No. 752,720. PATENTED FEB. 23, 1904.

G. F. STEEDMAN.

DIFFERENTIAL AIR PRESSURE ELEVATOR.

APPLICATION FILED DEC. 17, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

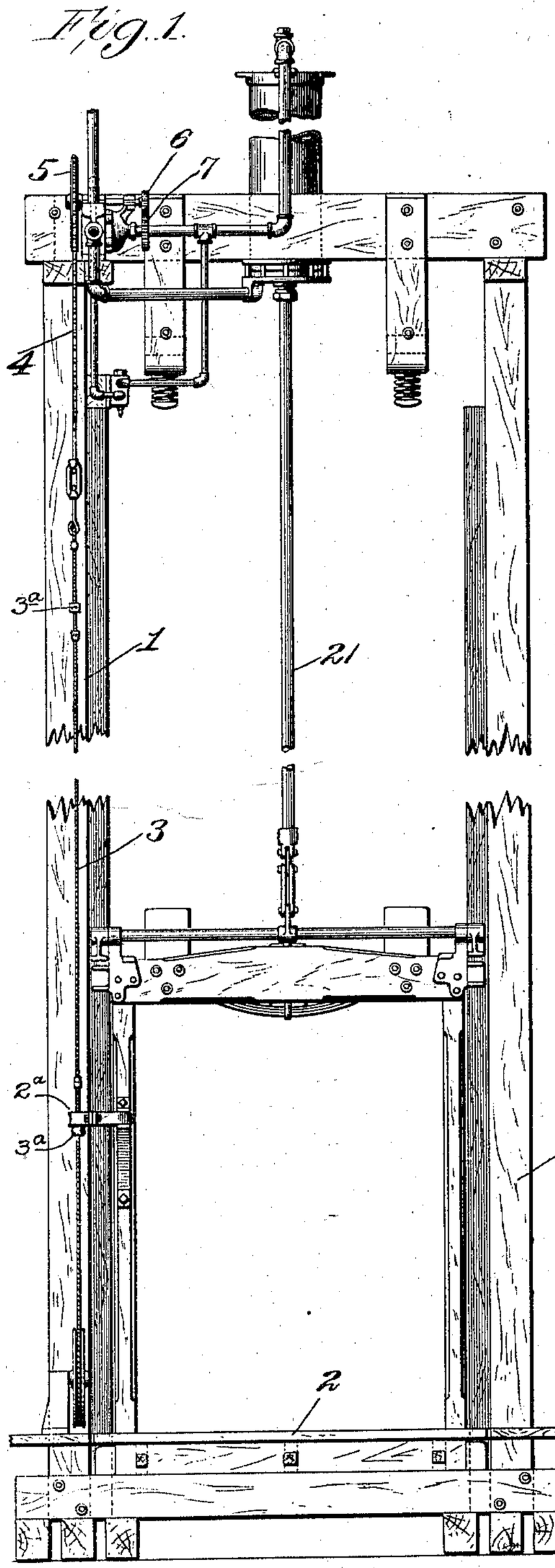
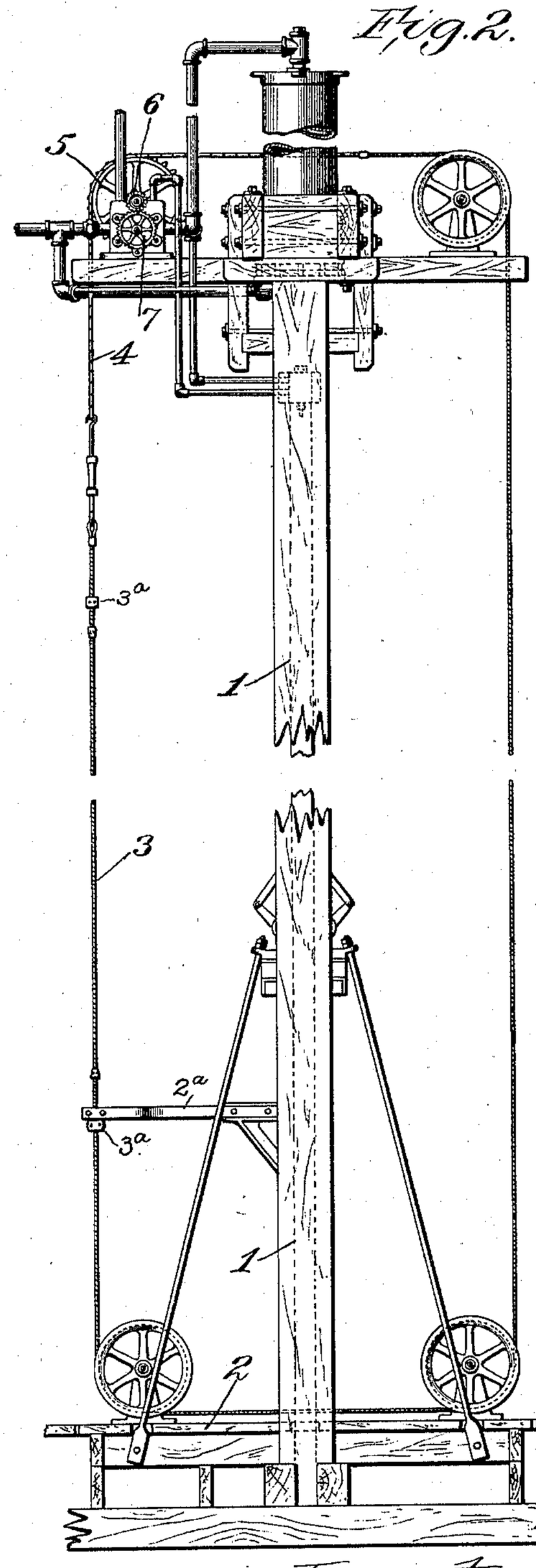


Fig. 2.



