No. 815,015. PATENTED MAR. 13, 1906.

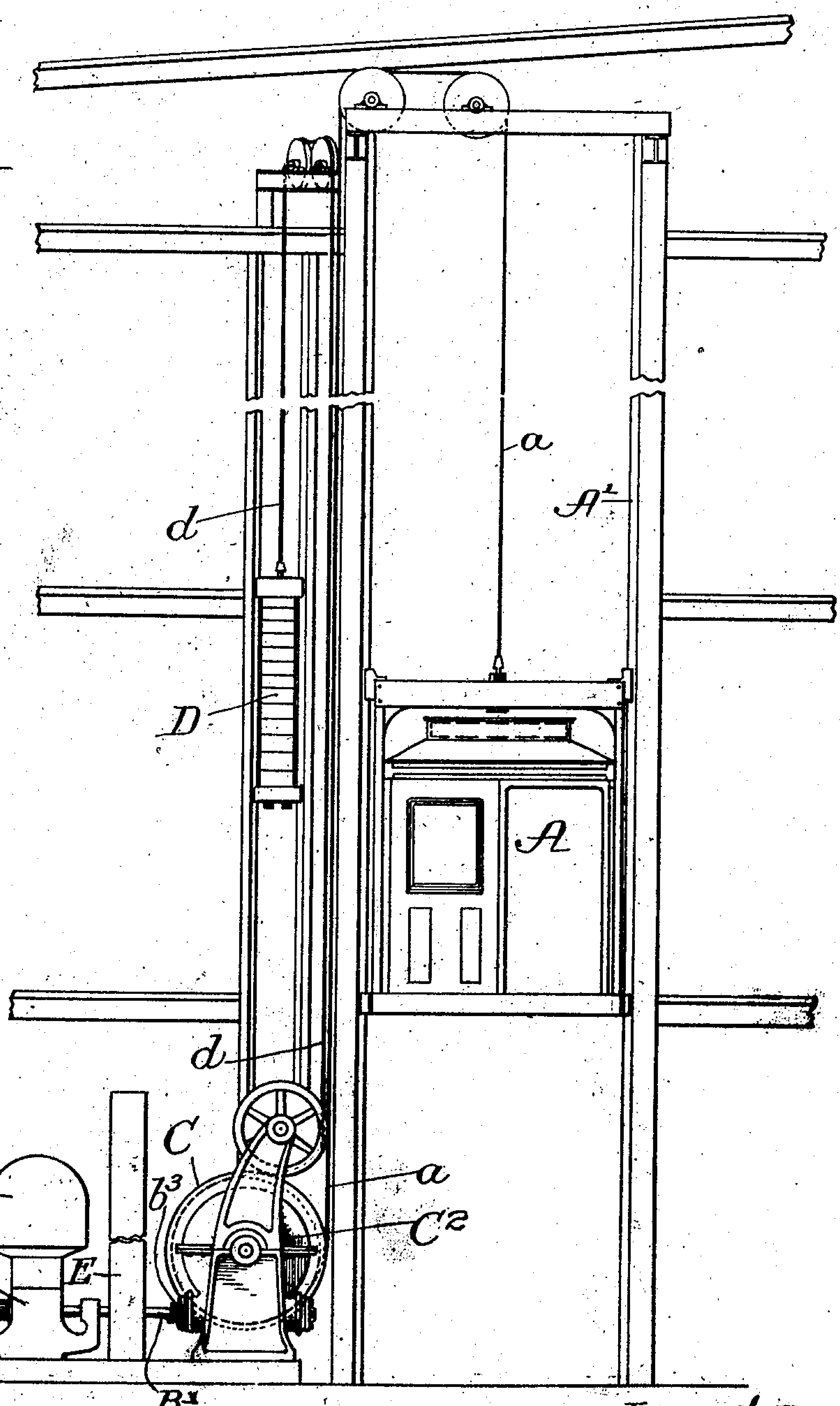
T. W. HEERMANS.

AUTOMATIC BRAKE FOR POWER ACTUATED ELEVATORS.

