(No Model.)

3 Sheets—Sheet 1.

R. M. CURTISS.

SAFETY DEVICE FOR ELEVATORS.

No. 324,751. Patented Aug. 18, 1885.

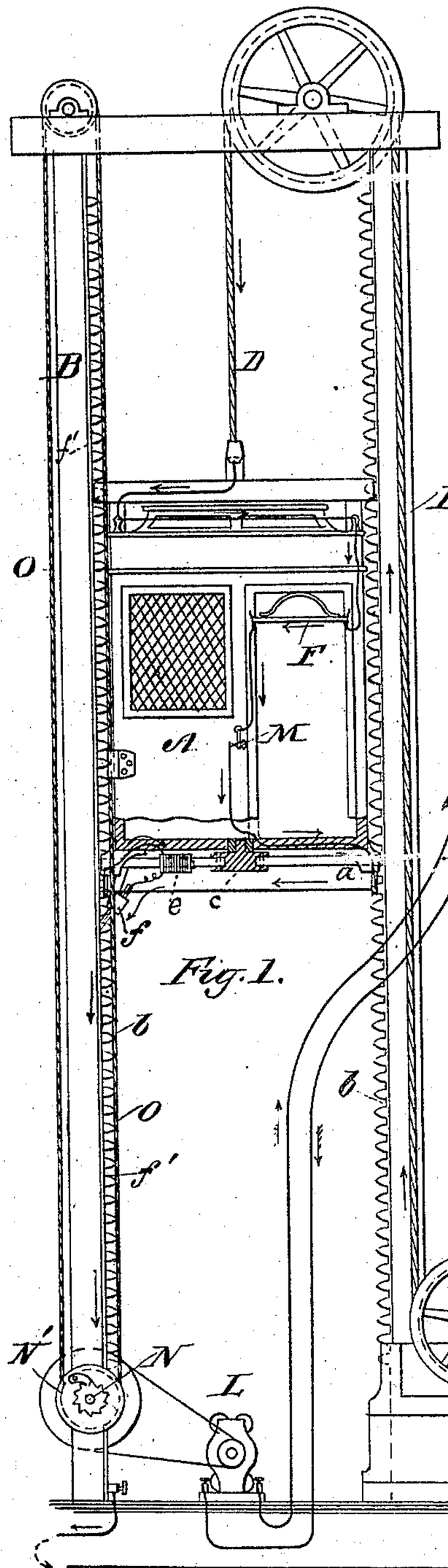


Fig. 1.

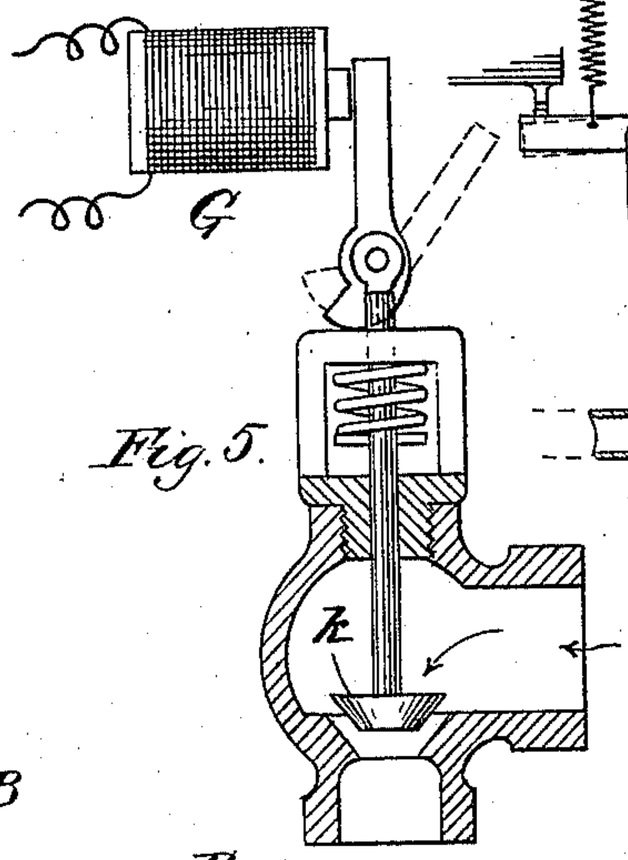


Fig. 5.

