959,998.

A. M. COYLE.

STOP MOTION APPARATUS FOR HOISTS.

APPLICATION FILED JUNE 28, 1907.

Patented May 31, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

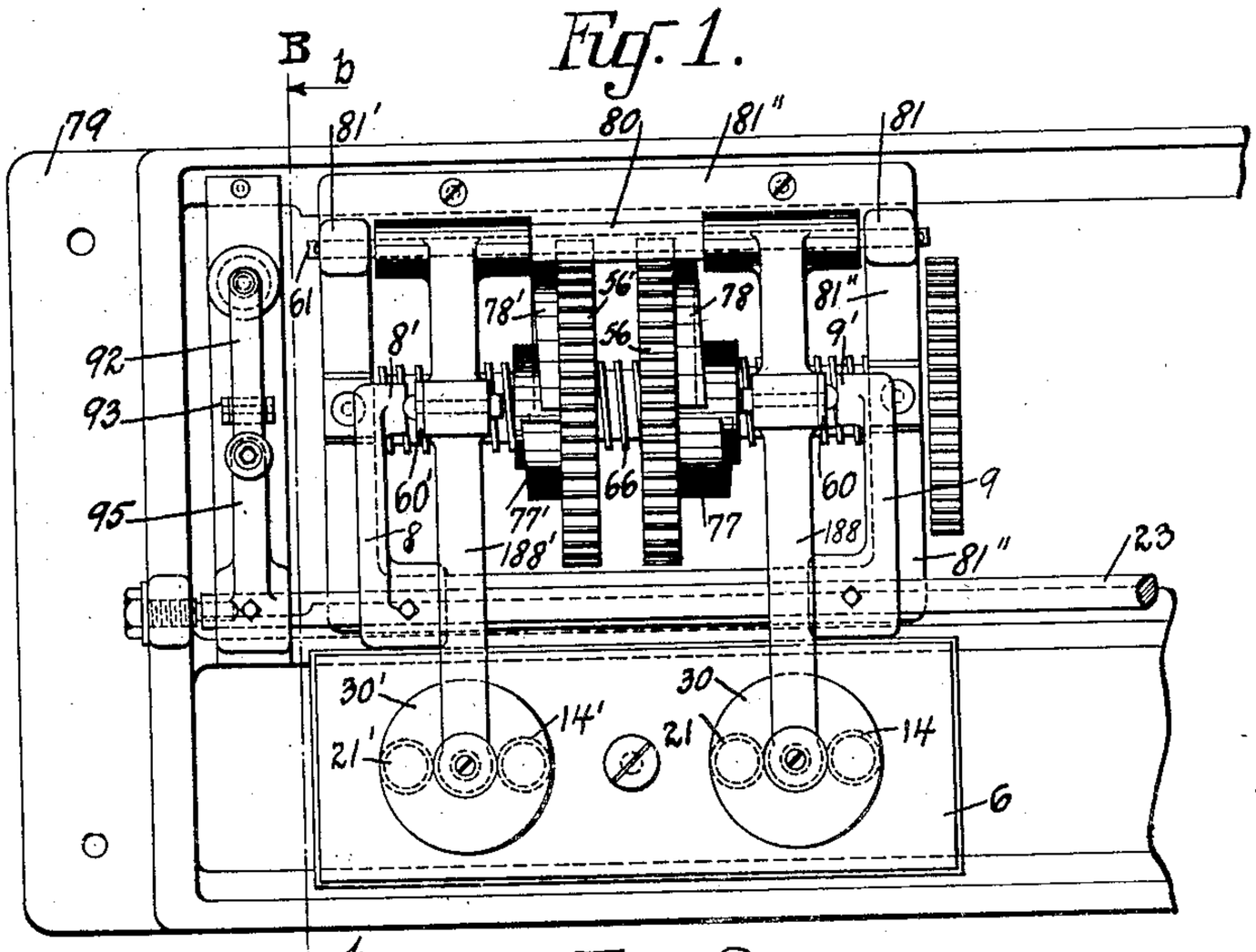


Fig. 2.

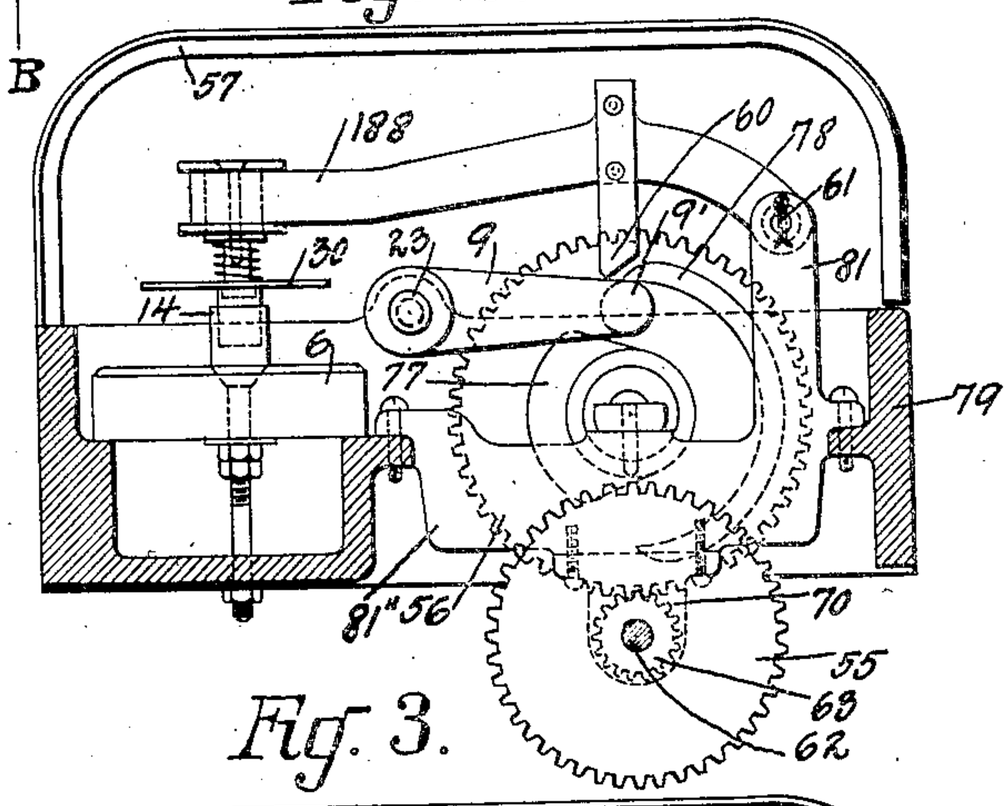
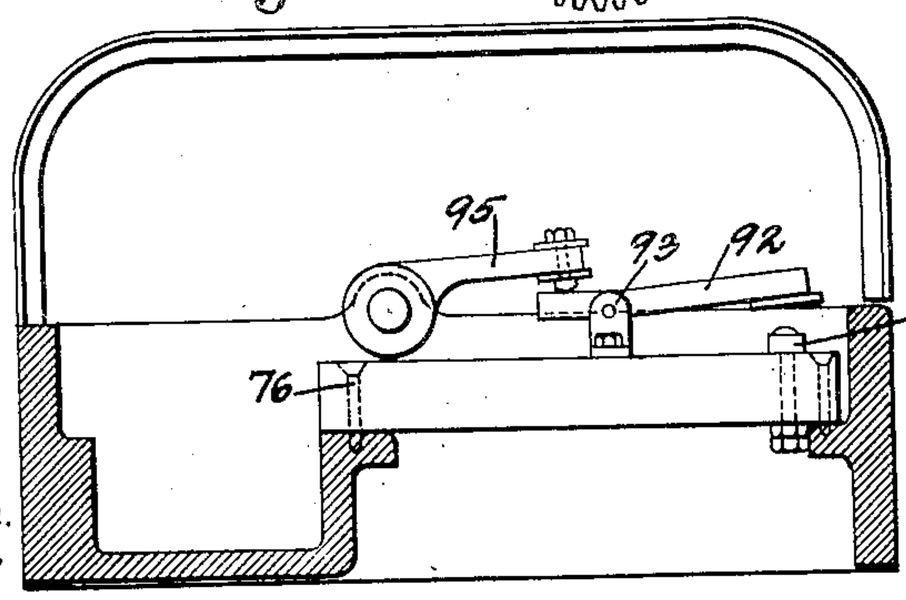