APPLICATION FILED JAN. 16, 1905.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses

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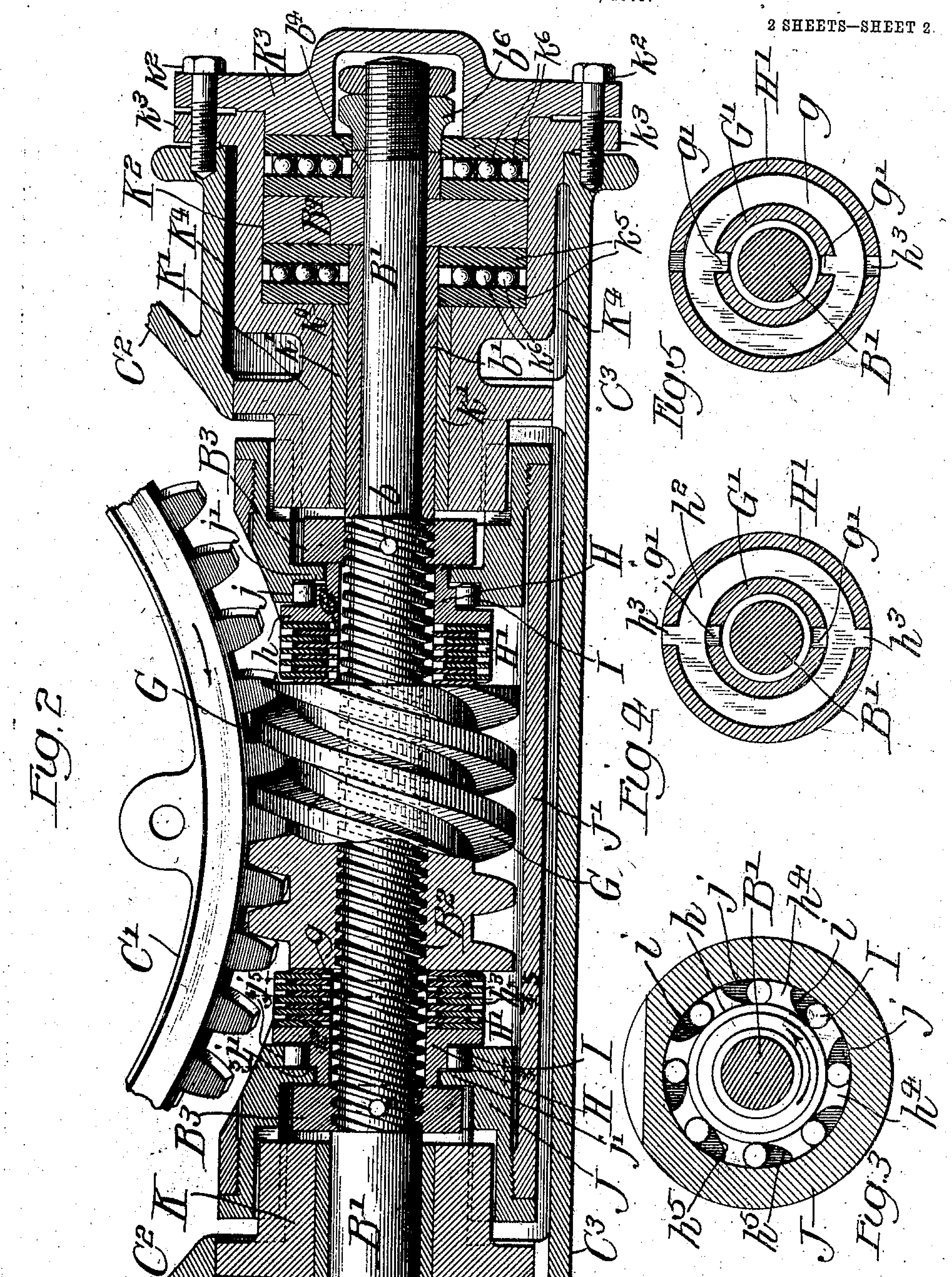

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UNITED STATES PATENT OFFICE.

THADDEUS W. HEERMANS, OF EVANSTON, ILLINOIS.

AUTOMATIC BRAKE FOR POWER-ACTUATED ELEVATORS.

No. 815,015. Specification of Letters Patent. Patented March 13, 1906.

Application filed January 16, 1905. Serial No. 241,366.

