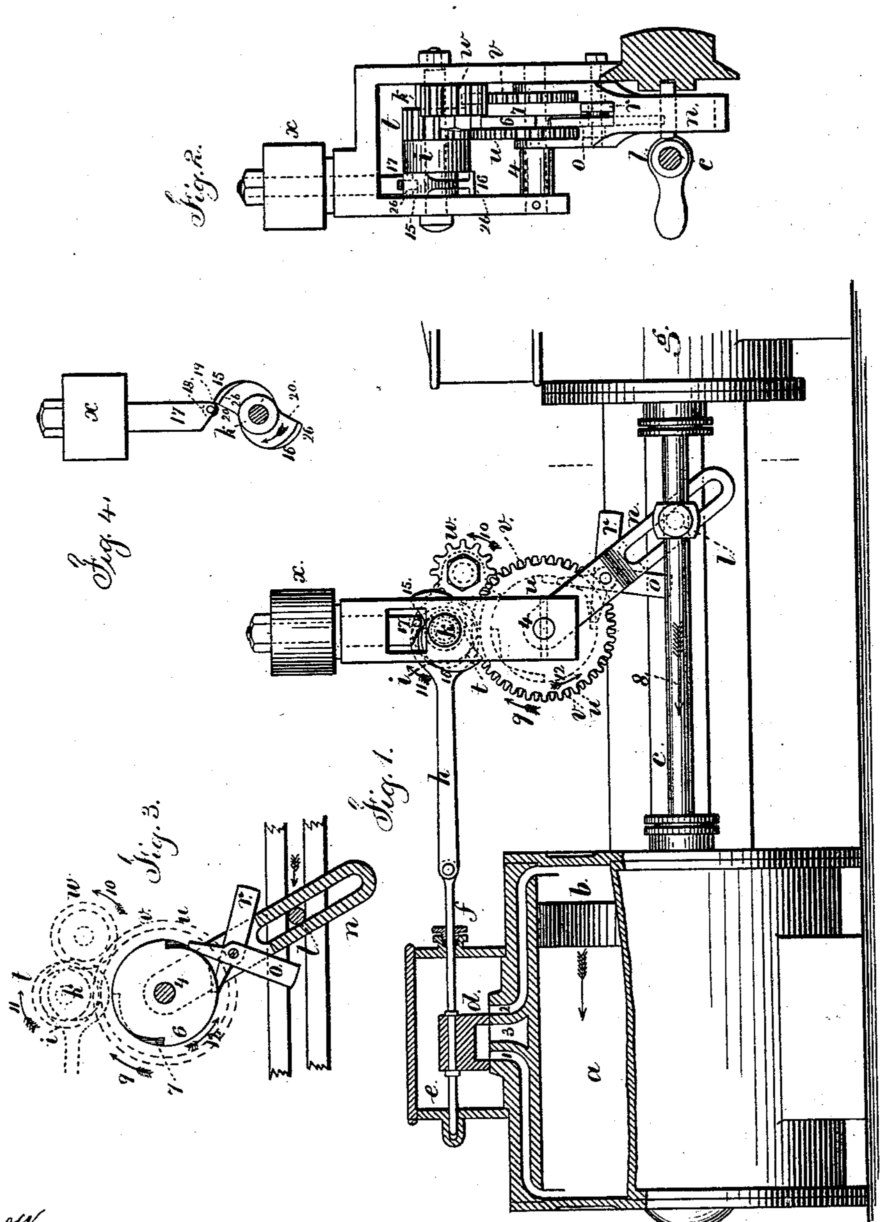
A. CARR & J. ARTHUR.
Direct Acting Engine and Pump.

No. 208,291. **Patented Sept. 24, 1878.**



Witnesses
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Inventors
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Fig. 7.

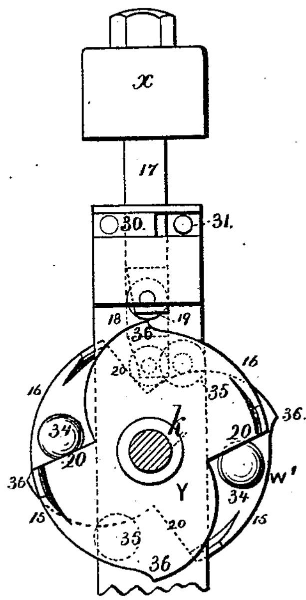


Fig. 5.

