Aug. 9, 1932.

E. E. ARNOLD

1,870,827

BUFFER

Filed July 30, 1930

2 Sheets-Sheet 1

Fig. 2.

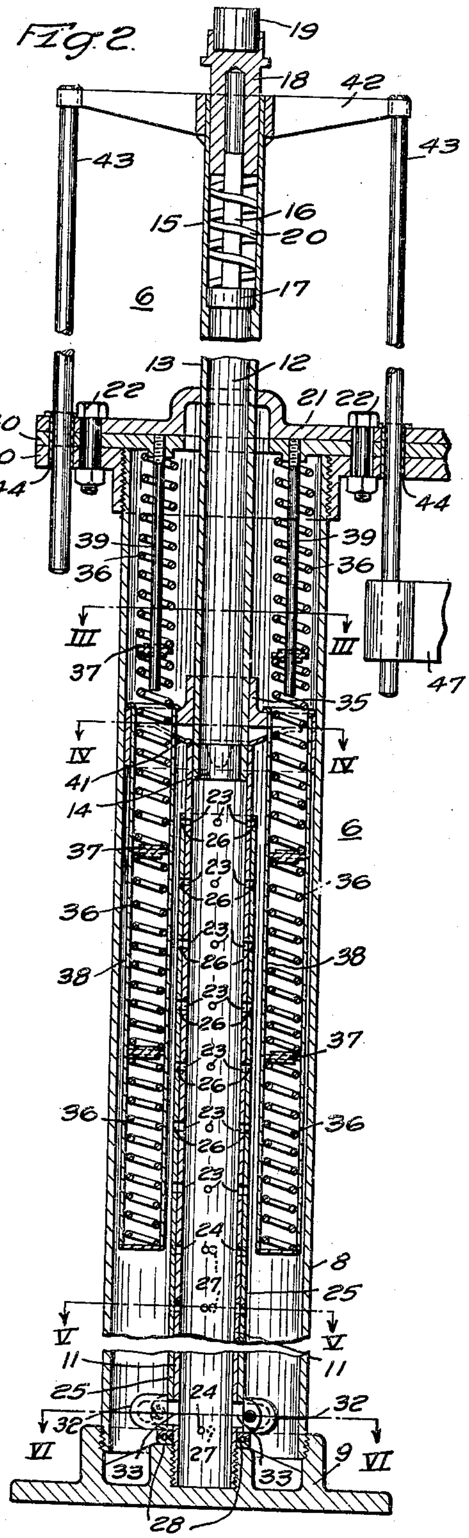
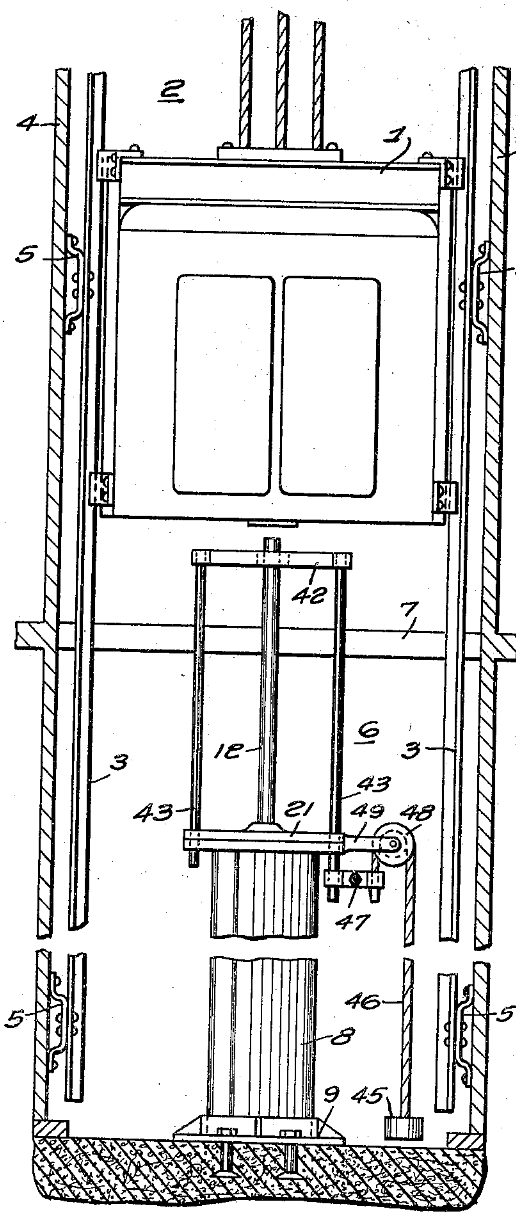