To all whom it may concern:

Be it known that I, THADDEUS W. HEERMANS, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Brakes for Power-Actuated Elevators; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to a novel braking apparatus for elevator-cars; and the invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

The invention is adapted for power-actuated elevators of any kind, and its construction peculiarly adapts itself to electric passenger-elevators. In this class of elevators it is common to employ a braking apparatus wherein the load is arrested and sustained, when the driving power is shut off, by means of a brake acting upon the motor-shaft, as the armature-shaft of an electric motor, the brake serving not only to counteract the momentum and arrest the movement of the motor-shaft, but also to arrest the movement of the elevator-car. It is highly desirable in a successful elevator apparatus that the braking mechanism be so constructed as to bring the elevator-platform to a state of rest and hold the same at the level of the floors from which or upon which the car is to be loaded or unloaded. Inasmuch as the load of an elevator-car constantly varies, it is extremely difficult in practice to operate the motor braking apparatus in a manner to bring the car to a gentle stop or state of rest within a fixed distance from the time of application of the braking power and hold the car at such level. This is due to the fact that it is impracticable to so adjust the motor-brake to existing conditions as to arrest the motor-shaft and therethrough the car within prescribed limits, there being no maintainable relation between such braking action and the varying loads. It is customary to slightly overweight the car with the counterweight, and the unreliability in stopping the car at a predetermined level is liable to occur when the car is moving in either direction. In other words, when the car is moving upwardly slightly loaded or downwardly heavily loaded it is inclined to overrun or pass the level at which it is intended that it should stop, to the same extent that the car is inclined to reverse its direction of motion after it has been arrested when moving upwardly heavily loaded or moving downwardly lightly loaded. To overcome these defects, a braking apparatus supplementary to the motor braking apparatus is employed, and it is constructed to utilize the load of the car and its contents or the overload of the counterweight when the motor is arrested or slowed down by its brake for bringing the car to rest or reducing its speed. Any ordinary or preferred brake may be applied for arresting the momentum and bringing to rest the motor-shaft. The braking apparatus for the car relieves the motor-brake from the work of arresting the car, so that the only work required of the motor-brake is to arrest its own momentum. Inasmuch as this factor is a constant one, the motor-shaft is arrested within the same periods under all conditions of loads. My improved braking apparatus is constructed to be operated by the overload in either direction, so that the holding of the car when arrested is not thrown on the motor-brake. The action of the car-brake is, however, modified by that of the motor-brake in the sense that its response is dependent upon the character of the action of the motor-brake. If the motor be arrested suddenly by its brake, the action of the car-brake is prompt to arrest the car, while a gradual reduction of the speed of the motor results in a correspondingly gradual reduction of the speed of the car. The action of my improved brake is such also that its retarding influence is felt whenever there is a tendency of the load to drive the motor-shaft or other actuating power either when the motor is in operation or at other times—that is to say, whenever there is an overload in either direction of movement of the car the tendency of this overload to drive the actuating power is absorbed by the braking apparatus herein shown and described, and such braking device acts within a practically-fixed distance to arrest the movement of the car. Said braking apparatus is so associated with the driving connections between the motor and car that it constitutes when the car is running at a normal load a part of the driving connection and only functions as a braking apparatus when an overload exists in one direction or other of the car.

As shown in the drawings, Figure 1 illustrates a typical elevator apparatus including the motor, car, and counterweight to which my invention may be applied. Fig. 2 is a longitudinal sectional view of my improved braking device, showing the same in meshing gear with the drum gear-wheel. Figs. 3, 4, and 5 are transverse sections taken on lines 3 3, 4 4, and 5 5 of Fig. 2.

As shown in the drawings, Fig. 1, A designates an elevator-car; A′, the shaft therefor; B, the motor for driving the car, herein shown as comprising an electric motor; C, a drum which is driven by said motor through the medium of suitable gearing, and D a counterweight. Said car and counterweight are connected with the drum through the means of cables a d, which are trained over suitable guiding and directing sheaves in a familiar manner. The drum C is shown as located at the foot of the shaft A′, and the car is counterweighted through the drum in a familiar manner.

E and F designate diagrammatically the usual braking device for the motor-shaft B′ and the controller for the motor, both of which devices are operated in any suitable manner from the car.

