(No Model.) 2 Sheets—Sheet 1.

R. C. SMITH.

COMPOUND ENGINE.

No. 485,568. Patented Nov. 1, 1892.

Fig. 1.

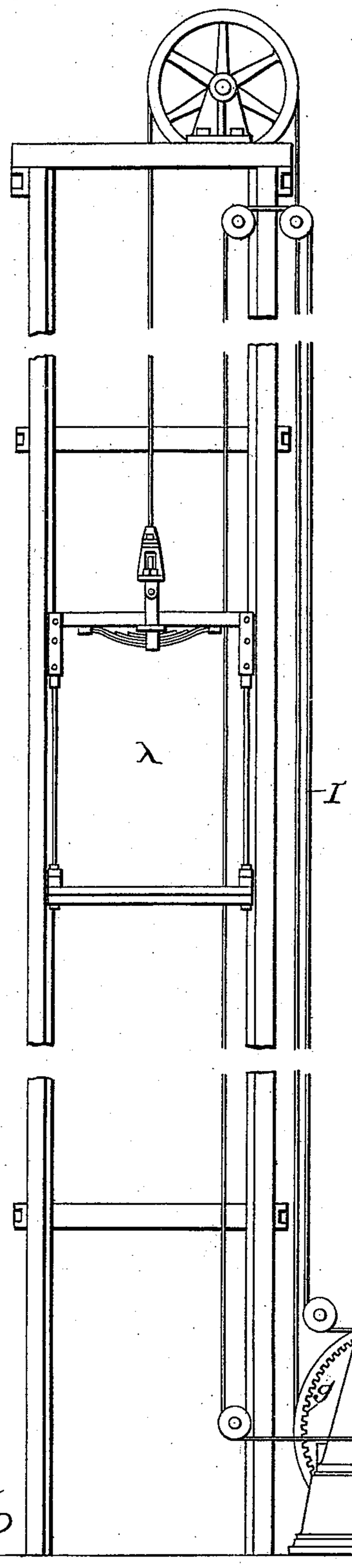


Fig. 4.

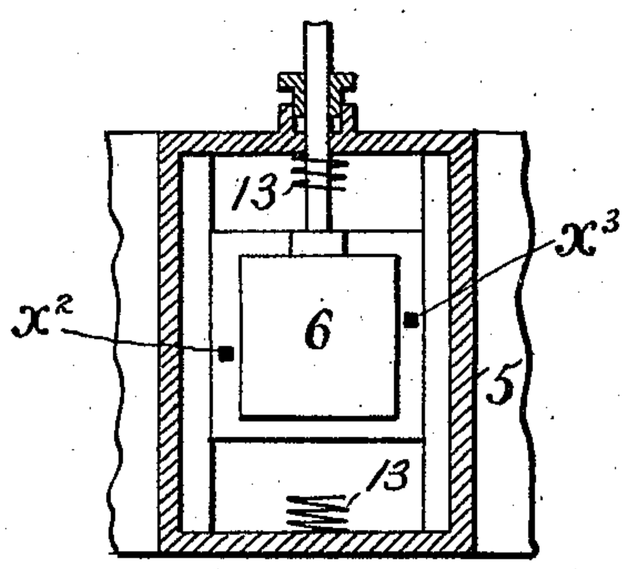
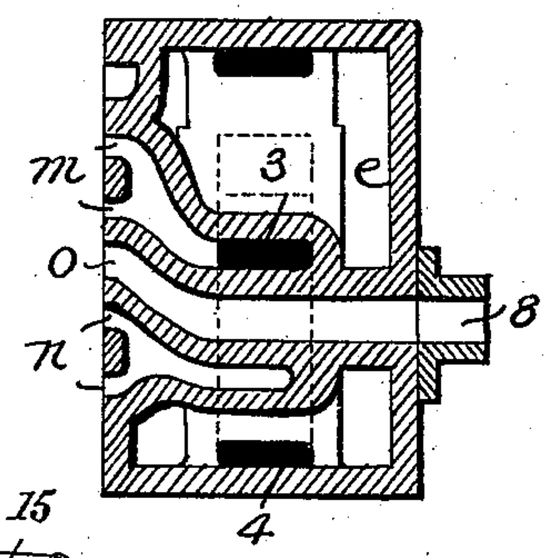
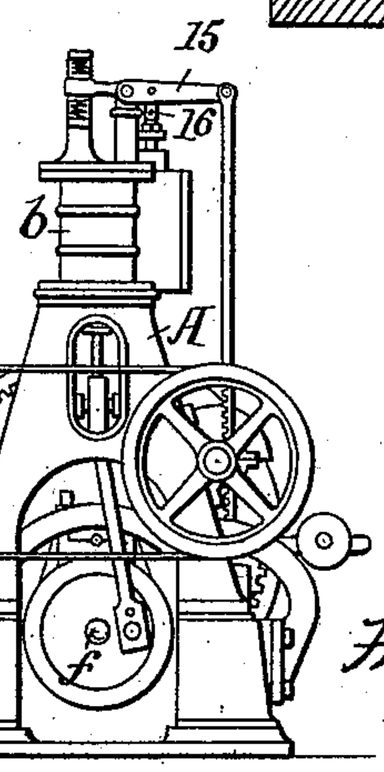


Fig. 5.





