Feb. 8, 1955 G. V. JEFFERSON 2,701,856

ELECTRIC MOTOR CONTROL FOR HIGHWAY CROSSING GATE MECHANISMS

Filed April 28, 1951 3 Sheets-Sheet 1

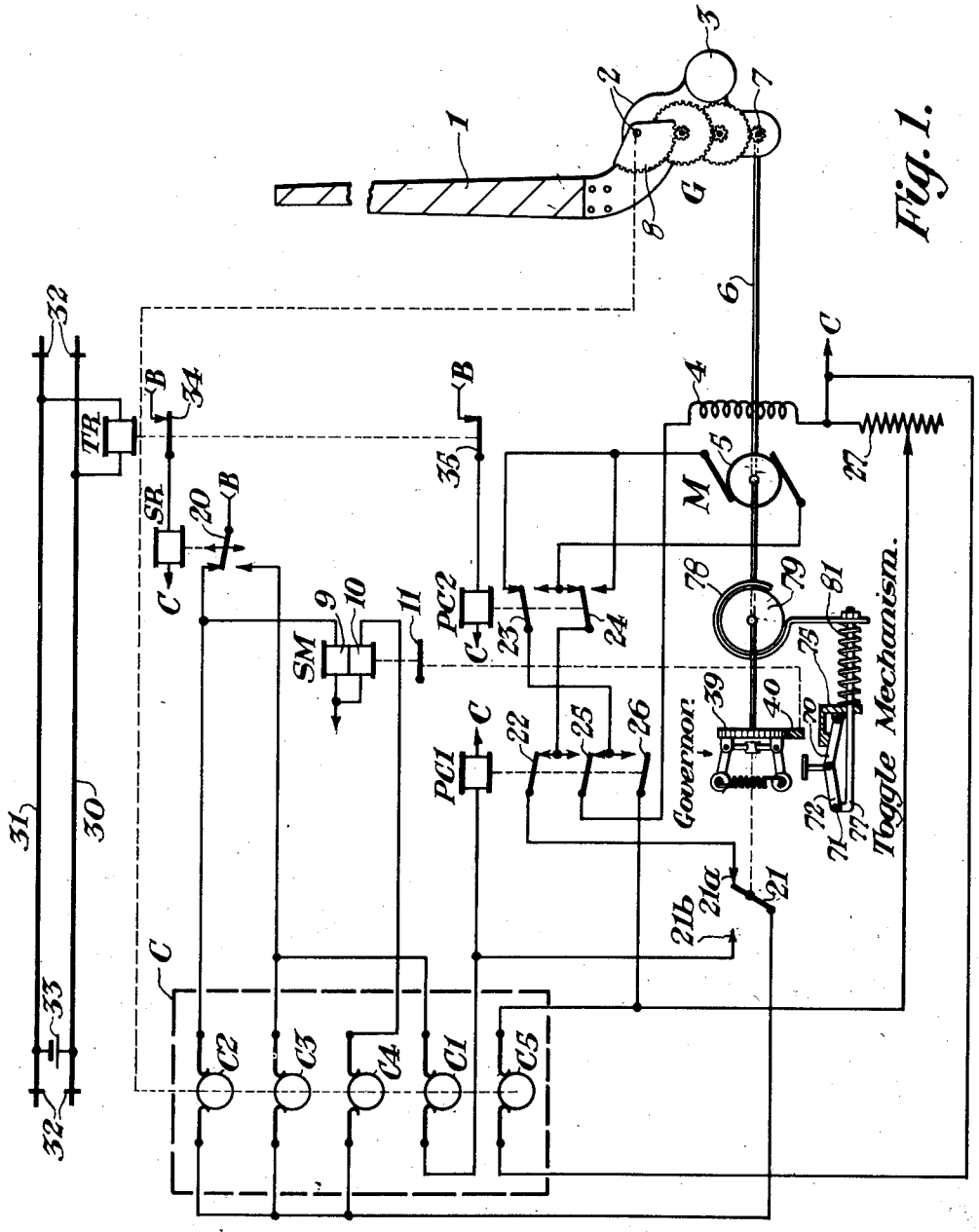


Fig. 1.

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Contacts	Closed in Lowering	Closed in Raising.
C1	44°~0°	0°~44°
C2	83°~0°	0°~89°
C3	90°~45°	45°~90°
C4	89°~86°	86°~89°
C5	10°~0°	0°~10°

Fig. 2.

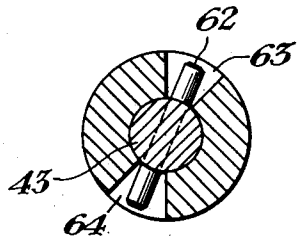


Fig. 5.

