July 18, 1944. J. E. STEPHENSON 2,353,942

HIGHWAY CROSSING GATE

Original Filed Dec. 20, 1938 2 Sheets-Sheet 1

FIG. 1.

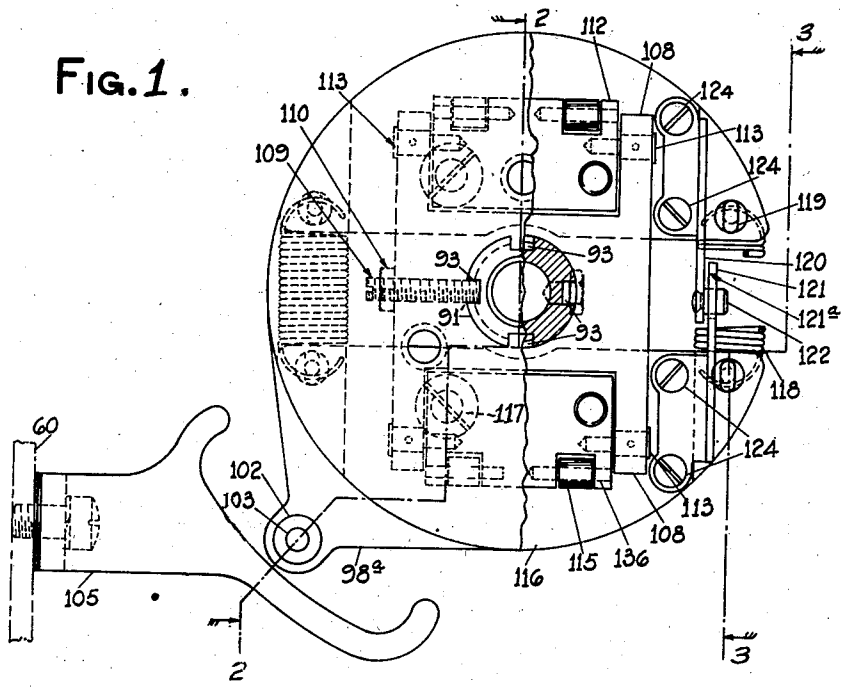


FIG. 2.

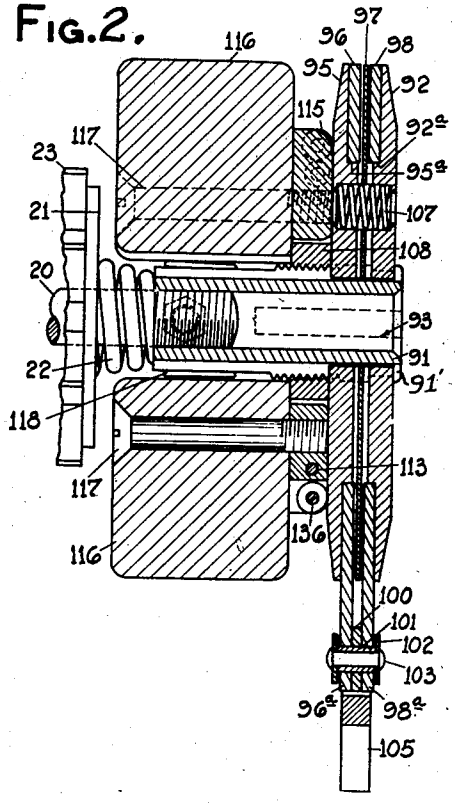
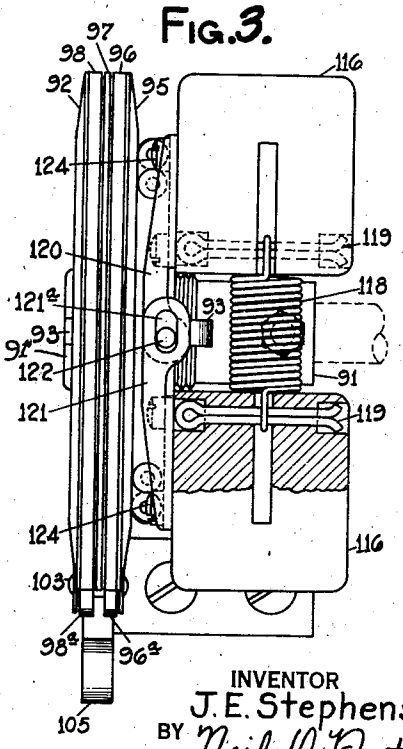


FIG. 3.



