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, 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 snow, 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 released 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 illustrates a top view of the novel centrifugal brake forming part of the gate operating mechanism of the present invention shown in Fig. 5:

Fig. 2 is a front elevation of the centrifugal brake shown in Fig. 1 with a portion thereof shown in section taken on the line 2-2 of Fig. 1;

Fig. 3 shows in elevation the centrifugal brake shown in Figs. 1 and 2, a part thereof being shown in section on a line 3-3 as viewed from left to right in Fig. 2 of the drawings;

Fig. 4 shows a partial section of the centrifugal clutch shown in Fig. 2, as viewed from left to right on the line 4-4 in Fig. 2 of the drawings;

Fig. 5 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. 5 of the drawings the railroad track illustrated is divided by insulating joints 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. 1,524,131 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 Q and P conventionally shown adjacent the highway comprises a gate plate P, having fastened thereto a gate arm ± 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 tends to rotate counterclockwise, which 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 ends of these plates are pivoted, as by a pin 34 passing through the vertical arm of the other lever 35-36, this other 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 (4-) and (C-), 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.

Centrifugal brake structure, Figs. 1-4

Referring now to Fig. 1 of the drawings which shows a top view of one form of centrifugal clutch, it will be noted that the armature shaft 20 contains a clutch wheel 23 against which is pressed the clutch plate 21 by the spring 22, this clutch wheel 23 being held stationary by the locking pawl 25. Attention is directed to the fact that all of these elements are also shown in Fig. 5 of the drawings. This centrifugal brake shown in Figs. 1, 2 and 3 of the drawings is mounted on the end of the motor shaft 20 and is housed in a cast iron box 60. Referring to Fig. 3 it will be noted that the end of the shaft 20 is threaded and that a threaded sleeve 61 is screwed thereon to an extent to compress the spring 22 such an amount as to create the necessary friction in the friction slip clutch 21-23, this sleeve being locked in position by lock screw 135. On this sleeve 61 is mounted a hub 62 provided with a groove 62a which is engaged by the lip 63a of an angle plate 63. This hub 62 is longitudinally slidable on but not rotatable with respect to sleeve 61. This angle plate 63 is also shown in Fig. 4 of the drawings. This angle plate 63-63a is pivoted by a pin 64 to the wings 65-65 integral with the braking plate 65. This braking plate 65 through the medium of its hub 65b is secured directly to the sleeve 61 by a pin 83. To this angle plate 63-63a is secured a centrifugal weight 66 as by a machine screw 67. A similar angle plate 63-63a is provided on the opposite side of the centrifugal brake as shown and these like parts have been designatd by like reference characters. The two angle plates 63-63a are provided with hooked extensions 63b, which extensions are biased toward each other by an initially tensioned coil spring 69 (see Figs. 1 and 2) and this coil spring 69 is bolted to, as by machine screws 71, a braking plate 72. Between the rotatable braking plates 65 and 72 are located stationary braking plates 73 and 74, which latter braking plates are fastened together near their end as shown in Fig. 1 and which will be kept from rotating through the medium of the link 76 connected by pins 77 and 78 to the plates 73 and 74 and the stationary lug 79. Between these stationary plates 73 and 74 is contained a rotatable plate 80 which is longitudinally slidable on but non-rotatably keyed to the hub 62.

Referring now to Fig. 3 of the drawings it will be observed that if the braking plates 65 and 72 are urged toward each other as would be the case if the hub 62 were moved to the left on the sleeve 61, these braking plates 65 and 72 will cause the rotatable plate 80 and the stationary plates 73 and 74 to be urged into engagement with each other and into engagement with these braking plates 65 and 72. It will also be observed that if the weights 66 move away from each other as by centrifugal force sufficient to elongate the initially tensioned coil springs 69 that such movement of these centrifugal weights will cause the hub 62 to be moved toward the left on the sleeve 61 as viewed in Fig. 3 of the drawings. Attention is directed to the fact that the braking plate 65 and its wing 65a has integral therewith a hub 65b on which the angle plate 63 may normally rest, and also that these elements 65, 65a and 65b are secured to the sleeve 61 through the medium of a lock pin 62.
This centrifugal brake illustrated in Figs. 1-4 of the drawings is fastened to the end of the motor shaft illustrated in Fig. 5 of the drawings. By reason of the initial tension in the coil spring 69 this centrifugal brake will not come into play, that is, the centrifuge weights 66 will not be lifted away from the hub 69, when the crossing gate 10 is under normal conditions operated to its clear position. If, on the other hand, there is a strong wind in a direction to aid the movement of the crossing gate to its clear position, and as a result of this wind the speed of the motor increases above its normal value the centrifuge weights 66 will overcome the tension of the initial tension spring 69 and cause the braking plate 73 to be moved with the hub 62 in a direction to urge all of the braking plates 65, 72, 73, 74 and 80 into frictional engagement with each other. This action of the centrifugal brake will of course retard the speed of the motor to its normal value.