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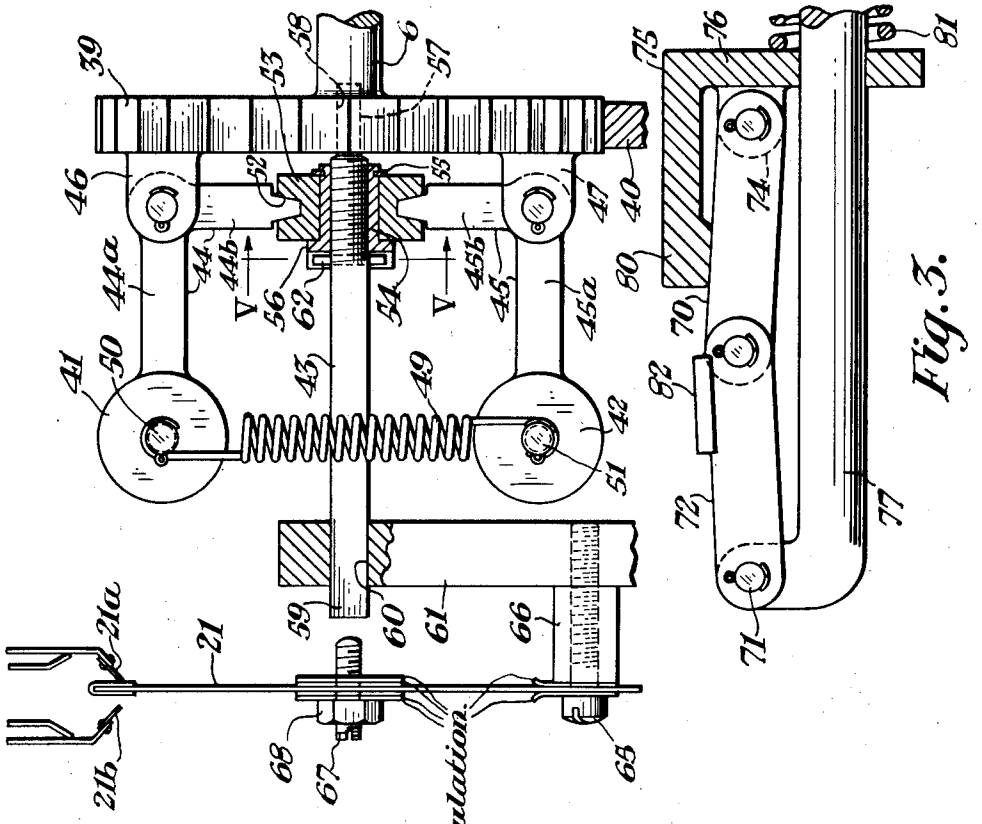


Fig. 3.

Fig. 4.

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United States Patent Office 2,701,856 Patented Feb. 8, 1955

2,701,856

ELECTRIC MOTOR CONTROL FOR HIGHWAY CROSSING GATE MECHANISMS

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Application April 28, 1951, Serial No. 223,613

5 Claims. (Cl. 318—258)

My invention relates to highway crossing gate mechanisms and more particularly to a highway crossing gate mechanism incorporating novel and improved means for controlling the speed of the gate arm.

A crossing gate mechanism includes as essential elements, a motor, a latch magnet and a circuit controller. The motor is operatively connected through a suitable gear train to the gate arm which is movable between a lowered or obstructing position and a raised or non-obstructing position. Though the gate is counterbalanced so that the arm may gravitate to its lowered position the motor may nevertheless be of the reversible type and it may be reversibly energized through pole changing contacts to drive the gate up and down according to the position of such pole changing contacts as determined by a pole changing relay. In the raising of the gate arm the motor is disconnected from the current source at a contact of the controller opened at substantially the full raised position of the arm, and the gate arm is latched in such full raised position by the latch magnet to prevent the gate arm from immediately lowering when the gate motor is deenergized. In the lowering operation, if power is applied to the arm to drive it down such power is preferably applied only during a preselected first portion of the gates downward movement after which the motor is disconnected from the current source and provided with a snubbing circuit including a snubbing resistor during the final portion of the lowering movement to effect a dynamic braking, such switching of the motor circuits being accomplished through the medium of contacts of the circuit controller. Circuit means controlled by a controller contact may be provided for short circuiting the snubbing resistor for approximately the last 10° of gate travel to prevent a bouncing action of the gate due to the action of the gate stop.

With the foregoing gate mechanism the gate arm may be moved at an excessive speed by a high wind blowing in the direction of gate travel or by ice formations upon the gate arm. There is also the possibility that the gate arm will be broken off by an automobile driving through the gate arm while the gate is in its lowered position in which event the counterweight with which the arm is provided will cause the gate to be operated to its non-obstructing position at an excessive speed.

I propose to provide a gate mechanism which will maintain the speed of the gate arm within desirable limits.

It is an object of my invention to provide a gate mechanism incorporating circuit means controlled by the contacts of a speed governor for maintaining the speed of the gate arm within desirable limits, such speed control being obtained by the deenergization of the gate motor to eliminate the driving force of the motor upon the gate arm, and by the completion of a snubbing circuit connected across the motor armature to provide for the dynamic braking of the motor.

It is another object of my invention to provide a gate mechanism for highway crossing gates incorporating circuit means controlled by the contacts of a speed governor for maintaining the speed of the gate arm within desirable limits by deenergizing the gate motor if the gate arm attains a first predetermined speed in descending or a second predetermined speed greater than said first predetermined speed in ascending, and by completing a snub circuit connected across the motor armature if the speed of the gate arm in descending is increased over said first predetermined speed to a third predetermined speed or if the speed of the gate arm in ascending is

increased over said second predetermined speed to a fourth predetermined speed greater than said third predetermined speed.

It is still another object of my invention to provide in addition to the foregoing speed control means, other means actuated by the speed governor for applying a braking force to the motor shaft under emergency conditions when the gate arm would if unrestrained move at a tremendous speed as for example when the gate arm is broken off while the gate is in its lowered position.

