

Nov. 4, 1969

KAZUYOSHI OZAKI
DEVICE FOR BRAKING AND STOPPING DOOR
LEAF OF AUTOMATIC DOORS

3,475,862

Filed Oct. 23, 1967

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FIG. 1

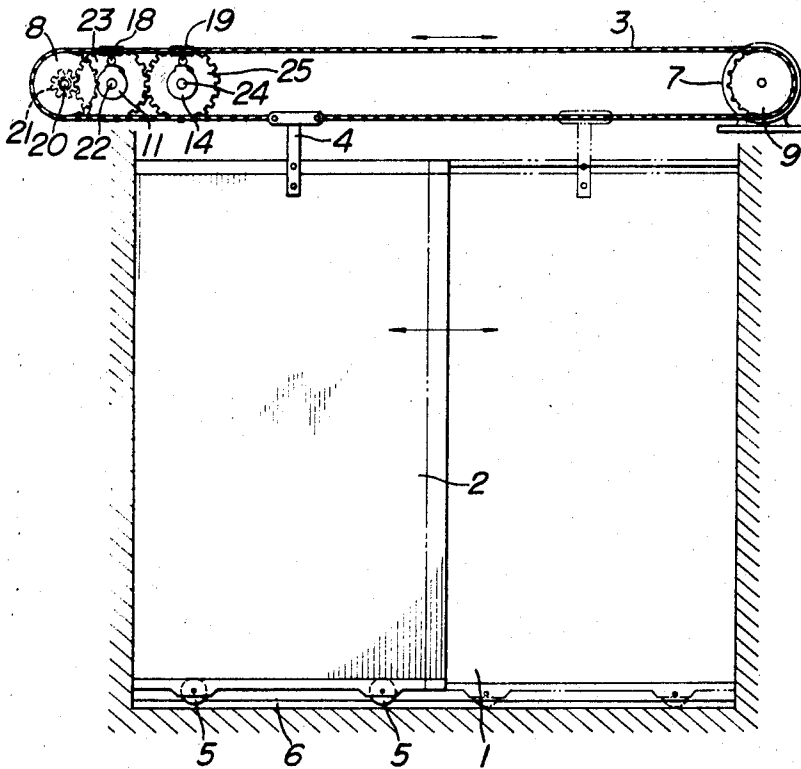
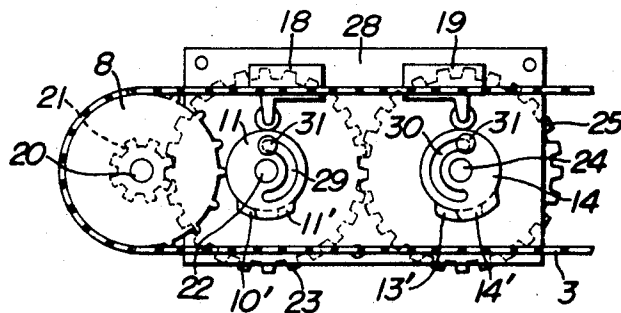