Fig. 1.



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BUFFER

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Fig. 3.

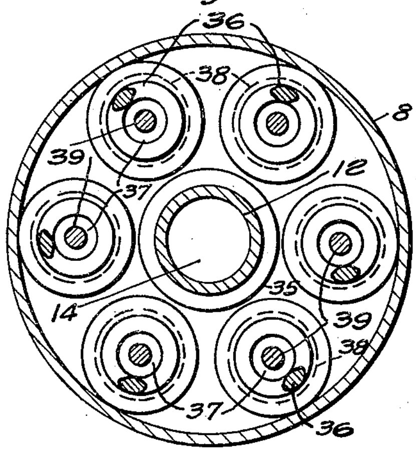


Fig. 4.

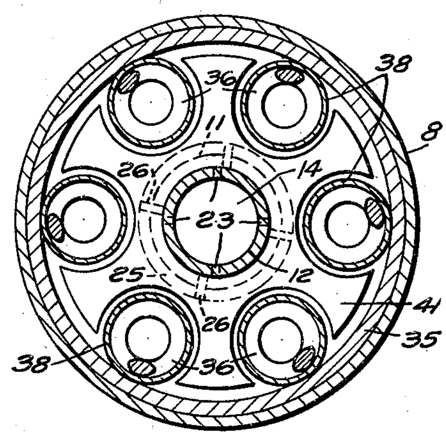


Fig. 5.

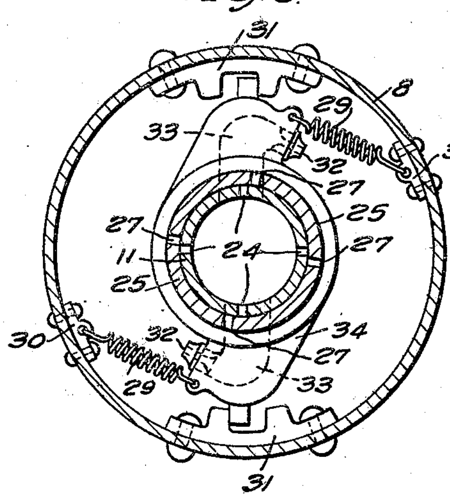
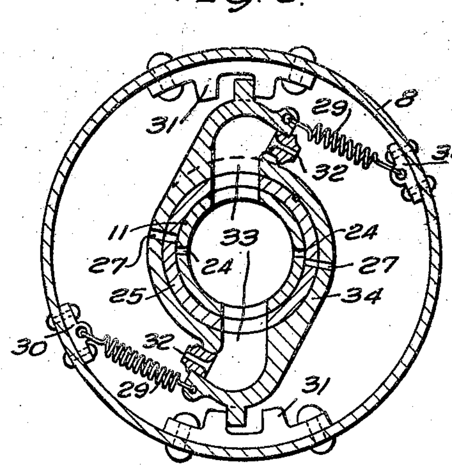


Fig. 6.



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UNITED STATES PATENT OFFICE

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BUFFER

Application filed July 30, 1930. Serial No. 471,636.

My invention relates to shock-absorbing cushions for vehicles and has particular relation to cushions or buffers for elevator cars.