It is a further object of my invention to provide a novel and improved speed governor having an actuating member the operation of which is dependent both upon the speed of the governor and its direction of rotation.

It is still a further object of my invention to provide in combination with the foregoing speed governor a toggle mechanism which is at times actuated by the centrifuge weights of the governor.

To attain the objects and advantages of my invention, I provide circuit means controlled by the contacts of a speed governor connected with the gate arm for maintaining the speed of the gate arm within desirable limits. Preferably the governor is provided with two contacts one of which is included in the energizing circuit for the gate motor and the other of which is included in the energizing circuit of a control relay. When the first mentioned contact is opened the gate motor is deenergized to eliminate the driving force upon the gate arm and when the other contact is closed the control relay picks up to complete a snub circuit connected across the motor armature. The speed of the gate arm may usually be maintained within desirable limits by opening and closing these contacts at appropriate times. Preferably the governor is so constructed that the first mentioned contact is opened if the gate arm attains a first predetermined speed in descending or a second predetermined speed greater than said first predetermined speed in ascending, and the other contact is closed if the speed of the gate arm in descending is increased over said first predetermined speed to a third predetermined speed or if the speed of the gate arm in ascending is increased over said second predetermined speed to a fourth predetermined speed greater than said third predetermined speed.

Accordingly, I provide a speed governor which is dependent in its operation not only upon the speed with which it is operated but also upon its direction of rotation. Its contact operation is controlled by a plunger which is operatively connected to a pair of centrifuge weights and which is advanced in a given direction a varying amount dependent upon the speed with which the weights are rotated. The plunger is also threaded for a portion of its length and such threaded portion engages a threaded bushing which is rotated when the weights are rotated and which advances the plunger an additional amount when rotated in one direction and retracts the plunger when rotated in the other direction. I also provide a toggle mechanism which is actuated by the centrifuge weights when their speed is substantially increased over that required to operate the governor contacts, for applying a braking force to the shaft of the gate motor.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings Fig. 1 is a diagrammatic view showing one form of crossing gate mechanism embodying the features of my invention. Fig. 2 is a chart showing the positions at which the controller contacts of the gate mechanism of Fig. 1 are closed. At positions other than those indicated in the chart the controller contacts are open. Fig. 3 is an elevational view, portions of which are shown in section, of one form of centrifugal governor embodying the features of my invention and suitable for use in the crossing gate mechanism shown in Fig. 1. Fig. 4 is an end view of the governor shown in elevation in Fig. 3. Fig. 5 is a sectional view taken substantially on the line V—V of Fig. 3.

Similar reference characters refer to similar parts in each of the several views.

Referring to Fig. 1, reference character 1 designates the gate arm of a highway crossing gate which gate arm

is fixed to operating shaft 2 of the gate mechanism. The gate arm is connected with counterweight 3 which is preferably so adjusted that the gate arm will gravitate from its vertical or non-obstructing position to its horizontal or obstructing position in the event the power supplied to the gate operating mechanism is cut off.

In the present embodiment of my invention the crossing gate mechanism is similar to that shown and described in Letters Patent of the United States No. 1,138,087, granted to John P. Coleman on May 4, 1915 for Railway Signals, and comprises as essential elements thereof, a motor M, a latch magnet SM and a circuit controller C.

Motor M includes field winding 4 and motor armature 5 which is rotatably mounted upon shaft 6. Shaft 6 has a pinion 7 mounted thereon and connected through a suitable gear train G with a toothed right angle sector or quadrant 8 fixed to operating shaft 2 whereby rotation of the motor will raise or lower the gate arm depending upon the direction of rotation. The plurality of pinions and gears of gear train G by means of which motor shaft 6 and operating shaft 2 are connected, are selected to effect a reduction in the speed of the gate arm relative to the speed of the motor shaft.

Motor M is preferably a direct current reversible motor which is operated in one direction to raise the gate arm when supplied with current which flows in its armature in one direction with respect to the flow of current in the field winding, and is operated in the other direction to lower the gate arm when supplied with current which flows in its armature reverse with respect to said one direction. In the following description the horizontal or obstructing position of the gate arm will be considered as its 0° position and the vertical or non-obstructing position will be considered as its 90° position. It will be understood however, that apparatus embodying my invention is not limited to a 90° movement of the gate arm. Also, it is to be observed that the arm may be provided with a slightly greater than 90° movement in order to permit adjustment.

Latch magnet SM includes a holding winding 9, a pick up winding 10 and an armature 11. As fully explained in the aforementioned Coleman patent, the armature 11 when picked up latches the gate arm in the 90° position, and when the magnet is deenergized and the armature released, the gate mechanism is free to move toward its zero degree position. The arrangement is such that armature 11 is raised to its attracted and latching position only when both windings 9 and 10 are energized, but once picked up the armature is held at its latching position by the energization of winding 9 alone.

Controller C, as shown, includes a series of contacts C1, C2, C3, C4 and C5, which are shown conventionally for the sake of simplicity. Controller C is operatively connected to the gate arm through the gate mechanism in such manner that the contacts are closed as indicated by the chart of Fig. 2. It is to be observed that contact C2 is opened at the 89° position in the raising of the gate arm and is not reclosed until the 83° position of the arm when the arm is being lowered. The construction of contact C2 may be that disclosed and claimed in Letters Patent of the United States No. 2,363,936, granted November 28, 1944, to H. L. Bone for Circuit Controllers.

