May 27, 1952 J. H. STALEY 2,598,196

VARIABLE-SPEED SIGNALING CROSSING GATE

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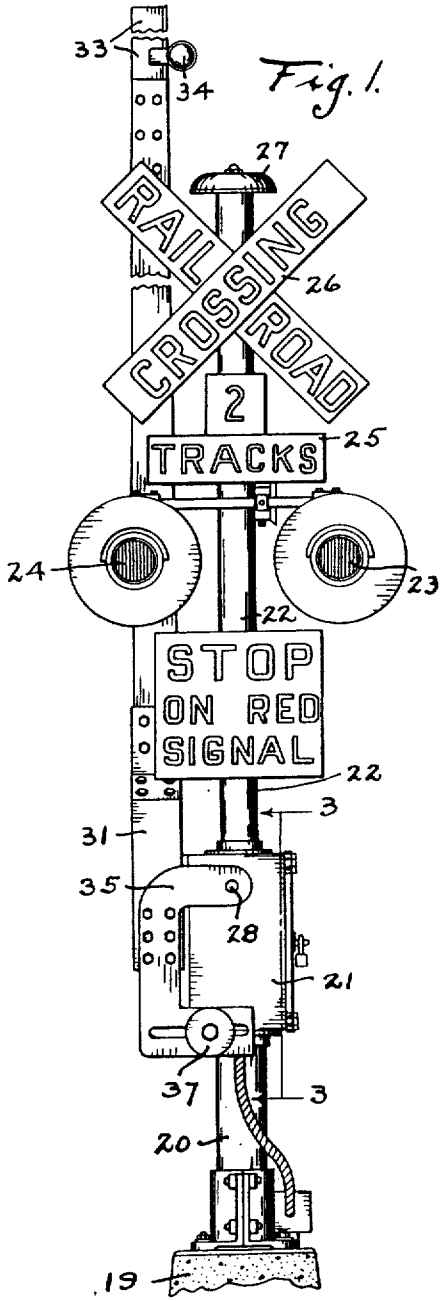


Fig. 1.

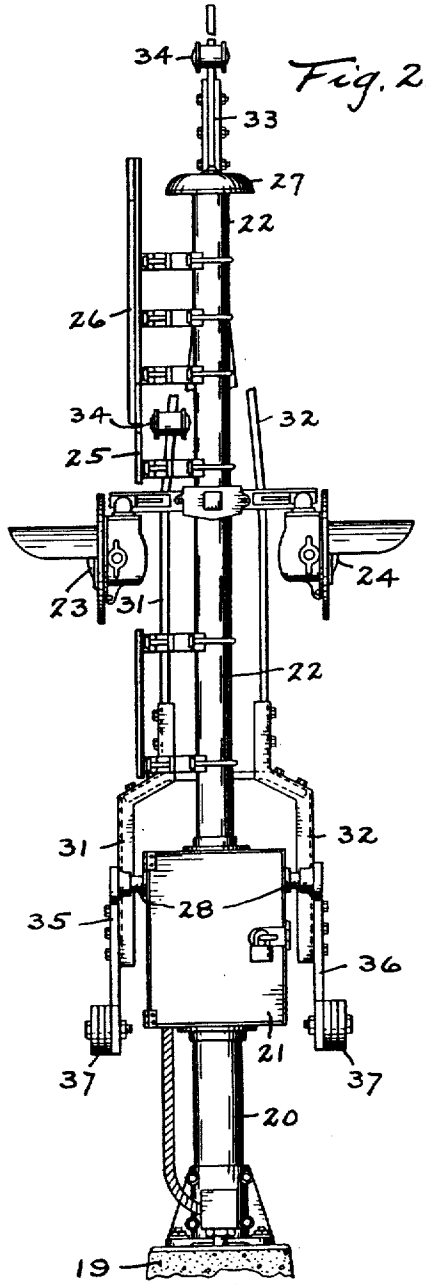


Fig. 2.

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Fig. 4.