With the advent of the modern high-speed elevator, operating at speeds over 600 ft. per minute and up to 1000 ft. per minute or even more, the stopping of the elevator car at the lower terminal, in the event of overrun, presents new problems in elevator safety mechanisms.

It has long been the practice to provide a retarding buffer in the elevator pit below the terminal landing for the purpose of safely, and even comfortably, stopping the elevator car in the event that it should overrun the terminal landing by reason of faulty electrical control, or by reason of some mechanical derangement of the elevator system.

With low-speed cars, such as have been used in the past, the buffer was required to stop the car comfortably, only from a relatively low speed, such as was not greatly in excess of the normal running speed of, say, 600 ft. per minute, and, for this reason, such buffers could be successfully operated with relatively short strokes. That is, a buffer having a stroke range from 3 to 6 feet was ample for absorbing the impact of the elevator car and for decelerating it to a stop, without discomfort to the passengers.

However, with the heavy mass of the elevator car operating at higher speeds, the retarding force required must be proportionately greater, and, for this purpose, the buffer must be provided with a sufficiently long stroke to absorb the kinetic energy stored in the rapidly moving car at a rate that will be safe for both car and passengers.

It has been the practice in the prior art to so locate the buffer in the pit that its uppermost end is at some distance below the level of the terminal floor, whereby the buffer acts only after the car passes the lower terminal-floor level. With the long stroke buffer, however, such arrangement would necessitate a pit of such extreme depth that it would be impracticable and sometimes impossible to provide the necessary space below the terminal floor in which to locate the buffer.

On the other hand, a buffer, designed to stop an elevator car moving at an impact speed of a relatively high value, would exert an initial retarding force too great to allow the upper end of the buffer to be so located that the car would strike it before arriving level with the terminal floor, if it were desired to utilize such location of the buffer in an effort to reduce the extreme pit depth which otherwise would be required.

However, I propose to utilize a buffer that is capable of retarding the elevator car from a relatively high speed within a reasonably short distance and which may extend above the lower terminal-floor level. To this end, I provide a buffer with a variable retarding effect, the variation being dependent upon the speed of the car at the time it engages the buffer.

With this construction, the buffer may be normally disposed in such position as to allow it to be engaged by the car before the car reaches the level of the floor at the lower terminal. Furthermore, the buffer, when in this position, may be utilized to aid the usual electrical braking in stopping the car at the terminal-floor landing.

To accomplish this result, I propose to utilize a fluid-equipped buffer of relatively long stroke having a plurality of sets of fluid-escapement ports, one set of which is designed to gently retard the car, and the other sets of which are designed to produce an augmented retarding effect, the various sets of ports being selectively rendered effective in accordance with the pressure built up in the buffer upon impact of the car thereon.

It is, therefore, an object of my invention to provide a retarder or buffer for an elevator car wherein the retarding force shall be automatically suited to the speed of the retarded car.

It is a still further object of my invention to provide a buffer that shall be effective for stopping a body traveling at normal speed and additionally effective for stopping a body traveling at an excessive rate of speed.

It is a still further object of my invention to provide, in a buffer, a retrieving mechanism for restoring the buffer to its operating position, wherein the retrieving device will move through a short distance in order to retrieve the buffer through a comparatively long distance.

Other objects of my invention will appear from consideration of the detailed description which follows.

My invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view, partly in section and partly in front elevation, of an elevator installation embodying my invention.

Fig. 2 is an enlarged view, in vertical section, of the buffer shown in Fig. 1.

Fig. 3 is an enlarged horizontal sectional view of the buffer, taken on line III—III of Fig. 2, and shows the retrieving springs.

Fig. 4 is an enlarged horizontal sectional view of the buffer shown in Fig. 2, taken on line IV—IV of Fig. 2, and shows the retrieving piston and the relation of the ports in the upper cylinder section.

Fig. 5 is an enlarged horizontal sectional view of the buffer shown in Fig. 2, taken along line V—V of Fig. 2, and shows the arrangements of the ports and valves in the lower cylinder section.