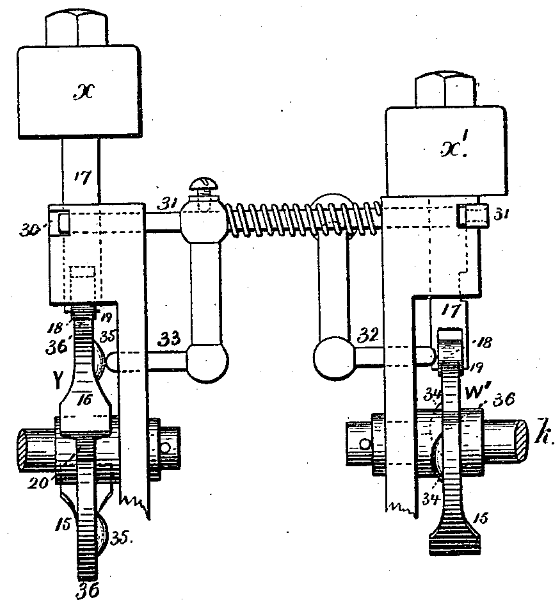
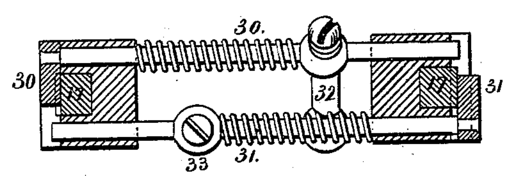


Fig. 6.



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'NITED STATES PATENT OFFICE.

\M CARR, OF PATERSON, AND JAMES ARTHUR, OF JERSEY CITY, \SSIGNORS TO SAID CARR, AND SAID CARR ASSIGNOR TO WILLIAM S. CARR, OF JERSEY CITY, NEW JERSEY.

'MPROVEMENT IN DIRECT-ACTING ENGINES AND PUMPS.

Specification forming part of Letters Patent No. **208,291**, dated September 24, 1878; application filed January 2, 1878.

To all whom it may concern:

Be it known that we, ADAM CARR, of Paterson, in the State of New Jersey, and JAMES ARTHUR, of Jersey City, in the State of New Jersey, have invented an Improvement in Direct-Acting Engines, of which the following a specification:

Pumps are frequently run automatically, the speed of the pump depending upon the demand for water. That is the case in many places where there is a system of pipes for distributing water, and the pump maintains the pressure without a reservoir. In pumps that have a crank and fly wheel there are advantages, because the valves are moved with certainty to the proper place, but there are great disadvantages. If the movement of the engine is very slow, the fly-wheel is liable to stop, and the engine does not turn its centers unless there are two or more engines and cranks; and if the engine is running and the delivery of the water is suddenly checked, the momentum of the fly-wheel is likely to cause injury to the pump or the connections.

In crank engines and pumps the pressure is liable to vary in consequence of the regular motion of the fly-wheel and the varying speeds of the piston consequent thereon.

In direct-acting pumps many of the before-named difficulties are obviated; but the varying speeds and the wear of the parts render it almost impossible to secure a certain and regular movement of the valve. When the valve is moved by steam the wear of the parts and of the passages interferes with uniformity of action, and the sudden admission of steam through a full opening is often objectionable.

The direct-action pumps are remarkably well adapted to the varying conditions under which they are run, because they will go fast or slow or stop, according to the supply or demand.

Our invention is intended to obviate the difficulties hereinbefore mentioned, and to secure in a direct-acting pump all the advantages of a crank movement for the valve. The speed of the pump is dependent upon the demand for the water, and the pressure will be uniform, or nearly so, with a given pressure of steam. The valve movement is positive, and effected by mechanical means. Injury to the steam-cylinder by "priming" is prevented, and the mechanical movement for the valve is adapted to any engine-valve, whether used with a pump or otherwise.

In the drawing, Figure 1 is a side view of the valve movement with the valve-chest in section, and Fig. 2 is an elevation of the valve-moving devices at right angles to Fig. 1.

The steam-cylinder *a*, piston *b*, piston-rod *c*, valve *d*, ports 1 2 3, valve-chest *e*, and valve-rod *f* are of any desired character. I have shown the engine as connected to a pump, *g*.

