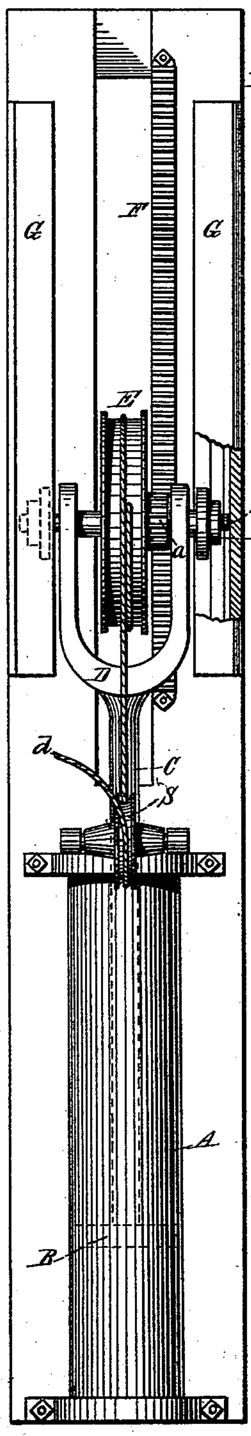
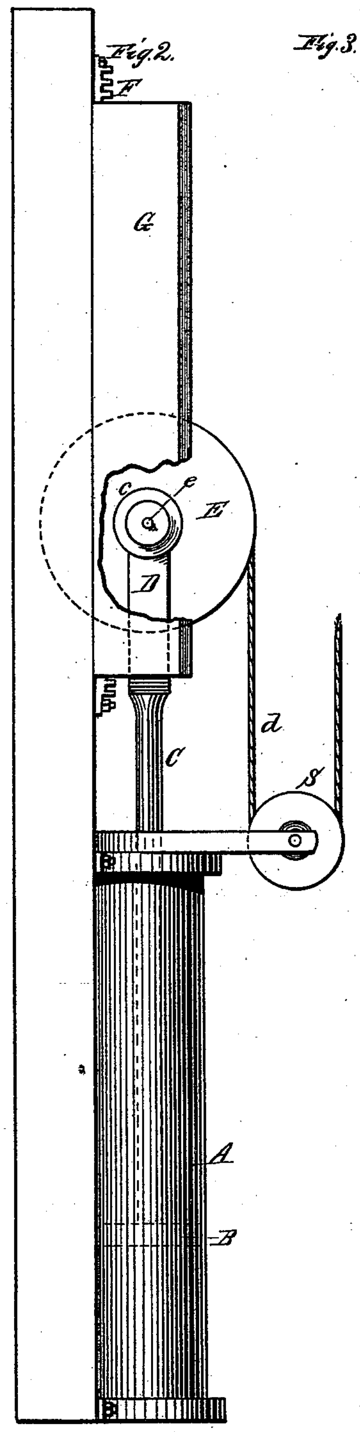
S. SWARTZ.
Hydraulic Elevator.

No. 213,143 **Patented Mar. 11, 1879.**





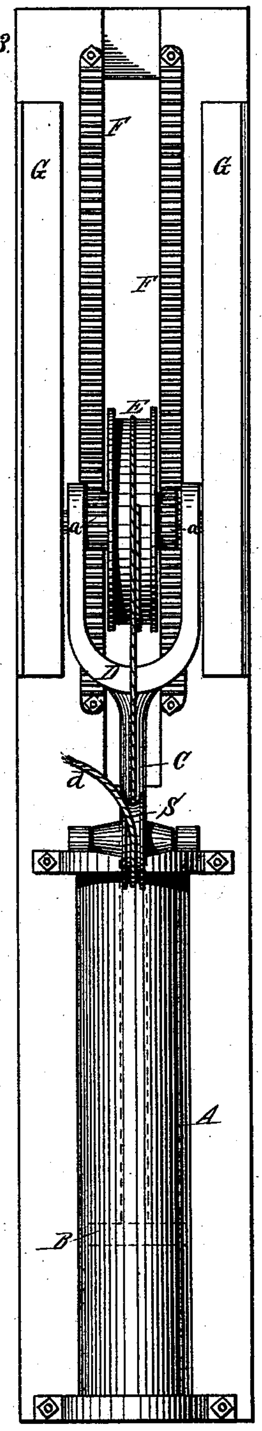


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Fig. 4.