FIG. 2



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FIG. 3

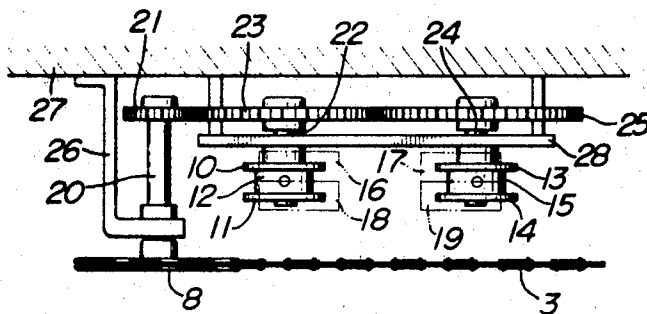


FIG. 4

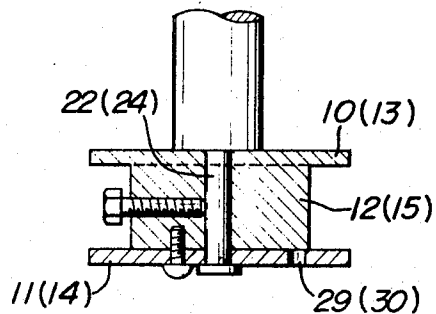
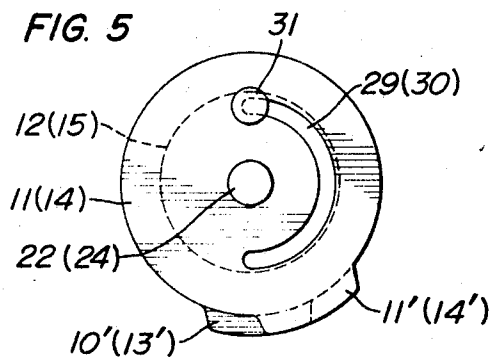


FIG. 5



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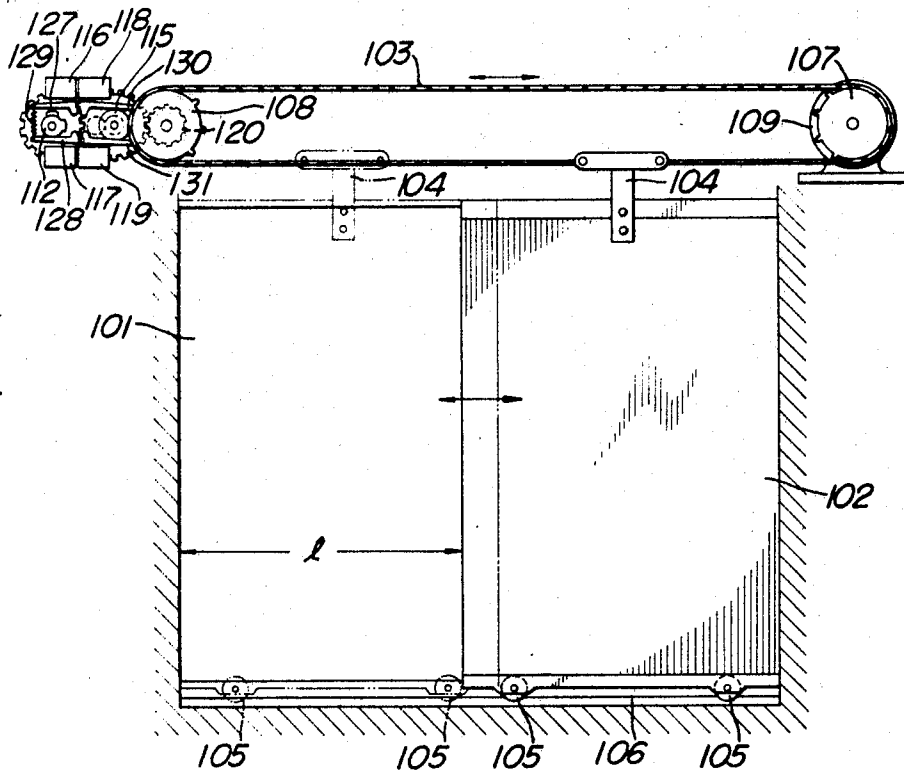
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FIG. 6