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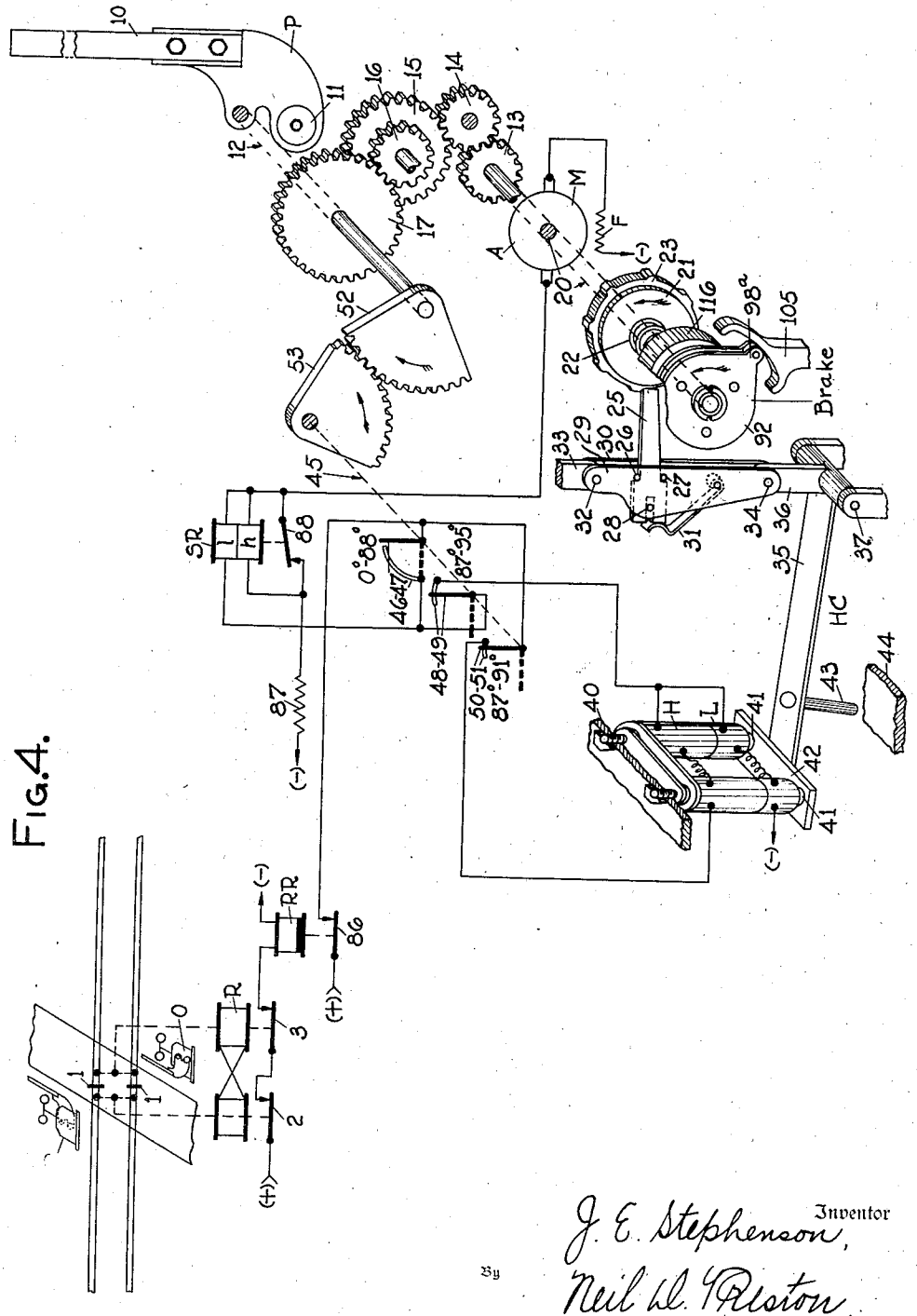


FIG. 4.