Attest.
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George Bakewell

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.

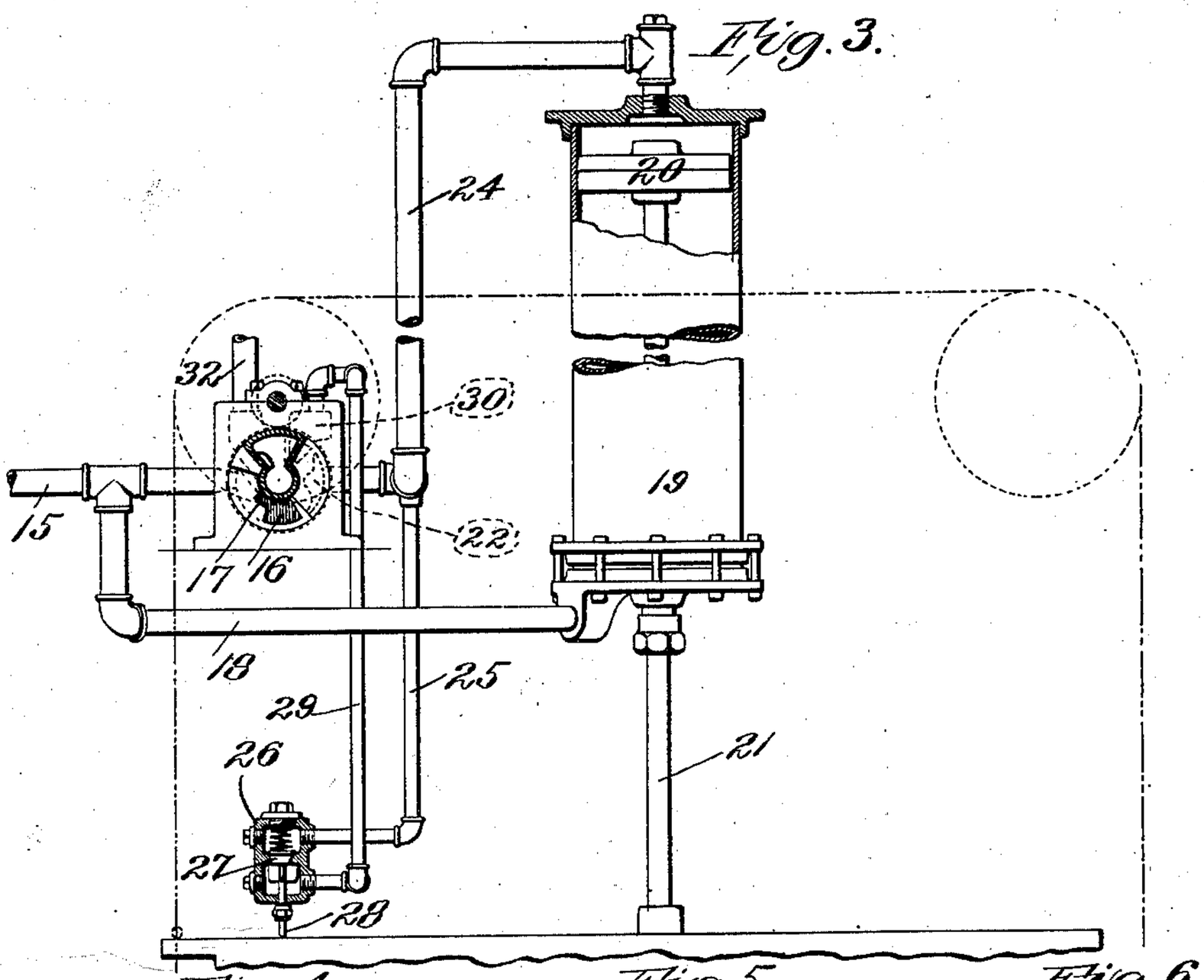
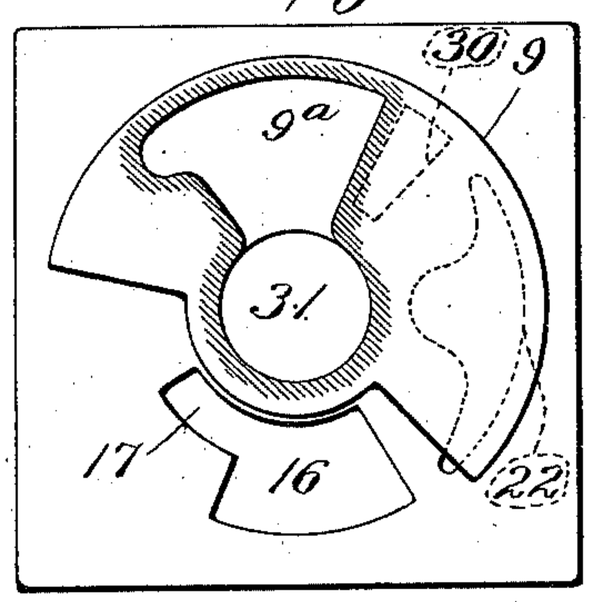
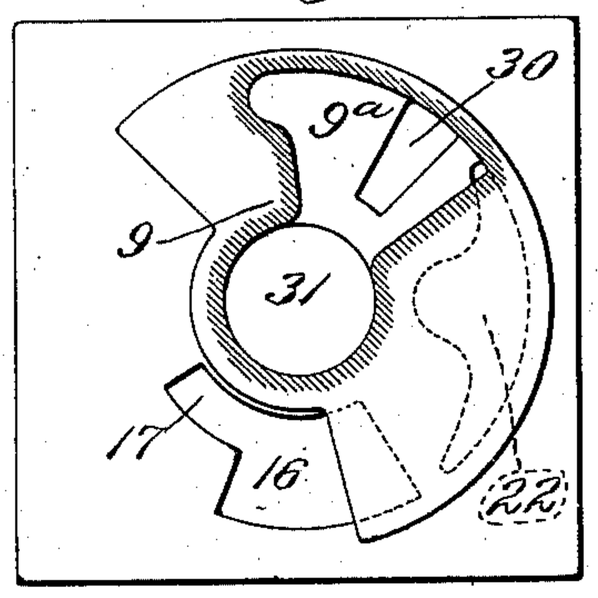