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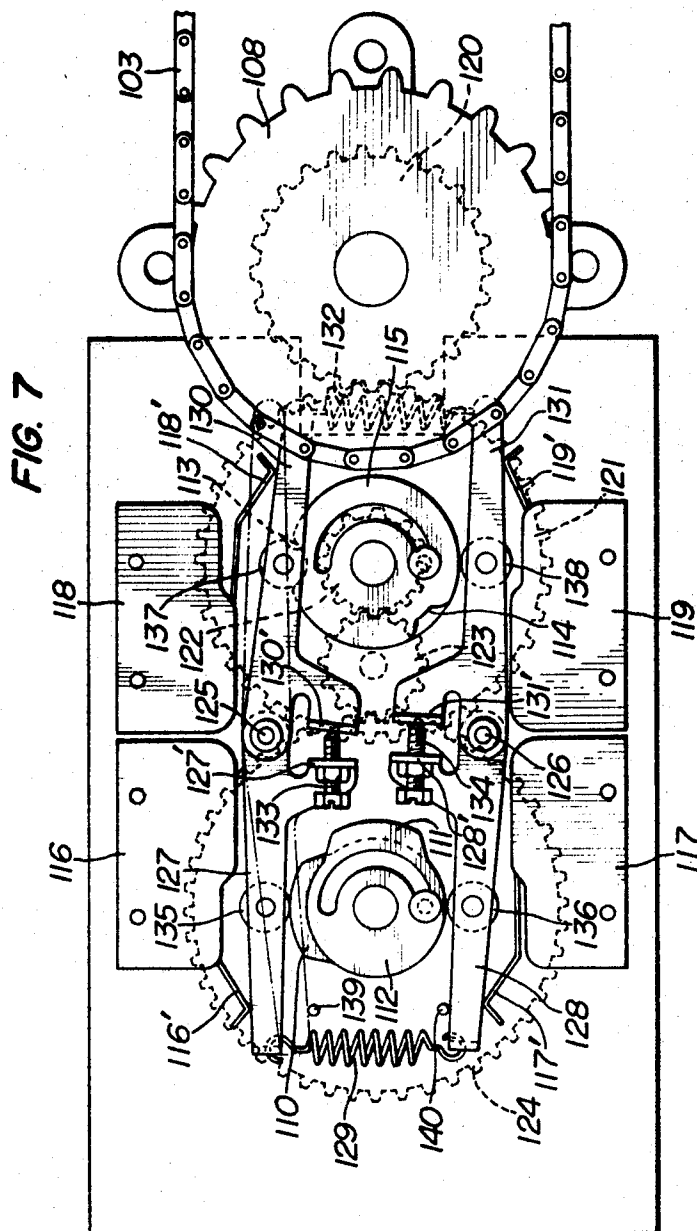
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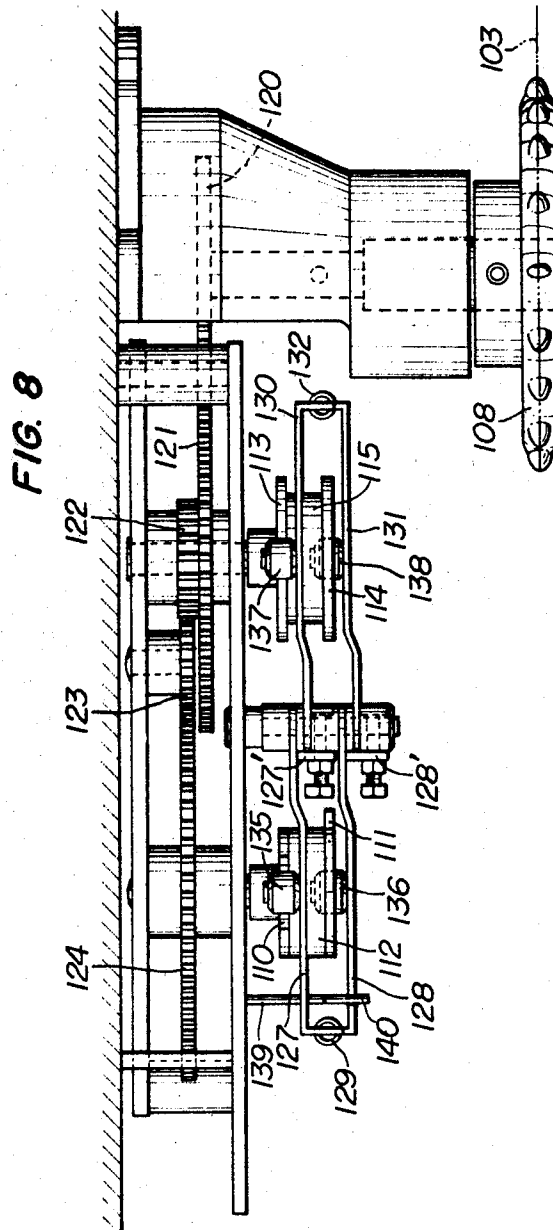
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DEVICE FOR BRAKING AND STOPPING DOOR LEAF OF AUTOMATIC DOORS