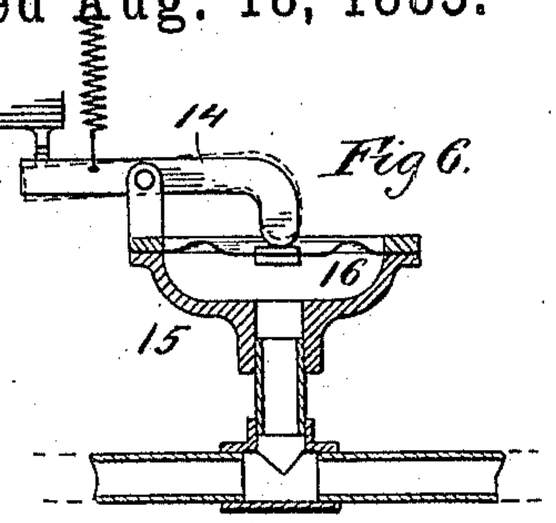
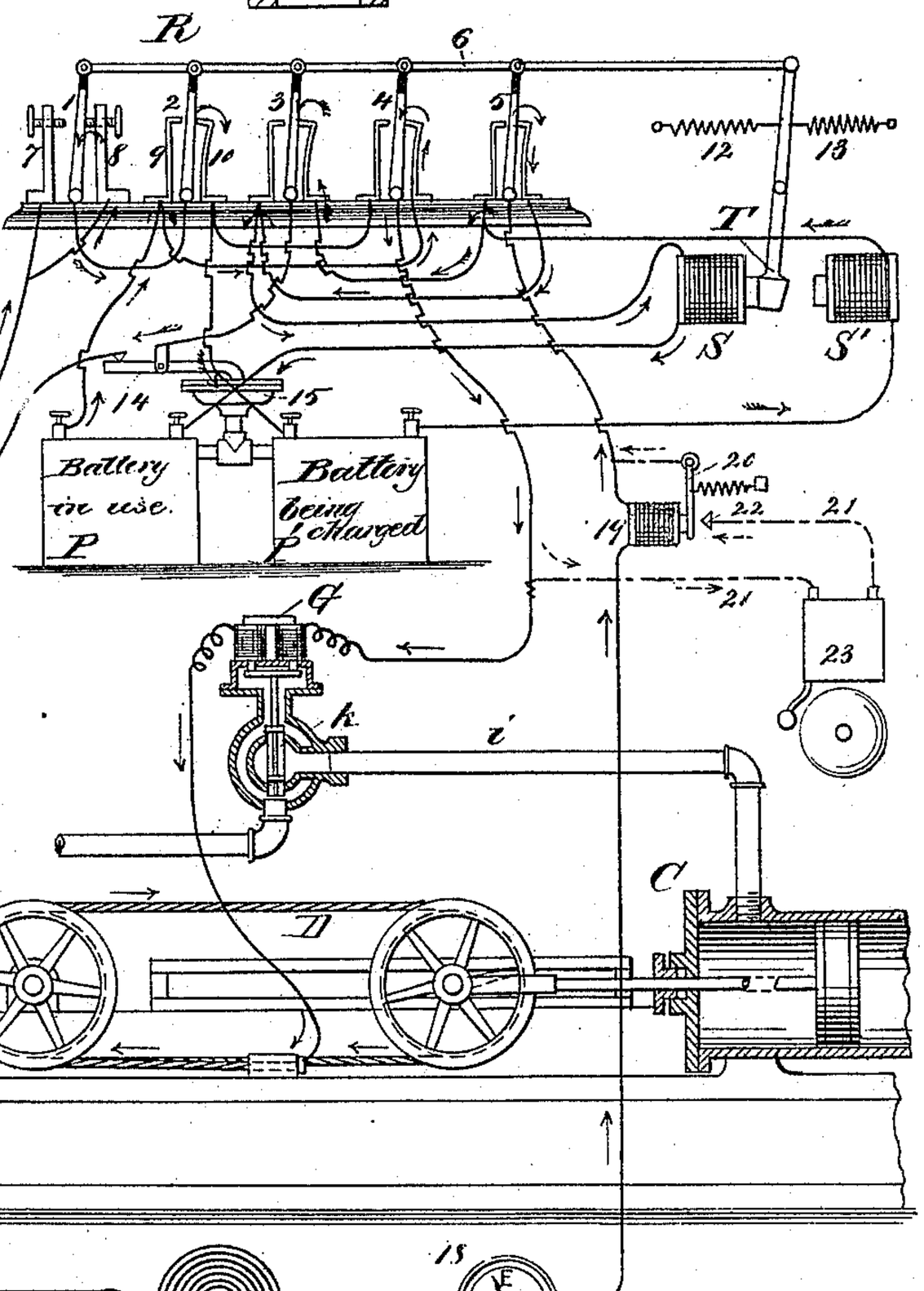
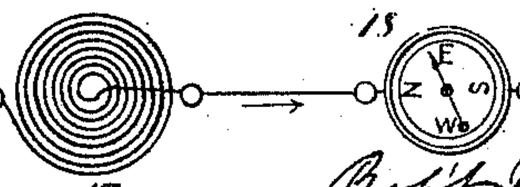


Fig 6.





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(No Model.) 3 Sheets—Sheet 2.

R. M. CURTISS.

SAFETY DEVICE FOR ELEVATORS.

No. 324,751. Patented Aug. 18, 1885.

Fig. 2.

