P. O. POULSON.

ENGINE.

APPLICATION FILED MAY 18, 1909.

950,866.

Patented Mar. 1, 1910.

3 SHEETS—SHEET 1.

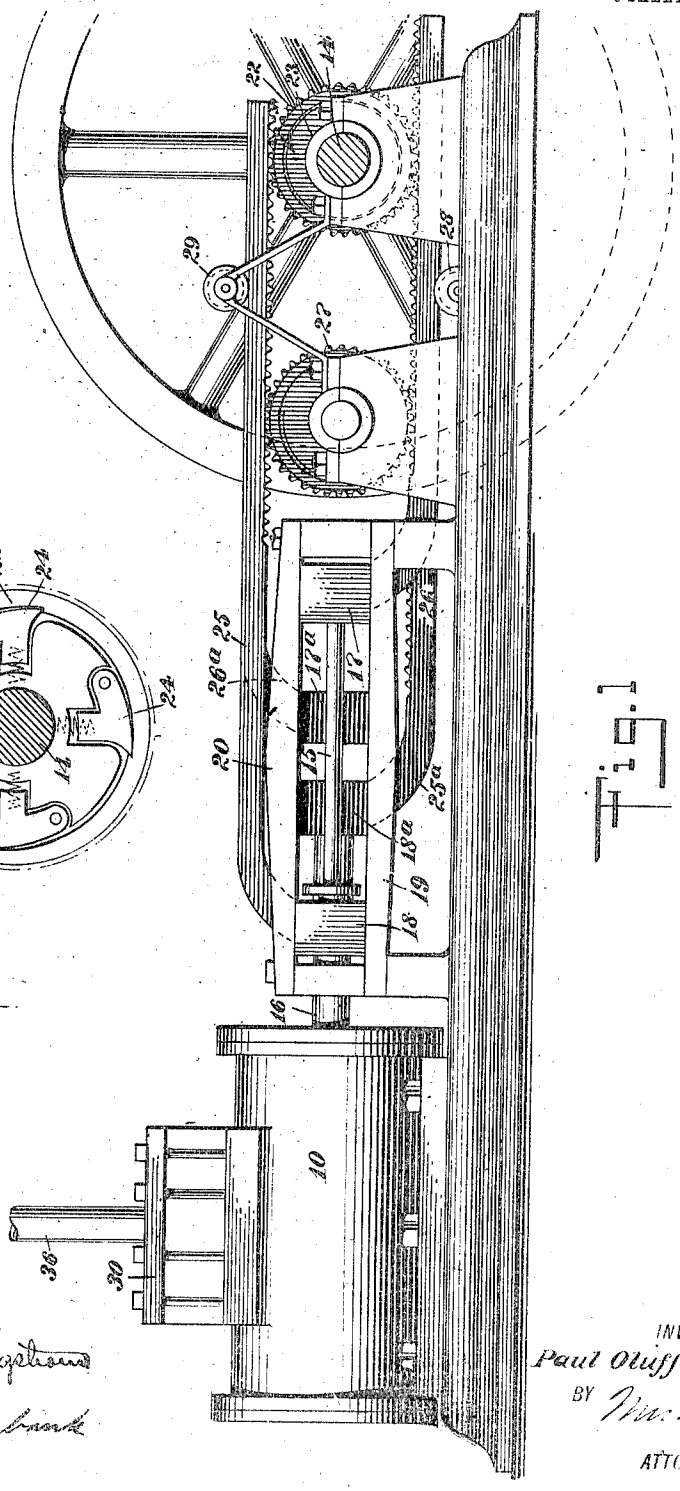