Fig. 6 is an enlarged horizontal sectional view of the buffer shown in Fig. 2, taken on line VI—VI of Fig. 2, showing the arrangement of the valve-operating nozzles.

The apparatus shown in Fig. 1 comprises an elevator car 1 movably mounted in a hatchway 2 on vertical guide rails 3. The guide rails 3 may be attached, in any suitable manner, to the elevator hatchway walls 4, as by a plurality of brackets 5 which may be riveted to the guide rails.

At the bottom of the hatchway 2, a buffer 6 is shown as having a plunger that extends above a terminal floor 7 for retarding the elevator car as it approaches the terminal-floor level.

Referring now to Fig. 2, the buffer comprises an outer cylindrical casing 8 attached to a base plate 9 and a top flange 10 by any suitable means, such as screw threads. A cylinder 11, which is inserted in the casing 8, also attached to the base plate 9 by suitable means, such as screw threads, and is adapted to slidably receive a plunger 12.

Any suitable construction may be utilized for the plunger, the construction I have illustrated comprising a tube 13 that is closed at its lower end by a plug 14 welded or otherwise affixed to the tube 13 in a leak proof manner. A recessed portion 15 is provided in the upper end of the tube 13 into which is fitted a shaft 16 having a plug base 17. An annular member 18 is slidably fitted into the recessed portion 15 and over the shaft 16, this member being provided with a hollow head for receiving a rubber pad 19. A spring 20 is interposed between the plug base 17 and the member 18, thereby constituting an auxiliary cushion within the plunger. A cover 21, which slidably engages the plunger 12, is removably attached to the flange 10 by bolts 22.

The cylinder 11 and the casing 8 are designed to contain a relatively non-compressible fluid, such as oil, which may pass from the cylinder to the casing through a plurality of sets of ports provided in the cylinder 11. The set of ports in the upper portion of the cylinder 11 is designated by the reference character 23, and the ports in this set are spaced throughout a predetermined length of the upper end of the cylinder. Another group of ports 24 is similarly disposed in the lower portion of the cylinder 11. As the plunger descends, following the impact of the elevator car, fluid is forced from the cylinder 11 through the restricted openings provided by the ports, and the resistance offered by the ports to the escaping fluid results in deceleration of the car.

The construction described thus far is typical of the old and well-known buffers which have been employed to stop a car at the end of its travel. However, the use of such a buffer to stop a heavy car from a high speed would require a length of stroke which is prohibitive, especially if the upper end of the buffer is to be located below the terminal floor.

Referring again to Fig. 1, it will be observed that my improved buffer is illustrated as having its upper end extending somewhat above the terminal-floor level 7, so that it will engage the car above the terminal floor, irrespective of the speed of approach. When the car strikes the buffer, at its normal slow speed, upon approaching the lower floor, the buffer will apply only such retardation as will aid the usual braking equipment in bringing the car gently to rest at the lower-terminal floor.

To accomplish this purpose, I provide means for normally closing all of the ports in the lower portion of the cylinder, while leaving the upper set of ports open, thereby making the buffer, in effect, a short-stroke buffer in which the stroke extends only the length of the cylinder containing the upper set of enclosed ports.

By referring to Fig. 2, it will be observed that a valve cylinder 25 surrounds the cylinder 11 and is provided with sets of ports 26 arranged similarly to those in the cylinder 11. However, the upper set of ports in the cylinder 25 are arranged to be normally in registration with the upper set of ports 23 in the cylinder 11 while the lower set of ports 27 in the valve cylinder 25 are arranged to be normally out of registration with the lower set of ports 24 in the cylinder 11. The cylinder 25 is disposed to be rotatable about the cylinder 11 upon suitable bearings 28 but is biased toward a normal position wherein the above described registration of ports is effected. This normal position is maintained by means of suitable springs 29 connecting the cylinder 25 to projecting lugs 30 secured to the casing wall (see Figs. 5 and 6). Suitable stop members 31 may be provided to limit the extent of the rotary movement of the cylinder.