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2,353,942

HIGHWAY CROSSING GATE

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Original application December 20, 1938, Serial No. 246,859. Divided and this application January 11, 1943, Serial No. 471,991

6 Claims. (Cl. 188—180)

This invention relates to crossing gates for blocking highway traffic on a highway intersecting a railroad, and more particularly to a crossing gate operated wholly electrically.

This application is a division of my application Ser. No. 246,859, filed December 20, 1938, for Highway crossing gates, now Patent No. 2,310,716 granted Feb. 9, 1943.

In the electrical operation of crossing gates by reason of the length of such gates certain problems are encountered that have not been encountered in the electrical operation of semaphore blades for railway signalling purposes. One of the obstacles surrounding the economic operation of crossing gates is due to the enormous wind resistance offered by gates of a length to extend across a highway, by reason of which wind resistance the operation of the gate may be either aided or retarded depending on the direction of the wind. If the electrical operation of the gate is retarded this effect may be compensated for by installing a higher gear ratio gear train or by employing a larger motor. If, on the other hand, the direction of the wind is such as to aid the motor in moving the gate arm it is found necessary to add supplemental means for preventing excessive speed of operation of the gate arm. The second obstacle encountered when operating a crossing gate wholly electrically is the variable and greatly increased forces that are encountered when the gate arm is broken off, as for instance by an automobile driving through the gate. This increased force is due to the fact that the force exerted by the counterweight of the gate is in a direction to move the gate to its clear position and is considerably in excess of the biasing force that existed in the opposite direction before the gate was broken off. In other words, the crossing gate by reason of its length is of considerable weight and in practice a counterweight is added so that the biasing force of the gate tending to move it to its stop position is almost entirely counterbalanced. If now the crossing gate is broken off, either due to excessive loading as by ice or sleet, or by being struck by an automobile, the counterweight alone remains, as a result of which the mechanism will be operated toward its clear position at a tremendous speed.

In accordance with the present invention it is proposed to employ a highway crossing gate which is provided with a counterweight to almost neutralize the torque produced by the gate and to provide a motor and suitable gearing for operating the gate to its clear vertical position, and to provide normally energized hold-clear mechanism for electrically holding the gate in its clear position, which hold-clear mechanism is released when the clearing potential is removed, to provide a friction slip clutch through the medium of which the hold-clear mechanism may retard the operation of the mechanism near the end of its clearing stroke, and to provide electro-dynamic braking means to retard the operation of the crossing gate in its gravitational movement from the clear to the stop position, and to provide suitable centrifugal braking means for preventing too rapid operation of the crossing gate toward its clear position.

Other objects, purposes and characteristic features of the present invention will be pointed out in the following specification and will in part be obvious from the accompanying drawings, in which:

Fig. 1 shows in elevation a centrifugal brake with the braking plates partly broken away;

Fig. 2 shows a sectional elevation of the centrifugal brake shown in Fig. 1 as viewed from left to right and along the line 2—2 of Fig. 1 of the drawings;

Fig. 3 shows a side view of the centrifugal brake shown in Fig. 1 with a portion thereof shown in cross section taken along the line 3—3 of Fig. 1, as viewed from right to left; and

Fig. 4 shows a highway which crosses a railroad track and which highway is provided with electrically operated crossing gates embodying the present invention, the mechanical and electrical apparatus of only one of these crossing gates being shown in detail.

Gate operating structure

Referring to Fig. 4 of the drawings the railroad track illustrated is divided by insulating joints 1 into track circuits, each of which track circuits energizes one of the coils of the interlocking relay R. This interlocking relay R is preferably of the construction shown in either the patent to Field No. 1,824,131 or in the patent to Henry et al. No. 1,969,075. This interlocking relay R through front contacts 2 and 3 included in series controls the slow acting repeater relay RR. Each of the crossing gates O and P conventionally shown adjacent the highway comprises a gate plate P, having fastened thereto a gate arm 10 and a counterweight 11. In practice this counterweight is so located and of such weight that the counterweight 11 will greatly aid in moving the gate 10 to its clear position, but also of such weight that upon release of all extraneous

