of their respective strokes may be obtained by any one skilled in the art, by fixing the ratios of the arms and their angularities in the rocker beam 20 and the rocker 16 according to the degree of expansion determined upon.

Approximately the same results can be obtained with the mechanism made to fundamental principle shown in diagram in Fig. 1 which would be equivalent to abandoning rocker beam 20 and links 24 and making pin 21 stationary instead of pin 22. But by adopting the construction illustrated in Figs. 2, 3, 4, and 5 the same amount of oscillation can be given to the rocker 16 with a minimum distance between the pins in 16 upon which the links 14 and 15 hinge thus bringing the force transmitted through 14 and 15 in a more direct line with the direction of motions with the pistons. I have not thought it necessary to show or describe any valve operating mechanism for controlling the admission and release of steam in the cylinder as any one skilled in the art will readily adopt such mechanism as may be suitable for the purpose.

What I claim as new and desire to secure by Letters Patent is:—

1. The combination of a steam cylinder, its piston and piston rod, a rocker connected with said piston rod on a transverse pivot, and having an approximately vertical arm and an approximately horizontal arm, a pump cylinder, its piston and piston rod, a link connecting the pump piston rod with the approximately vertical arm of said rocker and a swinging link pivotally connected with the approximately horizontal arm of said rocker, and a movable device to which the other end of said link is pivoted for increasing the movement of said rocker, substantially as specified.

2. The combination of a steam cylinder, its piston, a reciprocating member operated by said piston, a rocker having a transverse pivotal connection with said reciprocating member, a pump cylinder, a piston therein, and a rod transmitting motion to said pump piston, with a link pivotally connected with said pump piston rod and one arm of said

rocker, a rocker beam pivoted on a fixed fulcrum, a link connecting one arm of said rocker beam with an arm of the rocker first named, and a second link pivotally connected with the said reciprocating member and with the opposite arm of the rocker beam, substantially as specified.

3. The combination of a steam cylinder, its piston and piston rod, a yoke secured to said rod, a pump cylinder, its piston, and piston rod, a rocker pivotally connected with said yoke and suitably connected with said pump piston rod, a rocker beam pivoted on a fixed fulcrum, a link connecting one arm of the rocker beam with one arm of the rocker, and a second link pivotally connected with the opposite arm of the rocker beam and with said yoke, substantially as specified.

4. The combination of a steam cylinder, its piston, and a rod connected with said piston, a pump cylinder, a piston therein, a tubular piston rod secured to said piston, a second piston in the pump cylinder, and a rod secured thereto and extending out through said tubular rod, with a three-armed rocker having a pivotal connection with the steam piston rod, links respectively connecting two arms of said rocker with the two pump piston rods, a rocker beam pivoted on a fixed fulcrum, a link connecting one arm of said rocker beam with the third arm of the rocker, and another link connecting the opposite end of the rocker beam with the rod of the steam piston, substantially as specified.

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

JOHN C. SMITH.

Witnesses:

L. T. GRISWOLD,

CHAS. CAWOOD.