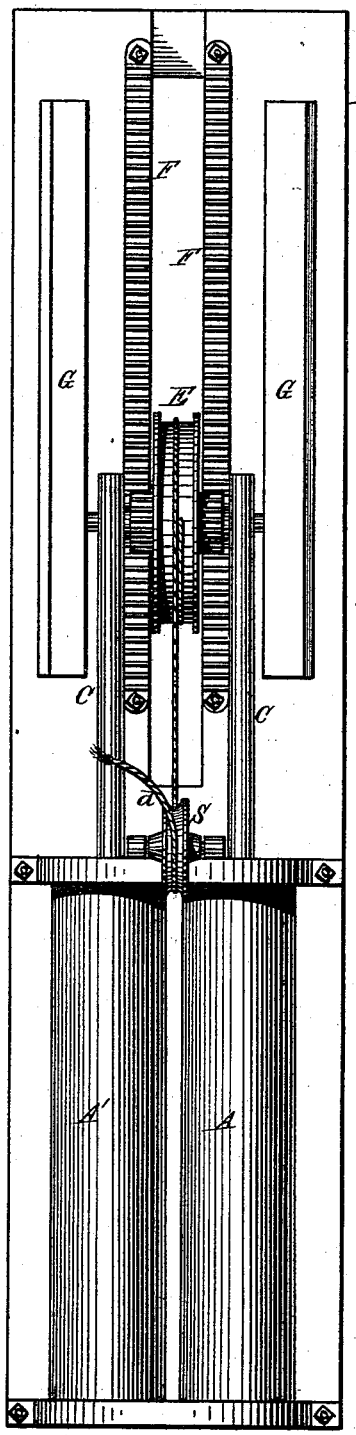


Fig. 5.

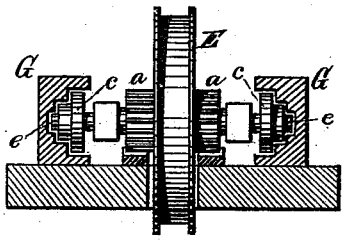
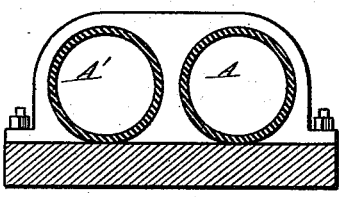


Fig. 6.



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UNITED STATES PATENT OFFICE.

SAMUEL SWARTZ, OF BUFFALO, NEW YORK.

IMPROVEMENT IN HYDRAULIC ELEVATORS.

Specification forming part of Letters Patent No. **213,143**, dated March 11, 1879; application filed December 26, 1878.

To all whom it may concern:

Be it known that I, SAMUEL SWARTZ, of Buffalo, county of Erie, and State of New York, have invented certain new and useful Improvements in Hydraulic Elevators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Figure 1 is a front elevation of a hydraulic apparatus, showing a single cylinder and a single stationary rack, a small portion of one of the guide-rails being broken away, so as to illustrate one method of preserving the proper relative working positions of the pinion and rack, the whole constructed and arranged in accordance with and embodying the principles of my invention. Fig. 2 is a side elevation of device represented in Fig. 1, showing also a portion of one of the guide-rails broken away for same purpose as in Fig. 1. Fig. 3 is an elevation similar to Fig. 1, but showing double racks and pinions as assembled for use in connection with a single cylinder; and Fig. 4 is still another front elevation, illustrating a convenient method of assembling double racks and double pinions for use in connection with double or twin cylinders. Fig. 5 is a section through the axis of the drum and pinion-shaft shown in Figs. 3 and 4, and intended to further illustrate one means of properly confining and guiding the traveling pinions with respect to the racks which impart rotary motion thereto. Fig. 6 is a cross-section through the twin cylinders of Fig. 4.

Inasmuch as the engine or apparatus may be placed so that its main or longitudinal axis shall lie horizontally as well as vertically, or in any other desired position, Figs. 1, 3, and 4 may be regarded as plan views as well as elevations.

Like letters in all the figures indicate corresponding parts.

My invention has special relation to that class of apparatus or engines intended for operating the well-known passenger, baggage, or freight elevators through the medium of a rope, cable, or chain, which apparatus, together with the car, has now come to be ordinarily denominated a "hydraulic elevator," for the reason that the motive power is derived from water-pressure; but it should be observed that the principles of my invention are equally applicable to engines driven by steam, gas, air, or other pressure than water, since the operative parts perform their required functions independently of the kind of fluid-pressure produced in the cylinder, and it should also be noted that the engine may be used for moving other weights than elevator cars or platforms.