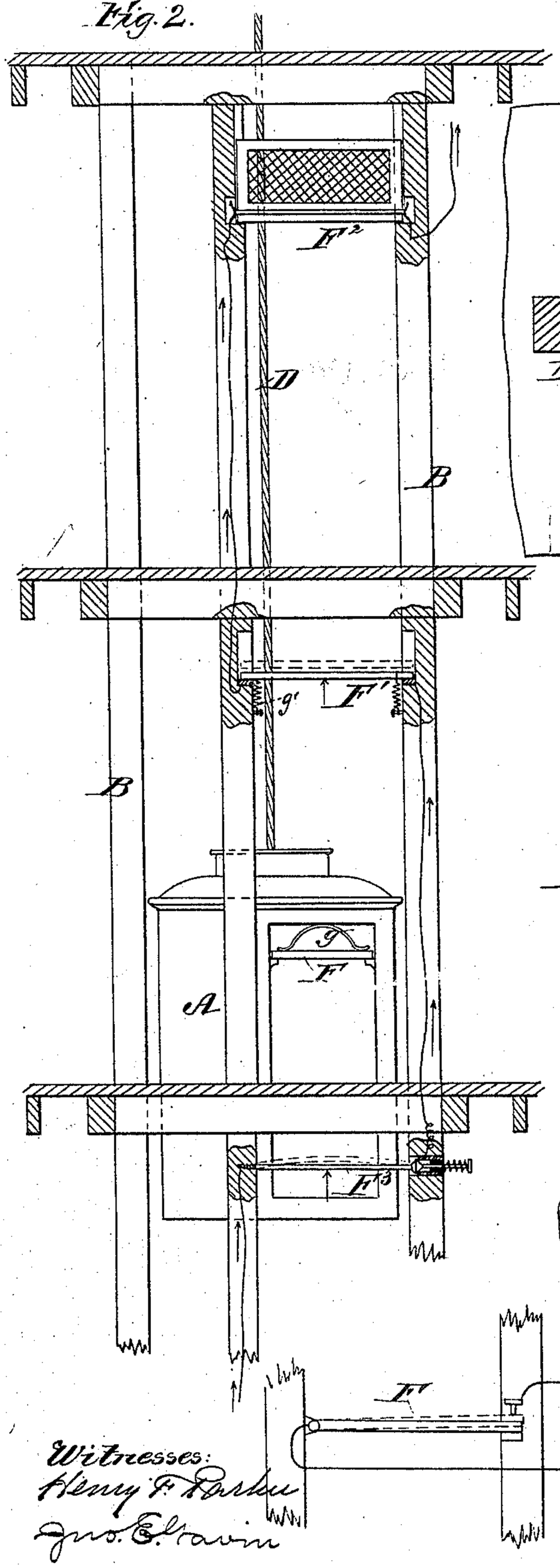


Fig. 3

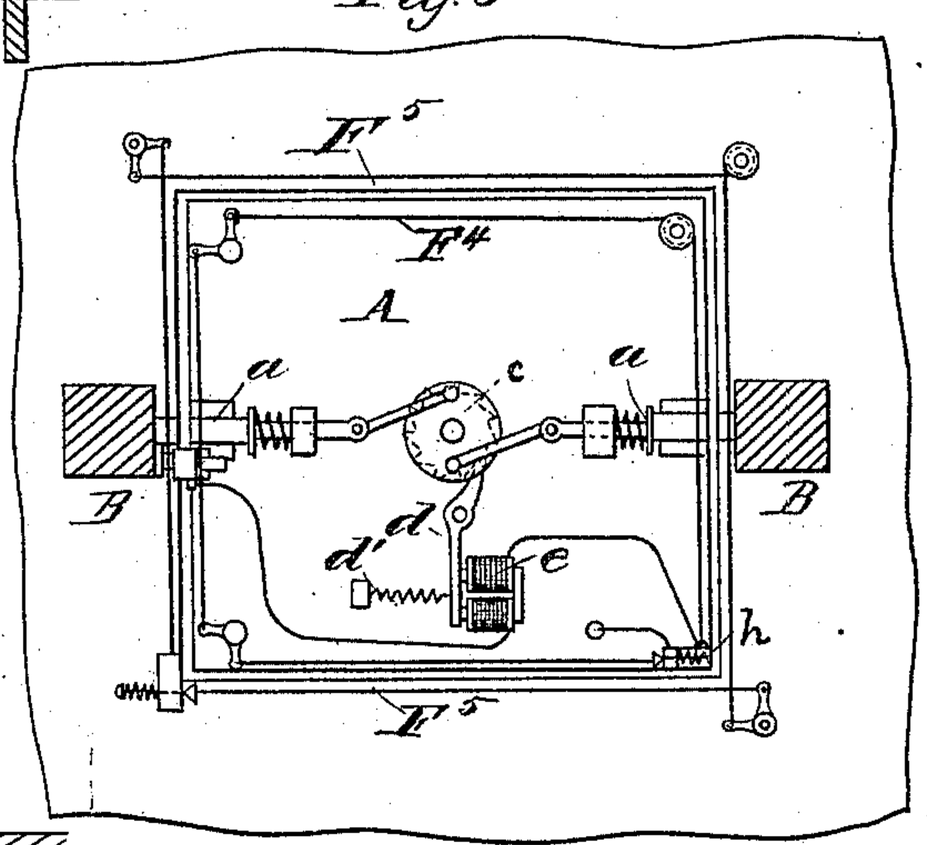


Fig. 7.

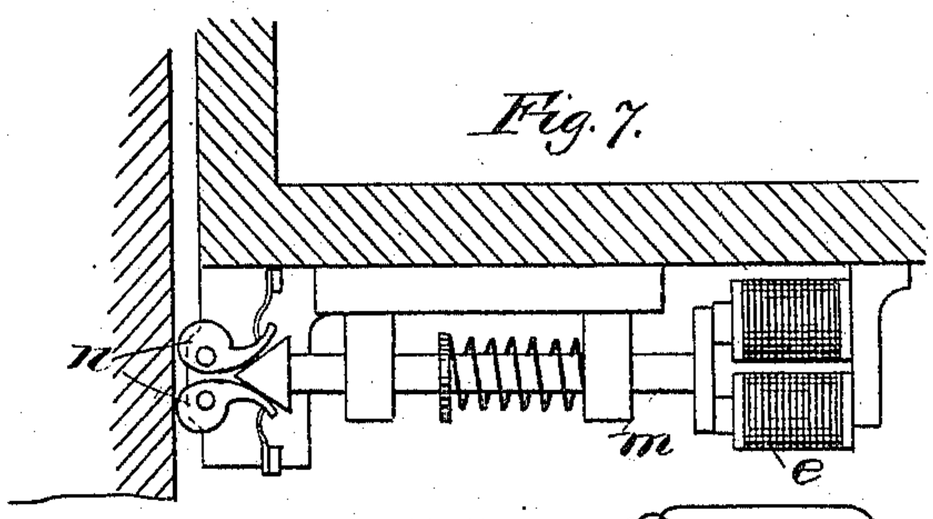
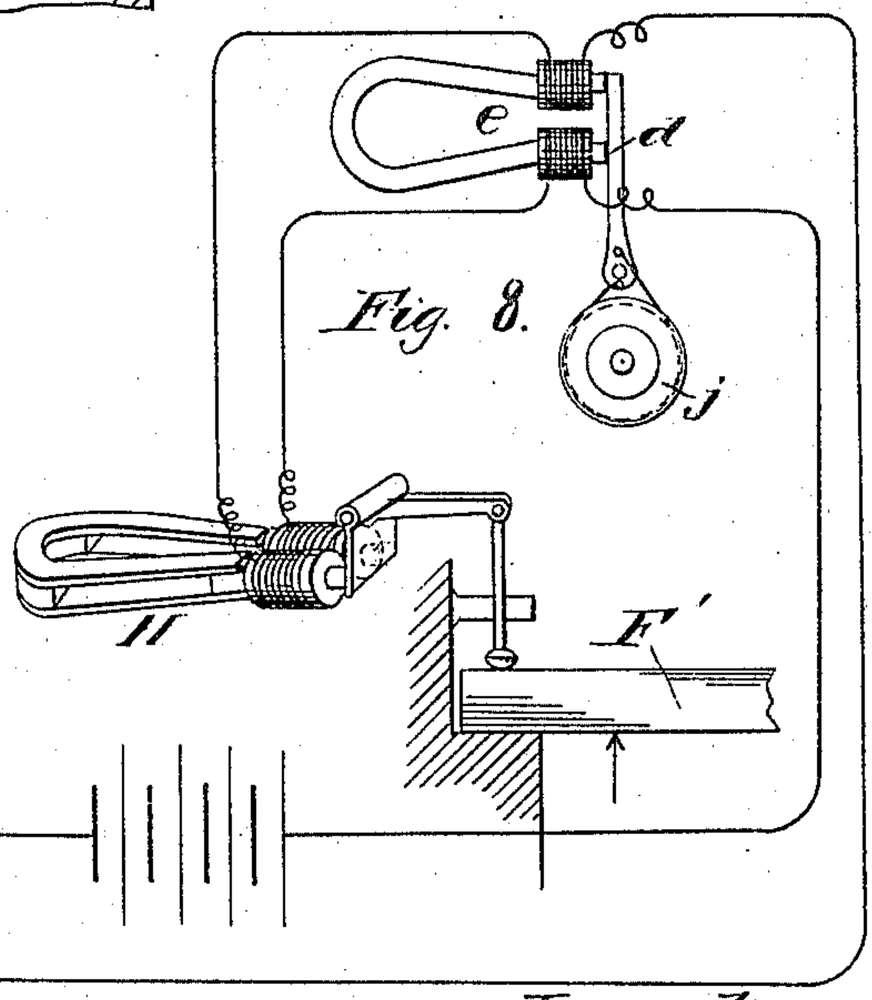


Fig. 8.