Fig. 3.



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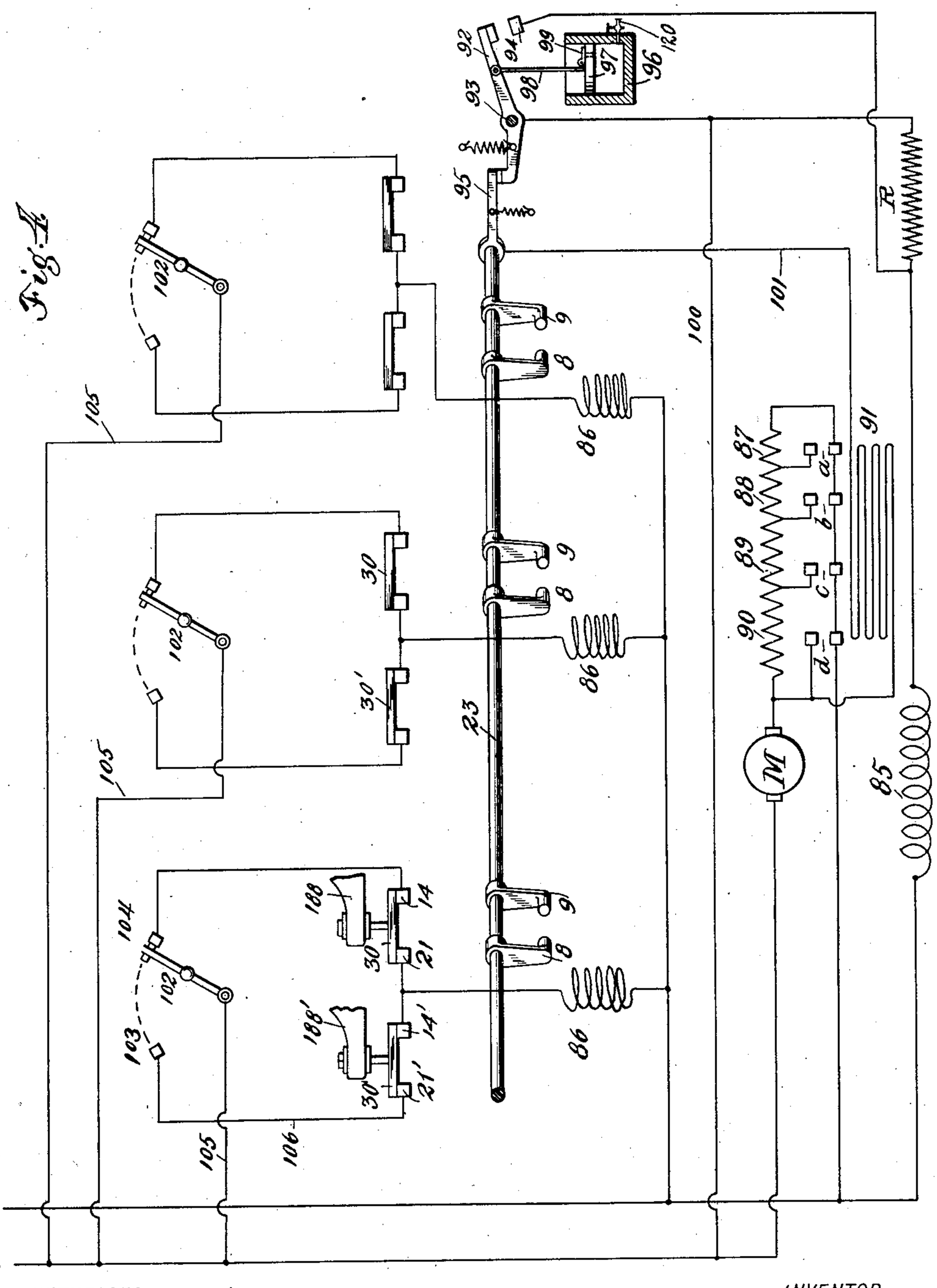
4 SHEETS—SHEET 2.

Fig. 4.



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4 SHEETS—SHEET 3.