With the cylinder 25 in its normal position, the buffer will act as the usual short-stroke buffer, its effect being determined by selection of the number of ports in the upper end of the cylinder 11 to cause the car, when approaching the terminal floor, to be gently decelerated to a stop at the floor level. The effect of the buffer, under the slow-speed condition, is merely to aid the electrical and mechanical braking devices usually provided for stopping the car.

However, if the car approaches the terminal floor at a high speed, by reason of failure of the control devices to exert their usual decelerating effects, or because of any other failure of the usual devices for slowing down, the car will strike the buffer at a high speed. Therefore, I provide for causing the buffer, when it is struck by the car at a high speed, to act through its full stroke and apply such retardation to the car as will stop it before it hits the bottom of the shaft.

For this purpose, I provide the lower end of the cylinder 25 with two nozzles 32, the openings of the nozzles being in communication with continuous passages 33 through the walls of the two cylinders 11 and 25. The nozzles 32 are attached to a supporting member in any suitable manner, as by welding, and the member, in turn, is keyed or otherwise affixed to the cylinder 25. The nozzles are so arranged that any flow of fluid through them, from the cylinder 11 to the casing 8, produces a reaction tending to rotate the cylinder 25 in such direction as to bring the lower sets of ports 24 and 27 into registration and to turn the upper ports 23 and 26 out of registration. Springs 29 resist this rotation, and the stops 31 limit it to just the amount necessary to cause registration of the sets of ports.

As stated above, the valve cylinder 25 is provided with two sets of ports, the lower set 27 being normally out of alignment with the ports 24, and the upper set 26 being normally in alignment with the ports 23. When the jet reactions at the nozzles rotate the cylinder 25, the lower valve ports 27 are brought into registration with the corresponding ports 24, and the upper ports 26 are turned out of registration with the corresponding ports 23. The upper ports 23 and 26 have larger areas than the lower ports 24 and 27, and, when in registration, offer a relatively low resistance to descent of the plunger 12. The lower sets of ports 24 and 27, being of relatively small area, offer a relatively high resistance to the plunger descent when they are in their operative positions.

The recovery of the buffer after an operation is accomplished by a retrieving mechanism associated with a floating piston 35 which forms a snug, slidable union with the plunger 12 and the casing 8. Nests of springs 36, spaced by loose ferrules 37, are arranged to resist upward motion of the piston 35 and are partially contained in a plurality of cups 38, the cups being attached, in any suitable manner, to the piston 35 to form a leak-proof connection therewith. A plurality of rods 39 depend from an annular plate 40 interposed between the cover 21 and the flange 10. These rods are in alignment with the cups 38 and serve as guides for the springs. A serrated spring disk 41, which rests upon the upper end of the cylinder 11, serves as a limit stop to the downward motion of the piston 35. The cups 38 permit a long spring section to be employed, with no increase in buffer length.

The piston 35 and the plunger 12 act as differential pistons separated by a body of fluid. When the plunger descends, it forces fluid from the cylinder 11, thereby raising the piston 35 and compressing the springs 36. Because of the difference in areas, the piston moves a relatively short distance, as compared with the plunger motion. When the load is removed from the plunger, the springs force the piston 35 to its normal position, thereby returning the fluid into the cylinder 11 through the nozzle passages 33, and raising the plunger 12 to its initial position. This short-stroke retriever is, therefore, compact and efficient.

It may sometimes be desirable to supplement the above-described retrieving mechanism in order to compensate for leakage of fluid past the piston 35. An auxiliary retriever that may be employed for this purpose is shown in Fig. 1 and comprises a counterweight 45 which is attached to one end of a flexible cable 46, the other end of which passes over a sheave 48 and is secured, by a clamp 47, to the lower end of one of a pair of rods 43. The rods 43 are slidably mounted in bushings 44 and their upper ends are firmly attached to opposite ends of a yoke or crossbar 42 that is attached to the upper end of the plunger 12. The counterweight 45, therefore, serves to maintain the plunger 12 in its extended position.