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(No Model.) 3 Sheets—Sheet 3.

R. M. CURTISS.

SAFETY DEVICE FOR ELEVATORS.

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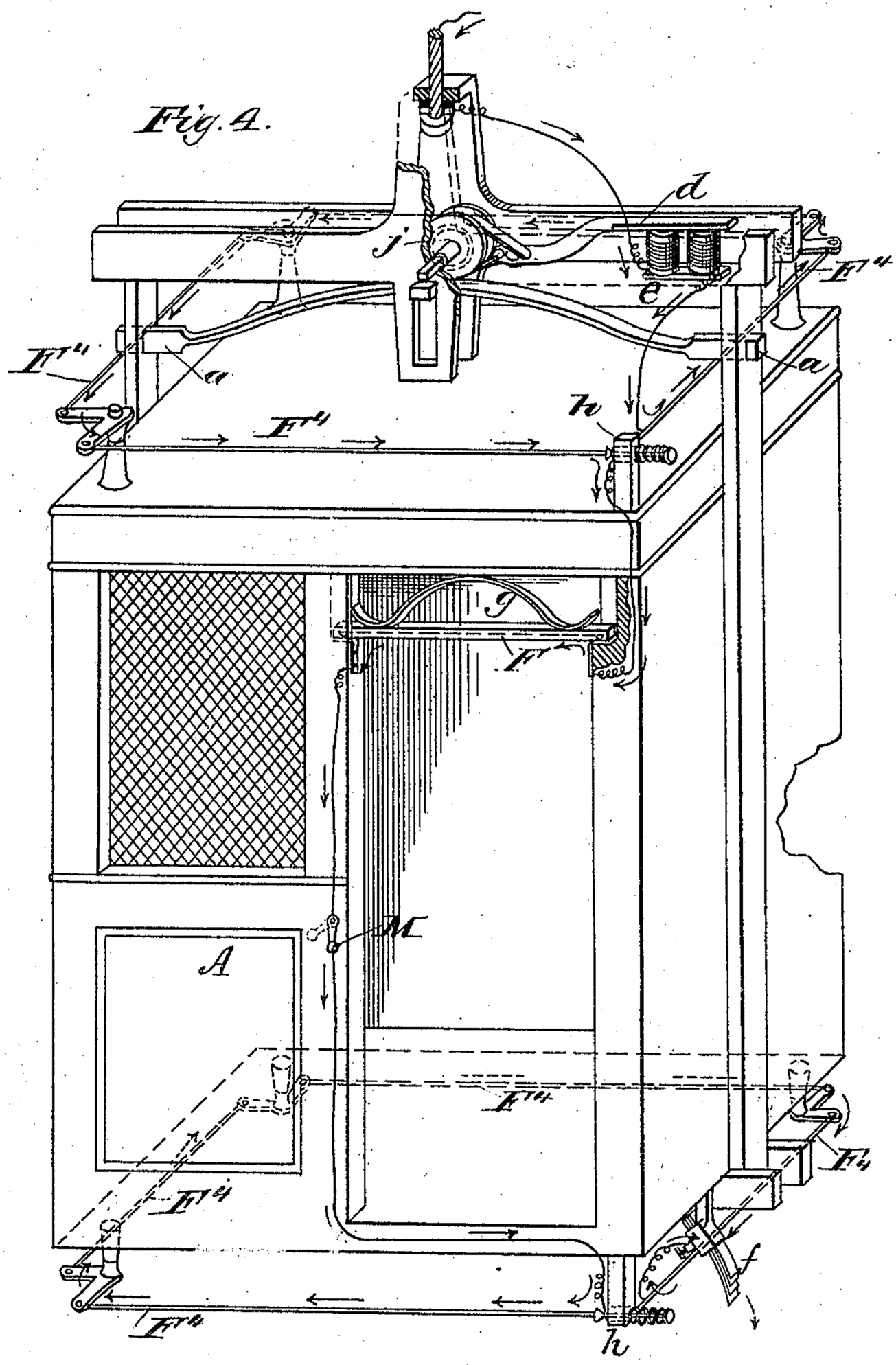
Fig. 4.



Witnesses:
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UNITED STATES PATENT OFFICE.

ROBERT M. CURTISS, OF BROOKLYN, NEW YORK.

SAFETY DEVICE FOR ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 324,751, dated August 18, 1885.

Application filed January 22, 1884. (No model.)

To all whom it may concern:

Be it known that I, ROBERT M. CURTISS, of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Safety Devices for Elevators, of which the following is a specification.

It is well known that numerous devices have been heretofore invented which act to stop or sustain the car in its guides in case of any breakage of the suspending-cables, or in case the car should at any time, by some derangement, acquire an abnormal speed of descent, thereby preventing the fall or wreck of the car and consequent damage to its passengers or contents. Now, while such devices are quite necessary and have prevented damage on many occasions, there is yet another class of accidents likely to occur, and, in fact, occurring frequently, which are caused by no breakage of cables or derangements of mechanism, but simply by passengers or freight becoming caught and crushed between the moving car and the hatchway, for which no means of prevention have been heretofore devised, and which are, in fact, more numerous and fatal than the accidents of the first-described class, to which invention has been chiefly directed heretofore.

