Nov. 5, 1940. W. K. HOWE ET AL 2,220,154

HIGHWAY CROSSING GATE

Filed Dec. 24, 1938

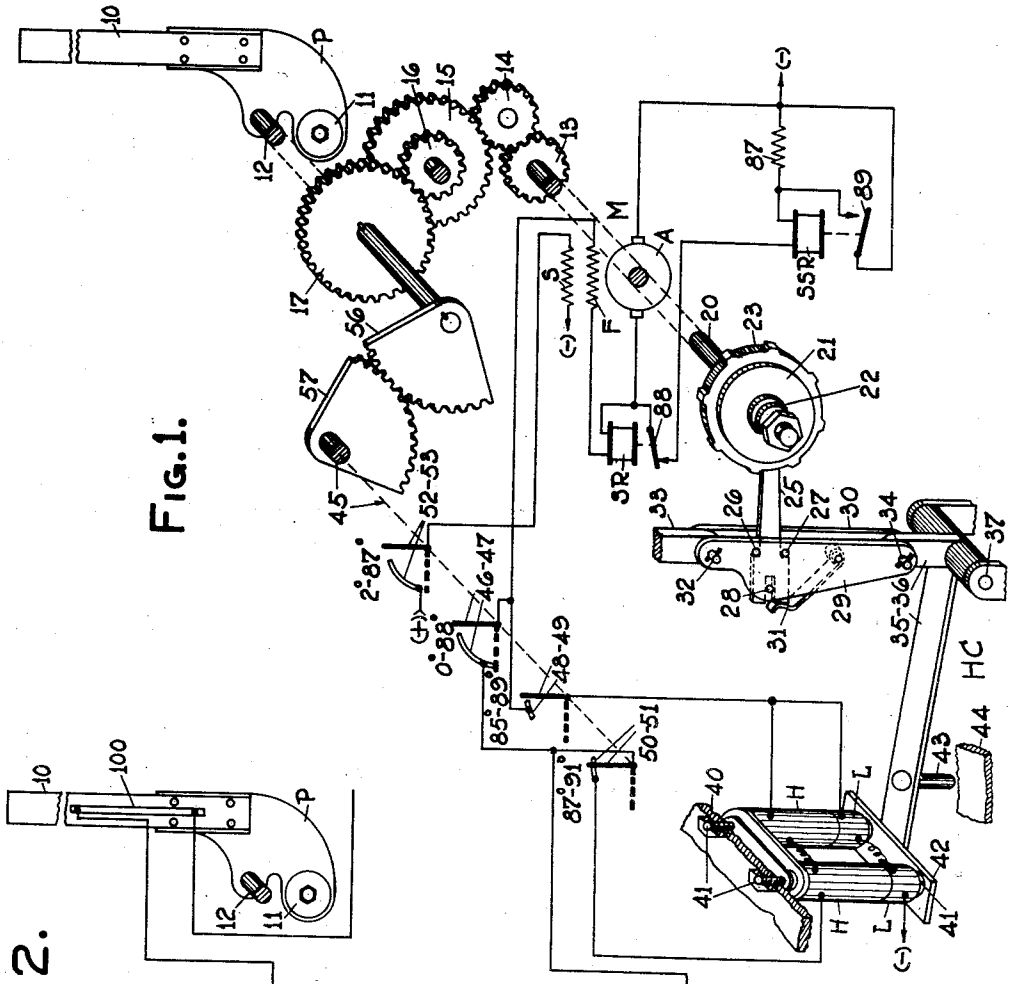


FIG. 1.