Fig. 3

Fig. 1

WITNESSES

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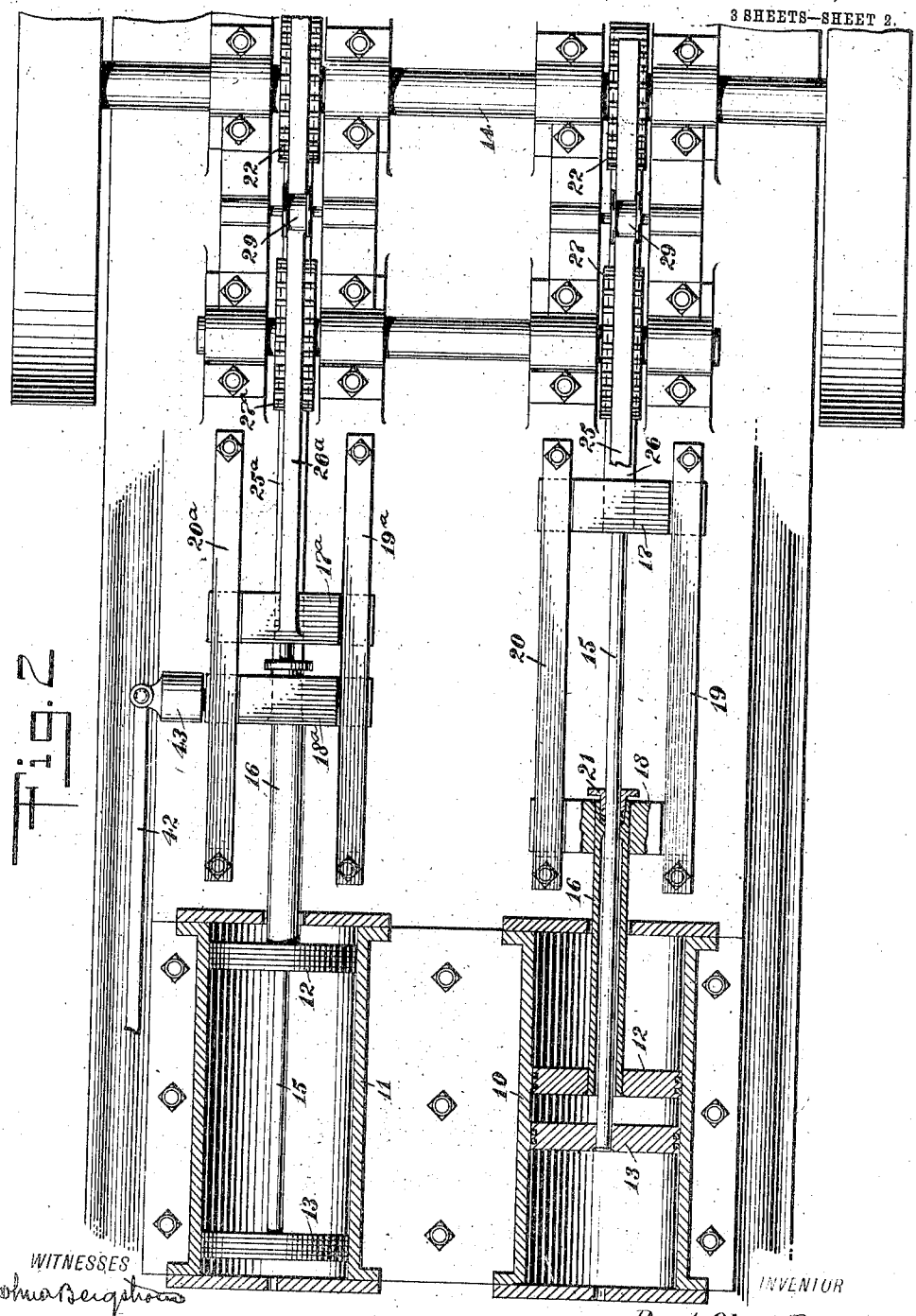

Fig. 2.