Fig. 4. Fig. 5. Fig. 6.





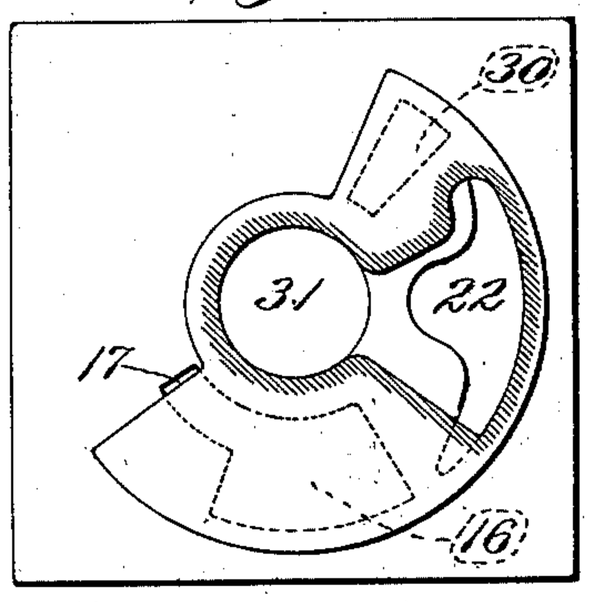


Fig. 7.

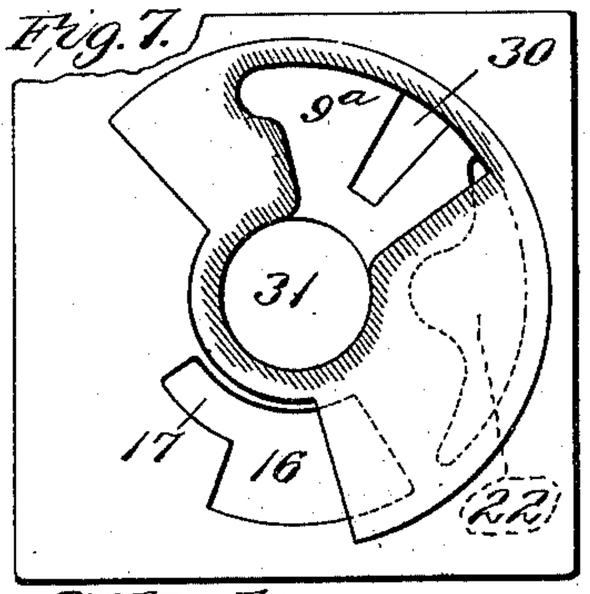


Fig. 8.

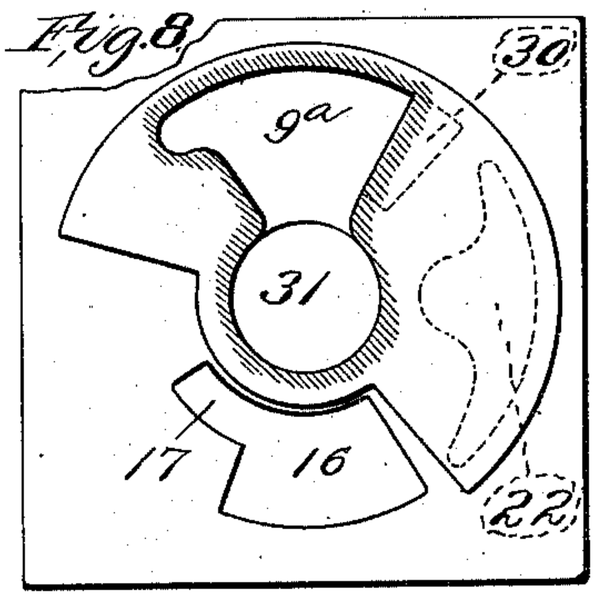
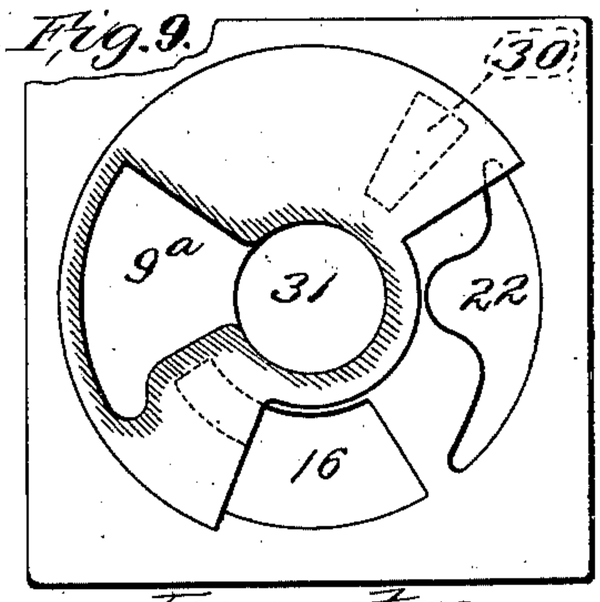


Fig. 9.