C′, Fig. 2, designates a worm-gear which is connected with and drives the drum C in a familiar manner. Said gear is inclosed in a case C^2, Fig. 1. It is rotated through the medium of a suitable driving-gear, herein shown as consisting of a worm-screw G, which latter is mounted on and is rotated by the motor-shaft B′ and meshes with the worm-gear C′, Fig. 2. The said worm-screw G has the form of a nut, it being interiorly screw-threaded to engage the screw-threaded section B^2 of the armature-shaft, whereby said worm-screw may by relative rotation of the worm-screw and the armature-shaft be shifted endwise of said armature-shaft. As herein shown, both the worm-screw and armature-shaft are provided with left-handed threads. The said worm-screw and a portion of the armature-shaft are inclosed by a suitable casing C^3, which is made integral with the gear-wheel casing C^2, as shown, and the operative parts are adapted to be submerged in oil contained in said casing. It will be observed, therefore, that rotation of the screw-threaded worm-screw therein tends to shift the worm-gear endwise of the shaft, its direction of movement depending upon the direction of rotation of the shaft. Mechanism is provided which coöperates with such endwise shifting of the worm-screw G and serves to lock said worm-screw temporarily to the armature-shaft, at which time the worm-screw constitutes part of the driving connection, and power is transmitted from the armature-shaft through the worm-screw to rotate the gear-wheel C′. Said mechanism also embraces or coöperates with a suitable ratchet or other locking mechanism, which operates to lock the worm-screw from rotation, and thereby arrest the drum and the car from movement in either direction. Said mechanism is made as follows: B^3 B^3 designate collars which are non-rotatively fixed to the armature-shaft by pins b b and are located one at each end of the screw-threaded part of said shaft. H H designate cam or wedge rings loosely surrounding the armature-shaft, one between each of the collars B^3 and the adjacent end of the worm-screw G. Said rings serve also as thrust-rings and are brought into use to lock the worm-screw to the shaft. Said cam-rings are provided at their inner ends with radial flanges h, and extending inwardly from the outer margins of said flanges are tubular extensions or sleeves H′. Said sleeves H′ surround and receive smaller tubular extensions or sleeves, as G′, extending outwardly from the ends of the worm-screw. The outer ends of said rings H are reduced and bear against the inner faces of the fixed collars B^3 on the shaft. Interposed between the flanged ends of said cam-rings and the adjacent ends of said worm-screw G and contained in the annular spaces between the sleeves G′ H′ are a plurality of annular friction-plates g h^2. The plates h^2 are interlocked with the sleeves H′, whereby they rotate about the armature-shaft when the rings H rotate, while the plates g are similarly interlocked with the sleeves g' of the worm-screw and rotate with said worm-screw. As herein shown, said friction-plates are provided with lugs h^3 g', which enter suitable longitudinal slots in said sleeves or tubular telescopic extensions of the rings and worm-screw. The lugs g' of the plates g extend inwardly from the inner margins thereof and enter oppositely-located slots in the sleeves G′ of the screw G, while the lugs h^3 of the alternate plates h^2 extend outwardly from the outer margins thereof and enter oppositely-disposed slots in the sleeves or extensions H′ of the cam-rings H.