The gate mechanism also includes a slow release relay SR and two pole changing relays PC1 and PC2. Relay PC1 controls a snubbing circuit for motor M and relay PC2 controls the direction of the current supplied to the motor armature.

Motor M, as shown, is provided with an energizing circuit which includes either front contact 20 of relay SR and controller contact C2, or back contact 20 of relay SR and controller contact C3, according as relay SR is picked up or released, governor controlled contact 21—21*a*, back contact 22 of relay PC1, front or back contacts 23 and 24 of relay PC2 according as relay PC2 is picked up or released, motor armature 5, back contact 25 of relay PC1, and field winding 4. A motor snubbing circuit is connected across the motor armature at front or back contacts 23 and 24 of relay PC2 depending upon whether relay PC2 is picked up or released and such circuit includes front contacts 25 and 26 of relay PC1, field winding 4 and resistance 27. When relay PC1 is picked up to close front contacts 25 and 26 the motor energizing circuit is open at back contacts 22 and 25 of relay PC1. An alternate path extending over controller contact C5 is provided without resistance 27 in the snubbing circuit to short circuit the resistance during the last 10° travelled by the gate arm in its descent. The snubbing circuit is complete only when relay PC1 is picked up over its energizing circuit which circuit is provided with a plurality of paths one of which extends from terminal B of a suitable source of current such as a battery not shown over front contact 20 of relay SR, controller contact C2 and governor controlled contact 21—21*b* through the winding of relay PC1 to the other terminal C of the same source of current. Another path extends from terminal B over back contact 20 of relay SR, controller contact C3, and governor contact 21—21*b* through the winding of relay PC1 to terminal C. A third path in the energizing circuit for relay PC1 may be traced from terminal B over back contact 20 of relay SR and controller contact C1 through the winding of relay PC1 to terminal C. Governor contacts 21—21*a* and 21—21*b* are operated in accordance with the speed of the gate arm in a manner to be made clear hereinafter.

Relays SR and PC2 are governed by traffic on a control section of track such as shown in Fig. 1 wherein the reference characters 30 and 31 designate the rails of a stretch of track and the reference character 32 designates the insulated joints forming a control section therein. Such track section is provided with track battery 33 connected across the rails at one end of the section and track relay TR connected across the rails at the other end of the section. Relays SR and PC2 are provided with obvious energizing circuits, the energizing circuit for relay SR extending over front contact 34 of relay TR and the energizing circuit for relay PC2 extending over front contact 35 of relay TR.

As previously mentioned latch magnet SM includes a holding winding 9 and a pick up winding 10 which control the operation of armature 11. The energizing circuit for holding winding 9 extends from terminal B over front contact 20 of relay SR through winding 9 to terminal C while the energizing circuit for pick up winding 10 extends from terminal B over front contact 20 of relay SR, controller contact C2, and controller contact C4 through winding 10 to terminal C. The armature 11 operates a latch pall 40.

Referring now to Figs. 3, 4 and 5 wherein is shown a speed governor of the type preferable for controlling contacts 21—21*a* and 21—21*b*, reference character 39 designates a ratchet wheel fixed to and rotatable with motor shaft 6. Ratchet wheel 39 cooperates with a pawl 40 which is lifted by a suitable mechanism not shown into engagement with the wheel when windings 9 and 10 are energized to latch the gate arm in its clear position and which pawl when once picked up is held in such position by the energization of winding 9 alone until both windings 9 and 10 are deenergized.

In the embodiment of my invention shown, ratchet wheel 39 is adapted to rotate centrifuge weights 41 and 42 (Fig. 3) which are connected to a plunger 43 by suitable means for moving the plunger longitudinally to a position dependent not only upon the speed with which the weights are rotated but also upon their direction of rotation. Weight 41 is integrally formed on arm 44*a* of bell crank 44 and weight 42 is integrally formed on arm 45*a* of bell crank 45. Bell cranks 44 and 45 are pivotally mounted on bosses 46 and 47, respectively, the bosses being integrally formed at diametrically opposite locations on one side of ratchet wheel 39. When the weights are motionless arms 44*a* and 45*a* are approximately parallel to each other and to plunger 43, but as the weights are rotated by ratchet wheel 39 they are moved outwardly from plunger 43 to a position which is dependent upon their speed of rotation. The weights are interconnected by springs 48 and 49 (see Fig. 4) the ends of which are looped about the projecting portions of pins 50 and 51 extending through centrifuge weights 41 and 42, respectively.

Bell cranks 44 and 45 are also provided with arms 44*b* and 45*b*, respectively, which extend inwardly toward plunger 43. Each such arm has a tooth formed at the end which engages a groove 52 in rectangular block 53. The block has a circular opening centrally located and extending through the block for receiving threaded bushing 54 such that the surface defining the opening in the block and the exterior surface of the bushing are in frictional engagement with one another. While block 53 may at times be rotated about bushing 54, lateral movement of the block with respect to the

bushing is prevented by confining the block 53 between a snap ring 55 on one end and a flange 56 on the other end of the bushing. The threaded inner surface of bushing 54 engages a threaded portion of plunger 43.

Plunger 43 has its center line in alignment with the axis of rotation of ratchet wheel 39. The plunger is guided for longitudinal movement but restrained against rotation having one end 57 of lesser diameter than the main portion of its length registering in pilot hole 58 in motor shaft 6 and having the other end 59 (see Fig. 4) rectangular in shape and registering in square broached hole 60 in frame 61.