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No. 752,720. PATENTED FEB. 23, 1904.

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APPLICATION FILED DEC. 17, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 11.

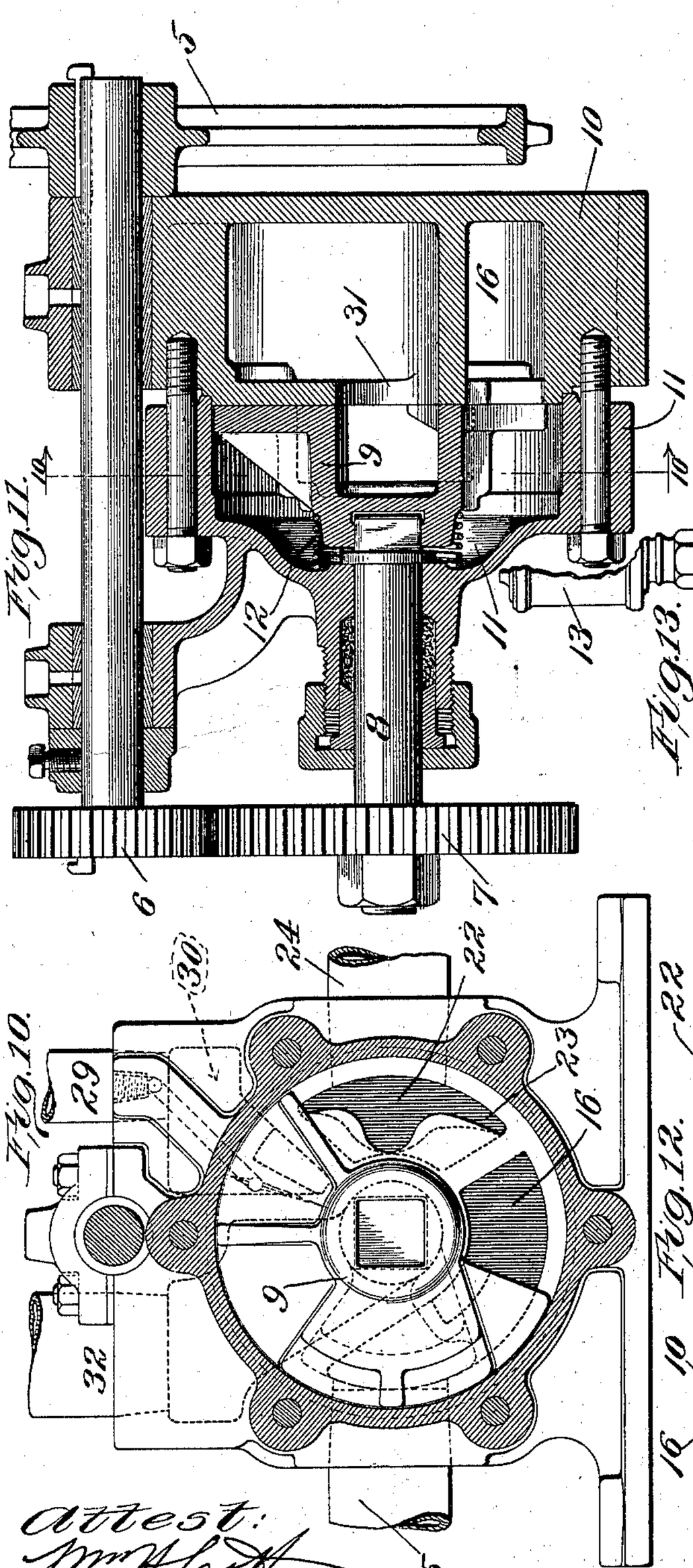


Fig. 14.

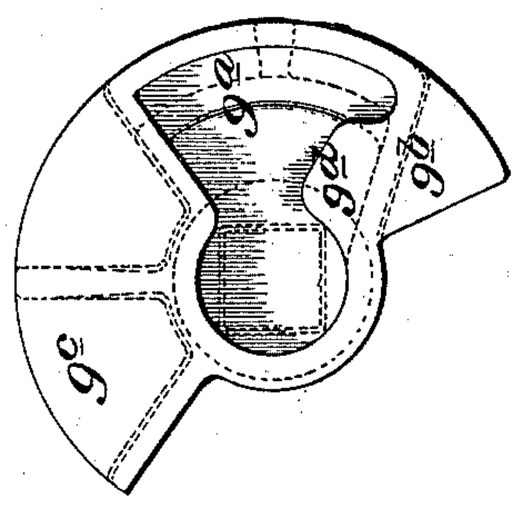


Fig. 13.