I I designate a plurality of cylindric rollers which are located in annular chambers i between the peripheries of the rings H, just in rear of the flanged parts h thereof and surrounding inner-facing cylindric bearing-surfaces j, Fig. 3, formed in stationary annular parts J, that have screw-threaded engagement with the ends of a sleeve J′, contained within the casing c^3. The sleeve and end screw-threaded parts are non-rotative in said casing, as shown in Fig. 2. Such annular parts J of the casing are provided with inwardly-extending flanges j', Fig. 2, parallel with the flanges h of the rings H, the two flanges h j' constituting the end walls of the annular roller spaces or chambers before referred to. Said cylindric rollers I are separated in said annular chambers by means of short cam-arms h^4, extending outwardly from the peripheries of the rings H and across the annular chambers. Said cam-arms are each formed on one side with a cylindric recess to receive the associated roller I and on its other side with a cam or wedge face h^5, as clearly shown in Fig. 3. It will thus be seen that the rings H are free to rotate in the direction toward which face the cylindric recesses of the arms without being restricted by the rollers, but are prevented from rotating in the opposing direction, inasmuch as said rollers are pinched between the cam-faces of the arms and the inner cylindric surfaces j^2 of the bearing-chamber. The cam-arms are so disposed that one ring H is thus locked from rotation in one direction and the other is locked from rotation in the opposite direction. With this construction it will be observed that rotation of the armature-shaft in the proper direction acts, through the screw-threaded connection of said shaft with the worm-screw, to shift the worm-screw endwise in one direction and to force said worm-screw tightly against one group or complement of friction-plates g h^2 and therethrough to force the associated cam-ring H against the adjacent collar B^3. When said parts are thus forced together, the worm-screw is locked to the armature-shaft in a manner to transmit power therefrom to the worm-wheel C′ and drum. It will be furthermore observed that when the worm-screw is thus shifted in one direction and is locked to the armature-shaft through one complement of friction-plates and cam-ring it moves away from the other complement of friction-plates and ring and frees the latter from frictional contact with each other and the associated collar B^3. It will be observed also that the worm-screw is locked to the armature-shaft through the medium of one set of washers and their associated ring H and collar B^3 when the shaft is rotating in one direction and is locked to said shaft when the rotation of the latter is reversed through the medium of the other set of washers and their associated ring H and collar B^3. When, therefore, one complement of friction-plates at one end of the worm-screw functions to lock the worm-screw to the shaft, the opposite complement are loose, and vice versa. The cam or wedge rings and rollers I coöperating with the cylindric bearing-surfaces of the parts J of the casing coöperate with the friction-plates g and h^2 and worm-screw to utilize the momentum of the load of the car or counterweight in either direction to prevent overrunning of the car and arresting it within practicable prescribed limits, and said parts also coöperate to arrest the car when either the weight of the car or the counterweight tends to move the car beyond its landing-level after the car has been brought to a state of rest. Said braking mechanism operates not only to stop the car when the motor is arrested, but its retarding influence is felt whenever there is a tendency of the load of the car or counterweight to drive the motor in either direction.

The operation of the braking mechanism to utilize the momentum of the car to arrest the movement thereof will be understood from a consideration of the following: It is first to be noted that in the illustrated construction both the armature-shaft and the worm-screw have left-hand screw-threads. It will be furthermore observed that the noiseless ratchet mechanism (embracing the rollers I and the coöperating cam-arms) are so arranged that when the armature or motor shaft rotates to the left and the worm-screw or nut G is locked to the armature-shaft through the medium of the left-hand complement of friction-plates g h^2, the ring H, and collar B^3, Fig. 2, the said ring H is free to rotate with the shaft, it rotating at this time in the direction indicated by the arrow in Fig. 3. When the armature or motor shaft rotates in the opposite direction, or to the right, the worm-screw is locked to the shaft by the right-hand complement of friction-plates g h^2, ring H, and collar B^3, and the arrangement of the associated noiseless ratchet mechanism permits the shaft to rotate in this direction. When the worm-screw is thus locked to rotate with the shaft in either direction, an overload tending to cause the car to overrun its landing-level has the effect to back the worm-screw away from the active set of friction-plates without change of direction of rotation of the screw and lock said screw to the shaft through the other set of friction-plates, and inasmuch as the ratchet mechanism adjacent to the latter plates is active in this direction the worm-screw and shaft are arrested. If under the same conditions the overload of the car or counterweight tends to reverse the direction of rotation of the worm-screw and shaft after the latter have been arrested, the screw will remain locked to the shaft, as before, but both the drum and car will be arrested by the ratchet mechanism adjacent to the active friction-plates.