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(No Model.) 2 Sheets—Sheet 2.

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COMPOUND ENGINE.

No. 485,568. Patented Nov. 1, 1892.

Fig. 2.

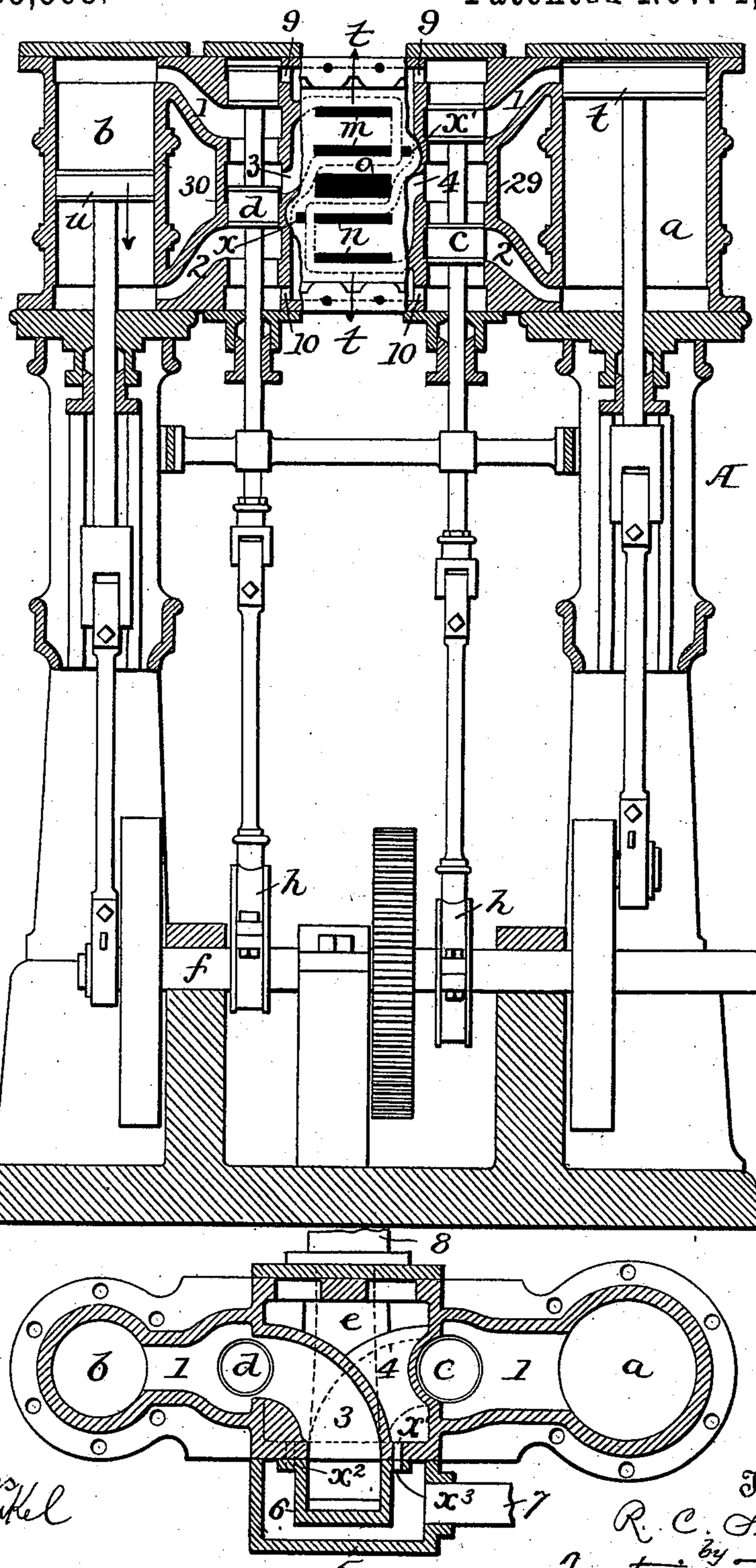

Fig. 3.