When motor M is set into operation ratchet wheel 39 and centrifuge weights 41 and 42 are caused to rotate. The weights move outwardly from their axis of rotation, and bell crank 44 is moved in a clockwise direction (as viewed in Fig. 3) about its pivot point on boss 46, and bell crank 45 is moved in a counterclockwise direction about its pivot point on boss 47. Rectangular block 53 is moved to the left carrying bushing 54 and plunger 43 along with it. Obviously, the position of the plunger is dependent upon the position which weights 41 and 42 assume and as the position of the weights is dependent upon their speed of rotation as determined by the speed of motor M the position of the plunger is also dependent upon the speed of the motor. The position of the plunger is however also dependent upon the direction of rotation of motor M as will now be pointed out.

When ratchet wheel 39 is caused to rotate, arms 44*b* and 45*b* of bell cranks 44 and 45 are caused to revolve. Rectangular block 53 also revolves due to the frictional force between the teeth formed at the ends of arms 44*b* and 45*b* and the sides of groove 52 of block 53, and because of the frictional engagement between block 53 and bushing 54, the latter is also caused to rotate within the limits hereinafter stated. Now plunger 43 is restrained against rotation, its one end 59 being rectangular in shape and guided in square broached hole 60 in frame 61. It may, however, move longitudinally and because of the threaded engagement between bushing 54 and plunger 43, when bushing 54 is rotated plunger 43 is caused to move longitudinally in one direction or the other depending upon the direction of rotation of bushing 54 as determined by the direction of rotation of motor M and the threads employed on the plunger and bushing. In the embodiment of my invention shown in the drawing, right-handed threads are employed so that when motor shaft 6 and ratchet wheel 39 are caused to rotate in a clockwise direction as viewed from the left in Fig. 3, plunger 43 is moved to the left, while it is moved to the right when the motor and ratchet wheel are rotated in the opposite direction. Such longitudinal movement of the plunger due to rotation of bushing 54 may however occur only within certain defined limits, further movement being prevented by pin 62 extending through plunger 43 and positioned between the sides of sector shaped recesses 63 and 64 (see Fig. 5) machined in one end of bushing 54 on opposite sides thereof such that the bushing may be rotated only through an angle determined by the size of the recesses.

Secured to frame 61 by bolt 65 is terminal block 66 supporting contact finger 21 at one end. Intermediate the ends of contact finger 21 is set screw 67 and lock nut 68 secured in assembled relationship to the finger in a well-known manner, the position of the screw being such that the plunger 43 may engage it to actuate the contact finger. Contact finger 21 is insulated from terminal block 66 and its securing bolt 65 and from set screw 67 and lock nut 68 by suitable insulating material.

When the gate arm is at rest in either its obstructing or non-obstructing position contact finger 21 assumes an initial position in which it engages fixed contact 21*a*. It is at times moved by plunger 43 to an intermediate position between fixed contacts 21*a* and 21*b* and at other times to a final position in which it engages fixed contact 21*b*. Obviously, for reasons already stated, the position of the contact finger is dependent upon the direction and speed of rotation of motor M. As may be seen in Fig. 1, gate arm 1 is connected through gear train G with one end of motor shaft 6, and ratchet wheel 39 is fixed to the other end of the shaft, with a clockwise rotation of motor shaft 6 and ratchet wheel 39 as viewed from the left in Fig. 3 corresponding to a descending gate arm and their counterclockwise rotation corresponding to an ascending gate arm. Now the parts of the apparatus are so proportioned that due to the rotation of bushing 54 previously mentioned contact finger 21 is moved away from its initial position to disengage fixed contact 21*a* at a first predetermined speed in descending and at a second predetermined speed in ascending, the second predetermined speed being more than the first because movement of bushing 54 when the gate ascends is in a direction such as to cause the plunger 43 to have a greater stroke before actuating screw 67, thereby requiring a greater displacement of the weights 41 and 42 and requiring to obtain this greater displacement a higher speed of rotation for an ascending movement than for a descending move. It is of course to be understood that the first and second predetermined speeds (at which contact fingers 21 disengages fixed contact 21*a*) in each case exceed the normal speed of operation of the gate arm ordinarily experienced. Contact finger 21 engages fixed contact 21*b* when the speed of the gate arm is increased over said first predetermined speed to a third predetermined speed in descending or if the speed of the gate arm in ascending is increased over said second predetermined speed to a fourth predetermined speed.

For speeds sufficiently great to cause contact finger 21 to disengage fixed contact 21*a* but insufficient to cause it to engage fixed contact 21*b*, the contact finger will assume its intermediate position between fixed contacts 21*a* and 21*b*.

A toggle mechanism is provided to apply a braking force to the motor shaft in the event the speed of the gate arm is substantially increased above the aforementioned predetermined speeds due for example to the gate arm being broken off while the gate is in its lowered position. The toggle mechanism includes two pairs of parallel spaced links and an actuating member. One such pair of links including the link 70 and another link not shown are pivotally mounted at one end on a boss 74 integrally formed on a depending portion 76 of frame 75. The free ends of these links are pivotally connected to corresponding ends of links 72 and 73 (see Fig. 4) of the other pair of parallel spaced links, the free ends of the one pair of links (including link 70) being positioned between the corresponding ends of links 72 and 73. Connected to links 72 and 73 by a pin 71 is actuating member 77 one end of which is positioned between the corresponding other ends of links 72 and 73 and pivotally mounted on pin 71. Member 77 extends through an opening in the depending portion 76 of frame 75 and has attached thereto at its other end a brake band 78 (see Fig. 1) which surrounds a brake drum 79 fixed to the gate motor shaft 6.