If it be assumed that the armature-shaft rotates to the left to raise the elevator-car, the direction of movement of the screw G and gear C′ will be that indicated by the arrows, and at such time the worm-screw is locked to the shaft through the left-hand washers, cam-ring, and collar. If now the car is to be stopped, the armature-brake is thrown into action to arrest the rotation of the armature-shaft. Should the car be so lightly loaded that the momentum of the counterweight tends to carry the car beyond its landing-level, the result is that the gear C′ or other gear connected with the car is driven by the load of the counterweight and drives the worm-screw or nut G in the original direction, with the result of backing the worm from the left-hand complement of friction-rings against the right-hand complement of friction-rings and cam-ring H. Inasmuch as the right-hand cam-arms and rollers are active to lock the adjacent ring H from rotation in such original direction of rotation of the worm-screw or nut, the result of thus forcing said worm-screw against said right-hand complement of thrust-washers and cam-ring is to lock said worm-screw, and therefore arrest the gear C′ and the car connected therewith. When the car is again started upwardly, the worm-screw or nut is shifted to the left and locked to the shaft, as before. It is evident also that the braking action of the mechanism described manifests itself during the time the car is traveling upwardly if the car be lightly loaded and is overbalanced by its counterweight. In such case when the action of the weight tends to drive the armature such overload acts, through the endwise-shifting worm-screw and friction-washers, to momentarily arrest the car until it is overtaken and again driven by the armature-shaft. Such action is not sufficiently evident as to manifest itself perceptibly in the movement of the car. If, however, a heavily-loaded ascending car be stopped and the load of the car after the car is arrested tends to drive the worm-screw and armature-shaft in a reverse direction, the worm-screw will not be released from the shaft, and inasmuch as the locking mechanism—to wit, the associated cam-arms and rollers—are active in this direction the load will be held.

The action of the driving and braking mechanism on a descending car is the reverse to that described when operating to lift the car. For instance, if the car is overbalanced by its counterweight and is descending lightly loaded, power will be exerted through the armature-shaft and worm-screw (rotating in the illustrated instance to the right) to overcome the weight of the counterweight. When the car is now brought to a stop, it is prevented from reversing its direction in the same manner as a heavily-loaded descending car is held and as hereinabove described—that is to say, by the ratchet mechanism adjacent to the friction-plates theretofore in service. If the descending car be heavily loaded, however, the action of the armature-shaft when reversed to lower the car is to back the worm-screw from the friction-plates theretofore in service and release the latter. This action allows the load to momentarily descend by its own weight, thereby driving the worm-gear relatively to the armature-shaft until it is locked by the means described. The continued motion of the armature-shaft again releases the worm-screw, so that the action of lowering the load is that of continuously releasing the friction-plates by the motion of the motor-shaft and the continual effort on the part of the load to overtake the armature-shaft and relock itself.

It is manifest from the foregoing that while the motor-brake is relieved from the work of holding the car after it has been arrested, yet the action of the motor-brake modifies that of the car-brake, and therefore coöperates with the car-brake to control the car—that is to say, the promptness with which the car-brake is brought into action to arrest the car under usual running conditions depends upon the greater or less activity with which the motor-brake is operated to control the motor and its shaft. If the motor-brake be set to bring the motor to a stop within a minimum time, the car will be arrested by its brake with corresponding promptitude. If, however, the motor braking power be slowly applied, the effect of the action of the car-brake upon the car is therefore more gradual. The car is therefore under the perfect control of the conductor at all times and without the necessity on the part of the conductor calculating the relation of the load on the car to the effect of the action of the brake mechanism.

It will be observed that the friction-plates g h^2 and rings H constitute when the worm-screw or nut is locked to the shaft merely thrust elements interposed between the stop-collars B^3 and the worm-screw, whereby the worm-screw is locked to the shaft by a shearing action of the screw-threads of the shaft and screw. When, however, the cam or wedge rings are locked to the casing, the friction between the washers is utilized to arrest or brake the load of the elevator-car. When such braking action takes place, the load of the car is free or released from the armature-shaft; but such condition prevails but momentarily when the elevator is in active service. The construction described constitutes a sensitive brake and one which may always be relied upon for efficiency and prompt service.