The principal object of my invention is to produce a simple, cheap, and effective engine for the purposes intended, which shall be capable of transmitting a considerable portion of the pressure in the cylinder directly to the operating-cable, thereby greatly economizing the consumption of power, reducing the friction of the operating parts in proportion to the amount of power applied directly, and rendering it practicable to construct the racks and pinions required of a cheaper material than that heretofore used without any increased liability to wear or breakage; and among the objects of the invention may also be mentioned an adaptability of the engine for location and operation in any desired position, either having its axis horizontal, vertical, or inclined, as well as a saving in working-room required over and above the previously-existing styles of hydraulic engines, which afford an equally effective elevating capacity.

To accomplish all of these objects, the invention consists, essentially, in so arranging and connecting the operating parts that the pinion or pinions which cause the revolution of the cable-drum shall travel or move over the rack or racks being driven directly or indirectly through the medium of the piston-rod; and the invention also consists in certain peculiarities of construction and relative arrangements or combinations of parts, all of which will be hereinafter first fully described, and then pointed out in the claims.

In the drawings, wherein are shown the simplest forms of apparatus which I have been able to devise in order to clearly illustrate the principles of my improvements, A is the cylinder; B, the piston; C, the piston-rod, and E the cable drum or barrel. The drum E is mounted upon and connected with an axle, *e*,

to which the piston-rod C is coupled by any desired form of yoke or other device, as at D, and the axle *e* also carries a pinion, *a*, which is made to engage with a rack-bar, F, firmly secured to the foundation of the machine. The ends of the axle *e* are extended beyond the coupling device, and are provided with loose spools or collars *c c*, which are fitted to travel smoothly within grooves formed in the side rails, G G, and these collars operate to confine the axle and its attached pinion, so that the latter cannot slip over the rack without being caused to turn thereby.

It has not been deemed at all necessary to illustrate any of the valve-connections with the cylinder by which the inflow and outflow of the motive fluid is regulated. These valve-connections may be of any approved form, and they operate in the present machine in the ordinary manner, which is very well understood.

From an inspection of the drawings it will appear that as the piston B advances or recedes, the drum E will also advance or recede, since it is connected with said piston through rod C and connecting device D; and it will also appear that as the drum moves forward or backward it will be caused to revolve by means of the pinion *a*, which must engage with the rack F.

To transmit the desired motion to the car or other weight intended to be raised or moved, the cable, rope, or chain *d* is connected with the drum, and also made fast to the object to be moved. The various methods of connecting the operating-cable with the car are so well understood that they do not require to be illustrated or explained herein; but in order that the best advantages may result from the arrangement herein indicated, it is necessary that the cable lead off from the drum in a direction contrary to the travel of the latter; and to provide for this effective use of the apparatus, I locate an ordinary sliding sheave, S, at some point most convenient with respect to the drum, and turn the cable about this sheave.

It will be found most advantageous to support this sheave from some point on the cylinder, and I therefore prefer to attach it to the cylinder-head, substantially as indicated.

Were it not for the fact that I cause the cable to lead off from the drum in the manner explained, it is apparent that the drum would follow up after the cable, and that therefore the cable would have to be taken up so much more by the revolution of the drum; but under the arrangement shown, as the drum is thrust away from the cylinder it takes up a length of the cable equal to the direct travel of the drum, leaving so much less of the length to be wound up, and this direct thrust requires an expenditure of much less power than would be required if the whole length of cable had to be taken up by the rotary motion of the drum.

Nothing herein should be construed as meaning that the apparatus could not be employed without this arrangement of the lead should circumstances or occasion require that it be differently arranged.

The single rack and pinion shown in Fig. 1 might be sufficient for ordinary uses; but the strain upon the axle and the connecting device would be brought more nearly perpendicular to the line of travel by using the double pinions and racks shown in Fig. 3. For light loads the single cylinder will ordinarily be sufficient for the required purposes.

Where more than one cylinder is desirable, a pair of cylinders may be conveniently arranged, as in Fig. 4, wherein the second cylinder, A′, has all the attachments and connections substantially the same as its twin, A. In the double-cylinder apparatus the valves should be so arranged as that the supply of fluid to either one may be cut off at pleasure, leaving the other to supply the working power for light loads, and the two to be used only in connection with heavy loads. This arrangement will economize in consumption of the motive fluid, especially in the case of water, since an equal quantity is required to fill the cylinder for raising a light or a heavy weight.

Heretofore in this class of devices, wherein a revolving drum has been employed, it has been customary to confine the axes of the driving-pinions, so that they shall have only a motion of rotation, and to cause them to turn through the medium of a rack, which is moved by the piston-rod, either by direct or indirect connection therewith, and this construction, owing to the great strain and wear of the parts, has necessitated the use of steel pinions and steel racks, adding thereby greatly to the expense of first cost, as well as of all repairs.