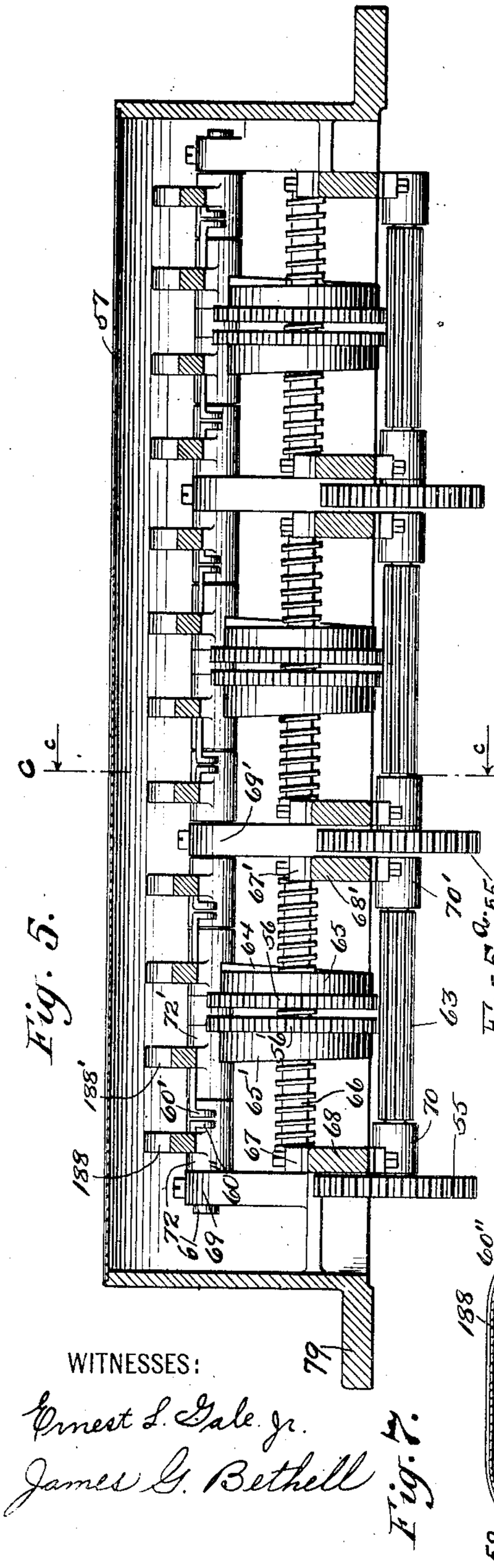

Fig. 5.

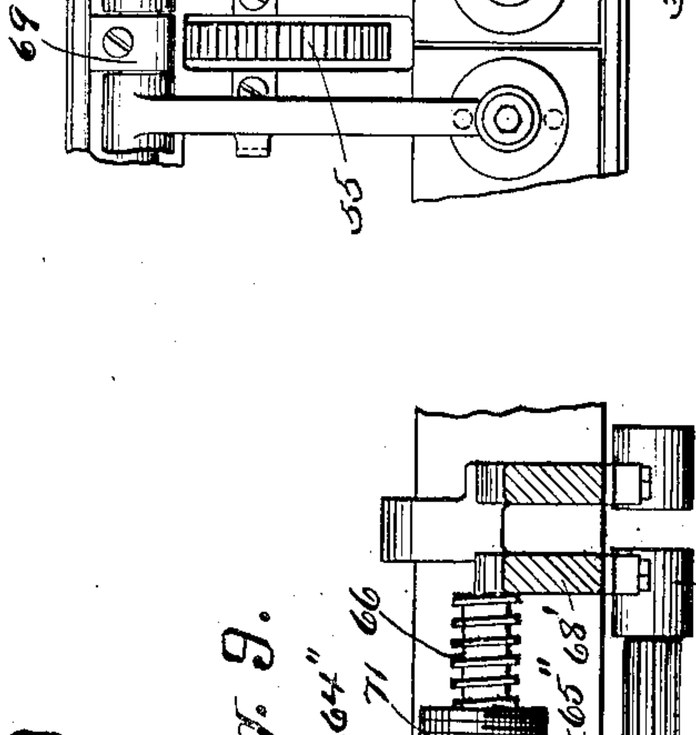

Fig. 5a.

Fig. 6.

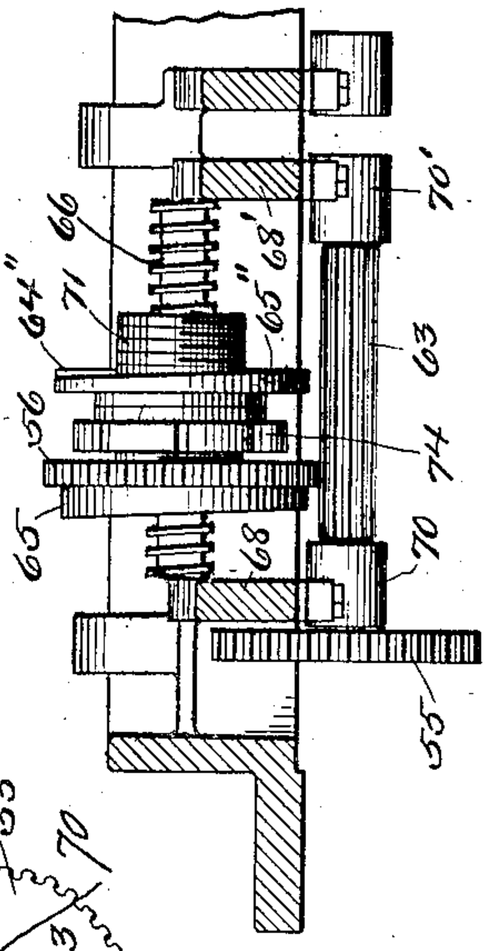

Fig. 9.

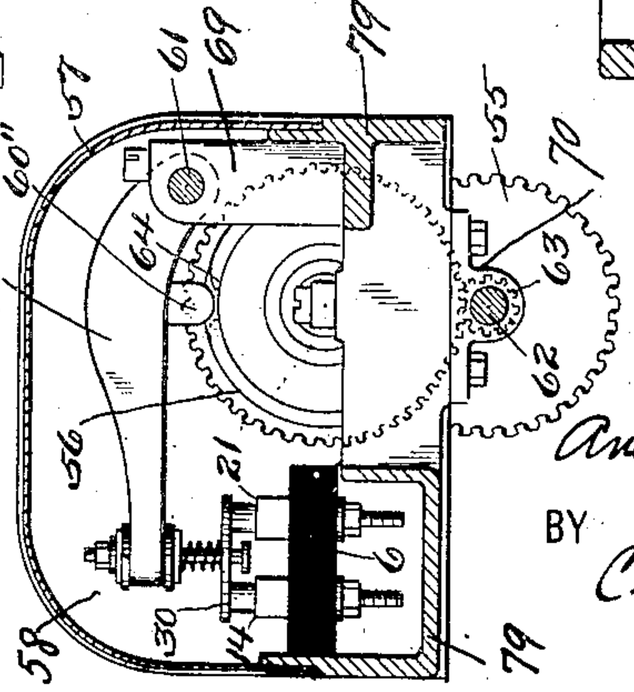

Fig. 7.

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Patented May 31, 1910.

4 SHEETS—SHEET 4.

Fig. 8.