forces the gate will gravitate to its horizontal stop position. This gate plate P is fastened to a main shaft 12, driven by the series motor M through the medium of gears 13, 14, 15, 16 and 17. This series motor M includes a series field winding F and an armature A. To the motor shaft 20 are keyed, but freely slidable, clutch plates 21, of which only one has been illustrated, which clutch plates are pressed toward each other through the medium of a coil spring 22 and between these clutch plates 21 and freely rotatable on the shaft 20 is a clutch wheel 23. It is thus seen that this clutch wheel 23 is frictionally held from freely rotating on the shaft 20 by reason of the clutch plates 21 frictionally engaging opposite sides of this clutch wheel 23 due to the action of the coil spring 22.

Under normal operating conditions, that is, when the gate is in its clear position and the hold-clear mechanism HC is energized, the clutch wheel 23 which tends to rotate counterclockwise is locked in its then position by a locking pawl 25. This locking pawl 25 is slidably supported in one of the links of a toggle mechanism through the medium of three pins 26, 27 and 28 passing through the plates 29 and 30 of this link of the toggle mechanism, this locking pawl being biased into an engaging position by a spring 31. These plates 29 and 30 are pivoted as by a pin 32 to a stationary lug 33. The lower end of these plates are pivoted, as by a pin 34 passing through the vertical arm 36 of the angle lever 35—36, this angle lever 35—36 being pivoted to stationary lugs through the medium of a pin 37.

This toggle mechanism is normally held in its effective but in a non-toggling or non-locking position by an electro-magnet including high resistance coils H and low resistance coils L. By a non-toggling position is meant a position in which upon deenergization of the magnet HC the weight of the armature 42 in addition to the force exerted on the pawl 25 will cause the pawl 25 to release. This electro-magnet includes the usual back yoke 40, cores 41 and armature 42. This electro-magnet when deenergized causes the angle lever 35—36 to assume an abnormal position, where the stop pin 43 engages a stop plate 44, such that the locking pawl 25 no longer engages between the lugs on the clutch wheel 23. This electro-magnet is so constructed that if the high resistance coils H and the low resistance coils L are connected in series and energized by the source of direct current illustrated by the legends (+) and (−), there will be insufficient flux to operate the hold-clear mechanism HC to its locking position. If however, only the low resistance coils L are connected across this source of current the armature 42 will be operated to its attracted position, thereby operating the locking pawl 25 to a position to lock the clutch wheel 23, this electro-magnet will, however, maintain its armature 42 in its attracted condition, if once lifted to this position, by the flux emitted when the high resistance coils H and the low resistance coils L are connected in series across this source of current.

The shaft 45 illustrated by dotted lines is provided with three pairs of contacts 46—47, 48—49 and 50—51. This shaft 45 is driven in accordance with the rotation of the shaft 12 through the medium of gear sectors 52 and 53. In order to provide electro-dynamic snubbing through the medium of the motor M when the crossing gate 10 gravitates to its horizontal stop position a snubbing relay SR has also been provided. This snubbing relay has a high resistance winding *h* and a low resistance winding *l*.

A centrifugal brake construction is shown in Figs. 1 to 3 inclusive. In this construction the outer plate 92 is fixedly secured to the sleeve 91, and butts against an outwardly projecting shoulder or radially projecting flange 91′ whereas the inner plate 95 is slidably but non-rotatably secured to the sleeve 91. This sleeve 91 is provided with four grooves or keyways 93 (see Fig. 1) into which tongues on the inner plate 95, the middle plate 97, and the outer plate 92 project, these tongues and keyways provide an operative connection between the sleeve 91 and these plates 92, 95 and 97. Two stationary braking rings or washers 96 and 98 are provided with extensions 96ª and 98ª which are fastened together by a spacer 100, a sleeve 101, washers 102, and a rivet 103, and these extensions 96ª and 98ª as riveted together are free to rotate with the shaft 20 only through an arc of about 45 degrees as permitted by the spacing of the forked ends of the bifurcated braking bracket 105. This lost motion is provided to prevent any braking action taking place for at least an arc of rotation of 45 degrees following each reversal of the motor M shown in Fig. 4 irrespective of whether this motor is rotated electrically or is rotated by gravity through the medium of the gate or its counterweight. These stationary braking rings or washers 96 and 98 are pivoted upon inwardly projecting circular extensions 92ª and 95ª constituting parts of braking plates 92 and 95. The braking plates 92 and 95 are normally separated by the force of compression springs 107 of which only one has been illustrated.