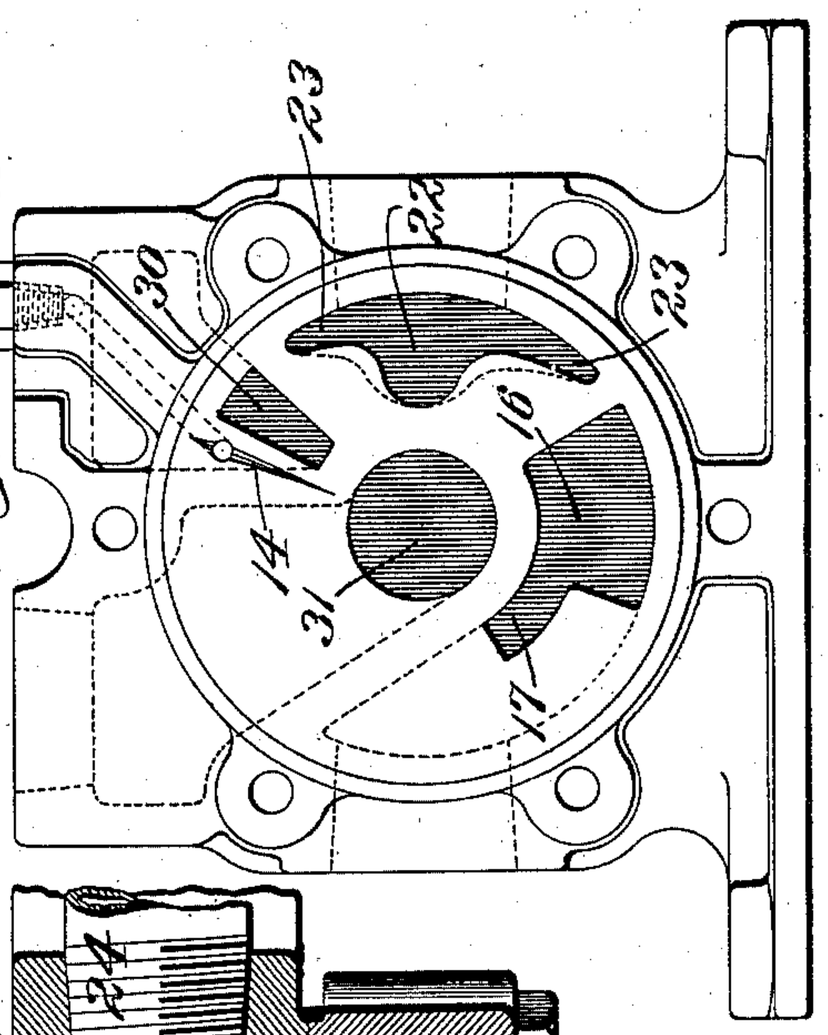
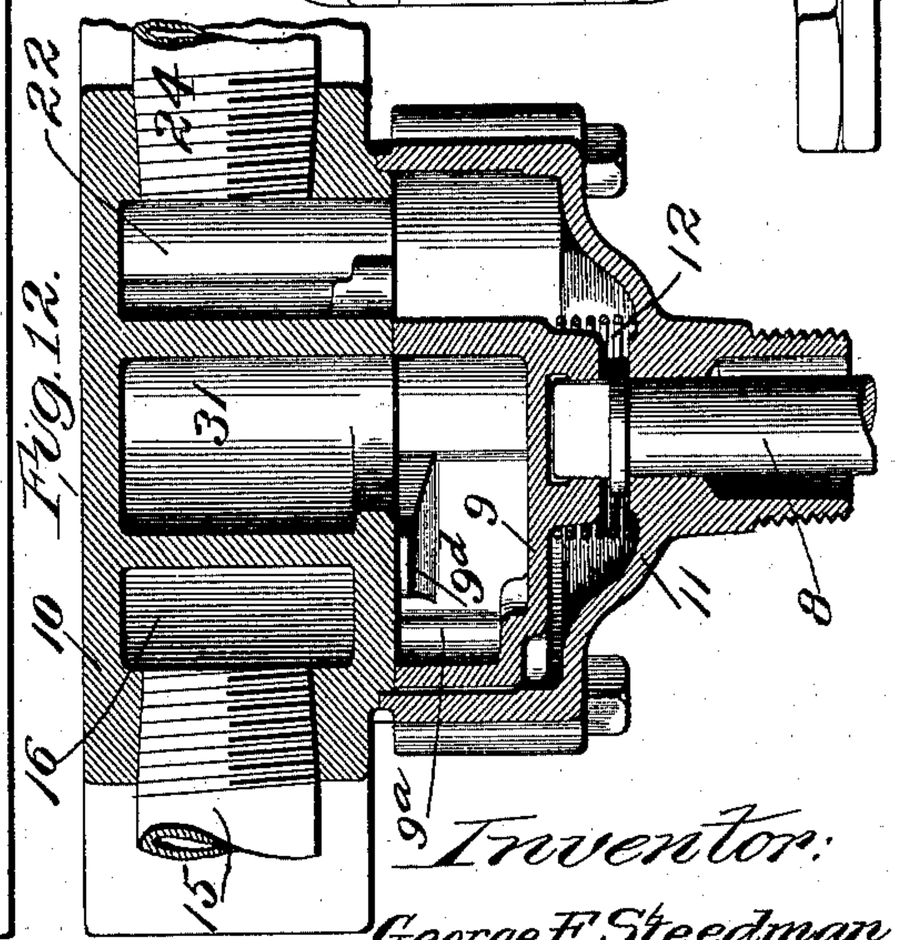


Fig. 10.