Some of the advantages of the construction of the centrifugal brake illustrated in Figs. 1, 2 and 3 reside in the construction permitting the centrifuge weights to be mounted inwardly of the braking plate 73 fixed to the shaft and at the same time permitting it to operate the slideable braking plate located outwardly of such braking plate fixed to the shaft, and in the unique construction permitting the brake to be wholly supported on the end of a very short projecting shaft. Also in the employment of initially tensioned springs for rendering the centrifugal brake critical in its operation.

Operation of system of Fig. 5 with brakes of Figs. 1-4

Referring to Fig. 5 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 the contact 54. The opening of this contact 54 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 R3 then through the back contact 58 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. 1-4 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 56 thereby closing circuit through the series motor M, which may be traced from the terminal (+) of a suitable source of direct current, from contact 56 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 68. With the back contact 60 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 67. This multiple branch circuit including the high resistance winding h of the relay SR assures that the contact 60 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 56 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 as 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 46-41, 46-43 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 contact 58 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 53-54 have been made so short as to be closed only between the 97 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 demagnetized by the opening of the contacts 55—51. If the gate now settles back below the 91 degree position and the contacts 55—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 coil H and the low resistance coil L in series. The gate will thus be returned a little further and when it reaches the 88 degree position and the contacts 45—41 of the operating mechanism reclose, the circuits reemergent 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 coil 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 a 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 an electric motor operated crossing gate, in combination, a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a horizontal stop position but is very strongly biased to a clear position if the gate be broken off, a gear train, an electric motor for operating said gate from said shaft to a clear position through the medium of said gear train, a clutch wheel frictionally connected to the shaft of said 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 the first of which contacts opens when said shaft on moving in one direction assumes a predetermined position; the second and third of which contacts close just before said shaft, on moving in said one direction, has 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 said source, a contact of said control relay, and said first and second contacts 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 said motor and a snubbing resistance; and a centrifugal brake for said motor effective if said motor is rotated above a predetermined speed to brake the motor.

2. In an electric motor operated crossing gate, in combination, a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a horizontal stop position but is very strongly biased to a clear position if the gate be broken off, a gear train, an electric motor for operating said shaft to a clear position through the medium of said gear train, a clutch wheel frictionally connected to said shaft of said motor; a hold-clear magnet having a high resistance coil and a low resistance coil and effective if in an active condition, to lock said clutch wheel; a control relay; a snubbing relay; a first contact, a second contact and a third contact controlled by said shaft, the first contact being open when said shaft on moving in one direction assumes a predetermined position and the second and third contacts closing when said shaft on moving in said one direction has almost reached said predetermined position; an operating circuit for said motor including a contact of said control relay, a source of current, a winding of said snubbing relay and said first contact; a circuit for said low resistance coil including in series said source, a contact of said control relay, said source and said third contact; a snubbing circuit for said motor including in series said motor, a back contact of said snubbing relay and a snubbing resistance; and a centrifugal brake for said motor effective if said motor is rotated above a predetermined speed to brake the motor.

3. In an electric motor operated crossing gate, in combination, a gate counterbalanced so that it is biased to a horizontal stop position but is very strongly biased to a clear position if the gate be broken off, an electric motor for operating said gate to a clear position; a hold-clear magnet having a high resistance coil and a low resistance coil and effective if in an active condition, to lock the gate; a control relay; a snubbing relay; a first contact, a second contact and a third contact controlled by said shaft, the first contact opening when the gate on moving in one direction assumes a predetermined position, and the second and third contacts closing when the gate on moving in said one direction has almost reached said predetermined position; an operating circuit for said motor including a contact of said control relay, a source of current, a winding of said snubbing relay 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 cir-
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 said motor, a back contact of said snubbing relay and a snubbing resistance; and a centrifugal brake for said motor effective, if said motor is rotated above a predetermined speed, to brake the motor.

4. In an electric motor operated crossing gate, in combination, a gate fastened to a horizontal shaft and partly counterbalanced so that the shaft is biased to a horizontal stop position but is very strongly biased to a clear position if the gate be broken off, an electric motor connected for operating said shaft to a clear position, a clutch wheel frictionally connected to the shaft of said motor, a hold-clear magnet having a high resistance coil and effective, when in an active condition, to lock said clutch wheel, a control relay, a snubbing relay, a motor control contact and magnet control contact means both controlled by said shaft, the magnet control contact means being positionable to determine two different degrees of energization of the hold-clear magnet, the motor control contact being opened when said shaft, moving in one direction, assumes a predetermined position, the hold-clear magnet control contact means changing its control at about said predetermined position of the shaft to thereby change the degree of energization of the magnet, a snubbing circuit for said motor including, in series, said motor and a snubbing resistance, and a centrifugal brake for said motor effective, if said motor be rotated above a predetermined speed, to brake the motor.

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