To the sleeve 91 is threaded an H-shaped spider 108, which spider is held in a particular threaded position by the lock screw 109 containing a lock nut 110. This spider is so located on the sleeve 91 that the compression springs 107 urge the inner plate 95 against the face of this spider 108. Into two opposite ends of this H-shaped spider 108 are pivotally secured brake operating plates 112, as by trunnions 113. These brake operating plates are notched at their outward edges to receive rollers 115 pivoted on pins 136. To these operating plates and to the side opposite from that engaged by the braking plate 95 are secured centrifugal weights 116 as by machine screws 117. These centrifugal weights 116 are biased toward each other by initially tensioned springs 118 hooked over cotter pins 119 secured in said centrifugal weights 116. The rollers 115 just barely project from the brake operating plates 112 in such a manner that outward movement of the centrifugal weights 116 will cause the brake operating plates to be turned about their trunnion 113 so as to force the rollers 115 against the inner braking plate 95, thereby causing compression of the springs 107 and movement of the braking plate 95 toward the braking plate 92 so as to bring all of these braking plates 95, 96, 97, 98 and 92 into frictional engagement with each other. In this construction there have been provided interlocking levers 120 and 121, of which the lever 120 is provided with a pin 122 which engages a slot 121ª contained in the interlocking lever 121. These interlocking levers 120 and 121 are secured to the weights 116 as by machine screws 124. It is thus seen that the outward movement of one of the weights 116 exerts a force through the pin and slot connection between levers 120 and 121 so that the other weight 116 is likewise caused to move away from the shaft

20. By reason of the initial tension stored in the tension spring 118 the centrifugal weights 116 will be maintained in their normal position, in which position they bear tightly against the H-shaped spider, until the speed of the shaft 20 has exceeded a predetermined value at which time the centrifugal weights will fly outwardly thereby causing the rollers 115 to press the plates 95 and 92 together.

This centrifugal brake functions to perform the additional result of not exerting any friction during the first 45 degrees of reversal of the motor M. This latter feature has been provided for in order to prevent the sticking together of the braking plates placing a load upon the motor during electric or gravitational starting.

Referring to Fig. 4 of the drawings, let us assume that there is a train approaching the highway and that as a result of this train one of the coils of the interlocking relay R is deenergized thereby opening the circuit for the repeater relay RR and resulting in the dropping of its contact 86. The opening of this contact 86 deenergizes the circuit including the high resistance coils H and the low resistance coils L of the hold-clear magnet in series. Deenergization of this magnet causes the armature 42 to drop thereby causing the locking pawl 25 to be moved to the left out of engagement with the slip clutch wheel 23. By reason of the weight of the crossing gate 10 over that of its counterweight 11, this crossing gate will gravitate toward the horizontal position and in so doing will rotate the armature A of the motor M in the opposite direction from that in which the motor was last electrically operated. By reason of the residual magnetism remaining in the motor field a voltage will be built up in the armature A which will create a current in the snubbing circuit in a direction to flow in the field winding F in a direction to aid this residual magnetism, so that a comparatively strong magnetic field will be set up in the stator poles of the motor M. This strong magnetic field will of course set up a larger current through the snubbing circuit extending from the (—) or ground connection, through the snubbing resistance 87, through the back contact 88 of the snubbing relay SR, through the armature A of the motor M, through the field winding F of the motor M, to the other ground or (—) connection, thereby causing a reaction between the armature A and the field F of the motor M tending to retard the rotation of the armature A, and thereby retarding the speed of operation of the crossing gate 10 toward its horizontal stop position. If the prevailing wind should be in a direction to aid the return of the gate to an extent to cause the speed of the gate to become too high, the centrifugal brake shown in Figs. 1–3 of the drawings will come into play and further retard the return of the crossing gate.