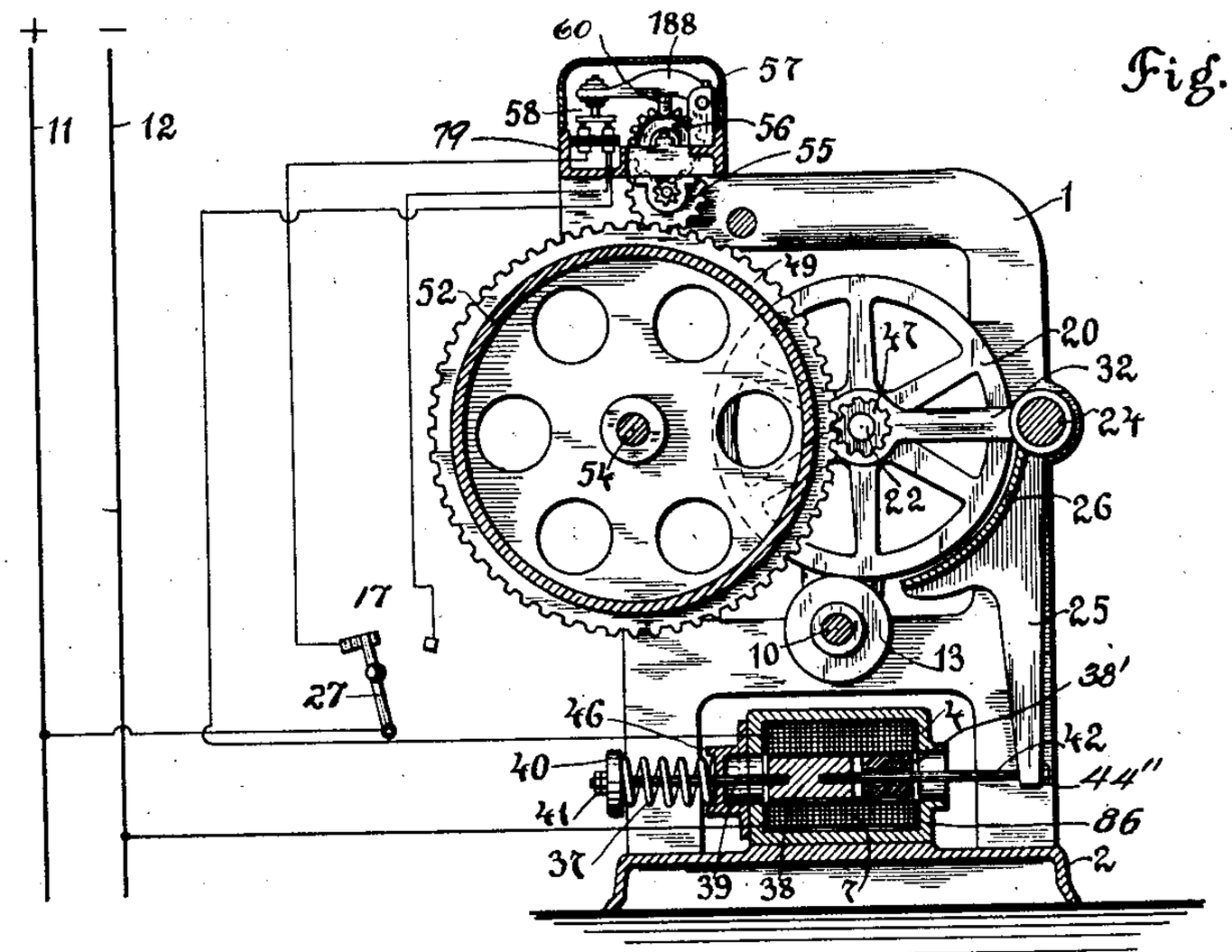
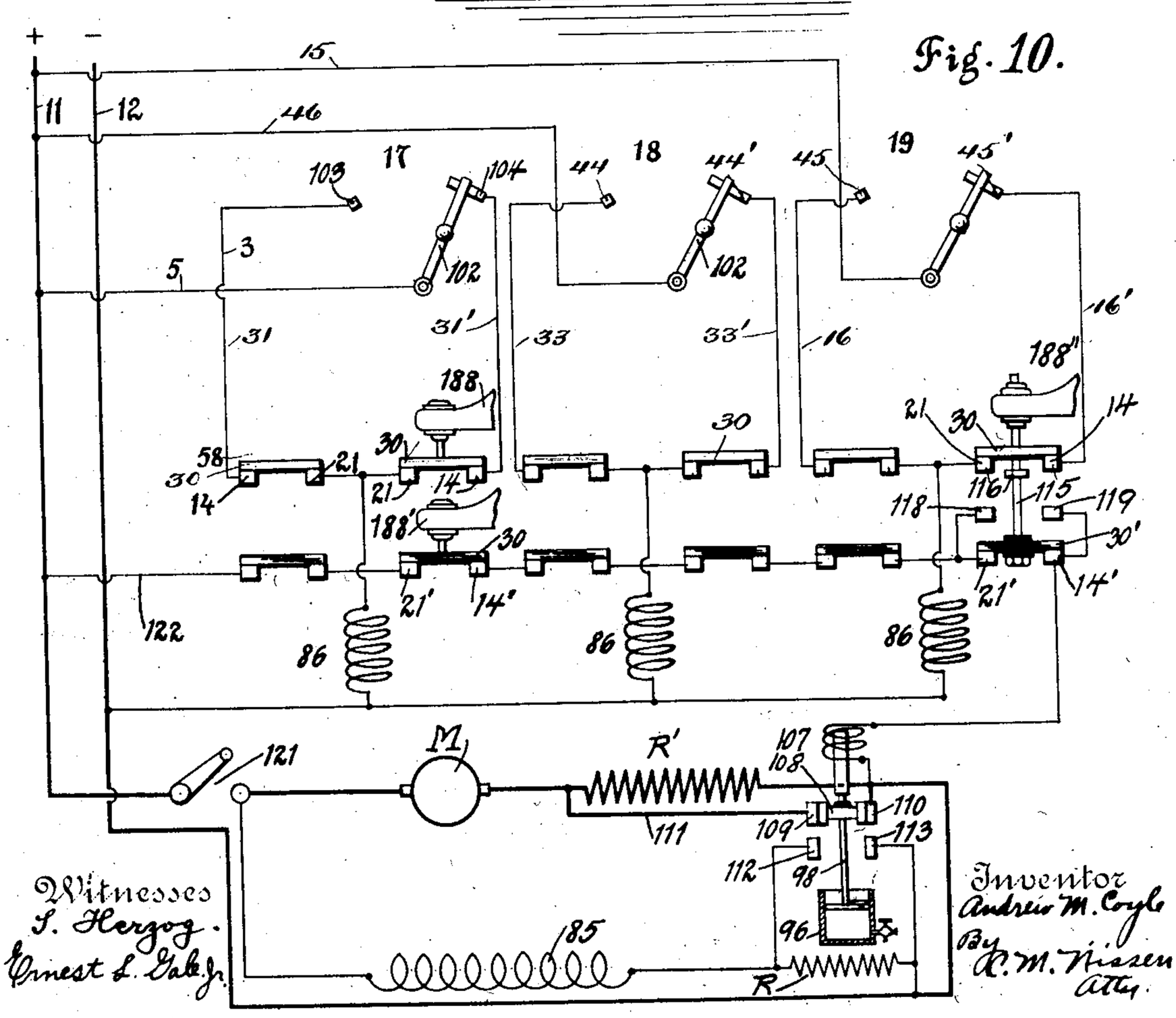


Fig. 10.