The valve-rod *f* is connected by a link, *h*, to the crank, cam, or eccentric *i*, and by the mechanical movement next described a continuous rotation is given to the shaft *k* and eccentric, crank, or cam *i* by the reciprocating movement of the cross-head *l* that is upon the piston-rod *c*.

There is a lever-arm, *n*, swinging upon the shaft 4, and receiving its movement from a link to the cross-head *l*, or preferably by a pin on the cross-head that passes through the slot in the said arm *n*. Upon this arm *n*, or between the bifurcations thereof, as shown, are two weighted or spring pawls, *o r*, seen more clearly in the detached view, Fig. 3. These pawls stand in opposite directions.

Upon the shaft 4 are two loose gear-wheels, *u v*, the wheel *u* gearing to a pinion, *t*, upon the shaft *k*, which carries the eccentric, having half the number of teeth, and the wheel *v* gearing to an intermediate pinion, *w*, which, in turn, gears with said pinion *t*. At the sides of and attached to the gear-wheels *u v*, respectively, are disks or hubs 6 and 7, each of which has two notches for the respective pawls *o r*.

It will be evident that as the engine moves in the direction of the arrow 8 the pawl *r* engages with the disk 7, turning that and the gear-wheel *v*, intermediate pinion *w*, and pinion *t* in the direction of the arrows 9 10 11, the gear-wheel *u* at the same time being free to revolve, and revolving in the direction of the arrow 12 by the action of the teeth of the pinion *t*, the pawl *o* sliding over the edge of the notches in the disk 6. This gives the eccentric or crank shaft k a half-rotation, the pawl that is in action having engaged with its tooth. When the engine commences to move the other way the pawl o engages the disk 6, and turns the same and the wheel u in the same direction as before, giving the shaft and eccentric a half-revolution, the pawl r being inactive and drawing over its disk 7. By this means the shaft k and eccentric, cam, or crank are given a rotary movement in one direction continuously, and make one revolution each complete stroke, and the valve, deriving its motion therefrom, is also properly moved. We thus interpose between the valve-eccentric and the piston-rod a step-by-step motion, acting progressively to turn the eccentric and receiving its movement from the piston-rod.

It will be evident that, if the wheel u were three times the size of the pinion t and three notches were made in each disk for the pawls, the parts would work as before described, or similarly if the gears were differently proportioned.

In order to prevent the valve stopping at the point where both ports are closed, we make use of a double cam, 15 16, upon the shaft k, and upon this cam the toe-piece 17 rests, and is pressed by a spring or weight, x, toward the shaft k. The weight is raised by one of the cams as the shaft k is revolved, and just as the inlet of steam is about to be closed one of the cam-points passes from beneath the toe, and the weight or spring, forcing it down the incline, completes the half-motion of the shaft, closing one port and opening the other, and the further movement of the shaft k by the engine insures the full completion of the movement of the valve, and also the return movement of the valve by the further revolution of the eccentric, as before.

The action of the double cam 15 16 will be more easily understood by reference to Fig. 4, where the weight x is shown as just ready to drop.

The end of the toe-piece 17 is preferably slotted to receive a roller, 18, somewhat thicker than the narrow part of the double cam 15 16. The lifting of the weight x is therefore performed in a very easy gradual manner by the curves of the cam acting on this roller.

By referring to Fig. 2 it will be seen, at 26, that the highest points of the double cam (where it attains its greatest diameter) have, for a short distance, projecting flanges 26, producing a breadth equal to the toe-piece 17. These flanges (at 26) come in contact with the corners of the toe-piece 17 for a very short distance before the weight drops, as shown at 19, thus insuring accuracy in the drop at the proper part of the revolution of the eccentric.

During the descent of the weight x the roller 18 becomes the driver to move the cam and its eccentric sufficiently to carry the valve over the center of its movement and give it lead enough to easily reverse the movement of the piston. The amount of this lead may be varied even while the engine is running. By screwing up or down the weight x on the stem of 17 the distance through which the roller acts on the incline 20 may be varied as said weight is arrested in its downward movement by the frame through which the stem 17 slides. According to the lead of the eccentric, the eccentric and its shaft will require to be revolved in one direction or the other, in the manner well known to engineers.