Now, my present improvement relates partially to safety devices of the first-described class, but more chiefly to safety devices for preventing the latter class of accidents, which usually occur through careless attempts to get in or out of the car while the same is in motion, the victim being usually caught between the doorway of the car and the doorway of the shaft, and crushed or decapitated, when the car is descending, between the transom of the car-door and the threshold of the shaft-door, or between the transom of the shaft-door and the threshold of the car when the car is ascending. In the case of freight-elevators the platform is sometimes overloaded or improperly loaded, so that the freight projects and catches against one of the floors or hatchways, thus blocking the car and causing an undue strain on the engine and hoisting-cable, which latter becomes sometimes broken or detached and leaves the car liable to fall, with its load or passengers, and become thereby wrecked.

My invention therefore aims chiefly to prevent this class of accidents; and in order to accomplish this object a main feature of my invention consists in movable or yielding guard-rails, bars, transoms, or their equivalents, arranged at or about the approaches or passages of the shaft and car, and operatively connected with the tripping mechanism of the safety-catches or with mechanism controlling the stopping of the hoisting machinery, or with both, so organized that in case of a collision of anything with one of the said bars or guards the safety devices will be at once set off, or the hoisting-machinery stopped, or both, thereby at once stopping the car in its guides before the colliding body can become crushed or injured between the car and the shaft. Any suitable operative connections may be employed between the yielding guards and the safety-catches or the stopping device of the hoisting machinery, and any suitable form of safety-catches may be employed. I prefer, however, to use the electrical safety-catches shown in my former patents, Nos. 216,024 and 266,107, in which the safety-catches are held out of engagement by the attraction of an electro-magnet in a closed circuit, which passes through the hoisting-cable and other working parts of the apparatus, so that in case of the breaking of the circuit at any point, due to fracture of the cable or any other sustaining part of the apparatus, the magnet loses its attraction, and instantly releases the catches, and sustains the car. I also prefer to employ operative connections of an electrical character between the said yielding guard-bars and the safety-catches and the stopping device, and also to have said stopping device operate electrically. The said guard-bars I prefer to form in fact as contact makers or breakers arranged in a circuit controlling the safety-catches and the stopping device, so that in case any of said guard-bars are moved ever so little by the collision of any obstructing body therewith an electric circuit is made or broken, which instantly actuates suitable magnets or electric-motor devices controlling the safety-catches and the stopping device, so as to release the catches and stop the machinery, and thus bring the car to rest before any damage can be done. Instead of employing a voltaic

battery to energize the electric circuit of the said safety devices, I prefer to employ secondary or storage batteries charged from a dynamo driven by the descending motion of the car, and I provide a system of automatic switches, which act to switch one battery out of action when exhausted and to switch the fresh battery into action while changing the charging-circuit from one battery to the other. My invention therefore also consists in the special features above outlined, as well as in further details, as hereinafter fully set forth.

In the drawings annexed, Figure 1 presents an elevation of an elevating apparatus equipped with my safety devices, and also showing the circuit of the safety devices, the batteries, dynamo, switches, &c., in diagram. Fig. 2 is an elevation of the shaft and car provided with the safety-guards, and further illustrating this feature of my invention. Fig. 3 is a plan view of the car and surrounding hatchway, showing the safety catches and guards. Fig. 4 is an enlarged perspective view of the car with its safety devices. Fig. 5 is a detail view of one form of automatic stopping-valve for the hoisting machin ry. Fig. 6 is a detail of cut-off switch for the storage-batteries. Fig. 7 is a fragmentary view showing a modified form of safety-catches for the car. Fig. 8 shows a modification of the electric safety mechanism.

Referring first to Figs. 1, 2, and 3, A indicates the car; B, the guides on the shaft; C, the hoisting-engine; and D, the cable, extending from the engine in the usual manner to the car. The guides B are provided with lines of teeth *b*, as usual, which, however, in my ca e are of the form of rack-teeth, and will catch positively in either direction, as illustrated. The car is provided either at top or bottom with safety-catches, to engage in case of emergency with said teeth, as usual. In Figs. 1 and 3 these catches are shown arranged on the bottom of the car, and consist of two square-ended bolts, *a a*, adapted, when released, to fit between the rack-teeth in the shaft, and thus hold the car positively from either ascending or descending. These bolts, as shown in Fig. 3, are connected by links to opposite crank-pins on a ratchet disk or wheel, *c*, which when partially rotated will retract the bolts against the stress of springs shown, and thus withdraw their engaging ends from the racks on the guides and permit the car to freely move up or down. When the ratchet-wheel *c* is thus rotated into its retracting position, it is there engaged by a pawl, *d*, which is held in this engagement by the attraction of an electro-magnet, *e*, against the stress of a retracting-spring, *d'*. Now, this electro-magnet *e* is included in an electric circuit (shown by the unfeathered arrows in Fig. 1,) which, according to the principle of my former patents, passes from a suitable battery to the fixed end of the cable, thence through the cable to the car, through the contacts of the safety-guards hereinafter to be described, through the magnet *e*, and, finally, to a brush, *f*, on the bottom of the car, which bears on a contact-strip, *f'*, on one of the guides B, and from said contact-strip through a return wire (shown) back to the opposite pole of the battery.

Now, the safety-guard devices before referred to are indicated by F F' F² F³ F⁴, &c., in Figs. 1, 2, 3, and 4.

F indicates a transom or transom-bar on the car-door, which, instead of being rigid, as heretofore, is made movable or yielding, with an ample range of movement, but is constantly pressed down to a seat by a suitable spring or springs, *g*, and the seat or seats of said transom form an electrical contact, and the transom itself forms a conductor or carries a conductor, which is included in the safety-circuit, as illustrated in the drawings, so that if any of said transoms are moved or raised at all off their seats the contacts will be separated and the circuit broken, and the safety catches and stops thereby released.

F' F² F³ indicate the transom or transom-bars on the doorways of the shaft, which are made yielding or movable, like those on the car, and also serve as contact-makers, their contacts being included in the same circuit, as illustrated. The bar F' is a simple conducting-bar, held down on its conducting-seats by springs with the same effect as the transom on the car. The transom F², I have shown, however, as a wooden frame, held down by its own weight on shoulders, but provided with a conducting-bar across its lower end, which fits between contact-springs included in the circuit, as will be understood from the drawings, so that as soon as the transom is raised the contacts will be separated and the circuit broken, as before. The bar F³ is shown as a flexible metallic rod or wire fixed at one end, and sliding at the other end through an insulating-sleeve within a conducting sleeve. A spring arranged between the end of the rod and insulating-sleeve tends constantly to keep the flexible rod taut across the doorway, and to keep a conical metal collar on said rod in contact with the conducting-sleeve, so that the circuit which connects to the fixed end of the rod and continues from the conducting-sleeve is thus kept closed; but should any object collide with the rod and bow the same, as indicated by dotted lines, the contacts would be separated and the circuit broken, with the same effect as in the other instances described.