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UNITED STATES PATENT OFFICE.

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STOP-MOTION APPARATUS FOR HOISTS.

959,998. Specification of Letters Patent. Patented May 31, 1910.

Application filed June 28, 1907. Serial No. 381,314.

To all whom it may concern:

Be it known that I, ANDREW M. COYLE, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in Stop-Motion Apparatus for Hoists, of which the following is a specification.

My invention relates to stop-motion apparatus and is particularly adapted to be used in connection with hoists, although it may have a general application.

One of the objects of my invention is the provision of simple and efficient means for automatically slowing down hoisting mechanism prior to stopping at the limits of its travel.

Another object of the present invention is to provide improved stop-motion apparatus for slowing down and stopping one or more units of multiple curtain hoisting apparatus.

Other objects of the invention will appear hereinafter, the novel combinations of elements being set forth in the appended claims.

In the accompanying drawings, Figure 1 is a plan view of a preferred form, showing a single unit of my stop-motion apparatus; Fig. 2 is a sectional elevation on the line A—A of Fig. 1, looking in the direction of the arrows *a—a;* Fig. 3 is a similar view on the line B—B of Fig. 1, and looking in the direction of the arrows *b—b;* Fig. 4 is a wiring diagram of the electrical circuits and connections used in conjunction with the form of construction shown in Figs. 1, 2 and 3; Fig. 5 is a sectional elevation of a modified form of my apparatus; Fig. 5ª is a plan detail view of Fig. 5; Fig. 6 is a plan view of a portion of Fig. 5; Fig. 7 is a sectional elevation on the line C—C of Fig. 5, looking in the direction of the arrows *c—c;* Fig. 8 is a sectional side elevation of a frictional hoisting apparatus, showing the application of my invention thereto; Fig. 9 is a modification of the construction shown in Figs. 5, 6 and 7; Fig. 10 is a wiring diagram of the electric circuits and connections used in conjunction with the construction shown in Figs. 5, 6, 7, 8 and 9.

Similar reference characters designate similar parts throughout the various views.

The stop-motion apparatus which is herein disclosed is particularly adapted to multiple hoisting apparatus which forms the subject matter of my co-pending application, Serial No. 282,234, filed October 11, 1905, Fig. 8 being a view of such hoisting apparatus.

Generally speaking, the hoisting apparatus above referred to comprises a single driving motor provided with a longitudinally extending shaft carrying a number of similar frictional driving members, disks or drums, each of which is adapted to engage a co-acting friction wheel geared to a hoisting drum, thus forming a series of hoisting units operated by a single motor. Each hoisting unit is provided with an electro-magnet which when energized effects a frictional engagement between a motor disk and the corresponding hoisting drum, and at the same time releases a brake device, causing the drum to lift or lower its load according to the direction of rotation of its motor. In order that each individual hoisting unit may automatically slow down before stopping at its limits of travel, or at any other predetermined points, I have devised the stop-motion apparatus herein shown and described.

Referring to Fig. 8 which illustrates a typical hoisting machine having my stop-motion apparatus applied thereto, 2 designates a bed upon which is mounted a framework 1, the latter supporting the hoisting mechanism consisting of a number of hoisting drums and the necessary driving mechanism for operating the same. Since these hoisting units are similar as to construction and operation, a description of one will suffice for all. The hoisting mechanism comprises a shaft 54 upon which is mounted a gear wheel 49 carrying a drum 52. The gear wheel 49 meshes with a smaller gear wheel or pinion 47. The latter is fixed to a shaft 22 having bearings in one end of the arm 32, the other end of said arm being supported by the shaft 24 carried by the framework 1. A motor shaft 10 journaled to the frame 1 is provided with a number of similar friction disks, drums or rollers 13 which are keyed or otherwise connected so as to rotate with the motor shaft 10. To the shaft 22 is secured a friction wheel 20 which is so arranged that under certain conditions it will engage the friction roller 13 and be driven thereby. The brake lever 25 provided with a shoe or engaging portion 26 is pivoted or fulcrumed on the shaft 24 and is arranged to be brought into contact with the periphery

of the friction wheel 20. The brake lever 25 is actuated by an electro-magnet 86 in one direction to release the shoe 26, and in the opposite direction by the spring 37 to apply said shoe to the wheel 20. This brake magnet 86 comprises a frame 4 secured to the bed 2, and contains a solenoid 7 in which are a fixed core 38′ and a movable core or armature 38. A stud bolt 39 is secured at its inner end to the armature 38. Surrounding this bolt is a helical spring 37 which is retained in position between the holding cups 40 and 46 through which the rod 39 extends. Cup 46 is secured to the frame 4 of the magnet, while the cup 40 is held by the spring 37 against the nuts 41 which provide a means for varying the tension of the spring. A bolt 42 passes loosely through the fixed member 38′ and its inner end is secured to the armature 38, while its outer end extends through an opening in the brake lever 25 and is provided with a retaining nut 44″ by means of which the position of the brake shoe with respect to the friction wheel 20 may be regulated. When the electro-magnet is deënergized the spring 37 acting through the cup 40 and the bolt 39 will move the armature 38 to the left, and with it the bolt 42 and brake lever 25. In this position the brake shoe 26 bearing against the friction wheel 20 will hold it up out of engagement with the friction driving roller 13. When, however, the electro-magnet is energized the armature 38 will be drawn to the right against the action of the spring 37 and move the brake shoe 26 out of contact with the wheel 20 and permit said wheel to descend into engagement with the driving roller 13. Under these conditions when the motor rotates the shaft 10, power will be transmitted to the hoisting drum 52 and the curtain connected to the latter lifted or lowered as desired.

The stop-motion apparatus which may be used with the hoisting device just described is shown in this instance as mounted in a housing 57 on top of the machine. This stop-motion apparatus is operated by small gear wheels 55 respectively in mesh with the gear wheels 49 of the hoisting units. The purpose of the stop-motion apparatus is to operate circuit-breakers so as to deënergize the electro-magnet 86, or to also slow down the motor a short time prior to the deënergization of the brake electro-magnet.

It is to be understood that for each unit of the multiple hoisting apparatus there is a corresponding unit of the stop-motion apparatus, and that when a stop-motion unit operates to open its circuit-closer only the corresponding unit of the multiple hoisting apparatus will be effected. This operation is automatic, as will be more fully explained hereinafter.