Fig. 12.



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No. 752,720. Patented February 23, 1904.

UNITED STATES PATENT OFFICE.

GEORGE F. STEEDMAN, OF ST. LOUIS, MISSOURI.

DIFFERENTIAL AIR-PRESSURE ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 752,720, dated February 23, 1904.

Application filed December 17, 1901. Serial No. 86,261. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. STEEDMAN, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Differential Air-Pressure Elevators, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevational view of my improved balanced air elevator. Fig. 2 is a side elevational view of the same. Fig. 3 is a diagrammatic view of the pipe connections and controlling-valve. Figs. 4 to 9, inclusive, are diagrammatic views of the main controlling-valve, showing the same in different positions. Fig. 10 is a detail view of the main controlling-valve and its casing, the same being taken on line 10 10, Fig. 11. Fig. 11 is a vertical sectional view through said valve and its casing. Fig. 12 is a horizontal sectional view through said valve and its casing. Fig. 13 is a detail view of the valve-block, showing the port arrangements in the valve; and Fig. 14 is an elevational view showing the inner or working plates of the valve.

This invention relates to a new and useful improvement in differential air-pressure elevators of that type wherein the cage or car travels between two landings. This cage or car is designed to be arrested at two landings, making no intermediate stops. This species of elevators is designed particularly for hauling freight and is used largely in factories, warehouses, and the like.

The objects of my present invention are to arrange the cylinder, preferably, above the cage, said cylinder having at all times a maximum supply of pressure under its piston, the main controlling-valve for the space above the piston admitting or exhausting pressure to cause the piston to descend or ascend, as the case may be. The presence of the piston-rod on the under side of the piston, said piston-rod extending through the lower cylinder, makes a difference in the areas of the top and bottom faces of the piston, which difference in area is taken advantage of and utilized in the following manner: The pressure from the source of supply is admitted at all times to the under face of the piston, which has the smaller area available to said pressure, and consequently the maximum pressure is always available for the purpose of lifting a load. The main controlling-valve admits and exhausts pressure to and from the space above the piston, and it follows that where a sufficient amount of pressure is admitted above the piston on account of the greater area of the upper face of the piston the piston will be caused to descend, whereas, on the other hand, if pressure is exhausted from the space above the piston the constant pressure under the piston will preponderate and the piston will be caused to rise. In utilizing this differential air-pressure in elevators I have also provided means whereby the elevator in its lower position will, in addition to the preponderating pressure admitted above the piston, have the benefit of a leakage permitted by the valve, said leakage constantly admitting pressure to the space above the piston, whereby the elevator is held by such preponderating pressure in its lower position. Likewise means are provided whereby when the elevator is in its upper position it is held in said upper position by a constant leakage of the exhaust, which leakage is permitted by the valve, and in addition thereto an auxiliary valve is so arranged that upon reaching its upper position said auxiliary valve is open and remains open while the elevator occupies its upper position, said auxiliary valve establishing free communication between the space above the piston and the exterior.

With these objects in view the invention consists in the construction, arrangement, and combination of the several parts, all as will hereinafter be described and afterward pointed out in the claims.

In the drawings, 1 indicates the framing in which the cage or car 2 travels. This framing guides the cage in its vertical movement, and appropriate safety devices may be employed in connection with the cage whereby if the power mechanism is disarranged said

safety devices become effective. However, as these features form no part of my present invention I will not describe them in detail.

3 indicates a hand-rope, or "tiller-rope," as it is called, which rope is provided with the usual stop-buttons 3^a and preferably has in its length a chain 4, said chain passing over a sprocket-wheel 5. Appropriate sheaves or pulleys are provided for this tiller-rope, as will be readily understood. An arm 2^a, projecting laterally from the car, is so situated as to engage with said buttons 3^a at a point slightly above the lower line of travel thereof and a little below the upper line of such travel.

The shaft of the sprocket-wheel 5 carries a pinion 6, which meshes with a gear 7, fixed to the end of a valve-stem 8. (See Fig. 11.) This valve-stem passes through a suitable packing-gland and has its inner end formed non-circular in cross-section, said non-circular portion being received in a correspondingly-shaped seat in a valve 9. The working face of this valve is seated against the side face of a chambered valve-block 10, to which block is secured a recessed cap 11, forming a valve-chamber for the valve 9. A spring 12 is interposed between cap 11 and valve 9 for the purpose of holding said valve to its seat at all times.

13 indicates an oil-reservoir secured to the valve-block and communicating by a duct or passage with a tapering groove 14, formed in the valve-seat. In this manner the working face of valve 9 is lubricated.