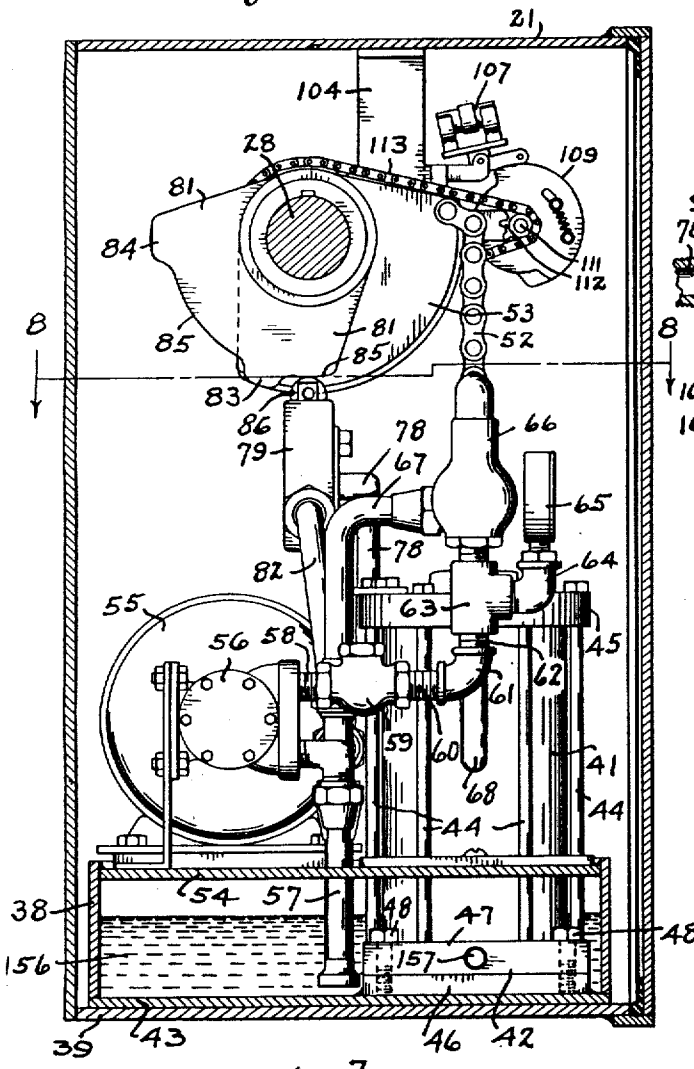
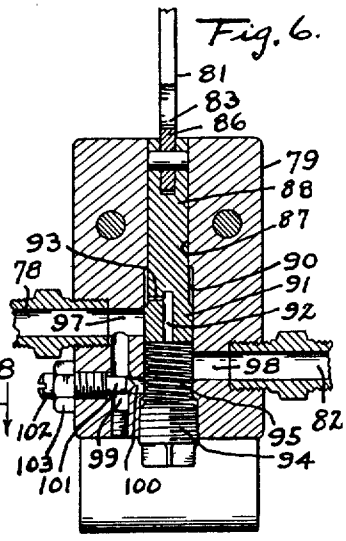


Fig. 6.



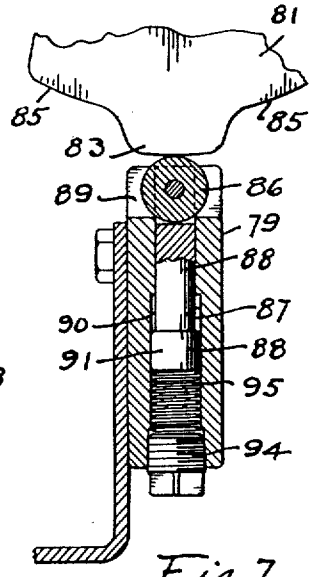


Fig. 7.

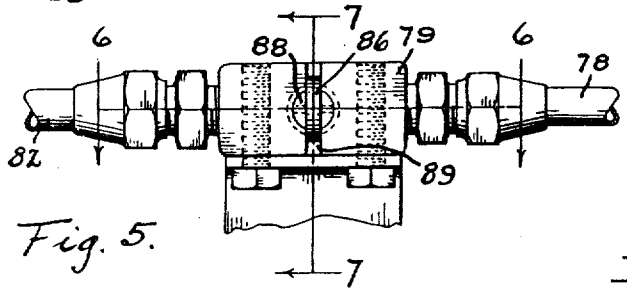


Fig. 5.

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VARIABLE-SPEED SIGNALING CROSSING GATE

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Fig. 8.