The links may assume a position such that a horizontal line may be drawn joining all the pivot points of the toggle mechanism, but in the normal position of the apparatus as viewed in Fig. 3 the linkages extend somewhat above such horizontal line, the one pair of links including link 70 being forced up against a lateral extending portion 80 of frame 75 by spring 81 (see Figs. 1 and 3). Now links 72 and 73 are provided with plates 82 and 83, respectively (see Fig. 4), integrally formed with the links, and the toggle mechanism is so positioned with respect to the centrifuge weights 41 and 42 that when the gate arm is moved at a sufficiently high velocity the weights are moved out to strike the plates. As the speed of the gate arm is further increased the weights move out still further forcing the links 72 and 73 (and the other pair of links) downwardly due to the impact of the weights upon plates 82 ann 83. At a predetermined speed of the gate arm the linkages are actuated to a position in which a horizontal line may be drawn through all of the pivot points of the toggle mechanism. When such speed is exceeded and the linkages forced below such horizontal line, the linkages collapse to their most downward position being actuated by the spring 81 (see Figs. 1 and 3). Member 77 is moved to the right as viewed in the drawing to tighten the brake band 78 on the drum 79 and so prevent the gate arm from attaining a speed which might result in damage to the gate operating mechanism.

Referring again to Fig. 1, when the control track section for the gate mechanism is unoccupied, as shown, track relay TR is picked up and the gate arm is in its vertical or non-obstructing position. Latch magnet SM of the gate mechanism has its holding winding 9 energized

and such energization of the slot magnet winding is effective to retain the gate arm at its 90° position it being understood that the machanism has been operated to that position in a manner to appear shortly. Relays SR and PC2 are picked up but relay PC1 and pickup-winding **10** are deenergized. Controller contacts C1, C2, C4 and C5 are open and motor M is deenergized. Controller contact C3 is closed.

When a train enters the control section, track relay TR releases to open the energizing circuits for relays SR and PC2 at front contacts **34** and **35**, respectively, of relay TR. Relay PC2 releases before relay SR since relay SR is a slow release relay. When relay PC2 releases its front contacts **23** and **24** open and its back contacts **23** and **24** close. After its slow release interval, relay SR releases whereupon its front contact **20** opens the energizing circuit for holding winding **9** of magnet SM and holding winding **9** releases operating latch pall **40** out of engagement with ratchet wheel **39** and unlatching the gate arm to permit the gate to move to its horizontal position. Back contact **20** of relay SR also closes to complete a circuit path in the energizing circuit for motor M extending from terminal B over back contact **20** of relay SR, controller contact C3, governor controlled contact **21—21***a*, back contact **22** of relay PC1, back contact **24** of relay PC2, motor armature **5**, back contact **23** of relay PC2, and back contact **25** of relay PC1, through field winding **4** to terminal C. Motor M becomes energized in the proper direction to drive the gate down and when the gate passes beyond its 45° position the circuit path traced above for the motor is opened at controller contact C3. Motor M is deenergized but the gate arm continues to descend by virtue of its own weight.

At the 44° position of the gate arm controller contact C1 closes to provide a complete path in the energizing circuit for relay PC1, extending from terminal B over back contact **20** of delay SR and controller contact C1 through the winding of relay PC1 to terminal C. Back contacts **22** and **25** of relay PC1 open and front contacts **25** and **26** of relay PC1 close. The closing of front contacts **25** and **26** completes the motor snubbing circuit which includes those front contacts of relay PC1, field winding **4**, armature winding **5**, resistance **27** and back contacts **23** and **24** of relay PC2. The snubbing circuit is now connected across the motor armature and since the gate arm is now descending due to its own weight the motor M functions as a generator to brake the movement of the gate arm, the braking force exerted being predetermined in the adjustment of resistance **27**.

When the gate arm reaches its 10° position controller contact C5 closes completing an obvious shunt path about resistance **27** in the motor snubbing circuit. The current in the snubbing circuit is greatly increased due to the shunt circuit established and the braking force exerted by the motor is increased a proportional amount to further slow down the gate arm to prevent bouncing of the arm due to the action of the gate stop when the gate arm reaches the horizontal position. The gate arm remains in its horizontal or 0° position until the train vacates the control section.

When the train vacates the control section, track relay TR picks up once again, its front contacts **34** and **35** closing to effect the energization of relays SR and PC2, respectively. Relay PC2 picks up and its back contacts **23** and **24** open while its front contacts **23** and **24** close. Relay SR picks up at the expiration of its slow acting interval when its back contact **20** opens the energizing circuit for relay PC1, which releases whereupon its front contacts **25** and **26** open and its back contacts **22** and **25** close. Front contact **20** of relay SR closes. There is now a complete circuit path in the energizing circuit for motor M extending from terminal B over front contact **20** of relay SR, controller contact C2, governor controlled contact **21—21***a*, back contact **22** of relay PC1, front contact **24** of relay PC2, armature **5**, front contact **23** of relay PC2, back contact **25** of relay PC1, and field winding **4** to terminal C. The direction of the current through armature **5** is now reversed from that which existed when the motor was driving the gate arm downward. Accordingly, the motor armature is caused to rotate in the other direction to drive the gate arm upward toward its vertical or non-obstructing position.