Referring now to Fig. 3, 15 indicates a pipe leading from some suitable source of pressure-supply, preferably in the form of compressed air, said pipe being screwed into the valve-block and admitting pressure into chamber 16 therein. Chamber 16 opens into a chamber containing the valve 9 through a suitable port, said port, as shown in Fig. 13, being formed with a lateral enlargement 17, the purpose of which will hereinafter be explained. 18 indicates a pipe leading from pipe 15 to the lower end of the cylinder 19, whereby pressure-supply is constantly admitted into said cylinder under the piston 20. 21 indicates the piston-rod, which, as shown in Figs. 1 and 2, is connected at its lower end to the elevator car or cage. 22 indicates a chamber in the valve-block, whose port-opening into the valve-chamber is formed with circumferential extensions or leads 23, whereby a graded opening of said port is obtainable. A pipe 24 connects this chamber 22 with the space in cylinder 19 above the piston. 25 indicates a pipe leading from pipe 24 to a valve-casing 26, in which is located a check-valve 27, the stem 28 of said check-valve being arranged in path of the elevator-car and being designed to be struck by said car when in its uppermost position. 29 indicates a pipe leading from the chamber under check-valve 27 to a chamber 30 in the valve-block 10, said chamber 30 having a port opening into the valve-chamber containing the valve 9. The valve 9 referred to consists of a hub portion formed with a non-circular seat in its outer end for receiving the projection on the inner end of the operating-stem 8. This hub is formed with a recess in its inner face, which at all times registers with a centrally-arranged port 31, being the exhaust-port, the exhaust being conducted off through a pipe 32. This central recess in the inner face of the valve 9 has a lateral chamber, (indicated at 9^a,) which lateral chamber is designed in the rotation of the valve to register with the ports of chambers 22 and 30. On each side of this chamber 9^a valve 9 is provided with wings 9^b and 9^c, and in order to prevent the pressure from blowing through the lateral enlargement of the port from chamber 16 I form a wing extension 9^d on said valve, which extension projects into the lateral chamber 9^a.

Referring now to Figs. 4 to 9, inclusive, Fig. 4 indicates the position of the valve when the elevator is at the bottom landing, and in this position it will be observed that pressure is being admitted from the valve-chamber through the lower lead 23 into the space above the piston, so that notwithstanding the fact that pressure is being constantly admitted below the piston through the pipe 18 a preponderating pressure is being admitted above the piston by reason of the communication mentioned. Thus leakage or other causes tending to reduce the pressure above the piston will not affect the position of the elevator, because of this constant supply of pressure to the chamber above the piston.

In Fig. 5 the valve is shown rotated slightly to the right, in which position of the valve pressure has been cut off from the chamber above the piston, and the pressure trapped in said chamber is being permitted to escape back through the pipe 24, the upper lead of chamber 22, and through the lateral chamber 9^a into the exhaust-chamber 31. By having the leads 23 of gradually-increasing areas the position of valve 9 with respect to this graded port can be so adjusted that the amount of pressure admitted to or from the space above the piston through pipe 24 can be regulated to a nicety. In the position of the valve shown in Fig. 5 the port 30 is ineffective by reason of the fact that the elevator is just starting from the bottom landing and the valve 27 is closed.

In Fig. 6 the valve has been rotated farther to the right, so as to fully open the exhaust to the space above the piston, in which position of the valve the elevator will ascend at full speed by reason of the constant pressure under the piston.

In Fig. 7 the valve occupies a position wherein the port of chamber 30 is fully open to the exhaust, and when the elevator reaches the top landing and raises the valve 27 any pressure above the piston will be instantly exhausted

through the pipes 25 29, chamber 30, and exhaust-chamber 31. It will also be noticed in this position of the valve that the upper lead of port 22 is likewise open to the exhaust-port, so that in the event that the elevator was brought to a position of rest before reaching the upper landing and before the valve 27 could be operated the pressure above the piston, if any remained, would leak back through the pipe 24, chamber 22, and the upper lead 23 into the exhaust-chamber. This position of the valve is similar to that shown in Fig. 5, and if the valve remained in the position shown in Fig. 5 the car would travel upwardly at slow speed, and shortly after reaching the upper landing all of the pressure would be exhausted by reason of the slow exhaust.

In practice it has been found that in approaching the upper landing while the auxiliary exhaust-valve 27 will instantly relieve the pressure above the piston and in this manner lock the elevator in its upper position the service-stop, wherein the valve occupies the position shown in Figs. 5 and 7, is ample to hold the elevator at the upper landing without the use of the auxiliary valve if sufficient time is given for the pressure above the piston to escape through this restricted opening. It is estimated that twenty seconds are sufficient for this purpose; but I prefer to use the auxiliary valve in order to suddenly and completely exhaust the pressure above the piston when the elevator reaches the upper landing, because otherwise if the elevator-cage were loaded before the pressure was completely exhausted the load might cause the elevator to drop slightly until it could be recovered by the escape of the pressure from above enabling the constant pressure below to act.

In Fig. 8 I have shown the valve in its lap position. The valve occupies this position temporarily in its reverse rotation necessary to cut off communication with the exhaust-chamber and establish communication between the pressure-chamber and the space above the piston. It follows that if the valve were rotated to the left from the position shown in Fig. 8 to the position shown in Fig. 9 the wing of the valve would first open the lower lead 23, admitting a small amount of pressure above the piston, causing the elevator to descend slowly. An increased area would admit more pressure above the piston, and the elevator would descend with greater speed.

Fig. 9 shows the position of the valve wherein practically the full area of port 23 is rendered available for the admission of pressure to the space above the piston.

As the elevator approaches the bottom landing the tiller-rope should be manipulated to bring it to a service-stop, which means that the valve will occupy the position shown in Fig. 4, in which position leakage of pressure through the valve is permitted to the space above the piston. In approaching the bottom the valve in restricting the available area for the passage of pressure to the space above the piston will cause the cage to slow up by practically trapping the air above the piston, and when the cage has nearly reached the bottom landing the small amount of pressure permitted to leak into the space above the piston will cause the cage to settle quietly down to its landing. This leakage practically locks the cage at the lower landing, and in order to start the elevator up the valve is moved successively to the position shown in Fig. 5 and to the position shown in Fig. 6, if full speed is required, and then back to Fig. 5 upon approaching the upper landing.