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UNITED STATES PATENT OFFICE.

RUDOLPH C. SMITH, OF YONKERS, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NATIONAL COMPANY, OF CHICAGO, ILLINOIS.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 485,568, dated November 1, 1892.

Application filed November 14, 1891. Serial No. 411,884. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH C. SMITH, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Compound Engines, of which the following is a specification.

My invention relates to certain improvements in compound engines and more especially to elevator apparatus in which such engines are employed; and my invention consists in so constructing the compound-engine that for purposes of breaking or retarding it may act as a compound compressor, where the motor fluid in starting the load for lowering or on a downgrade aids actively to propel the load, but is thereafter compressed on the exhaust side of the large cylinder to such an extent as to retard the continued downward action, with an effect proportioned to the extent to which the reversing-valve is shifted. To this end I provide a compound engine with certain ports and passages and valves and with means for operating the reversing-valve, as fully set forth hereinafter, and as illustrated in the accompanying drawings, in which—

Figure 1 is a view of an elevating apparatus embodying my improvements. Fig. 2 is an enlarged sectional elevation of the engine. Fig. 3 is a transverse section on the line 3 3, Fig. 2. Fig. 4 is a transverse section of the valve-chest and reversing-valve. Fig. 5 is a section on the line *t t*, Fig. 2, through the valve-seat.

My improvements may be embodied in compound engines of different constructions; but for illustration I have shown an engine similar in its ordinary structure to the usual "Otis hoisting engine," having two cylinders *a b* and valve-casing supported at the top of the frame A, which has bearings for a shaft *f*, with two crank-disks having their pins at right angles and connected, respectively, to the pistons *t u* of said engine, and with a drum *g*, geared to be driven by the rotation of the shaft *f*, eccentrics *h h* of which operate the piston-valves *c d* of the respective engines, which slide in casings 29 30, forming part of the main casing. The cables from the drum *g* pass over suitable guide-pulleys, and are connected with the cage X and a hand-rope I, passing around suitable pulleys, and through the cage serves to operate the stopping, starting, and reversing valve, as set forth hereinafter.

At any suitable point between the two cylinders *a b* is arranged a chamber *e*, which may be in a separate casing, but preferably, as shown, is in the casing formed in one piece with the cylinders and valve-casings with ports 9 10 between the ends of each casing and the chamber *e*. Each cylinder has two ports 1 2 leading to the adjacent valve-chambers, and from the respective valve-chambers channels 3 4 lead, respectively, to ports *m n* in the valve-casing 5, in which operates an ordinary D-valve 6. The inlet pipe 7 communicates with the interior of the valve-casing 5 and the exhaust-pipe 8 connects with a channel leading to the exhaust-port *o*.

When the parts are in the position shown in Fig. 2 and the engine is working expansively, the valve is up, the direct live-pressure steam from the valve-casing 5 passes into the exposed port through the channel 3 to the casing of the valve *d*, which is elevated, exposing the port 1 and admitting the steam to the top of the high-pressure cylinder *b*, while also permitting the exhaust from the said cylinder to pass through the port 2 and valve-casing port 10 into the chamber *e*, from whence it will on the descent of the valve *c* flow through the port 9 and valve-casing 29 and port 1 of the low-pressure cylinder *a* above the piston *t*. Meanwhile the exhaust from the low-pressure cylinder *a*, below the piston *t*, passes through the port 2, the valve-casing 29, and channel 4 and port *n* to the port *o*, and thence to the exhaust.

The arrangement of the valve 6 and operations above described will continue during the hoisting of the load, except that the valve will be shifted to vary the exposure of the port *m* according to the speed and power required. In descending, however, when the engine is reversed I provide not only for the reversing of the flow of the steam to the engines to reverse the direction of motion, but I also change its course, so that the direct pressure of live steam passes first to the larger engine, but of course in small volume,

so that in starting there is a direct propelling action of the live steam on the large piston to lower or drive the load downgrade; but the steam already in the small cylinder and chamber *e* and on the opposite side of the large piston is being compressed by the latter in proportion to its more-extended area and to the extent to which the exhaust is opened, so as to act with a retarding effect, more or less neutralizing the propelling effect of the live steam, so that there is maintained on the exhaust side of the large piston a body of compressed fluid, which insures an even and steady descent of the load or movement of the car upon the downgrade, as the case may be. It will be seen that in descending the live steam enters on the pressure side of the large piston and that the prior charge on the exhaust side in the chamber *e* and end of the small cylinder is being compressed, the exhaust being only from the opposite side of the small cylinder.