Now, F⁴ in Figs. 3 and 4 indicates the yielding guards, which encircle the top and bottom of the car and form a marginal guard-frame around the same, and are included in the circuit in a similar manner to the transoms. These guards F⁴ are preferably flexible metallic rods or wires, the first rod being fixed at one end of the system to a corner-post, *h*, on the car, while the last rod slides through a conducting-sleeve in the post in the same way as the bar F³ in Fig. 2, as already described.

The bars are coupled together at the three remaining corners of the car by elbow-levers, as shown, or may pass around pulleys at the corners, as shown in Fig. 3, so that if any one of the bars is collided with at any side of the car the said bar will become bowed, and thus pull upon the system, which will withdraw the terminal rod from contact with the conducting-sleeve at the corner-post *h*, and thus break the electric circuit which passes through said rods and through the terminal contact thereof, as well shown in Fig. 4. This circuit need not, however, pass through the rods themselves, as illustrated in Fig. 4, but only through the terminal contact thereof in the post *h*, as will be readily understood. I also prefer to arrange a similar set of guards, F^5, around the opening of the hatchways under each floor, as shown in Fig. 3, which are also included in the safety-circuit in the same manner, as will be readily comprehended.

Now, in addition to the aforesaid guards and catches, I arrange in the pipe *i*, through which the motive-fluid flows to or from the hoisting-engine C, a valve, *k*, preferably of the balanced kind, which I arrange to be normally held open by the attraction of a strong electro-magnet, G, in the said safety-circuit, as illustrated in Fig. 1, so that if the safety-circuit becomes broken at any point the said magnet will at once release its armature and allow the valve to drop, thus instantly shutting off the flow of the fluid, and thus stopping the engine and preventing any motion of the cable or car up or down. It will therefore be now observed that by means of the safety devices shown not only will the safety-catches be released and the car held in case the cable should become strained or broken, but, further, in case any person or object should become caught between the moving car and the shaft, through carelessness or otherwise, then one of the safety guards F F', &c., will be moved by the collision and the circuit instantly broken, thus demagnetizing the catch and stop magnets *e* G, and immediately stopping the car in the guides, whether ascending or descending, and at the same time stopping the hoisting-machine, thereby accomplishing a most important result and preventing the most frequent and fatal class of accidents heretofore occurring.

It will be seen that in case the person is caught in the doorway of the car when the car is descending he will collide with the transom F of the car, and as soon as the least movement thereof is effected by said collision the circuit will be broken and the car and machinery brought to rest, thus preventing any chance of crushing or injuring the person. In case the car is ascending, then the person or obstruction will collide with one of the transoms F', F^2, or F^3 on the shaft, and this collision will effect the instantaneous and automatic stoppage of the car in the same way. Furthermore, if any obstruction protrudes from the shaft above the car while the same is ascending, or below the car when descending, then a collision will occur with the guards F^4 on the top or bottom of the car and instantly cause a stoppage of the car before any damage can occur. Again, if any obstruction protrudes from the car while the same is ascending—for example, disarranged freight—then the obstruction will strike the guards F^5, (see Fig. 3,) around the under side of the first hatchway, and thus cause the car to stop before the obstruction is crushed or before any damage can be done to the car or hoisting apparatus by any excessive strain thereon. It will therefore be seen that by these guards all the approaches or passages of the shaft and car are protected, so that it is almost impossible for any of the usual accidents to occur, thus effecting a most important improvement in safety devices.

It will be understood that the safety bolts or catches *a a* may be affixed on the top or bottom of the car, and hence in Figs. 1 and 3 they are shown as affixed to the bottom of the car, and in Fig. 4 to the top of the car. In the latter case the safety-bolts are in the form of a pawl-spring, which is raised up or bowed at the middle, so as to retract the bolts by the winding up of a cord on the winding-drum *j*. Around this drum is a brake-band connected with the armature-lever *d*, which is held down by the attraction of the holding-magnet *e*, so as to keep said spring held up out of engagement. As soon, however, as the magnet loses its attraction by the breaking of the circuit it will release the armature-lever, relax the brake-band, free the drum and permit the pawl-spring to straighten, and thus force the safety-bolts into engagement, as will be readily comprehended. In the former instances the safety-catches are held out of engagement indirectly by the attraction of the magnets *e;* but, if desired, the catches may be held out of engagement by the direct attraction of the magnet, as shown in Fig. 7, in which case the magnet *e* attracts a powerful spring-bolt, *m*, having a wedging head on its outer end adapted to fit between the tails of two friction-dogs, *n n*, which approach the face of the guides, but are normally held out of contact by springs, so that as soon as the bolt is released by the weakening of the magnet it will diverge the dogs, and thus cause them to forcibly grip the guides, both in the direction of ascent and descent, so as to prevent the car from moving either up or down. These dogs will be preferably arranged to engage the two opposite sides of the guide-posts, instead of the inner face, as shown in Fig. 7.

Instead of using the form of stop-valve shown in Fig. 1, the modified form shown in Fig. 5 may be employed. In this case the valve *k* is of the single poppet form, and its stem is connected with a cam-lever, as shown, and a spring is arranged, as illustrated, to constantly tend to close the valve. The magnet G is arranged to attract the cam-lever and

hold it in its raised position, and thus keep the valve open against the stress of the spring. As soon, however, as the magnet loses its attraction the cam-lever will be released, and the valve will become instantly closed by its spring, thus stopping the engine, as before described. This modification has the advantage that a weaker magnet will serve to operate the valve, owing to the mechanical advantage of the cam-lever. I do not, however, limit myself to either special form of valve, as any equivalent construction may be employed without departing from the principle of my safety stopping device.