WITNESSES

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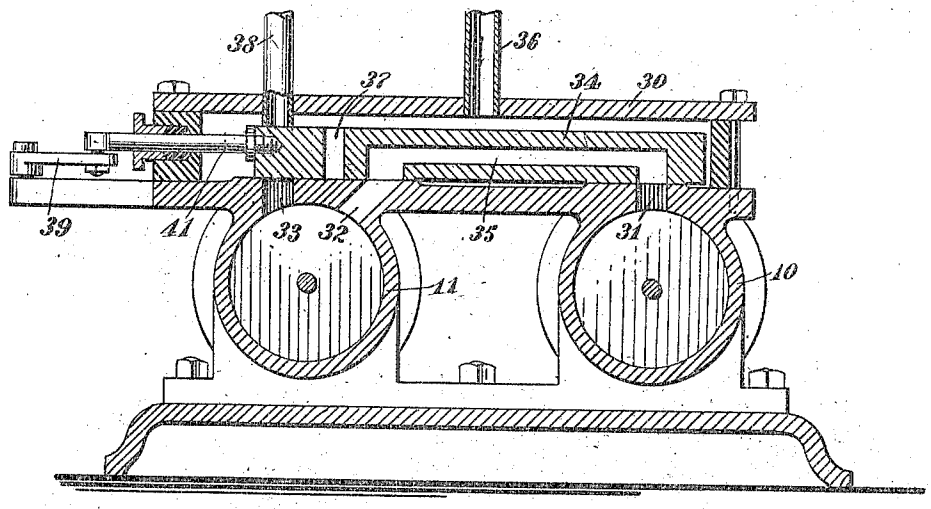

Fig. 4

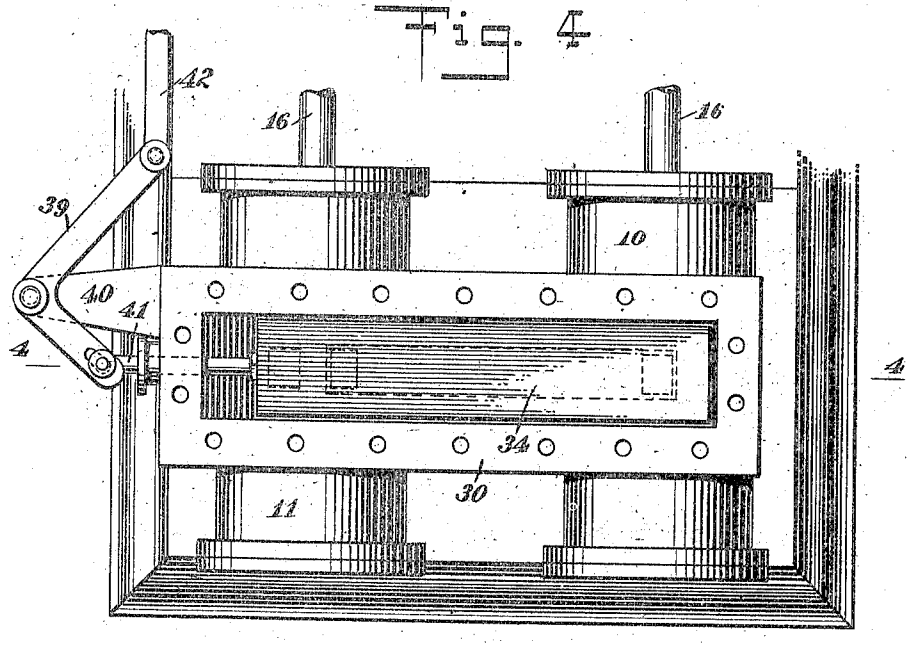

Fig. 5

WITNESSES

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UNITED STATES PATENT OFFICE.

PAUL OLUFF POULSON, OF BRIGHAM, UTAH.

ENGINE.

950,866. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed May 18, 1909. Serial No. 496,797.

To all whom it may concern:

Be it known that I, PAUL OLUFF POULSON, a citizen of the United States, and a resident of Brigham city, in the county of Boxelder and State of Utah, have invented a new and Improved Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in reciprocating engines, and more particularly to means for eliminating to a large extent, the vibration or shaking of the engine. In my improved engine I utilize two pistons within each cylinder and so connect these pistons that they will move simultaneously in opposite directions from the center. The pistons instead of being connected to a crank shaft are connected by gears to a pinion on the main shaft, so that the movements of the two pistons in opposite directions will simultaneously tend to rotate the shaft in the same direction.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures, and in which—

Figure 1 is a side elevation of an engine constructed in accordance with my invention; Fig. 2 is a top plan view thereof; Fig. 3 is a sectional detail of my improved combined gear and clutch; Fig. 4 is a transverse section through the inlet ports of the cylinders, said section being taken on the line 4—4 of Fig. 5; and Fig. 5 is a top plan view of the cylinders, a portion of the steam chest being removed.