It is important in many instances to positively start a cage or car on its lowering or downgrade movement, especially when the load is light or the grade small, and this is effected by the means set forth, while after the movement begins the exhaust from the large cylinder is compressed to act with a retarding or braking effect. This is effected by the interposition of the chamber *e* between the cylinders and the arrangement of valves and ports, whereby the exhaust of either engine may be thrown into said chamber while the exhaust of the other engine is directed to the main-valve casing so as to flow through the exit-port *o* thereof. Thus when the valve 6 is shifted to slightly uncover the port *n* the direct steam will flow through channel 4 to the low-pressure cylinder *a*, while the exhaust from the smaller engine *b* will be directed through the channel 3 to the port *o* and the exhaust from the low-pressure cylinder *a* passes to the chamber *e*, and thence to the cylinder of the smaller engine, the relatively-restricted size of which prevents any material expansion of the volume of steam from the larger cylinders.

In order to facilitate starting, it is desirable to admit steam directly to the chamber *e*, and for this purpose I provide two ports x x', one arranged to coincide with a port x^2 and the other with a port x^3 in the valve 6 when the latter is thrown to the extreme limit of its movement in either direction preliminary to starting. It is necessary, however, to cut off this communication as soon as the chamber is filled, and in order that this may be done without attention upon the part of the operator I make use of suitable automatic shifting means which shifts the valve from either extreme position, so as to unregister the ports x and x^2 or x' and x^3 as soon as the operating-rope or other valve-shifting means may be released. Thus there may be in the valve-casing 5 two springs 13 13 at opposite ends, so that when the valve is carried to either of its extreme positions it will compress the adjacent spring and on releasing the valve-rope the spring will shift the valve to the extent necessary to carry the ports out of line. Instead of this, the lever 15, connected to the valve-stem 16 and with the hand-rope, may swing between two springs 19 20, either of which will be compressed sufficiently by the swinging of the lever to an extreme in one direction to react and shift the valve to a limited extent.

Any other suitable automatic set-back device acting as above described may be employed with like effect. The valve 6 may have one port x^2 only, which may be brought to connect with either of two ports x x' when said valve is in extreme positions.

Without limiting myself to the precise construction and arrangement of parts shown and described, I claim—

1. In a compound engine, the main and secondary cylinders, reversing-valve to control the flow of motor fluid to and from said cylinders, intermediate chamber, and ports arranged to permit the direct-acting fluid to pass to either cylinder when the engine is moving in either direction, substantially as set forth.

2. The combination, with the cylinders of a compound engine, of passages permitting the exhaust-steam of either engine to flow into the other, valves controlling said passages, and a reversing-valve, substantially as set forth.

3. The combination, in a compound engine, of the cylinders *a b*, intermediate chamber *e*, valves and ports between the valve-chambers and the chamber *e*, and a reversing-valve and ports arranged, substantially as described, between the reversing-valve chamber and the cylinders, chamber *e*, and the exhaust to permit the exhaust of either engine to pass to the other, substantially as set forth.

4. The combination, in a compound engine, of large and small cylinders and pistons, intermediate chamber, and valves and ports constructed and arranged to change the flow of the motor fluid to act directly on either piston and when descending to direct the exhaust from the large cylinder into the small cylinder and intermediate chamber and the exhaust from the small cylinder to the atmosphere, substantially as described.

5. The combination, with the cylinders and pistons of a compound engine, of means for reversing and for admitting the direct-acting motor fluid to the large cylinder to reverse and descend and for compressing the exhaust from the large cylinder into the small cylinder and intermediate spaces, substantially as described.

6. The combination, in a compound engine, of the cylinders, valves, intermediate chamber, reversing-valve, passages x x' between the reversing-valve casing and said chamber,

and a port or ports in the reversing-valve arranged to coincide with one of said passages when the valve is in its extreme position in either direction, substantially as set forth.

7. The combination of the cylinders, intermediate chamber, reversing-valve, ports leading from the valve-chamber to the intermediate chamber and controlled by said valve, and automatic means for setting back the reversing-valve from either extreme position to an extent sufficient to close said ports, substantially as specified.

8. The combination, with the cage of an elevator, of a compound hoisting-engine having a chamber intermediate of the cylinders, a reversing-valve with ports in communication with said chamber when the valve is in its extreme position, valve-shifting means extending to the cage, and automatic valve setback appliances, substantially as described.

9. The combination, in a hoisting apparatus, of a cage or platform and a compound engine provided with channels and ports between the cylinders, reciprocating valves arranged to control said ports to permit the exhaust of either cylinder to pass to the other cylinder, and a reversing-valve and ports and passages, substantially as set forth.

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

RUDOLPH C. SMITH.

Witnesses:
ISAAC B. POTTER,
HUGO HENKEL.