The armature-shaft is rotatively mounted in suitable bearings K K′, which are located at the ends of the casing C^3. The end of said shaft remote from the armature is reduced and is provided with a sleeve b', non-rotative on the shaft, which sleeve has bearing in a sleeve k' in the bearing K′. The bearing K is formed to provide a typical form of stuffing-box b^3, Fig. 1, through which the armature-shaft B′ extends. The other bearing K^2 extends into the casing C^3 and is fastened therein by bolts k^2, extending through an annular flange k^3 at the end of the bearing and into the end of the casing. The same bolts fasten a cap K^3 over the end of the bearing. The outer end of the bearing K′ is enlarged to constitute an annular chamber K^4 to receive a thrust-bearing for the armature-shaft B′, said thrust-bearing acting to take the end thrust of the shaft in both directions. The thrust-bearing may be of any suitable form and, as herein shown, is made as follows: B^4 designates a collar non-rotative on the shaft within the annular enlarged part of the bearing K′ and is immovable endwise of the shaft between the sleeve b' and a short sleeve b^4, surrounding the shaft. The latter sleeve is held in place by a nut b^6, having screw-threaded engagement with the outer end of the shaft and occupying a recess in the cap K^3 of the bearing K′. Located between said collar B^4 and said cap on one side, and a shoulder k^4 on the other side are hardened plates k^5 k^5, arranged in parallel pairs and between which are interposed antifriction-rollers k^6, confined in suitable cages. The endwise thrust of the shaft in both directions is taken by the double thrust-bearing described. The parts are so constructed as to permit the parts of the brake and driving-gear contained within the casing C to be inserted for the most part, when being taken apart or assembled, through the end of the casing containing the thrust-bearing when the bearing K′ is removed.

I claim as my invention—

1. In a power-driven elevator, the combination with the car, its counterweight, a motor for driving the car and a brake for arresting the motor, of a braking mechanism for the car constructed to arrest the car by the momentum of the load acting in either direction.

2. In a power-driven elevator, the combination with the car, its counterweight, a motor for driving the car and a brake for arresting the motor, of a braking mechanism for the car, and connection between said braking mechanism and the car and counterweight constructed to be actuated by the load or momentum of the car and counterweight acting in either direction to automatically bring the car to rest.

3. In a power-driven elevator, the combination with the car, its counterweight, a motor for driving the car and a brake for arresting the motor, of a braking mechanism for the car and connections between the braking mechanism and car and counterweight so constructed that said braking mechanism operates independently of the motor-brake to arrest the car by the load or momentum of the car and counterweight acting in either direction.

4. In a power-driven elevator, the combination with the car, its counterweight, a motor for driving said car, gearing connecting the motor with the car and a brake for arresting the motor, of a friction braking mechanism operatively connected with the car and counterweight and designed to be set in motion by the momentum or weight of the load in either direction for arresting the car.

5. In a power-driven elevator, the combination with the car, its counterweight, a drum to the opposite sides of which the car and counterweight, respectively, are connected, a reversible rotary motor-shaft geared to the drum, and a brake for said shaft, of a braking mechanism for the car embracing in part a portion of the gearing between the shaft and drum and in part braking elements coöperating therewith in a manner to utilize the weight or momentum of the load on the drum in either to arrest the car.

6. In a power-driven elevator, the combination with the car, its counterweight, a motor for driving said car, gearing connecting the motor with the car and counterweight embracing a screw-threaded rotative motor-shaft, a gear surrounding and having screw-threaded engagement with said shaft, and designed to be locked to the shaft through rotation of said shaft to constitute part of the car-driving-gear mechanism and to be temporarily released from the shaft when the load tends to drive the shaft, and a brake for arresting the motor, of a braking mechanism for arresting the car, comprising means coöperating with said screw-threaded gear when said gear is temporarily released from the shaft as a driving connection for locking said screw-threaded gear to arrest the car.

7. In an elevator, the combination with the car, its counterweight, a motor for driving the car, gearing connecting the motor with the car and counterweight comprising a screw-threaded, rotative motor-shaft and its bearing, a screw-threaded gear mounted on said shaft and meshing with a coacting gear forming part of the driving-gear, and a brake for the motor, of means whereby said screw-threaded driving-gear is locked to the shaft when the motor is driving the car, and means whereby said gear is frictionally locked to the motor-shaft bearing when the load of the car or counterweight tends to drive the screw-threaded gear.

8. In an elevator, the combination with the car, its counterweight, a motor for driving the car, gearing connecting the motor with the car and counterweight embracing a screw-threaded motor-shaft and its stationary bearing, a worm-screw surrounding and having screw-threaded engagement with said shaft and meshing with a worm-wheel forming part of the gearing between said motor and the car and counterweight, means whereby the worm-screw is locked to the shaft by rotation of the latter to constitute part of the driving mechanism, and a brake for said motor, of a braking mechanism coöperating with said worm-screw, and operative when the worm-screw is released from the motor-shaft to frictionally lock the worm-screw to the stationary bearing of the motor-shaft.