In my improved engine, I preferably employ two parallel cylinders 10 and 11, the first of which receives the live steam and acts as a high pressure cylinder, while the other takes the exhaust steam from the first cylinder and operates from secondary expansion. In each cylinder there are two pistons 12 and 13, movable longitudinally and both operatively connected through the same end of the cylinder to the same drive shaft 14. The piston 13, at the end of the cylinder farthest from the drive shaft, is provided with a piston rod 15, disposed within the tubular piston rod 16 of the other piston. The two piston rods of the pistons in the cylinder 10 are provided with cross heads 17 and 18, movable in the same guides 19 and 20, and these cross heads move toward and from each other at the same time as the pistons. At the outer end of the piston rod 16, and preferably in the cross head 18, is a stuffing box 21, by means of which I prevent the escape of steam through the annular space between the exterior of the piston rod 15 and the interior of the piston rod 16.

The two piston rods of the pistons in the cylinder 11 are provided with cross heads 17^a and 18^a movable in guides 19^a and 20^a.

The shaft 14 is provided with a gear wheel 22 for each cylinder, and each gear wheel is constructed substantially as illustrated in Fig. 3. The outer peripheral portion of the wheel which carries the gear teeth, is separate and distinct from the inner or hub portion 23 of the wheel, so that one portion may rotate in respect to the other. The inner or hub portion 23 is keyed to the shaft, so as to rotate therewith, and a plurality of dogs 24 are pivoted to the inner portion 23 of the wheel and held outwardly against the inner circumference of the outer portion by means of suitable springs. The outer portion of the gear wheel is provided upon its inner surface with a plurality of recesses, adapted to receive said dogs, so that when the outer portion of the gear wheel is positively rotated in one direction, the inner portion and the shaft will be caused to rotate in the same direction, but when the outer portion of the gear wheel is rotated in the reverse direction, it will merely slip over the dogs 24 and will permit the gear wheel to continue rotating in the reverse direction or permit it to remain stationary.

For transmitting motion from the cross heads 17 and 18 to the gear wheel 22, I provide two rack bars 25 and 26, engaging with the gear wheel at diametrically opposite points. These rack bars are parallel and the upper rack bar 25 is bent downwardly at one end to engage with the cross head 18, while the other is bent upwardly to engage with the cross head 17. As the two pistons move in opposite directions, the two rack bars will also move in opposite directions, but as they engage with opposite sides of the gear wheel, the latter will be caused to rotate. The dogs 24 are so arranged that while the pistons are spreading apart, positive motion will be transmitted to the shaft 14, and during the return movements of the pistons toward each other, the shaft will be permitted to continue rotating but no positive movement will be communicated thereto. The cross heads 17^a and 18^a

are provided with rack bars 25ª and 26ª, similar to the bars 25 and 26, except that the bar 25ª from the cross head 18ª is disposed beneath the gear wheel and the bar 26ª is disposed above.

For equalizing the strain on the gear wheels and insuring the simultaneous and opposite movement of the rack bars, I provide two equalizing pinions 27 and 27ª, disposed intermediate the cross heads and the gear wheels 22. These pinions are keyed to the same shaft and are free to rotate in either direction and oscillate back and forth as the rack bars reciprocate. As the pistons in one cylinder are approaching each other while the pistons in the opposite cylinder are separating, it is evident that the piston 13 of one cylinder and the piston 12 of the other cylinder travel in the same direction at the same time. As the rack bar connected to the piston 12 of one cylinder is above the gear wheel 27 while the rack bar from the piston 12 of the other cylinder is below its gear wheel, it is evident that the two gear wheels 27 and 27ª will rotate simultaneously in the same direction, and they will insure the simultaneous operation of the pistons in the two cylinders. By equalizing the strain on the two rack bars by the pinions 27, 27ª, the outer shell of the gear wheels 22 may be made comparatively thin and plenty of space left for the clutches on the inner portion of the wheels. For holding the rack bars in engagement with the gear wheels 22 and the pinions 27, 27ª, I preferably employ anti-friction rollers 28 for engagement with the lower side of the rack bars 26, 25ª, and anti-friction rollers 29 for engagement with the upper side of the rack bars 25, 26ª.