By transposing the pawls and changing the direction of the notches or teeth in the disks 6 and 7 the shaft k may be revolved in the opposite direction; or, more simply, the motion of the valve with reference to the steam-piston will be reversed by turning the eccentric, cam, or crank i half a revolution forward on the shaft.

In some instances two direct-acting pumps are employed, and positioned so that one is acting full while the other is stopping and starting again, so as to make the discharge of the water uniform.

In this instance one pump may run at a slightly different speed from the other, on account of variations in the friction. In that case the movements of the two pumps would correspond periodically. To prevent this we arrange to detain the weight x so that it may not fall until the adjoining engine arrives at the proper point in the relative movements of the two engines to insure the proper relative rotation of the two.

Fig. 5 is an elevation, and Fig. 6 is a sectional plan, of the arrangement for effecting the aforesaid object, and Fig. 7 is a side view of the parts.

The double cams w' and y are made, as heretofore described, with the inclines 15 and 16, and each double cam is moved by the lever-arm and pawls, in the manner before described, and each weight x, with its toe 17 running down the incline 20, changes the valve by turning the shaft k and eccentric. We arrange two spring-catches, 30 and 31, that slide horizontally, and yield as the respective weights x x' are lifted. The catch 30 serves to hold up the weight x and the catch 31 to hold up the weight x'; hence the weights would cease to operate were it not for devices which move back the latches.

The latch 30 has an arm and finger, 32, that are adjacent to the cam w', and the latch 31 has an arm and finger, 33, that are adjacent to the cam y, and upon these cams w' and y there are projections 34 35. The weight x is raised by the inclines of the double cam y; but it cannot fall until the projection 34 on the double cam w' acts upon the finger 32 and sliding latch. So, also, the weight x' is raised by the double cam w', and the latch 31 holds it up until the projection 35 upon the double cam y unlatches the catch 31 and liberates such weight. By this means it is impossible for either engine to run faster than the other, and their proper relative movements are insured.

It is preferable to make each double cam w'

or y with the projections 36, (see side view, Fig. 7,) so as to lift the weight sufficiently high to allow the catch to enter the notch in the stem of the weight and support the same.

If the engine which moves fastest unlatches the weight of the other engine before the incline 20 of the slowest engine arrives beneath the roller 19, the weight can drop sufficiently to prevent its being latched again, and held up after the projection 34 of the other engine has passed its finger. This allows each engine to operate independently of the other, prevents the fastest-moving engine from leaving the weight of the slowest-moving engine sustained and out of action, and insures the pause of the fastest-moving engine at the end of the stroke until the slower engine comes to its proper relative position and unlatches the weight of the other engine.

We claim as our invention—

1. The combination, with the valve and its eccentric in an engine, of the gear-wheels u v, pinion t, intermediate w, pawls o and r, standing in opposite directions, and swinging arm n, receiving motion from the piston-rod, substantially as set forth.

2. In combination with the valve-eccentric and its gearing, substantially as shown, moved by a connection to the piston-rod, the cams 15 16, and weight x, acting in the manner and for the purposes set forth.

3. In combination with the direct-acting engine and the eccentric and valve thereof, the double-acting pawls receiving motion from the piston-rod, and acting in opposite directions upon the gearing that intervenes between the pawls and eccentric, substantially as set forth.

4. The combination, with the valve and the eccentric and rod for moving the same, of a lever and pawl receiving motion from the piston-rod and actuating the eccentric, substantially as set forth.

5. The arrangement of the double cams w' y, weights x x', latches 30 31, and projections 34 35, for insuring the proper relative movements between two direct-acting pumping-engines, substantially as set forth.

Signed by us this 20th day of November, A. D. 1877.

ADAM CARR.
JAS. ARTHUR.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

Correction in Letters Patent No. 208,291

This is to certify that the annexed Letters Patent No. 208,291, granted September 24, 1878, for Improvement in Direct-Acting Engines and Pump, have been corrected for the purpose of remedying a clerical error by erasing from the parenthetical clause next following the clause specifying the subject-matter of the grant in said Letters Patent, and from the caption of the printed specification, the legal residence stated, viz: "*Jersey City*," of the assignee, *W. S. Carr*, and in lieu thereof at each of said places inserting "*Paterson, N. J.*," to conform to the Office [*records*.]

November 9, 1878.