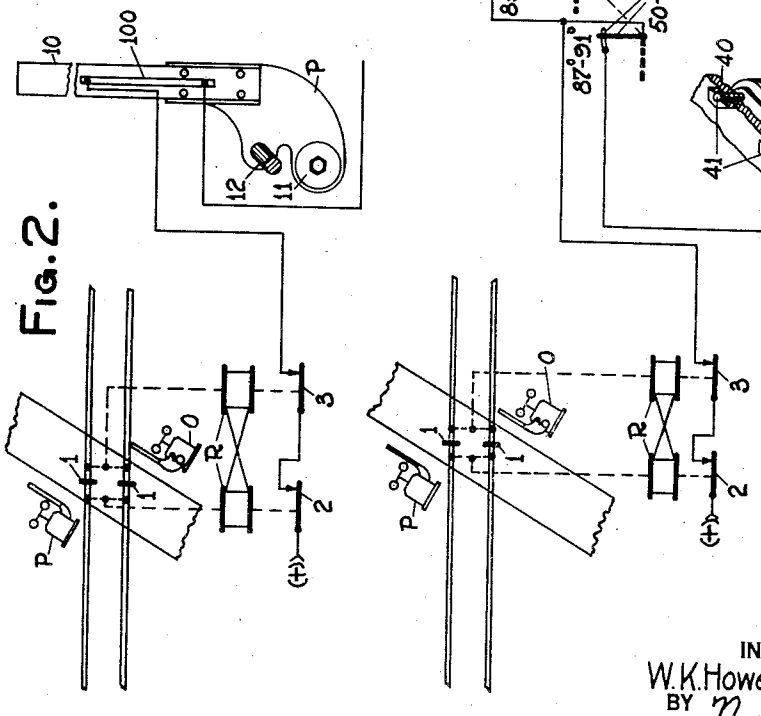


FIG. 2.

INVENTORS
W. K. Howe and J. C. Lindner,
BY Neil D. Preston,
THEIR ATTORNEY

Patented Nov. 5, 1940

2,220,154

UNITED STATES PATENT OFFICE

2,220,154

HIGHWAY CROSSING GATE

Winthrop K. Howe and John C. Lindner, Rochester, N. Y., assignors to General Railway Signal Company, Rochester, N. Y.

Application December 24, 1938, Serial No. 247,624

18 Claims. (Cl. 39—7)

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.

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, and also by the occasional breakage of the gate arm. By reason of such 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 at times 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 ice and sleet accumulates on the gate or the gate arm is broken off, as for instance by an automobile driving through the gate. This increased force when the gate is broken off 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 this force 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 of considerable weight 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 unless specially restricted, thereby damaging same.

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. It is proposed to provide a friction slip clutch or brake through the medium of which the hold-clear mechanism may retard the operation of the mechanism near the end of its clearing stroke and hold the gate against movement thereafter, 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 so construct the electro-dynamic braking means that it will also function when the motor runs idle toward its clear position. To provide additional means effective to afford a snubbing circuit to electrodynamically brake the motor more effectively when excessive forces are encountered as when the counterweight is moving from the stop to the clear position due to the gate arm having been broken off. More specifically, the present invention contemplates, as means for operating the gate, a series motor supplemented by a shunt field energized from a local battery and energized between the two and the eighty seven degree position of the mechanism.

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 drawing in which:

Fig. 1 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; and

Fig. 2 shows a modification of the invention shown in Fig. 1.

Gate operating structure

Referring to the drawing the railroad track illustrated is divided by insulating joints I into track circuits, each track circuit of which 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 gate operating mechanism. Each of the crossing gates O and P conventionally shown adjacent the highway comprises a gate, such as

plate P, having fastened thereto a gate arm 10 and a counterweight 11. In practice this counterweight 11 is so located and of such weight that it 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 including a series field F supplemented at times by the shunt field S through the medium of gears 13, 14, 15, 16 and 17. This series motor M becomes a compound motor when the shunt field is also energized. 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 acting against the nut on the end of the shaft 20, 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, as shown, the clutch wheel 23 which tends to rotate counter-clockwise 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 locking position, as illustrated, by an electro-magnet including high resistance coils H and low resistance coils L. Upon deenergization of the magnet HC the weight of the armature 42 in addition to the force exerted on the pawl 25 by the clutch wheel 23 causes 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 armature 42 of 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 position, 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 four pairs of contacts 46—47, 48—49, 50—51 and 52—53. This shaft 45 is driven in accordance with the rotation of the shaft 12 through the medium of two gear sectors 56 and 57. In order to provide electro-dynamic snubbing through the medium of the motor M a snubbing relay SR has also been provided. This snubbing relay SR may be of the two winding type as shown in the application of J. C. Lindner Ser. No. 247,587, filed December 24, 1938, but as here shown is of the single coils type.