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Int. Cl. E05f 15/14

U.S. Cl. 49—360

3 Claims

ABSTRACT OF THE DISCLOSURE

A device for controlling the braking and stopping of an automatic door is provided as a compact single unit. A sliding door is driven by a horizontally extended endless chain supported by a pair of sprocket wheels. The rotation of one of the sprocket wheels is transmitted via reduction gears to cam rotors controlling the switches effecting the braking and stopping of the door at opposite extreme positions.

The present invention relates to a device adapted for use with a door of the type which is opened and closed automatically by an electric motor, said device being capable of automatically braking a door leaf at a point adjacent the terminal end of the opening stroke or the closing stroke of said door leaf and then automatically bringing said door leaf to a halt at said terminal end of the opening stroke or closing stroke.

In order to obtain such operation of a door leaf as described above, it has heretofore been practiced to provide a projection at a portion of the door leaf, which projection is adapted to actuate a limit switch, which is provided for applying a brake to a torque motor operating the door leaf and will be hereinafter referred to as braking limit switch, upon engagement with an operating arm of said limit switch at a position of the door leaf approximating to the terminal end of its opening or closing stroke, thereby braking the door leaf in motion, and thereafter to actuate another limit switch, which is provided for stopping the operation of the torque motor and will be hereinafter referred to as stopping limit switch, upon engagement with an operating arm of said limit switch at the open or closed position of the door leaf, thereby bringing the door leaf to a halt. Such a method, however, is not satisfactory, because variation in height of the door leaf caused by wear of rollers and/or rail will not only result in non-contact or excessively hard contact of the projection with the braking or stopping limit switch, thus making the operation of the limit switches unreliable, but will also result in the limit switches being damaged due to hard contact between the projection and the limit switches. In addition, the conventional method requires the braking limit switch and stopping limit switch to be adapted for the operation of the door leaf at both terminal end portions of the opening and closing strokes, so that the mounting operation and the wiring of the limit switches becomes complicated. Further, since the limit switches are provided above the opposite ends of the door leaf in a spaced relation to each other, adjustment of the limit switch system requires an extremely troublesome operation.

The primary object of the present invention, therefore, is to provide a novel and effective device for braking and stopping a door leaf of an automatic door, which is free from the aforesaid drawbacks of the conventional device of the type described. According to the present invention, there is provided a device for braking and halting a door leaf of automatic doors, characterized in that a braking limit switch and a stopping limit switch are respectively

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actuated by independent cams provided on a rotary body driven by a sprocket wheel through a reduction gear, said cam which actuates the braking limit switch being hereinafter referred to as braking cam and said cam which actuates the stopping limit switch being hereinafter referred to as stopping cam.

The present invention will now be described in further detail hereunder with reference to the accompanying drawings which illustrate preferred embodiments of the present invention and in which:

FIG. 1 is a front elevational view of one form of the device of this invention as applied to an automatic door; FIG. 2 is an enlarged front view of the limit switch system of the automatic door braking and stopping device shown in FIG. 1;

FIG. 3 is a top plan view of the limit switch system shown in FIG. 2;

FIG. 4 is an enlarged front view of the cam used in the limit switch system;

FIG. 5 is a cross sectional view, through the axis, of the cam shown in FIG. 4;

FIG. 6 is a front elevational view of another form of the device of this invention as applied to the automatic door;

FIG. 7 is an enlarged front view of the limit switch system of the automatic door braking and stopping device as shown in FIG. 6; and

FIG. 8 is a top plan view of the limit switch system shown in FIG. 7.