Let us now assume that the approaching train has passed the crossing and that the repeater relay RR is again energized. Energization of the repeater relay RR causes closing of its contact 86 thereby closing a circuit through the series motor M, which may be traced from the terminal (+) of a suitable source of direct current, front contact 86 of the relay RR, contacts 46—47 of the operating mechanism, low resistance winding *l* of the snubbing relay SR, the armature A and the field F of the motor M, to the other terminal (—) of that source of current. The completion of this circuit will cause sufficient current to flow through the low resistance winding *l* of the snubbing relay SR to cause this snubbing relay SR to pick up and open its back contact 88. With the back contact 88 of relay SR opened a useful multiple path for assuring control of the motor M is established which includes the high resistance winding *h* of the relay SR, and the snubbing resistance 87. This multiple branch circuit including the high resistance winding *h* of the relay SR assures that the contact 88 will remain open in spite of sparking at the brushes and intermittent opening of the circuit of this motor M. As the motor operates it turns the gear sector 53 in a clockwise direction and when it has operated through an angle of 87 degrees the contacts 48—49 and 50—51 are simultaneously closed. Closure of the contacts 48—49 completes a circuit from the terminal (+), through contacts 86 of relay RR, contacts 46—47 and contacts 48—49 of the operating mechanism, through the low resistance winding L of the hold-clear magnet, as a result of which this hold-clear magnet is energized to an extent to pick up its armature 42. After another degree of operation of the crossing gate 10, namely, when it has been operated to the 88 degree position from its horizontal position, the contacts 46—47 of the operating mechanism open, thereby removing the shunt which had been established around the high resistance coils H of the hold-clear magnet by the contacts 46—47 and 48—49 in series, as a result of which the high resistance coils H and the low resistance coils L of this hold-clear magnet are connected in series through a circuit including front contact 86 of the relay RR and contacts 50—51 of the operating mechanism in series. This circuit by reason of the high resistance of the coils H draws very little current but at the same time is able to maintain the armature 42 in its raised position. When the armature 42 of the hold-clear mechanism was actuated to its attracted position the locking pawl 25 of course engaged the friction wheel 23 of the friction slip clutch as a result of which a braking action is applied to the motor M. The slipping between the friction wheel 23 and the clutch plates 21 will soon bring the motor M to a stop.

In order to prevent the crossing gate from being operated and held beyond the 91 degree position the contacts 50—51 have been made so short as to be closed only between the 87 degree and the 91 degree position. It thus follows that if the gate is operated beyond the 91 degree position the hold-clear magnet will be deenergized by the opening of the contacts 50—51. If the gate now settles back below the 91 degree position and the contacts 50—51 reclose the circuit for the hold-clear magnet its armature 42 will not be picked up, because it is incapable of being picked up by a circuit including the high resistance coils H and the low resistance coils L in series. The gate will thus be returned a little further and when it reaches the 88 degree position and the contacts 46—47 of the operating mechanism reclose, the circuits reenergizing the motor M and for shunting the high resistance coils H of the hold-clear magnet are closed so that this hold-clear magnet will be picked up through its low resistance coils L.

Let us now assume that the crossing gate is assuming its stop position and that an automobile strikes the gate and breaks off the arm 10 at just about the time that the train passes beyond the crossing and picks up the repeater relay RR. When this occurs the circuit for the motor M heretofore traced is completed so that the motor M is trying to operate the gate plate P to its

clear position at the same time that the counterweight 11 is trying to operate the gate plate P to its clear position. With both of these forces acting upon the shaft 12 there is a tendency for this shaft 12 to be rotated at a very high speed causing breakage of the operating mechanism upon reaching the end of the stroke. Such high speed rotation of the shaft 12 is however prevented by the centrifugal brake illustrated and shown specifically in Figs. 1–4 of the drawings for reasons heretofore given. Also, even though the motor M is not energized when the gate is broken off the counterweight alone may operate at excessive speed and bring the centrifugal brake into action.