This counterweight is not essential to the working of the buffer but is merely shown as an extra means to insure the full retrieving of the plunger, which may or may not be used in practice.

The operation of the above described apparatus may be set forth as follows: The elevator, in its normal descent, engages the plunger 12 at a low speed. The plunger is carried down with the car, developing a pressure within the cylinder 11 which forces fluid through the nozzles 32. Since the speed of the car, during its normal descent, is low, the jet reactions do not attain the magnitudes necessary to rotate the cylinder 25. Therefore, the fluid will be discharged from the cylinder 11 through the large-area ports 23 and 26, resulting in the application of a low order of deceleration to the car. The fluid displaced from the cylinder 11 raises the piston 35, thereby compressing the springs 36. When the car ascends, the plunger load is removed, and the springs 36 move the piston 35 downward to displace fluid from the casing 8 into the cylinder 11 by way of the nozzle passages 33 and thereby restore the plunger 12 to its normal position.

If, however, the car, in its descent, engages the plunger while traveling at an excessive speed, such as that due to failure of the control mechanism, a high pressure will be generated in the cylinder 11 by the rapidly descending plunger. This pressure displaces fluid through the nozzles 32 at such velocity as to develop a large jet reaction which suffices to rotate the cylinder 25, thereby closing the upper large-area ports 23 and opening the lower small-area ports 24. The jet discharges through the nozzles 32 against a high back pressure caused by the force exerted by the piston 35 upon the fluid within the casing 8. This back pressure promotes positive action of the rotating nozzles.

Since fluid, escaping through the cylinder 11, must now pass through a restricted area, the resistance offered to the plunger during its descent is relatively high. The buffer, therefore, rapidly decelerates the car to bring it to a complete stop within a reasonably short distance. The plunger is retrieved in the manner described above.

The areas and spacings of the various sets of ports may be arranged to satisfy the particular requirements of each elevator installation. The nozzles and biasing springs may be designed to alter the effective port area for any predetermined value of car-impact speed, which may serve as a criterion of the pressure developed within the buffer. Therefore, a single buffer structure may be utilized for different installations by making minor changes in the above details.

My invention, therefore, is a marked improvement in the buffer art. A buffer designed in accordance with the preceding disclosure is an extremely flexible unit, offering a low order of deceleration to a slowly moving elevator car and a high rate of deceleration to a rapidly moving car. The above construction permits the buffer to be utilized as an aid for normal car braking, with its upper end located well above the terminal floor and, nevertheless, brings a rapidly moving car to rest within a short distance. The short maximum stroke of the buffer coupled with the location of the buffer head above the terminal floor decreases the depth requirement of elevator shaft pits, with the attending construction difficulties. Finally, the gentle initial retardation of the car promotes longevity of the apparatus and comfort of the passengers.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. A retarder for an elevator car comprising a plurality of retarding sections and speed responsive means for selectively rendering each of said sections operative for a predetermined speed range of the elevator car during its period of retardation.

2. A retarder for an elevator car comprising fluid means for opposing motion of said car and means for varying the opposing force exerted by said fluid means, said last named means being responsive to the speed of said car during the period of retardation.

3. A retarder for a moving body comprising a plunger, a cylinder within which said plunger operates, a casing surrounding said cylinder, a fluid disposed within said casing and said cylinder, a plurality of ports in the wall of said cylinder for permitting fluid flow between the cylinder and the casing resulting from the pressure due to displacement of said plunger and means responsive to the fluid pressure in said cylinder for varying the effective area of said ports.