Referring first to FIG. 1, an endless chain 3 is arranged above the entrance and exit 1 to operate a door leaf 2. The door leaf 2 carries an arm 4 at the top end thereof which is fixedly connected to a portion of the endless chain 3. The door leaf 2 also has rollers 5 mounted to the bottom edge thereof which rollers are adapted to roll on a rail 6 provided on a threshold. Alternatively, the door leaf 2 may be hung on a rail provided above the entrance and exit 1. The endless chain 3 is trailed around sprocket wheels 8 and 9, and is driven by a torque motor 7. When a person approaches the entrance and exit 1, the torque motor 7 is set in operation by means of photoelectric means not shown, driving the endless chain 3, and thus the door leaf 2 is opened or closed automatically.

According to one form of the present invention, as shown in FIGS. 2 and 3, a pinion 21 is mounted on the axis 20 of the sprocket wheel 8 and this pinion 21 is in engagement with a gear 23 mounted on the axis 22 of a rotary body 12. The gear 23 in turn is in engagement with a gear 25 which is mounted on the axis 24 of another rotary body 15. The rotary body 12 carries thereon a cam 10, which initiates a braking action on the door leaf in the opening stroke, and another cam 11, which initiates a halting action on the door leaf in the opening stroke, whereas the rotary body 15 carries thereon a cam 13, which initiates a braking action on the door leaf in the closing stroke, and another cam 14 which initiates a halting action on the door leaf in the closing stroke. The cams 10 and 11 are operatively connected with a braking limit switch 16 and a stopping limit switch 17, for the opening stroke, respectively, and the cams 13 and 14 are operatively connected to a braking limit switch 17 and a stopping limit switch 19, for the closing stroke, respectively.

When the sprocket wheel 8 is rotated, the gears 23 and 25 are caused to rotate, whereby the rotary bodies 12 and 15, and accordingly the cams 10, 11, 13 and 14 are rotated. In this case, obviously, the rotation of the rotary bodies 12 and 15 must be within one complete turn, for the full opening or closing stroke of the door leaf 2. For this purpose, the number of teeth on the pinion 21 and the gears 23 and 25 are selected such that

the reduction gear ratio therebetween will be quite considerably large so as to cause a rotation of the rotary bodies 12 and 15 through a suitable angle. The limit switch system of the construction described above is mounted to a portion 27 of the building structure through mounting members 26 and 28.

The braking cams 10 and 13, as shown in FIGS. 4 and 5, are fixedly mounted on one side of the respective rotary bodies 12 and 15 or may alternatively be formed integrally therewith. The stopping cams 11 and 14, however, are independent of the respective rotary bodies 12 and 15, and are each formed therein with an arcuate slot 29 or 30, through which a set screw 31 extends to adjustably secure said cam to the other side of the associated rotary body 12 or 15. Therefore, by changing the position of the stopping cam 11 or 14 upon loosening the set screw 31, the relative position of the cam lobe 10' or 13' of the braking cam 10 or 13 with respect to the cam lobe 11' or 14' of the stopping cam 11 or 14 can be adjusted simply. Thus, the time interval between braking and stopping of the door leaf can be adjusted as desired, by suitably revolving the stopping cam 11 or 14 with respect to the rotary body 12 or 15.