For controlling the admission of motive fluid to the cylinders, I preferably provide a single steam chest 30, which may extend across the two cylinders and communicate with both. The cylinder 10 is provided with a single port 31, intermediate its ends and communicating with the steam chest, and serving both as an inlet and an exhaust port. The cylinder 11 is provided with two ports 32 and 33, one of which serves as an inlet port and the other of which serves as an exhaust port. Within the steam chest is a slide valve 34, having a passage 35 extending longitudinally thereof. With the valve in the position indicated in Fig. 4, this passage 35 in the valve establishes communication between the port 31 of the cylinder 10 and the port 32 of the cylinder 11. At this time partially expanded steam may exhaust from the high pressure cylinder 10 through the passage 35 to the low pressure cylinder 11, and operate to spread apart the pistons in the latter. Upon shifting the valve toward the left, the port 31 is uncovered, so that it communicates directly with the interior of the steam chest. Live steam may now enter from a conduit 36 and flow through the steam chest and the port 31 to the cylinder 10. A port 37 in the valve will be brought into registry with the port 33, so that the exhaust steam in the low pressure cylinder 11 may escape through an exhaust conduit 38. The slide valve thus controls the admission and exhaust of steam to both of the cylinders and thus insures the operating of the two cylinders in unison.

For operating the slide valve, a suitable bell crank lever 39 may be employed and pivoted intermediate its ends to a bracket 40 at one end of the steam chest. One end of the bell crank lever may have slot-and-pin-connections with a valve rod 41, connected to the slide valve, and the other end of said lever may be connected by a link 42 to a bracket 43 on the cross head 18 of the low pressure cylinder.

I have described the engine illustrated as a compound steam engine, but it is evident that the same principle of operation may be employed in an internal combustion engine, and certain of the features, particularly, the connection between the drive shaft and the pistons, be employed in engines having a single expansion. As the motive fluid enters the cylinder between the two pistons, it is evident that the cylinder heads might be entirely omitted, if desired. If cylinder heads are provided as illustrated, it is necessary to provide apertures through which the air may freely pass to and from the ends of the cylinder during the reciprocation of the pistons.

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

1. An engine having a cylinder, two pistons arranged to move simultaneously in opposite directions, a drive shaft, a gear wheel mounted thereon, a clutch connecting said shaft and said gear wheel to permit of their relative rotation in one direction, and rack bars operatively connected to said piston and in engagement with said gear wheel at diametrically opposite points, to move simultaneously in opposite directions with the pistons.

2. An engine having a cylinder, two pistons arranged to move simultaneously in opposite directions, a shaft, a gear wheel mounted thereon, rack bars connected to said pistons to reciprocate therewith and in engagement with said gear wheel at diametrically opposite points to simultaneously rotate the latter, the direction of rotation being reversed during successive reciprocations of the piston, and a clutch for connecting said gear wheel and shaft to positively rotate the latter during alternate rotative movements of the gear wheel.

3. An engine having a cylinder, two pistons arranged to move simultaneously in

opposite directions, piston rods connected to said pistons and both extending through the same end of the cylinder, cross heads on said piston rods, a drive shaft, a gear wheel mounted thereon, a rack bar in engagement with the upper side of said gear wheel and operatively connected to one of said cross heads, a rack bar in engagement with the under side of said gear wheel and operatively connected with the other cross head, whereby the simultaneous movement of the two pistons is insured, and the gear wheel is positively rotated in alternate directions during the successive reciprocations of the pistons, and means adapted to be rotated by said gear wheel during alternate rotative movements of the latter.

4. An engine having two cylinders, each having two pistons arranged to move simultaneously in opposite directions, a shaft, two gear wheels mounted thereon, two rack bars in engagement with each gear wheel at diametrically opposite points and operatively connected to the two pistons of the corresponding cylinder, clutches connecting said gear wheels and said shaft to rotate the shaft during the rotation of the gear wheels in one direction, and means for synchronizing the pistons of one cylinder with those of the other, said means comprising a second shaft and gear wheels connected thereto and in engagement with the several rack bars, whereby all of the rack bars are caused to reciprocate simultaneously.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

PAUL OLUFF POULSON.

Witnesses:
JAMES PETER THOMPSON,
ANTHON CHRISTIAN NIELSEN.