In the electrical mechanism shown in Figs. 1, 2, 3, and 4 it will be noted that the electro-magnets are constantly energized by being in a closed circuit, and that the movement of the trigger bars or guards acts to break this circuit and to demagnetize the magnets. This may be reversed, however, and an open circuit used with the trigger-bars or transoms arranged to make contact and close the circuit to energize the magnets, as shown in Fig. 8. In this case the holding-magnet *e* is a polarized magnet, the permanent magnetism of which tends normally to hold the armature and brake-lever *d* with the same effect as in Fig. 4. The coils of this magnet, however, are connected with the poles of a battery whose circuit is normally open. If, however, the transom F or its equivalent is moved, it will make an electric contact, as shown by dotted lines, and close the said circuit, and thereby send a current through the coils of the polarized magnet, which will weaken or neutralize the permanent magnetism, and thus release the lever *d*.

It will be readily understood that instead of the circuit being conveyed to the car through the hoisting-cable it may be conducted through a separate cable, or through a pendent loop of wire, or through conductors on the guides and brushes on the car, or in any other suitable way.

It will be noted, by referring to Figs. 1 and 4, that I provide the car with a cut-off switch, M, arranged in and controlling the safety-circuit and disposed in some part of the car, preferably on the inside, convenient to the hand of the operator, so that in case of any emergency, or in case the operator foresees some possible accident, he can at once open the switch and thus break the circuit and cause the car and engine to be brought to rest before any damage can occur, which on some occasions may prove to be a very important provision, and forms one feature of my improvement.

As before stated, a voltaic battery may be employed to energize the safety-circuit; but I prefer to use a dynamo-electric machine and storage-batteries, as fully illustrated in Fig. 1, to which reference may now be made. In this view L indicates the dynamo-machine, and N indicates a spindle at the bottom of the shaft, on which is mounted a pulley, N′, over which an endless rope, O, passes, which extends up through the shaft and passes over a pulley at the top thereof, and is connected with the car, as shown, so that as the car moves up or down it moves said rope and revolves the pulley N′. The pulley N′ is, however, connected by ratchet and pawl with the shaft N, so that it will revolve said shaft only when the car is descending, and on this shaft is mounted a driving-wheel, from which a belt passes to the pulley of the dynamo; hence, by this arrangement, when the car descends the dynamo is driven, and when the car ascends the dynamo remains at rest, thus taking off resistance from the car when it is raising its load and utilizing the load which descends to drive the dynamo.

Now, P P′ indicate the storage-batteries, one of which is always in circuit with the safety-circuit or working-circuit, which is indicated by unfeathered arrows, while the other battery is in connection with the charging-circuit from the dynamo, which is indicated by feathered arrows. An automatic switch or series of switches is employed, which will act to switch the using battery when nearly exhausted out of the working-circuit and switch the freshly-charged battery into the same, while changing the charging-circuit from the fresh to the exhausted battery. This switch mechanism consists of a series of contacts or switches, R, and a pair of magnets, S S′, arranged, respectively, in the charging and working circuits, and acting on an armature, T, which plays between them and is operatively connected with the switches. The switch or switches R consist of five switch arms or levers, 1 2 3 4 5, all coupled with a connecting-rod, 6, which is connected with the lever of the armature T. Each of these switch-arms 1 2 3 4 5 moves between a pair of contact-tongues, the first pair of which, 7 8, are preferably rigid and more widely separated, and which pair, with the arm 1, may be called the "main" contacts, and govern the circuit of the dynamo alone, while the four other contact-tongues are elastic or yielding spring-tongues, and with their respective arms 2 3 4 5 form the minor switches, which govern the connection of the two batteries, respectively, with the dynamo and the working-circuit. Now, when the apparatus is at rest with the magnets S S′ demagnetized, the equalizing springs 12 13 of the armature-lever T will hold the armature midway and balanced between the two magnets, and in this position the switch-arms 1 2 3 4 5 will also be in a mid or balanced position between their contact-tongues. The first arm, 1, however, of the main or dynamo switch will, on account of its more widely-separated and rigid contact-points, be out of circuit with both contacts, and hence the circuit of the dynamo or charging-circuit will be opened. The remaining four switch-arms, 2 3 4 5, will, however, be in contact with both of their contact-tongues, for the reason that these tongues are

springy, and in the said position of the switch-arms both press up toward each other and embrace the switch-arms; hence assuming, now, that the battery P is charged and that the circuit is closed thereon, say, by closing the switch M in the car, this will of course close the entire safety or working circuit, and the magnet S will become energized and attract the balanced armature T toward it in the position shown in Fig. 1, thereby swaying the switch-arms 1 2 3 4 5 to one side and making or keeping contact with the tongues toward which they incline while breaking contact with the opposite tongues, as illustrated. This position of the switch-arms, as may now be seen by tracing the connections and arrows in Fig. 1, will close the charging-circuit with the dynamo and the exhausted battery P′, and at the same time cut the exhausted battery off from the working-circuit, while keeping the charged battery P in said circuit, as may be readily seen by following the arrows. It will now be seen that the magnet S′ will be energized by the charging-circuit and tend to pull the armature T away from the magnet S, but will not yet be able to do so on account of the strong attraction of the magnet S, (being in the fresh battery-circuit,) and by reason of the greater distance of the armature from the magnet S′. As soon, however, as the magnet S weakens sufficiently by the gradual weakening of the battery P, so as to cause the retractile tendency of the armature T (due to its springs and the magnet S′) to preponderate, then the armature will be attracted toward the magnet S′, and this will shift the switch-arms 1 2 3 4 5 to their opposite inclinations and into contact with the opposite tongues, thus reversing the connections and throwing the battery P and its magnet S off the working-circuit and into the charging-circuit, while putting the battery P′ and its magnet S′ into the working-circuit, as will be readily understood by tracing the connections. When, again, the working-battery is sufficiently weakened, a reversal of the connections will take place, as before, bringing the parts back to the position illustrated in Fig. 1; hence by these contrivances the usually-wasted power of the descending car is utilized to furnish electricity to charge the safety-circuit, and by the automatic switch mechanism described one battery is always being charged while the other is being used without requiring attention.

The batteries P P′ are presumed to be inclosed air-tight, and are connected with a diaphragm-chamber, 15, over which is fixed a diaphragm, 16, upon which rests a contact-making lever, 14, as shown in detail in Fig. 6, which lever in its normal position closes a contact through which the charging-current of the dynamo is conveyed, as shown in Fig. 1. When, therefore, the battery is fully charged, any additional or excessive current will produce a generation of gas, which will press upon and distend the diaphragm and thus sway the lever 14 and break the charging-circuit, thus opening the circuit on the dynamo and preventing any further charging of the battery, and thereby forming a simple cut-off device for the described purpose.