For operation of the mechanism from the clear position to the stop position the snubbing does not begin until the gate arm has been lowered to the 87 degree position where the contacts 52—53 close to energize the shunt field S. The magnetism produced in the field poles by the direct current flowing in this shunt field winding induces a current in the armature which by flowing through the snubbing circuit including the supplemental snubbing relay SSR and the snubbing resistance 87 in series will retard the motor M. This flow of current will of course produce electro-dynamic braking of motor M. This current flows through the back contact 88 of the snubbing relay SR, the relay SSR and through snubbing resistance 87. If now the electro-dynamic snubbing current becomes excessive possibly because the gate arm 10 is broken off and the mechanism is operated from its stop to its clear position by gravity through the medium of the counterweight 11 at an excessive rate, the supplemental snubbing relay SSR is picked up and by closing of its front contact 89 shunts the snubbing resistance 87. In applicant's construction this desired result has been accomplished by including a shunt field winding S which functions not only when the motor is operated as a motor but also when used as a dynamic current generator. When the motor is operated from its local direct current source it operates as a compound motor so long as the contacts 52—53 are closed but operates as a series motor through the medium of series field F alone when the shunt field winding S is deenergized. In other words, the field coils F and S are wound cumulatively.

Operation of system

Referring to the drawing, 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 including the high resistance coils H and the low resistance coils L of the hold-clear magnet in series. Deenergization of the hold-clear 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 is electrically operated. By reason of the closure of the circuit for the shunt field S when the gate 10 comes below the 87 degree position a voltage will be built up in the armature A which will create a current in the snubbing circuit including the armature A, the back contact 88 of the snubbing relay SR, the winding of the supplemental snubbing relay SSR and the snubbing resistance 87 in series. This strong magnetic field produced by the field coils S will of course set up a large current through the snubbing circuit just traced, but this current will

ordinarily not be strong enough to pick up the supplemental snubbing relay SSR. If the prevailing wind should be in a direction to aid the return of the gate additional dynamic braking current will flow due to the slight increase in the motor speed thereby causing the supplemental snubbing relay SSR to pick up and shunt the snubbing resistance 87. This will, of course, further increase the braking.

Let us now assume that the approaching train has passed the crossing and that the interlocking relay R is again energized. Energization of this relay R causes closing of its open contact 2 or 3 thereby closing a circuit through the series motor M, which may be traced from the terminal (+) of a suitable source of direct current, front contacts 2 and 3 of the relay R, contacts 46—47 of the operating mechanism, series field winding F of the motor M, winding of the snubbing relay SR, the armature A 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 winding 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 open a multiple path for the motor M is opened. This multiple path includes the supplemental snubbing relay SSR, and the snubbing resistance 87 in series. As the motor M operates it turns the gear sector 57 in a clockwise direction and when it has operated through an angle of 85 degrees the contacts 48—49 are closed and when it has reached the 87 degree position the contacts 50—51 are closed. Closure of the contacts 48—49 completes a circuit from the terminal (+), through contacts 2 and 3 of relay R, 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 three additional degrees 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, 48—49 and 50—51 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 contacts 2 and 3 of the relay R and contacts 50—51 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. The motor M is however still energized to move the mechanism toward the clear position and will after a short time open the contacts 46—47, resulting in the high resistance coils H being included unshunted in series with the low resistance coils L.

Let us now assume that the crossing gate is in its horizontal stop position because one or the other of the contacts 2 or 3 is open, and let us further assume that an automobile was operated against the gate arm 10 and broke it off near the plate P. Under this condition the counterweight 11 produces a very large torque in a counter-clockwise direction in the shaft 12, thereby causing the mechanism to move very quickly toward its clear position. As the mechanism reaches the 2 degree position the contacts 52—53 close resulting in the energization of the shunt field S for the motor M. The magnetic field produced by the shunt winding S is very strong and induces in the armature A a direct current voltage of substantial value. As a result of the voltage induced in the armature A snubbing current flows through the back contact 88 of the snubbing relay SR, through the winding of the supplemental snubbing relay SSR and through the snubbing resistance 87 back to the armature A. Because this snubbing current is considerably in excess of the normal snubbing current value the supplemental snubbing relay SSR is picked up, causing its front contact 89 to shunt the snubbing resistance 87. The resistance of the snubbing circuit has now been greatly decreased resulting in the flow of a heavier snubbing current and resulting in more pronounced snubbing action and greater retardation for the armature of the motor A driven by the gravity through the medium of the counterweight 11.