Controller contact C5 opens when the gate arm is raised beyond the 10° position and controller contact C1 opens when the gate arm is raised beyond the 44° position.

When the gate arm reaches its 86° position controller contact C4 is closed to effect the energization of pick-up winding **10** over its energizing circuit extending from terminal B over front contact **20** of relay SR, controller contact C2, and controller contact C4, through the winding of pick-up coil **10** to terminal C, and armature **11** is raised to its latching position to operate pall **40** and latch the gate arm in its vertical position since both windings **9** and **10** are now energized.

When the gate arm is raised beyond its 89° position controller contacts C2 and C4 open to effect the deenergization of motor M and pick-up winding **10**. The operation of the motor is discontinued but the gate arm is held latched in its raised position due to the energization of holding winding **9**.

As already described, during the descent of the gate arm, motor M is deenergized when the gate arm passes beyond its 45° position and the snubbing circuit is completed when the gate arm reaches its 44° position. Means are also provided however for deenergizing the gate motor and completing its snub circuit before the gate arm reaches its 45° position in descending or at any time during its ascent, provided the speed of the gate arm exceeds certain predetermined values.

Assume for example that when the gate arm is descending, ice formation upon the gate arm or a wind blowing in the direction of descent, is effective together with the driving force of the gate motor to cause the gate arm to be moved at more than the previously mentioned first predetermined speed. In this event the governor will in a manner hereinbefore described become effective to open contact **21—21***a* in the circuit path over which motor M is energized when it is driving the gate downward. The motor is deenergized eliminating the driving force of the motor on the gate arm and such elimination of the motor driving force may be sufficient to check the speed of the gate arm so that it resumes normal operating speed in which event governor controlled contact **21—21***a* is closed once again to effect the reenergization of the motor. Of course, the motor is deenergized when controller contact C3 opens as the gate arm passes its 45° position, and the motor snubbing circuit is completed when the gate arm reaches its 44° position. As the gate continues its descent and during the raising which follows, the gate mechanism operates in the same manner as hereinbefore described.

The motor snubbing circuit is completed before the gate arm reaches its 45° position in descending if deenergization of the gate motor due to the opening of governor controlled contact **21—21***a* does not prevent the speed of the gate arm from being increased to the third predetermined speed. When such third predetermined speed is attained the governor becomes effective to close governor controlled contact **21—21***b* and relay PC1 is picked up over the circuit path extending from terminal B over back contact **20** of relay SR, controller contact C3 and governor contact **21—21***b* through the winding of relay PC1 to terminal C. When relay PC1 picks up it completes the motor snubbing circuit at front contacts **25** and **26** of relay PC1 to provide for the dynamic braking of the motor which braking will ordinarily be sufficient to reduce the speed of the gate arm below the third predetermined speed and when that happens governor controlled contact **21—21***b* is opened once again. Motor M however remains deenergized until the gate arm resumes its normal operating speed when governor controlled contact **21—21***a* is again closed to effect the reenergization of the motor. The operations which occur as the lowering movement continues and as the gate is subsequently raised to its vertical position, are the same as those described heretofore and it is therefore believed unnecessary to describe them in detail at this point.

Assume now that the gate arm is being raised and that a wind blowing in the direction of ascent causes the gate arm to be moved at more than the second predetermined speed. The governor will then be operated to open contact **21—21***a* in the circuit path over which motor M is energized during the raising operation. The motor is deenergized eliminating the driving force of the motor on the gate arm to check its speed. If elimination of the motor driving force is sufficient to check the speed of the gate arm so that it resumes normal operating speed, governor controlled contact **21—21***a* closes once again and the motor is reenergized. If, however, elimination of the driving force of the motor does not check the speed of the gate arm and its speed is further increased to the

fourth predetermined speed governor controlled contact **21—21***b* will close causing relay PC1 to be picked up over the circuit path extending from terminal B over front contact **20** of relay SR, controller contact C2 and governor contact **21—21***b* through the winding of relay PC1 to terminal C. Front contacts **25** and **26** of relay PC1 close completing the snubbing circuit, now connected across the motor armature at front contacts **23** and **24** of relay PC2 since relay PC2 is picked up during the raising operation. With the snubbing circuit connected across the motor armature the speed of the motor will ordinarily be reduced below the fourth predetermined speed and governor controlled contact **21—21***b* will open. When the gate arm resumes normal operating speed governor controlled contact **21—21***a* is closed again to effect the reenergization of the motor. Other operations which occur during the raising of the gate arm have already been described in detail and it is believed unnecessary to reconsider them here.

If the gate arm attains a speed substantially in excess of the speeds necessary to operate the governor controlled contacts such as might occur if gate arm **1** is broken off while in its lowered position the toggle mechanism previously described will be actuated in a manner hereinbefore described to apply a sufficient braking force through the brake band **78** and drum **79** to motor shaft **6** to limit the speed of the gate arm to one insufficient to cause damage to the operating mechanism.

Although the contact operation of the governor which I have herein illustrated and described is dependent both upon the speed of the gate arm and its direction of operation it will be readily appreciated that in practicing my invention I may use a governor the contact operation of which is dependent only upon the speed of the gate arm so that the gate motor energizing circuit is opened at one predetermined speed and the motor snub circuit closed at a different predetermined speed regardless of the direction in which the gate is operated.