In the working-circuit I prefer to introduce suitable resistance, as shown at 17 in Fig. 1, to prevent the battery from being exhausted too rapidly, and I also show a galvanometer, 18, to indicate the strength of current.

Whenever the circuit becomes broken by the action of the safety devices, as already described, I prefer to have an alarm automatically sounded in the engine-room to call the attention of the engineer thereto, which alarm is shown in Fig. 1—that is, 19 indicates an electro-magnet in the working-circuit, which normally holds its armature 20 retracted, and therefore keeps a shunt-circuit, 21, open at the retracting contact-stop 22, and in this shunt is an electrical bell, 23. As soon, therefore, as the safety-circuit is broken the magnet 19 loses its power and its armature retracts and closes the shunt 21, thus ringing the bell 23. When the contact 22 is closed, it will be seen that a direct circuit will be made with the battery and switches, excluding the safety devices of the elevator, and hence the bell will continue to ring until the circuit is changed.

Instead of having the marginal guards F′ around the top and bottom of the car, a "false" bottom or top may be used in the form of a continuous platform of the same size as the top or bottom of the car, arranged to yield by collision with any object and break the circuit in substantially the same way as the movable transoms already described.

In the arrangement shown in Fig. 8, instead of using a permanent polarized magnet, a simple electro-magnet may be used, arranged when the circuit is closed at the transom F to attract an armature and thereby release the safety devices.

In the alarm shown in Fig. 1, instead of having the armature 20 to close a shunt in the working-circuit on the bell 23, it may act to close a separate battery-circuit to ring the said bell.

I am aware that it is not new to provide an elevator-car with a disk or other similar device which is caused to move by the air if the car is descending too rapidly, which movement of said disk breaks or makes an electric circuit, and make no claim to this; but, so far as I am aware, it has never, previous to my invention, been proposed to place a guard near one or more of the lateral edges of a car, so that any solid obstruction—such as a person's body or any part thereof—coming in contact with such guard would open or close electrical circuit and thus operate a safety mechanism or stop the movement of the hoisting apparatus.

I am also aware that it has been proposed to connect the doors of an elevator with a magnetic clutch in such a manner that the opening of the doors caused the clutch to hold the starting-rope fast, so that the engine could

not ordinarily be started until the doors were closed.

What I claim as my invention is—

1. In an elevator apparatus, the combination, with mechanism for stopping the car, of a movable or yielding transom or transoms on the door or doors of approach to the car, and electrical connections between said transoms and stopping mechanism, whereby a collision with or movement of said transoms acts to automatically stop the car, substantially as herein set forth.

2. The combination, in an elevating apparatus, with mechanism for stopping the car, of a movable or yielding guard near one of the lateral edges of the top of the car, and electrical connections, substantially as described, between said guard and stopping mechanism, whereby the collision of any obstruction with the top of the car on its ascent moves said guard and thereby releases the stopping mechanism and stops the car.

3. The combination, in an elevating apparatus, with mechanism for stopping the car, of a movable or yielding guard near one of the lateral edges of the bottom of the car, and electrical connections between said guard and said stopping mechanism, substantially as herein set forth, whereby the collision of the bottom of the car with any obstruction in its path will move said guard and thereby release the stopping mechanism and stop the car.

4. The combination, with an elevating apparatus with mechanism for stopping the movement of the car, of an electric motor device or magnet controlling the action or release of said mechanism, and of a movable or yielding guard or bar guarding the approach to the car and serving as a contact-maker controlling the electric circuit of said motor device, whereby a collision with and movement of said bar will open or close the circuit, and thereby actuate the motor device, release the stopping device, and stop the car, substantially as herein set forth.

5. The combination, with a hoisting-engine, of a valve for stopping the movement thereof, and an electro-magnet constructed and arranged to operate said valve, with an electric circuit energizing said magnet, and means, substantially as described, for breaking and closing said circuit at the will of the operator, substantially as and for the purpose set forth.

6. The combination, with a hoisting-engine and a valve controlling the flow of motive fluid to or from the same and an electro-magnet controlling the action of said valve, of an electric circuit energizing said magnet, and means, substantially as described, for breaking or closing said circuit in case of coming in contact with a solid obstruction, whereby the action of the magnet shuts the said valve and stops the engine, substantially as set forth.

7. The combination, with an elevating apparatus and mechanism for stopping the movement of the car, of electric motor devices controlling said mechanism, and an electric circuit energizing said mechanism and extended to the car, with a circuit-breaking switch in said circuit on the car, whereby the car may be stopped by moving said switch, substantially as set forth.

8. The combination, in an elevating apparatus, with a safety electric circuit traversing the same, and with mechanism for stopping the movement of the car, of an electric magnet or electric motor device in said circuit arranged to control said stopping mechanism, a storage-battery for energizing said circuit, and a dynamo-electric generator for charging said battery driven by the movement of the car, substantially as herein set forth.

9. The combination, with an elevating apparatus, of an electric circuit, energizing-motor devices arranged to effect the stopping of the car upon the breaking of said circuit, with a dynamo-electric generator driven by the movement of the car, and two storage-batteries, one of which is in circuit with the generator and the other with the safety-circuit, with means for changing the respective circuits with the respective batteries, substantially as herein set forth.

10. The combination, with an elevating apparatus, of an electric safety-circuit, energizing electric-motor devices arranged to effect the stoppage of the car upon the breaking of said circuit, with a dynamo-electric generator and two storage-batteries, one of which is connected to the generator or charging-circuit, and with switch mechanism arranged to reverse the said circuits in relation with the said batteries, and with the magnets S S′, arranged, respectively, in the charging and working circuits, and the armature T, playing between said magnets and connected with the said switch, substantially as and for the purpose set forth.

11. In combination with an elevating apparatus, the safety electrical circuit-energizing motor devices arranged to effect the stopping of the car on the breaking of said circuit, with an electric alarm normally out of circuit, and means, substantially such as described, whereby the breaking of the safety-circuit closes the alarm-circuit and causes the same to sound when the safety-circuit is broken, substantially as herein set forth.

ROBERT M. CURTISS.

Witnesses:
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