Upon energizing the torque motor 7, the chain 3 is driven and the door leaf 2 is set in an opening or closing motion. At the same time, the sprocket wheel 8 is revolved and, when the door leaf is in the opening stroke, the braking limit switch 16 is first actuated by the braking cam 10 at a position of the door leaf 2 approximating to the terminal end of the opening stroke, whereby a brake is applied to the torque motor 7 and the opening speed of door leaf 2 is reduced. When the door leaf 2 has reached the terminal end of the opening stroke, the stopping limit switch 18 is actuated by the stopping cam 11 and thus the operation of the torque motor 7 is stopped. The braking cam 13 and the stopping cam 14 operate in a similar manner when the door leaf 2 is in the closing stroke.

According to another form of the present invention, as shown in FIG. 6, the door leaf 2 is also operated by the endless chain 3 and one of the sprocket wheels 8 is arranged to cooperate with a limit switch system, shown in detail in FIGS. 7 and 8.

Referring to FIGS. 7 and 8, a gear 120 fixedly mounted on the axis of the sprocket wheel 8, is in engagement with a gear 121 mounted on the axis of a rotary body 115, and a pinion 122 mounted on the axis of the rotary body 115, is in engagement with a gear 124, mounted on the axis of a rotary body 112, through another pinion 123.

The rotary body 112 carries thereon a braking cam 110 for initiating a braking action on the door leaf in the opening stroke and another braking cam 111 for initiating a braking action on the door leaf in the closing stroke, whereas the rotary body 115 carries thereon a stopping cam 113 for initiating a halting action on the door leaf in the opening stroke and another stopping cam 114 for initiating a halting action on the door leaf in the closing stroke. The relative position of these cams is adjustable in the same manner as described in the preceding embodiment.

On both the upper and lower sides of the rotary body 112 are provided levers 127 and 128 which are pivotable about pivot pins 125 and 126 respectively, and the free ends of said levers 127 and 128 are biased against each other by means of a spring 129. The inward pivotal movement of the levers 127 and 128 are limited by stoppers 139 and 140 provided inwardly of the respective levers. The levers 127 and 128 respectively carry thereon rollers 135 and 136 for engagement with the lobes of the respective cams 110 and 111, and are so arranged as to actuate the operating arm 116' of the braking limit switch 116 for opening stroke and the operating arm 117' of the braking limit switch 117 for

closing stroke respectively with the exterior side edges thereof.

On the other hand, levers 130 and 131 are provided on both the upper and lower sides of the rotary body 115 for pivotal movement about respectively pivot pins 125 and 126, and the free ends of said levers are biased against each other by means of a spring 132. In this case, the spring 132 has less strength than the spring 129. The levers 130 and 131 respectively carry thereon rollers 137 and 138 for engagement with the lobes of the cams 113 and 114 respectively and are so arranged as to actuate the operating arm 118' of the stopping limit switch 118 for opening stroke and the operating arm 119' of the stopping limit switch 119 for closing stroke respectively, with the exterior side edges thereof.

The levers 127, 128, 130 and 131 are formed at their root portions with lugs having flexed ends 127', 128', 130' and 131' respectively, and screws 133 and 134 are extending through holes perforated in the flexed ends 130' and 131' respectively. Thus, it will be seen that the inward pivotal movements of the levers 130 and 131 are limited by said respective screws. The levers 127 and 128 are retained by the respective stoppers 139 and 140 in such positions at which the rollers 135 and 136 are slightly spaced from the root portion of the rotary body 112, whereas the positions of the screws 133 and 134 are adjusted such that the rollers 137 and 138, carried on the levers 130 and 131, are spaced slightly from the root portion of the rotary body 115 when the levers 127 and 128 are in abutment against the respective stoppers 139 and 140.