The applicant has thus shown and described an electrically operated crossing gate embodying certain new features including novel centrifugal braking means for retarding the speed of the operating mechanism for any reason as, for instance, due to the breaking of the crossing gate, which would result in a tremendous torque being exerted upon the mechanism due to the force of the counterweight which normally counterbalances the gate itself. Although a rather specific construction of applicant's invention has been illustrated in the drawings it is desired to be understood that this has been done to facilitate description of the invention rather than to illustrate its scope or the particular construction preferably employed in practicing the invention, and it is further desired to be understood that such changes as are within the scope of the appending claims may be made without departing from the spirit or scope of the present invention.

What I claim as new is:

1. In a centrifugal brake, in combination with a shaft provided with a radially projecting flange, a spider secured to said shaft, a first set of braking plates slidably, but non-rotatably, mounted on said shaft between said spider and said flange, a second set of braking plates each of which is located between two successive plates of the first set, centrifugal weights provided with rollers and so pivoted to the spider that the weights, if thrown out by centrifugal force upon rotation of said shaft, cause said rollers to press said plates together to set up frictional resistance between the plates of the first set and the plates of the second set, and means for limiting rotation of the plates of said second set.

2. In a centrifugal brake, in combination with a shaft provided with a radially projecting flange, a spider secured to said shaft, a first set of braking plates slidably, but non-rotatably, mounted on said shaft between said spider and said flange, a second set of braking plates each one of which is located between two successive plates of the first set, centrifugal weights provided with rollers and so pivoted to the spider that said weights if thrown out by centrifugal force, upon rotation of said shaft, cause said rollers to press said plates together to set up frictional resistance between the plates of the first set and the plates of the second set, and means allowing rotation of said second set of plates only through a predetermining angle of rotation.

3. In a centrifugal brake, in combination with a shaft provided with a radially projecting flange, a spider secured to said shaft, a first braking plate slidably, but non-rotatably mounted on said shaft between said spider and said flange, a second braking plate located with its face against the first plate, centrifugal weights provided with rollers and so pivoted to the spider that said weights, if thrown out by centrifugal force, upon rotation of said shaft, cause said rollers to press said plates together to set up frictional resistance between the plates, means allowing rotation of said second plate through only a predetermining angle of rotation, and interlocking means operatively interconnecting said weights to allow only substantially simultaneous and equal movements of said weights from said shaft.

4. In a centrifugal brake, in combination with a shaft provided with a radially projecting flange, a spider secured to said shaft, a first braking plate slidably, but non-rotatably, mounted on said shaft between said spider and said flange, a second braking plate located with its face against the first plate, centrifugal weights provided with rollers and so pivoted to the spider that said weights, if thrown out by centrifugal force, upon rotation of said shaft, cause said rollers to press said plates together to set up frictional resistance between the plates, and means preventing rotation of said second plate.

5. In a centrifugal brake, in combination with a shaft provided with a radially projecting flange, a spider secured to said shaft, a first braking plate slidably, but non-rotatably, mounted on said shaft between said spider and said flange, a second braking plate located with its face against the first plate, centrifugal weights provided with rollers and so pivoted to the spider that said weights, is thrown out by centrifugal force, upon rotation of said shaft, cause said rollers to press said plates together to set up frictional resistance between the plates, means preventing rotation of said second plate, and interlock means operatively interconnecting said weights so as to permit only substantially simultaneous and equal movements thereof relative to said shaft.

6. In crossing gate control means, in combination, a rigid rotatable shaft, a sleeve fixed to one end of the shaft and forming an outwardly projecting shoulder on the shaft, a controllable friction clutch on the shaft and including a first clutch plate slidably but non-rotatably carried on the shaft, a second clutch plate supported on the shaft and facing against the first clutch plate, a compression coil spring sleeved on the shaft and bearing at one end against the shoulder and the other end against said first clutch plate, a controller effective at times to hold said second clutch plate against rotation, a centrifugal brake on said rigid shaft and including a radially projecting flange on the outer end of the sleeve, a spider fixed to the sleeve and inwardly spaced from the flange, a first braking plate slidably but non-rotatably mounted on said shaft between said spider and said flange, a second braking plate located with its face against the first plate, centrifugal weights provided with rollers and so pivoted to the spider that said weights if thrown out by centrifugal force upon rotation of said shaft cause said rollers to press said plates together to set up frictional resistance between the plates, and means preventing rotation of said second plate.

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