Referring now more particularly to Figs. 1, 2 and 3, where is shown a preferred form of my improved stop-motion apparatus adapted to a hoisting machine having any desired number of units, it will be seen that I have provided a base 79 for the stop-motion apparatus, which base may be bolted to the frame 1 of the hoisting apparatus shown in Fig. 8. A rectangular frame 81″ is secured to the base 79 and projecting upwardly from its opposite rear corners are integral bracket arms or bearing standards 81 and 81′ which support a rod 61 upon which are loosely mounted swinging arms 188 and 188′. Between these arms is a bushing 80 on the rod 61, the purpose of said bushing being to hold the arms 188, 188′ spaced apart and in their proper positions. The gear wheel 55 which is driven by a gear 49 of a hoisting unit is secured to a shaft 62 which carries a small pinion 63. The latter extends the entire length of the shaft 62, as shown in Fig. 5. Mounted on the frame 81″ and parallel with the shaft 62 is a screw-threaded shaft 66 which is held stationary by its supports. Mounted on the shaft 66 are two gear wheels 56 and 56′ whose hubs are screw-threaded to correspond with the threads on the shaft 66. On the hub of the gear wheel 56 are two cams 77 and 78 and on the hub of the gear wheel 56′ are similar cams 77′ and 78′. A rock-shaft 23 is journaled on the base 79, and rigidly secured thereto are rock-arms 8 and 9 which have at their outer extremities lateral projections 8′ and 9′, respectively, which are arranged to be engaged by the cams 77′ and 77, respectively. The cams 78 and 78′ are arranged to engage the detents or trips 60 and 60′ which are carried by the arms 188 and 188′. The latter each carry bridging members 30 and 30′ to electrically connect the contacts 14, 21 and 14′, 21′.

The operation of the construction shown in Figs. 1, 2 and 3 is as follows. When the hoisting mechanism shown in Fig. 8 is in operation the gear wheels 56 and 56′ of the stop-motion device are rotated by means of the gear connections above described. This rotation will impart to the gears 56 and 56′ a lateral movement, owing to their threaded engagement with the shaft 66. If it be assumed that the gear wheel 56 is rotated in a counter-clockwise direction when looking at it from the right, then said gear wheel will move toward the right-hand end of the shaft 66, the threads on the shaft 66 being right-handed. As the gear wheel 56 approaches its limit of travel to the right, the smaller cam 77 will first engage the lower surface of the lateral projection 9′ on the arm 9 of the rock-shaft 23, lifting said arm and partially rotating the said rock-shaft. The larger cam 78 which projects a less distance to the right than the cam 77 will next engage the detent 60 on the arm 188, thus lifting the latter with its contact plate 30 and

breaking the electrical connection between the contacts 14 and 21.

It will be observed that the lateral surfaces of the cams 77 and 78 are inclined or spiral in form and of the same pitch as the threads on the shaft 66. This is for the purpose of preventing any lateral or side thrust of the cams against the parts they engage. This inclination of the cams corresponds to the pitch of the threads on the shaft 66, so that the forward movement of the cam 78, for example, as it approaches the lug 60, is just equal to the receding movement due to the inclined surface of the cam, and the lug 60 will therefore not be engaged until the end of the cam rides under it, lifting the arm 188.

Referring now to Fig. 4 which shows diagrammatically the electrical circuits and connections which may be used in controlling the mechanism shown in Figs. 1, 2, 3 and 8, + and — designate the main lines or the conductors leading from the source of electric current supply. Connected across the mains are the motor and motor-controlling apparatus comprising the motor armature M, shunt field 85 and the accelerating mechanism. In series with the motor armature M are sectional resistances 87, 88, 89 and 90 which as the speed of the motor increases are successively cut out of the circuit by the accelerating magnet 91 and the switches *a*, *b*, *c*, *d* operated thereby in a well known manner. Connected in shunt with the resistance R in the shunt field circuit is a switch arm 92 pivoted at 93 and normally held out of engagement with the contact 94 by an arm 95 on the rock-shaft 23. A dash-pot 96 is provided with a piston 97 which is connected by the rod 98 to the switch arm 92. A valve 99 pivoted on the upper side of the piston opens upwardly, thus permitting the dash-pot piston 97 to move freely in a downward direction. The retardation of the piston 97 in its upward movement may be regulated by the small valve 120. The circuit of the accelerating magnet is controlled by the rock-arm 95. 102 designate reversing switches for controlling the energization of the brake magnets 86.

The operation of the mechanism thus far described is as follows. Let it be assumed that the reversing switch 102 at the left of Fig. 4 is moved onto contact 104 so that the magnet 86 will be energized to release the brake and permit the frictional engagement of the roller 13 and the wheel 20. The corresponding unit of the hoisting apparatus will then be operated and the gears 56 and 56′ will be rotated on the shaft 66. If the gears 56 and 56′ with their cams are rotated in a counter-clockwise direction they will be moved toward the right. As the curtain, for instance, connected to the hoisting drum approaches its limit of movement, the cam 77 will engage the projection 9′ on the arm 9 and rock the shaft 23. The first part of this rocking movement will lift the arm 95 sufficiently to permit the switch arm 92 to engage the contact 94, thus forming a short circuit for the field resistance R. This will effect a reduction in the speed of the motor. The contact on the arm 92 may have a sliding engagement with the contact 94, or said contacts may have a yielding engagement to permit a limited movement of the arm 92 after the contacts are brought together. A further movement of the rock-shaft 23 moves the arm 95 entirely out of contact with the switch lever 92, opening the circuit of the accelerating coil 91. The accelerating electro-magnet will then be deënergized and the switches *a*, *b*, *c* and *d* will automatically open and throw the resistances 87, 88, 89 and 90 back into the motor circuit. This effects a still further reduction in speed of the motor. As soon as this occurs, or shortly thereafter, the larger cam 78 rides under the lug 60 on the switch arm 188, lifting the latter, and with it the contact disk 30, thus opening the circuit including the contacts 21, 14 and the brake magnet 86. The brake spring will then effect the application of the brake and the disconnection of the friction wheel 20 from the driving roller 13.

Just as the cam 78 comes into position to operate the arm 188 and open the brake magnet circuit, or a short time before this operation, the cam 77 disengages the arm 9 and permits the shaft 23 to move back to its original position, which original position is shown in Fig. 2. During this reverse movement of the shaft 23 the circuit through the accelerating electro-magnet is first closed, and the latter operating its switches will again cut out the sectional starting resistance to increase the speed of the motor. A further movement of the shaft 23 in this reverse direction operates the switch arm 92 to disengage it from the contact 94, opening the shunt circuit across the resistance R and throwing the latter into the field circuit again, reducing the strength of the field and still further accelerating the speed of the motor.

The purpose of the dash-pot 96 is to retard the movement just described of the switch arm 92 and thus prevent the motor from speeding up before the magnetic brake 86 has had time to become deënergized and permit the brake spring to throw the hoisting drum out of gear with the motor.