It is thus seen that provision has been made through the medium of the shunt field S, which is energized only between the 2 degree and 87 degree position of the plate P to which the gate arm 10 is normally bolted, to cause the motor M to be snubbed irrespective of the direction in which its armature is operated. Provision has also been made by the employment of the supplemental relay SSR for reducing the resistance of the snubbing circuit when the extraneous forces which operate the armature A are beyond those present when the gate arm 10 gravitates from its clear to its stop position. In other words, the supplemental snubbing relay SSR may through the medium of its front contact 89 shunt the snubbing resistance 87 and this takes place when the dynamic braking action necessary is greater than what is normally required.

Even though provision has been made for producing special and heavy snubbing action when the gate arm 10 has been broken off to prevent the gate moving to its clear position at such a speed as to break its mechanism, it becomes apparent that if the gate arm 10 should be broken off just at the instant that the open contacts

2 or 3 of the interlocking relay R became closed there is a possibility that sufficient current would flow through the motor M and the snubbing relay SR that the back contact 88 of the snubbing relay would be open and therefore no snubbing could take place. In order to avoid this coincidence of closure of the contacts 2 or 3 and the breaking of the arm 10 causing excessive speed movement of the mechanism to its clear position, it is proposed to employ a test link 100 constructed of brittle metal such as lead, cast iron, or zinc so secured to the gate arm 10 that breakage of the gate arm will also result in the breakage of the link 100 and breakage of the circuit including this link 100 in series with the contacts 2 and 3 of the relay R, all as shown in Fig. 2 of the drawing. This construction will assure that breakage of the gate arm will result in proper electro-dynamic braking of the motor.

One of the reasons for providing the supplemental snubbing relay is to increase the snubbing resistance under normal operating conditions so that the gate will not gravitate to its stop position too slowly. Also, if desired some resistance external of the relay SSR which is not shuntable by the contact 89 may be added.

Applicants have thus shown and described an electrically operated crossing gate embodying certain new features including novel electro-dynamic braking means, these means including a shunt field which is directly energized from a local source of direct current between certain degrees of operation of the crossing gate, so that the motor for operating such crossing gate may be electro-dynamically snubbed for either direction of rotation of its armature, and although these features of construction have been rather specifically illustrated in the drawing, 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 to be understood that such changes as are within the scope of the appended claims may be made to the present invention without departing from its spirit or scope.

What we claim as new is:

1. In an electrically operated crossing gate, the combination with a crossing gate pivoted to a stationary support and partially counterbalanced so as to be biased toward its substantially horizontal stop position only to an extent to move to and return its operating mechanism to such stop position, a direct current motor and reduction gearing for operating said operating mechanism and in turn said gate to its substantially vertical clear position, a shaft for said motor, a friction slip clutch on said shaft, a hold-clear mechanism effective to engage said clutch to render it effective when said motor is energized and said gate is in its clear position, a check link on said gate electrically broken when said gate is broken off, and a snubbing circuit including the armature of said motor effective to brake said motor when running in either direction, and a shunt field circuit for said motor energized from a local source and closed only during an intermediate position of such operating mechanism for inducing a voltage in said armature during snubbing action.

2. In an electrically operated crossing gate, the combination with a crossing gate pivoted to a stationary support and partially counterbalanced so as to be biased toward its substantially horizontal stop position only to an extent to move to and return its operating mechanism to such stop position, operating mechanism including a direct current series motor and reduction gearing for operating said gate to its substantially vertical clear position, a shaft for said motor, a friction slip clutch on said shaft, a hold-clear mechanism effective to engage said clutch to render it effective when said motor is energized and said gate is in its clear position, a shunt field winding for said motor, a snubbing circuit for the armature of said motor closed when said motor is disconnected from said source of direct current and effective to electro-dynamically brake said motor when a field circuit including said shunt field winding is closed irrespective of the direction of rotation of said motor, and contacts for controlling said field circuit closed only when said operating mechanism assumes an intermediate position.