Under this previous construction it is apparent that no part of the thrust of the piston-rod is applied directly to the hoisting rope or cable, and consequently a greater play is required for the racks, a longer stroke of piston is required, and the power is not economically applied. The first two of these consequences necessitate, under all ordinary circumstances, the placing of the engine so that it shall drive the racks in a vertical direction; whereas my improvements render it practicable and easy to locate the engine in any desired position, thereby accommodating the apparatus to any preferred location, which is frequently a matter of importance to be considered.

As a matter of course, the relative proportions of the pinion, drum, and rack are no essential features of the present invention, since, obviously, these may be varied to correspond with the circumstances of any particular case, care being taken, however, to make the parts of such strength and size as will best withstand the strain and wear incident to their proper operation; but the advantages of the present form of apparatus over the kind heretofore used and previously referred to herein may probably be made most apparent by a reference to some particular proportions. Suppose, for instance, it be required to raise the

car through a distance of sixty feet, that the engine affords a piston-stroke of ten feet, and that the circumference of the drum be fifteen feet, (its diameter fifty-seven + inches.) Under the old form of apparatus, with movable rack and drum, having only a motion of rotation, in order that the drum shall wind up sixty feet of cable while the rack moves ten feet, said drum must revolve four times at each complete movement of the rack, and the pinion must, therefore, be in circumference one-fourth the length of the rack, or 2.5 feet, or its diameter 9.6 inches. In this case the leverage of the resistance over that of the power will be as in the proportion of 57 to 9.6.

Now, with my improvements having same drum and same length of stroke of piston, the rectilinear movement of the drum takes up ten feet of cable, leaving only fifty feet to be taken up by the rotary motion; hence the drum must revolve only three and one-half times, and the pinion therefore should be three feet in circumference, or 11.5 inches in diameter, making the leverage of the power over that of the resistance as in the proportion of 57 to 11.5, or a gain in my construction of 1.9 inch leverage, which represents a total gain of twenty per cent. over the former construction. Hence, disregarding the friction in both cases, (which would, in fact, be in favor of my apparatus,) it will require the expenditure of twenty per cent. less power to move a given load with my apparatus than will be required by the previously-mentioned old styles.

Aside from these advantages in the economical use of power, my engine can be easily and cheaply constructed, the pinions and racks may be made of cast-iron, and the device is not liable to get out of order, or it may be very easily repaired in case it should.

I am well aware of the previous forms of elevators wherein the car has been mounted directly upon the piston-rod without the intervention of any gearing. This form requires too great accuracy of parts, and, owing to its cost of construction, is not applicable to ordinary uses like those forms having only a moderately long cylinder or piston-rod. I do not, therefore, desire to be understood as making any broad claim to the direct connection of piston-rod with the object to be moved; but

What I do claim herein as new, and desire to secure by Letters Patent, is—

1. In a hydraulic elevator, the combination, with the piston-rod, of a pinion movable therewith, said pinion being caused to turn as it advances or recedes, and being adapted to communicate rotary motion to the rope barrel or drum, substantially as and for the purposes set forth.

2. In a hydraulic elevator, the combination, with the piston-rod, of a rotating rope barrel or drum adapted to move along its ways or guides, said drum being provided with an attached pinion, and being caused to revolve by contact of its pinion with a suitable rack, substantially as shown and described.

3. In a hydraulic elevator, a stationary rack-bar, F, traveling pinion *a*, and traveling rope barrel or drum E, in combination with a cylinder, A, and piston B, substantially as herein shown and described.

4. In a hydraulic elevator, the combination of a piston, a traveling rope barrel or drum, and its operating-pinion, the several parts being arranged substantially as specified, so that a portion of the movement of the piston is transmitted to the rope or cable, for the purposes and objects named.

5. In combination with the movable and rotating drum, the pinion attached to its shaft, and held in proper working position relatively to the rack by means of the side rails, substantially as explained.

6. In combination with the movable and rotating drum, the projecting axle carrying the operating-pinion and the friction-rollers, which work in the grooved side rails, substantially as shown and described.

7. In a hydraulic elevator, the combination, with the cylinder, its piston, and connecting devices, of a stationary rack adapted to impart a rotary motion to the traveling pinion and connected drum as the two are made to advance or recede, substantially as and for the purposes set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal in the presence of two witnesses.

SAMUEL SWARTZ. [L. S.]

Witnesses:
S. HUME,
J. W. SANFORD.