The spring 12, hereinbefore mentioned, serves to hold the valve 9 to its seat; but in order to utilize the pressure for this purpose the circumferential enlargement 17 of the port to the live chamber 16 is provided, which enlargement admits pressure into the valve-chamber notwithstanding the fact that the valve may occupy a position of full exhaust, as shown in Fig. 6. Thus the valve is held firmly to its seat by live pressure.

While in the above I have referred to the piston-rod as being directly connected to the cage, it is obvious that the hoisting-cylinder containing the piston and piston-rod may be placed in any convenient position and connected to the cage or car by well-known means, such as ropes passing over sheaves. In the following claims reference to the "inner" side of the piston refers to that side adjacent the piston-rod, and by "outer" side is meant that side remote from the piston-rod.

I am aware that many minor changes in the construction, arrangement, and combination of the several parts of my device can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In an apparatus of the character described, the combination with a car, of a cylinder, a piston and its rod in said cylinder, means for admittting constant pressure under the piston, a valve for admitting and exhausting pressure above the piston, and an auxiliary valve operated by the car for exhausting pressure above the piston; substantially as described.

2. In an apparatus of the character described, the combination with a car, of a cylinder, a piston and piston-rod in said cylinder, the latter being connected to the car, means for constantly admitting pressure under the piston, means for admitting and exhausting pressure above the piston, and means for fully exhausting the pressure above the piston when the car is at its highest point; substantially as described.

3. In an apparatus of the character de-

scribed, the combination with a car, a cylinder, a piston and piston-rod in said cylinder, the latter of which is connected to the car, means for admitting constant pressure under the piston, means for admitting and exhausting pressure above the piston, means for constantly supplying the space above the piston with pressure when the elevator is at its lowermost position and means for fully exhausting the pressure above the piston when the car is at its highest point; substantially as described.

4. In an apparatus of the character described, the combination with a cylinder, its piston and piston-rod, of a passage for constantly admitting pressure under the piston, a valve for admitting and exhausting pressure above the piston, means for moving said valve whereby pressure above the piston is admitted or exhausted, said valve, in one position, when the piston is approaching its highest point in the cylinder, permitting the pressure above the piston to gradually leak past the valve, and an independently-operable valve for quickly exhausting the pressure above the piston; substantially as described.

5. In an apparatus of the character described, the combination with a cylinder, its piston and piston-rod, of a valve for controlling the admission and exhaust of pressure above said piston, said valve comprising a valve-block having pressure-chamber 16, an exhaust-chamber 31, and chambers 22 and 30 in communication with the space above the piston, of a rotary wing-valve having a recess in constant communication with the exhaust-chamber, said wing-valve controlling the ports to chambers 22 and 30, the port to chamber 16 being constantly open, and an auxiliary valve for controlling the opening between the space above the piston and chamber 30; substantially as described.

6. In an apparatus of the character described, the combination with a cylinder, its piston and piston-rod, of a valve for controlling the admission and exhaust of pressure above said piston, said valve comprising a valve-block having a pressure-chamber 16, said pressure-chamber having a lateral lead 17, a chamber 22 in communication with the space above the piston, an exhaust-chamber 31, of a rotary wing-valve having a recess constantly open to said exhaust-chamber for controlling the port to chamber 22, said valve being provided with a projection 9^{d} for closing the lead 17 in certainpositions of the valve; substantially as described.

7. The combination with an elevator-cage, of a hoisting-cylinder, its piston and piston-rod, the latter being connected to the cage, a source of compressed-air supply connected with the space on the under side of the piston for constantly supplying pressure thereto, a port 22 leading to the space above the piston, said port 22 having leads at its sides, a valve coöperating with said port 22 and its leads for admitting and exhausting pressure to the space above the piston, a hand-rope for operating said valve so as to leave one or the other of said leads open at each extremity of movement of the valve, an auxiliary valve for quickly exhausting the air from the space above the piston, when the cage reaches its upper limit of travel, and means on the cage for operating said auxiliary valve; substantially as described.

8. In an elevator mechanism or the like, the combination with an elevator-cage, of a hoisting-cylinder and its piston and piston-rod, said cylinder having a port, a valve arranged to admit and exhaust pressure through said port to and from said cylinder, a hand-rope for operating said valve, means on the hand-rope coöperating with the cage to partially close the said port as the cage reaches its upper limit, means on said hand-rope also cooperating with said cage to partially close the said port as the cage reaches its lower limit, and an auxiliary valve for exhausting the air from the upper portion of said cylinder for locking said cage at its upper limit of travel, said auxiliary valve being operated by the movement of the cage; substantially as described.

9. In an elevator mechanism or the like, the combination with an elevator-cage, of a hoisting-cylinder and its piston and piston-rod, said cylinder having a port, a valve for admitting and exhausting pressure through said port to and from said cylinder, a hand-rope for operating said valve, an arm on the cage, a button on the hand-rope coöperating with said arm to operate the valve to partially close said port as the cage reaches its upper limit, a second button on the hand-rope coöperating with the said arm on the cage and arranged to operate the valve to partially close the said port as the cage approaches its lower limit, and an auxiliary valve for exhausting air from the upper portion of said cylinder for locking said cage at its upper limit of travel, said auxiliary valve being operated by the movement of the cage; substantially as described.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 5th day of December, 1901.

GEORGE F. STEEDMAN.

Witnesses:
GEORGE BAKEWELL,
RALPH KALISH.