9. In an elevator, the combination with the car, its counterweight, a motor for driving the car, gearing connecting the motor with the car and counterweight, embracing a

screw-threaded motor-shaft and its stationary bearing, a worm-screw surrounding and having screw-threaded engagement with the shaft and meshing with a worm-wheel forming part of the gearing between said motor and the car, and counterweight, means whereby the worm-screw is locked to the shaft by rotation of the latter to constitute part of the driving mechanism, and a brake for said motor-shaft, of a car-braking mechanism coöperating with said worm-screw, comprising two sets of coacting friction-washers at each end of said screw, one set carried by the worm-screw, and rings loosely surrounding the motor-shaft and carrying the other or coacting set of washers, one ring rotating freely in one direction and the other in the other direction, and means for locking each ring from backward rotation.

10. In an elevator, the combination with the car, its counterweight, a motor for driving the car, gearing connecting the motor with the car and counterweight, embracing a screw-threaded motor-shaft and its stationary bearing, a worm-screw surrounding and having screw-threaded engagement with the shaft and meshing with a worm-wheel forming part of the gearing between said motor and the car and counterweight, means whereby the worm-screw is locked to the shaft by rotation of the latter to constitute part of the car-driving mechanism, and a brake for said motor-shaft, of a car-braking mechanism cooperating with said worm-screw, comprising coacting friction devices, one set being carried by each end of the worm-screw, rings loosely surrounding the motor-shaft at each end of the screw and carrying the other coacting friction devices, and means for locking said rings from rotation in one direction while permitting them to rotate with the shaft in the other direction and so arranged that the rings are locked from rotation in opposite directions relatively to each other.

11. The combination with an elevator-car, its counterweight, and a driving-motor, of driving connections between the motor and car, including a screw-threaded rotative shaft, a worm-screw surrounding and having screw-threaded engagement with said shaft, a worm-wheel meshing therewith, means for locking said worm-screw to the shaft when the shaft is rotated in a direction to drive the car, and means for frictionally locking said worm-screw from rotation independently of the shaft when the motor of the car or counterweight on the worm-wheel acts to drive the worm-screw in either direction.

12. The combination with an elevator-car, and a motor, of driving connections between the motor and car, which includes a brake mechanism comprising a screw-threaded rotative shaft, a worm-screw surrounding and having screw-threaded engagement with said shaft, a worm-wheel meshing therewith to the opposite sides of which are connected the car and counterweight, collars fixed to the shaft, one at each end of the worm-screw, a ring loosely mounted on the shaft between the worm-screw, and each collar and adapted to rotate with the shaft in one direction, but to be locked from rotation in the other direction, and coacting friction devices carried by said worm-screw and rings.

13. The combination with an elevator-car, its counterweight and its motor, of a driving and braking mechanism comprising, in combination with a screw-threaded motor-shaft, a worm-screw surrounding and having screw-threaded engagement with said shaft and meshing with a worm-gear constituting part of the car-driving mechanism, and to the opposite sides of which the car and counterweight are connected, collars fixed to said shaft, one at each end of said worm-screw, rings loosely mounted on said shaft between said collars and worm-screw, said rings and worm-screw being provided with sleeves entering one within the other, friction-washers surrounding the inner one of said sleeves affixed alternately to the said sleeves, whereby alternate washers of each set have frictional engagement with each other, and means whereby said rings are locked from rotation in one direction and are free to rotate with the shaft in the other direction.

14. The combination with an elevator-car, its counterweight, and its motor, of a combined driving and braking mechanism therefor, comprising a rotative screw-threaded shaft, a worm-screw surrounding and having screw-threaded engagement with the shaft, and meshing with a worm-gear constituting part of the elevator-driving mechanism and to the opposite sides of which gear the car and counterweight are connected, collars on the shaft at each end of the worm-screw, rings loosely mounted on said shaft between said collars and screw-threaded gear, and provided with a plurality of arms having at one side thereof wedge or cam faces and at the other side rounded recesses, rollers interposed between said arms and occupying chambers surrounding said rings, said rings and screw-threaded gear being provided with sleeves which fit one within the other, and friction-washers arranged between and carried in alternation by said sleeves.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 6th day of January, A. D. 1905.

THADDEUS W. HEERMANS.

Witnesses:
W. L. HALL,
GEORGE R. WILKINS.