4. In a retarder for a moving body, a plunger, a cylinder within which said plunger operates, a casing surrounding said cylinder, a fluid disposed within said casing and said cylinder, a plurality of ports in the wall of said cylinder for permitting fluid flow between the cylinder and the casing resulting from pressure due to displacement of said plunger, and means for varying the port area between said cylinder and said casing responsive to the reaction caused by pressure difference between the fluid in the cylinder and the fluid in the casing.

5. A retarder for a moving body comprising a plunger, a cylinder within which said plunger operates, a valve cylinder rotatively disposed about said plunger cylinder, a casing surrounding said cylinders, a fluid disposed within said casing and said plunger cylinder, a plurality of ports in the walls of said two cylinders, one set of ports normally permitting fluid flow between said plunger cylinder and the casing resulting from pressure due to displacement of said plunger, and means responsive to the fluid pressure in said inner cylinder for rotating said outer cylinder, thereby transferring the fluid flow to another of the sets of ports in said two cylinders.

6. A retarder for an elevator car compris-

ing a cylinder provided with ports, a piston slidable in said cylinder, a casing for said cylinder, a fluid disposed within said cylinder and said casing, a sleeve-valve rotatably disposed with respect to said cylinder for varying the effective area of said ports, a plurality of nozzles on said sleeve-valve, and means for passing fluid from said cylinder through said nozzles to provide fluid jets, whereby the reaction of said jets on fluid in said casing tends to rotate said sleeve-valve.

7. A retarder for an elevator car comprising a plunger, a cylinder within which said plunger operates, a valve cylinder rotatively disposed about a portion of said plunger cylinder, a casing for said cylinders, a fluid disposed within said casing and said plunger cylinder, a plurality of ports in the walls of said two cylinders for permitting fluid flow between said inner cylinder and the casing when said plunger is displaced, nozzles attached tangentially to said valve cylinder, passages for permitting fluid flow through the nozzles between said casing and the plunger cylinder, a spring for regulating the rotation of said valve cylinder, stops for limiting the rotation of said valve cylinder, and means for normally maintaining said plunger at one end of said inner cylinder.

8. A retriever for an elevator buffer comprising a fluid, means responsive to buffer motion for displacing the fluid surface, a piston adapted to float on the surface of said fluid and resilient means for forcing said piston against said fluid surface upon displacement of said surface.

9. In a retarder for elevators, a plunger, a piston, said piston having a cross-section greater than that of the plunger, a fluid disposed between said piston and said plunger, and resilient means for causing said piston to compress said fluid, whereby said plunger tends to maintain a predetermined position.

10. In a retarder for an elevator car, cushioning means adapted to be displaced by said car, and means for returning said cushioning means to their initial positions, said returning means requiring a smaller movement than that of said cushioning means.

11. In a retarder for an elevator car, a plunger adapted to be moved by said car, a fluid adapted to be displaced by said plunger, a piston, said piston having a cross-section greater than that of the plunger and movable in response to the displacement of said fluid, and resilient means for opposing the movement of said piston by said fluid, whereby said piston tends to maintain said plunger in its initial position.

12. A retarder for an elevator car comprising a plunger, a cylinder within which said plunger operates, a casing surrounding said cylinder, a fluid disposed within the casing and the cylinder, a plurality of sets of ports in the wall of said cylinder for permitting fluid flow between the cylinder and casing resulting from the pressure due to displacement of the plunger, and means responsive to the fluid pressure in said cylinder for placing a selected set of ports in an operative position for a predetermined speed range of the elevator car during its period of retardation.

13. A retarder for an elevator car comprising a plunger, a cylinder within which said plunger operates, a fluid disposed within said cylinder for resisting motion of said plunger, a set of ports in the wall of said cylinder having a large area, a set of ports in the wall of said cylinder having a relatively small area, means for opening said first named set of ports during retardation at low car speeds, and means opposing said first means for closing said first named set of ports and opening the second named set of ports during high car speeds.

In testimony whereof, I have hereunto subscribed my name this 26th day of July 1930.

EDWIN E. ARNOLD.