It will be readily apparent from the foregoing description that I have provided a gate mechanism effective to maintain the speed of the gate arm within desirable limits under adverse weather conditions and also effective under other circumstances, such as the breaking off of the gate arm while in a lowered position, to prevent the gate arm from attaining a speed which might result in damage to the operating mechanism. I have provided a gate mechanism incorporating circuit means controlled by the contacts of a speed governor for maintaining the speed of the gate arm within desirable limits. Control of the gate arm speed is obtained at times by deenergizing the gate motor to eliminate the driving force upon the gate arm and at other times by completing a snub circuit connected across the motor armature to provide for the dynamic braking of the motor. A toggle mechanism is also provided to apply a braking force to the gate motor shaft, which toggle mechanism is actuated by the governor when the speed of the gate arm is substantially increased over that required to operate the governor contacts.

Although I have illustrated and described only one form of highway crossing gate mechanisms embodying the features of my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A speed governor comprising a driving member rotatable in either of two directions, a pair of centrifuge weights rotatable with said driving member, a plunger having a threaded portion, guide means receiving said plunger and restraining the plunger against rotation but permitting it to move longitudinally, a threaded bushing engaging the threaded portion of said plunger, and means frictionally connecting the centrifuge weights to said threaded bushing so that said bushing is caused to turn on the plunger to move the plunger longitudinally a limited amount in one direction or the other according to the direction of rotation of said driving member, said connecting means also being effective for causing further longitudinal movement of said plunger by moving said bushing longitudinally in response to movement of said centrifuge weights by centrifugal force.

2. A speed governor comprising a driving member rotatable in two directions, a pair of centrifuge weights rotatable with said driving member, a plunger having a threaded portion, guide means receiving said plunger and restraining the plunger against rotation but permitting it to move longitudinally, a threaded bushing engaging the threaded portion of said plunger and having recesses machined in the surface of one end, a pin positioned between such recesses and secured to the plunger permitting only a limited rotation of the bushing with respect to the plunger, and means frictionally connecting the centrifuge weights to said threaded bushing so that said bushing is caused to rotate the limited amount with respect to the plunger to move the plunger longitudinally a corresponding amount in one direction or the other according to the direction of rotation of said driving member, said connecting means also being effective for causing further longitudinal movement of said plunger by moving said bushing longitudinally in response to movement of said centrifuge weights by centrifugal force.

3. A speed governor comprising a driving member rotatable in two directions, a pair of centrifuge weights rotatable with said driving member, a plunger having a threaded portion, guide means receiving said plunger and restraining the plunger against rotation but permitting it to move longitudinally, a threaded bushing engaging the threaded portion of said plunger and having recesses machined in the surface at one end, a pin positioned between such recesses and secured to the plunger permitting only a limited rotation of the bushing with respect to the plunger, a pair of bell cranks pivoted on said driving member each of said bell cranks having a centrifuge weight attached to one arm such that said centrifuge weights are constrained to rotate with said driving member, and means frictionally connecting the other arm of each bell crank with said threaded bushing in such manner that when the driving member is rotated the bushing is caused to rotate the limited amount with respect to the plunger to move the plunger longitudinally a corresponding amount in one direction or the other according to the direction of rotation of said driving member, said connecting means also being actuated by movement of said centrifuge weights due to centrifugal force to move said plunger longitudinally an additional amount.

4. A speed governor operatively connected to a driven member which is actuated by an electric motor driven mechanism and which driven member is rotated either in a normal or a reverse direction, a pair of centrifuge weights rotatable with said driven member, a plunger having a threaded portion, guide means receiving said plunger and restraining the plunger against rotation but permitting it to move longitudinally, a threaded bushing engaging the threaded portion of said plunger, means connecting the centrifuge weights to said driven member and said threaded bushing in such manner that said centrifuge weights are constrained to rotate with said driven member but that said bushing is caused to turn on the plunger to move the plunger longitudinally a limited amount in one direction or the other according to the direction of rotation of said driven member, said connecting means also being effective for causing further longitudinal movement of said plunger by moving said bushing longitudinally in response to movement of said centrifuge weights by centrifugal force, circuit contact means controlled by said plunger to govern said motor, and braking means for said driven member actuated by said centrifuge weights when the speed of operation of said driven member exceeds a predetermined speed.

5. A speed governor operatively connected to a driven member which is actuated by an electric motor driven mechanism and which driven member is rotated either in a normal or a reverse direction, a pair of centrifuge weights rotatable with said driven member, a plunger having a threaded portion, guide means receiving said plunger and restraining the plunger against rotation but permitting it to move longitudinally, a threaded bushing engaging the threaded portion of said plunger, means connecting the centrifuge weights to said driven member and said threaded bushing in such manner that said centrifuge weights are constrained to rotate with said driven member but that said bushing is caused to turn on the plunger to move the plunger longitudinally a limited amount in one direction or the other according to the direction of rotation of said driven member, said connecting means also being effective for causing further longitudinal movement of said plunger by moving said bushing longitudinally in response to movement of said centrifuge weights by centrifugal force, circuit contact

means controlled by said plunger to govern said motor, a brake for said driven member, and a toggle mechanism for actuating said brake, said toggle mechanism being actuated by the centrifuge weights to apply said brake when the speed of operation of the driven member exceeds a predetermined speed.

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