When the door leaf 2 is set in an opening motion upon energization of the torque motor 7, the sprocket wheel 8 is rotated as described above, causing the rotary bodies 112 and 115 to rotate. When the door leaf 2 has reached to a point adjacent the terminal end of its opening stroke, the lever 127 is forced outwardly by the action of the cam 110 and moves the operating arm 116' to actuate the braking limit switch 116, whereby a brake is applied to the torque motor 7. The outward pivotal movement of the lever 127 also causes the flexed end 127' to move away from the flexed end 130' and thereby the lever 130 is permitted to make an inward pivotal movement under the tension of the spring 132 and pressed against the rotary body 115. As the door leaf 2 moved further to the terminal end of its opening stroke, the cam lobe of the cam 113 is brought to a point right below the roller 137, so that the lever 130 is permitted to make a further inward movement, whereby the stopping limit switch 118 is actuated to stop the torque motor 7. The cams 111 and 114, and the levers 128 and 131 operate in a similar manner as described above, when the door leaf 2 is in the closing stroke. According to this form of the invention, as will be appreciated from the foregoing description, the rotation of the rotary body 115 is not required to be limited within one full turn but may rotate several turns for the full stroke of the door leaf 2, because the lever 130 or 131 is not operated unless the lever 127 or 128 is in its braking position. Therefore, it is possible, according to this form, to enhance the accuracy in the stopping position of the door leaf.

As described hereinabove, according to the present invention, the rotary bodies 12 and 15 or 112 and 115 are rotated by one of the sprocket wheels, on which the door leaf operating endless chain 3 is engaged, to actuate the braking or stopping limit switch by the braking or stopping cam means provided thereon, whereby a brake is applied to the torque motor 7 at a position of the door leaf approximating to the terminal end of the opening or closing stroke, and then the door leaf is brought to a halt accurately at said terminal end. Therefore, it is possible to eliminate the drawback of the conventional device that the device becomes inoperative due to variation in height of the door leaf or wearing of the guide rail or rollers. In addition, according to the present invention,

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the braking and stopping positions of the door leaf can be adjusted readily by changing the angular positions of the cams which are provided at one place in a group.

What is claimed is:

1. Apparatus for braking and stopping a driven door or the like comprising

a wheel means driven by the means driving said door or the like,

a first rotary member driven by said wheel means through a reduction gear means in such a manner as to make one revolution for the traverse of said door or the like through the length of its path in one direction, said first rotary member having mounted thereon a first cam means and a second cam means, said first cam means being positioned as to operate a first limit switch for braking the motion of said door or the like in a first direction of travel and said second cam means being positioned as to operate a second limit switch for braking the motion of said door or the like in a second direction of travel,

a second rotary member driven simultaneously with said first rotary member by said wheel means through a reduction gear means at a velocity relatively greater than the velocity of said first rotary member, said second rotary member having mounted thereon a third cam means and a fourth cam means, said third cam means being positioned as to operate a third limit switch for stopping the motion of said door or the like in said first direction and said fourth cam means being positioned as to operate a fourth limit switch for stopping the motion of said door or the like in said second direction,

a first cooperating means for preventing said third cam means for operating said third limit switch until said first cam means has operated said first limit switch, and

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a second cooperating means for preventing said fourth cam means from operating said fourth limit switch until said second cam means has operated said second limit switch.

2. The apparatus defined in claim 1 wherein each of said cooperating means comprises a first lever adapted to be operated by the cam means on said first rotary member to operate the limit switches associated therewith, a second lever adapted to be operated by the cam means on said second rotary member and to operate the limit switches associated therewith, each of said levers being pivotally mounted at an end thereof, and a limiting means for preventing said second lever from moving in a direction permitting one of said cam members on said second rotary member to operate the limit switch associated therewith until one of said cam means on said first rotary member has operated said first lever thereby operating the limit switch associated therewith.

3. The apparatus defined in claim 2 comprising in addition a first biasing means for biasing said first levers of said first and second cooperating means against each other and a second biasing means for biasing the free ends of said second levers against each other, the force of said first biasing means being greater than the force of said second biasing means.

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J. KARL BELL, Primary Examiner

U.S. Cl. X.R.

49—138