It will thus be seen that in the operation of the stop-motion device, as each individual curtain connected to the hoisting unit for operating the same approaches its limit of travel the speed of the motor is first reduced, the magnetic brake then brought into operation to permit the brake spring to throw the

hoisting device out of gear with the motor, and that then the motor is again brought up to normal speed until another curtain connected to another hoisting unit approaches its limit of travel, when these operations are repeated, the operations being entirely automatic.

When the hoisting drums are operated in the reverse direction, the switches 102 are reversed which will bring the control disks 30′ carried by the arm 188′ in circuit with the brake magnet 86. The cams 77′ and 78′ on the gear wheels 56′ will, as the hoisting drum approaches its opposite limit of travel, coöperate with the rock-arm 8 and the switch arm 188′ in a manner already described.

The modified construction shown in Figs. 5, 5ª, 6 and 7 will now be described. The shaft 61 in this construction is supported by brackets 69, 69′ on the base 79. The hub of the arms 188 and 188′ are longer than in the form shown in Fig. 1 and are not spread apart by bushings 80. The gears 55, pinions 63 and gears 56 and 56′ are similar to those shown in Figs. 1 and 2, but the gears 56 and 56′ each have but a single cam 65 and 65′, respectively, although each is provided with a slot 120 and 120′, respectively, as shown in Fig. 5ª. These cams 65 and 65′ coöperate with the cam lugs or detents 60′ and 60″ projecting laterally and downwardly from the arms 188′ and 188, respectively. In this instance there are two pairs of arms 188 and 188′ for each hoisting unit, one pair for control of the curtain in one direction, and the other to control it in the reverse direction. As the cam 65′, Fig. 5, moves to the left it will first engage the lug 60′ and operate the arm 188′, and a further movement of the cam will operate the arm 188 through the lug 60″.

In Fig. 10 is shown an illustrated diagram of circuits and connections which may be used for controlling the mechanism shown in Figs. 5, 6 and 7. It should be understood, however, with respect to both the wiring diagram shown in Fig. 4 and that shown in Fig. 10 that these are principally to illustrate the application of the invention, and such controlling circuits and connections may be modified and extended to any refinement desired. In Fig. 10 an electro-magnet switch 107 includes a contact member 108 which is normally in engagement with the fixed contacts 109, 110 and the shunt circuit 111 bridging the armature resistance R′ of the motor, whose armature is designated by the reference character M. The contact member 108 when moved downwardly electrically connects the contacts 112, 113. The contact member 108 is connected to a dash-pot 96 similar to that shown heretofore.

If it be assumed that the switch 17 has been operated so that the lever 102 is in engagement with the contact 104, the brake magnet 86 at the left will receive current, provided the contacts 14 and 21 are electrically connected by the plate 30. This circuit may be traced from the positive main by way of conductor 5, lever 102, contact 104, conductor 31′, contacts 14, 21, plate 30 and magnet 86, and thence to the conductor 12 which is connected to the negative main. When the switch 121 is closed the motor will receive current and the first operation will be the lifting of the contact member 108 out of engagement with the contacts 112, 113. This operation is produced by the electro-magnet 107 which receives current across the mains through the conductor 122 and the series of contacts 14′, 21′ and plates 30′. The contact member 108 is so arranged that it will connect the contacts 109 and 110 before it leaves the contacts 112 and 113. The starting resistance R′ will therefore be first short-circuited to increase the speed of the motor, and then the resistance R will be inserted in series with the field winding 85 to still further increase the speed of the motor. Now when the curtain corresponding to the switch 17 approaches its limit of travel the arm 188′ will be lifted by the cam 65′ to cause the plate 30′ to disconnect the contacts 14 and 21. This will effect the de-energization of the electro-magnet 107 and the contact member 108 will therefore begin to drop freely to first cut out the field resistance R and reduce the speed of the motor, and then reinsert the starting resistance R′ to still further reduce the speed of the motor. It will be observed that at this time the motor is only reduced in speed and the brake magnet 86 is still energized. Upon the operation of the arm 188, however, by the cam 65′ the brake magnet circuit is interrupted and the curtain brought to a stop at the upper limit of its travel. In order to permit the motor to again increase in speed the slots 120 and 120′ are provided so that substantially at the same time that the arm 188 is lifted, or a short time thereafter, the arm 188′ is allowed to drop, by reason of the detent 60′ entering the slot 120′. This will cause the plate 30′ to again connect the contacts 14′ and 21′. The electro-magnet 107 will therefore again be energized, but its action will be retarded by the dash-pot 96 so that the curtain desired to be stopped will not again be increased in speed just before the brake is applied. Upon the reënergization of the electro-magnet 107, the starting resistance is again cut out and the field resistance reinserted, thus bringing the motor back to full speed.

At the right of Fig. 10 is shown a stop-motion device which is controlled by a single

swinging arm 188″. This also shows diagrammatically the successive opening of the circuit through the magnet 107, the opening of the brake magnet circuit, and the closing of the former circuit thereafter. In this instance the arm 188″ carries a depending rod 115 which passes loosely through the upper contact disk 30. To the lower end of the rod 115 is secured a contact disk 30′. When the swinging arm 188″ is moved upwardly by the cam mechanism it first lifts the contact plate 30′ and breaks the circuit through the electro-magnet 107, causing the motor to be reduced in speed. A lug 116 on the rod 115 then engages the plate 30 and lifts it from the contacts 14, 21, thus opening the circuit through the brake magnet 86 and permitting the brake to operate. A further upward movement of the plate 30′ causes the electrical connection of the contacts 118, 119 and the reëstablishment of the circuit through the solenoid 107 to again bring the motor to full speed. This form of stop motion device just described may be used as shown in Fig. 10 in combination with the other form of stop motion device shown in said figure, to control one or more of the hoisting units. This form of stop motion device, shown at the right of Fig. 10, obviously might also be applied to each of the hoisting units.

Fig. 9 shows a modification of the cam mechanism in that the gear wheel 56 is provided with a screw-threaded hub 71. The cam 65″ is threaded onto this hub so as to be movable longitudinally thereof. A locking nut 74 holds the cam 65″ in its adjusted position. By this construction the relative position of the cams 65 and 65″ may be adjusted to vary the point at which the stop-motion device will operate.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of my invention, and I desire therefore not to be limited to the precise construction herein disclosed.

What I claim and desire to have protected by Letters Patent of the United States is:—

1. The combination with a hoisting device and driving means therefor, of automatic means for releasing said hoisting device from its driving means at a predetermined point in the operation of the hoisting device, and appliances for reducing the speed of said driving means prior to such release.

2. The combination with a hoisting device and an electric motor for driving the same, of automatic devices for reducing the speed of the motor at a predetermined point in the operation of the hoisting device, and means for disconnecting the hoisting device after the speed-reducing-means has operated.

3. The combination with a hoisting device and an electric motor connected to drive the same, of a starting resistance, a field resistance, automatic means for successively controlling said resistance at predetermined points in the operation of the hoisting device to reduce the speed of the motor, and means for automatically again increasing the speed of the motor when the hoisting device is stopped.