3. In an electric motor operated crossing gate, the combination with a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a substantially horizontal stop position but is very strongly biased to a substantially vertical clear position if the gate is broken off, a gear train, a series motor including an armature and a series field in series for operating said shaft to a clear position through the medium of said gear train, a snubbing circuit including in series said armature and a snubbing resistance for electro-dynamically braking said motor when operated in either direction, a shunt field for said motor so wound that the magnetism from said series field and said shunt field when energized is cumulative, and means for energizing said shunt field including a local source of direct current and contacts closed only when said horizontal shaft assumes a position between said clear and said stop position.

4. In an electric motor operated crossing gate, the combination with a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased substantially to a stop position but is very strongly biased to a substantially vertical clear position if the gate is broken off, a gear train, a series motor for operating said shaft to a clear position through the medium of said gear train, a clutch wheel frictionally connected to the shaft of said series motor; a hold-clear magnet having a high resistance coil and a low resistance coil and which if in an active condition locks said clutch wheel; a control relay; a first contact, a second contact and a third contact controlled by said shaft of which the first contact opens when said shaft assumes a predetermined position and of which the second contact and third contact close when said shaft has almost reached said predetermined position; an operating circuit for said motor including a contact of said control relay, a source of current and said first contact; a circuit for said low resistance coil including in series said source, a contact of said control relay said first contact and said second contact in series; a circuit for said high resistance coil and said low resistance coil in series including a contact of said control relay, said source and said third contact; a snubbing circuit for said motor including in series the armature of said motor and a snubbing resistance; a shunt field for said motor, and means for energizing said shunt field when said horizontal shaft assumes a position between said clear position and said stop position, whereby said motor may be dynamically braked irrespec-

tive of the direction of operation of said armature.

5. In an electric motor operated crossing gate, the combination with a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a substantially horizontal stop position but is very strongly biased to a substantially vertical clear position if the gate is broken off; a gear train, a motor for operating said horizontal shaft through the medium of said gear train from the stop to the clear position, a shunt field winding for said motor deenergized at and near the stop position and the clear position of said shaft and energized for all intermediate positions of said shaft, a snubbing circuit for said motor closed when the control circuit for said motor is open and including in series the armature of said motor, a relay and a snubbing resistance whereby said armature may be dynamically braked irespective of the direction of rotation of said armature so long as said shunt field is closed, and a front contact on said relay for shunting said snubbing resistance whereby the resistance of the snubbing circuit is reduced if the snubbing current is large enough to pick up the armature of said relay.

6. In an electric motor operated crossing gate, the combination with a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a substantially horizontal stop position but is very strongly biased to a substantially clear position if the gate is broken off, a gear train; a snubbing relay; a motor for operating said horizontal shaft through the medium of said gear train from the stop to the clear position through a control circuit including a series field of said motor, said snubbing relay, the armature of said motor and a source of direct current in series; a shunt field winding for said motor deenergized at and near the stop position and the clear position of said shaft and energized from said source for all intermediate positions of said shaft and in a direction to produce magnetism cumulatively with respect to the magnetism produced by said series field when energized by said control circuit; and a snubbing circuit including a back contact of said snubbing relay, said armature and a snubbing resistance in series.

7. In an electric motor operated crossing gate, the combination with a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a substantially horizontal stop position but is very strongly biased to a substantially clear position if the gate is broken off, a gear train; a snubbing relay; a motor for operating said horizontal shaft through the medium of said gear train from the stop to the clear position through a control circuit including a series field of said motor, said snubbing relay, the armature of said motor and a source of direct current in series; a shunt field winding for said motor deenergized at and near the stop position and the clear position of said shaft and energized from said source for all intermediate positions of said shaft and in a direction to produce magnetism cumulatively with respect to the magnetism produced by said series field when energized by said control circuit; a snubbing circuit including a back contact of said snubbing relay, said armature, a supplemental snubbing relay and a snubbing resistance in series; and a front contact on said supplemental snubbing relay which if closed shunts said snubbing resistance.

8. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; and a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series.

9. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; a supplemental snubbing relay; and a front contact on said supplemental snubbing relay included in multiple with said snubbing resistance, said supplemental snubbing relay being constructed so as not to pick up for snubbing current of normal value but which will pick up and reduce the resistance of the snubbing circuit when the snubbing current becomes excessive.

10. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; and means for open-

ing said operating circuit at another point if said gate arm is broken off.

11. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; a supplemental snubbing relay; a front contact on said supplemental snubbing relay included in multiple with said snubbing resistance, said supplemental snubbing relay being constructed so as not to pick up for snubbing current of normal value but which will pick up and reduce the resistance of the snubbing circuit when the snubbing current becomes excessive; and means for opening said operating circuit at another point if said gate arm is broken off.

12. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; hold-clear means controlled by a circuit in multiple with said operating circuit for holding said gate arm in its clear position; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; a supplemental snubbing relay; and a front contact on said supplemental snubbing relay included in multiple with said snubbing resistance, said supplemental snubbing relay being constructed so as not to pick up for snubbing current of normal value but which will pick up and reduce the resistance of the snubbing circuit when the snubbing current becomes excessive.

13. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; hold-clear means controlled by a circuit in multiple with said operating circuit for holding said gate arm in its clear position; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; and means for opening said operating circuit at another point if said gate arm is broken off.

14. In an electrically operated crossing gate, the combination with a gate arm which may assume a substantially vertical clear position and a substantially horizontal stop position, a counterweight biasing said gate from its clear position and partly counterbalancing said gate between the stop position and an intermediate position, a motor including an armature and a field coil in series for operating said arm from a stop to a clear position, a snubbing relay; an operating circuit for said motor including said armature, said field coil, a source of current and said snubbing relay in series; hold-clear means controlled by a circuit in multiple with said operating circuit for holding said gate arm in its clear position; a shunt field coil for said motor; a circuit for energizing said shunt field coil including said source of current closed for substantially all positions of said gate arm except the stop and the clear position, said shunt field coil being poled to produce magnetism cumulatively with said series coil; a snubbing circuit for said motor including said armature, a back contact of said snubbing relay and a snubbing resistance in series; a supplemental snubbing relay; a front contact on said supplemental snubbing relay included in multiple with said snubbing resistance, said supplemental snubbing relay being constructed so as not to pick up for snubbing current of normal value but which will pick up and reduce the resistance of the snubbing circuit when the snubbing current becomes excessive; and means for opening said operating circuit at another point if said gate arm is broken off.

15. In an electrically operated crossing gate, in combination, a gate movable to a stop and a clear position, an electrical motor connected to the gate, means partly counterbalancing the gate so that the gate and its operating means is biased to move to its stop position, a local, separately excited field winding on the motor, and a low resistance snubbing circuit connected to the motor and closed when the motor is mechanically driven in the direction corresponding to movement of the gate to clear position.

16. In an electrically operated crossing gate, in combination, a gate movable to a stop and a clear position, an electrical motor connected to the gate, means partly counterbalancing the gate so that the gate and its operating means is biased to move to its stop position, a local, separately excited field winding on the motor, a low resistance snubbing circuit connected to the motor and closed when the motor is mechanically driven in the direction corresponding to movement of the gate to clear position, and means for reducing the resistance in the snubbing circuit upon the snub-

bing current exceeding a predetermined value, whereby to vary the degree of snubbing.

17. In an electrically operated crossing gate, in combination, a gate movable to a stop and a clear position, an electrical motor having a series field winding and connected to the gate, means partly counterbalancing the gate so that the gate and its operating means is biased to move to its stop position, a local, separately excited field winding on the motor and poled in the same direction as the series winding, and a low resistance snubbing circuit connected to the motor and closed when the motor is mechanically driven in the direction corresponding to movement of the gate to clear position.

18. In an electrically operated crossing gate, in combination, a gate movable to a stop and a clear position, an electrical motor having a series field winding and connected to the gate, means partly counterbalancing the gate so that the gate and its operating means is biased to move to its stop position, a local, separately excited field winding on the motor and poled in the same direction as the series winding, a low resistance snubbing circuit connected to the motor and closed when the motor is mechanically driven in the direction corresponding to movement of the gate to clear position, and means for reducing the resistance in the snubbing circuit upon the snubbing current exceeding a predetermined value, whereby to vary the degree of snubbing.

WINTHROP K. HOWE.
JOHN C. LINDNER.