4. The combination with a hoisting device and an electric motor for driving the same, of accelerating apparatus for said motor, and means for causing said accelerating apparatus to reduce the speed of the motor before the hoisting device is stopped and again increasing the speed of the motor after such hoisting device is stopped.

5. The combination with a hoisting device, of brake mechanism therefor, an electric motor connected to the hoisting device for operating the same, and automatic means for successively reducing the speed of the motor, effecting the application of the brake mechanism, and then accelerating the speed of the motor.

6. The combination with a hoisting device, of a brake mechanism therefor, a motor for operating the hoisting device, and means for automatically reducing the speed of the motor, effecting the operation of the brake mechanism, and then accelerating the speed of the motor more slowly than it was reduced.

7. The combination with a hoisting device and means for driving the same, of means for applying braking action to the hoisting device and disconnecting it from the driving means, and means for reducing the speed of the driving means prior to the operation of said disconnecting means and again increasing the speed after said operation.

8. The combination with a hoisting device and driving means therefor, of apparatus for effecting a braking action on the hoisting device and disconnecting it from its driving means, and means for reducing the speed of the driving means prior to the operation of said braking apparatus, and for accelerating the speed of the driving means after the hoisting device is disconnected therefrom.

9. The combination with a hoisting device and an electric motor, of electro-magnetic brake apparatus to effect a braking action on the hoisting device and to disconnect same from the motor, means operated by the hoisting device for automatically and successively reducing the speed of the motor, effecting the application of said brake apparatus, and accelerating the speed of the motor as the hoisting device approaches its limit of movement in either direction.

10. In a stop-motion device, the combination with a rock-shaft, of a rock-arm connected thereto, an electric switch operated

by said arm, a second shaft, and means movable longitudinally of said second shaft for engaging said arm to operate the rock-shaft.

11. In a stop-motion device, the combination with a rock-shaft, of a second shaft parallel thereto, a cam device movable longitudinally of said second shaft, means carried by the rock-shaft in position to be engaged by the cam device and an electric switch controlled by said rock-shaft.

12. In a stop-motion device, the combination with a screw-threaded shaft, of a gear wheel mounted thereon for longitudinal movement, a plurality of cams carried by said gear wheel, means for rotating said gear wheel, and a plurality of circuit-controlling devices operatively positioned with relation to the cams.

13. The combination with a screw-threaded shaft, of a pair of gear wheels screw-threaded on said shaft for movement longitudinally thereof, a cam device carried by each gear wheel, means for rotating the gear wheels to move them longitudinally of the shaft, a circuit-controlling device positioned to be operated by one of the cam devices when its gear wheel is moved in one direction, and a circuit-controlling device positioned to be operated by the other cam device when its gear wheel is moved in the opposite direction.

14. In a stop-motion device, the combination with a threaded shaft, of a member threaded on said shaft movable longitudinally thereof and carrying a plurality of cams, a movable arm having a cam-engaging portion in the path of travel of one of said cams, a rock-shaft parallel with the threaded shaft, and an arm on the rock-shaft extending into the path of travel of another of said cams, the relative position of the cams and arms being such that the arms will be operated successively.

15. In a stop-motion device, the combination with a frame, of a screw-threaded shaft rigidly mounted in said frame, a plurality of gear wheels with hubs internally screw-threaded and rotatably mounted on said shaft, a cam on the hub of each of said gear wheels, means for rotating said gear wheels, a second shaft in the frame parallel with the threaded shaft, swinging arms pivoted to said second shaft and each extending into the path of movement of one of said cams, and circuit-controlling devices connected to said second shaft and operated by movement thereof.

16. In a stop-motion device, the combination with a screw-threaded member, of a cam device having corresponding screw threads, and mounted for spiral movement on said member, said cam device having a spirally inclined lateral face, the inclination being of the same pitch and extending in the same direction as the threads on the threaded member, and means for rotating said cam to cause the same to move longitudinally along said member.

17. In a stop-motion device, the combination with a screw-threaded shaft, of a member mounted for rotating on said shaft and having a cam surface at or near its periphery, and a spirally inclined lateral surface, the pitch of said inclined surface being equal to the pitch of the threads on the shaft and extending in the same direction, a cam-engaging member in the path of travel of the cam, and means for operating said cam member.

18. The combination with a hoisting device and power operating means for driving the same, of a stop motion device operatively connected to the hoisting device, and appliances operated by the stop motion device to temporarily vary the speed of the power operating means and then restore the speed to normal.

19. The combination with a hoisting device, of electro-magnetic brake apparatus therefor, an electric motor connected to drive the hoisting device, appliances for varying the speed of the motor, a fixed screw-threaded shaft, a gear wheel threaded on said shaft, driving connections between the hoisting device and the gear wheel, cams carried by said gear wheel, a swinging arm having an engaging member in the path of travel of one of said cams, a rock-shaft having an arm extending into the path of travel of the other cam, a switch for the electro-magnetic brake apparatus and controlled by said swinging arm, and operative connections between said rock-shaft and said speed-varying appliances, the relative positions of the cams and their coöperating members being such that the rock-shaft will first be actuated to effect the operation of the speed-varying appliances and then the swinging arm will be actuated to effect the application of the electro-magnetic brake apparatus.

20. The combination with a plurality of hoisting devices, of a single electric motor for driving all of the hoisting devices, a plurality of stop-motion devices, one for each of said hoisting devices, a plurality of electro-magnetic brakes, one for each of said hoisting devices, and means operated by each stop-motion device for slowing down the motor and thereafter effecting the application of the brake for the hoisting device corresponding to said stop-motion device.

21. In multiple curtain hoisting apparatus, the combination with a plurality of units of hoisting devices, of a plurality of electro-magnetic brake devices, one for each of the hoisting devices, individual stop-motion mechanisms connected separately to said hoisting devices, a single motor for driving one or more of said hoisting devices, and means operated by each of said stop-motion mechanisms for slowing down the

motor prior to the application of a brake device and after such application and the stopping of the corresponding hoisting devices permitting the motor to again attain normal full speed.

22. In a stop-motion device, the combination with a pair of movable members, of a cam device movable into engagement with said members to operate them successively, and hold them contemporaneously in operated position, and circuit-controlling means operated by said members.

23. In a stop-motion device, the combination with a fixed screw-threaded shaft, of a gear wheel threaded on said shaft, driving mechanism for rotating the gear wheel and moving it longitudinally of the shaft, a cam device carried by the gear wheel, swinging arms with cam-engaging portions projecting into the path of movement of the cam device in position to be operated successively by the latter, and held in operated position contemporaneously, and circuit-controlling mechanism operated by the movement of said arms.

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

ANDREW M. COYLE.

Witnesses:
W. H. BRADY,
A. M. ZABRISKIE.