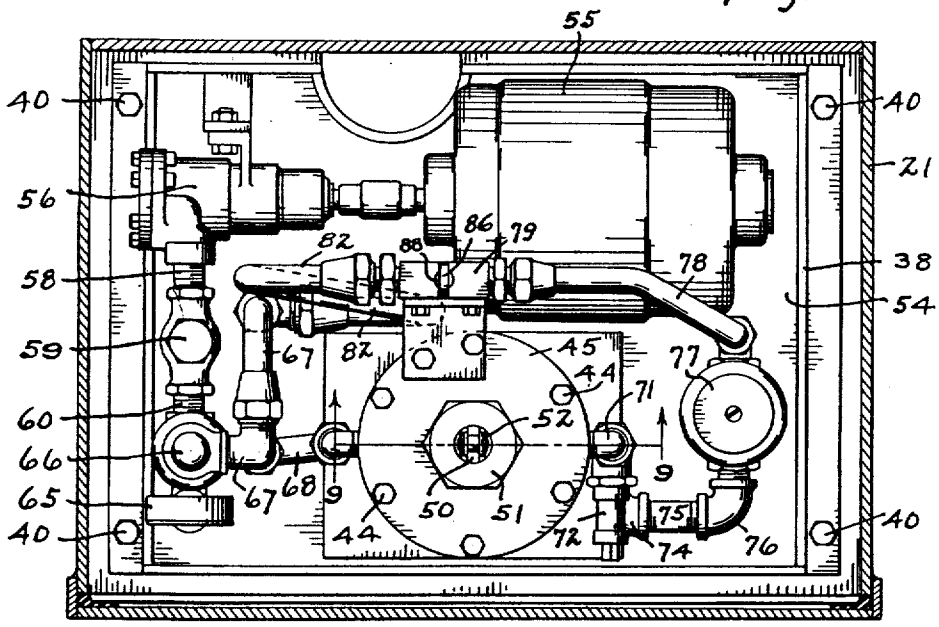


Fig. 10.

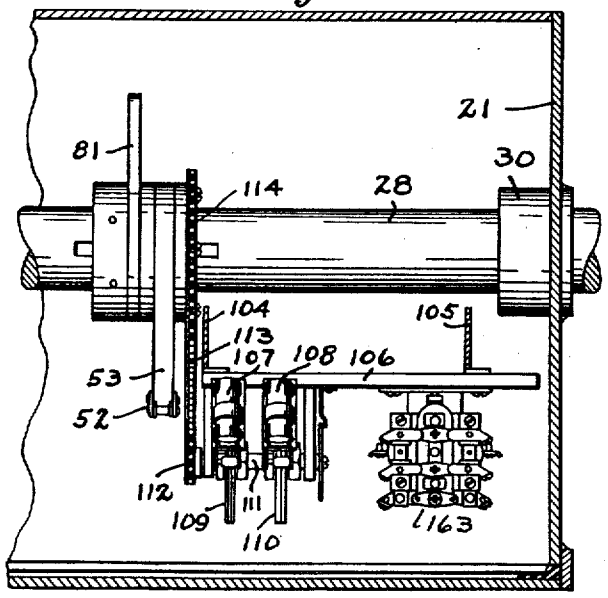
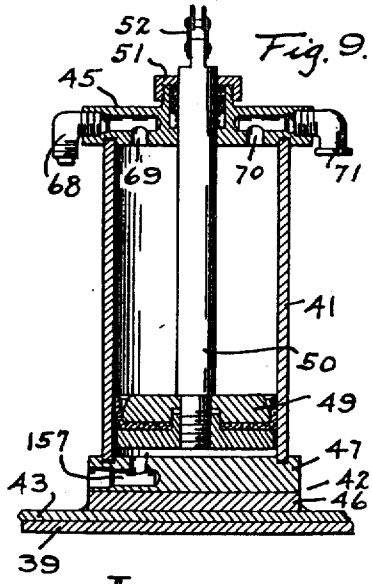


Fig. 9.



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Fig. 11.

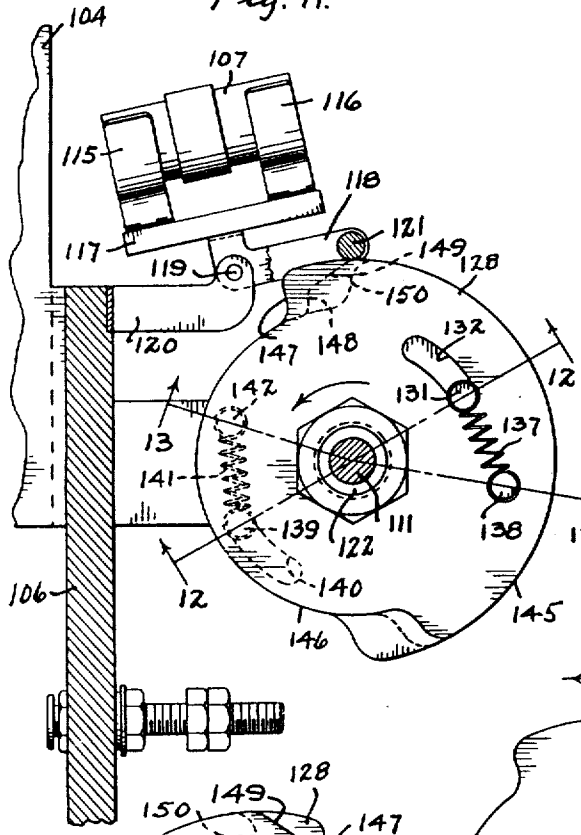


Fig. 12.

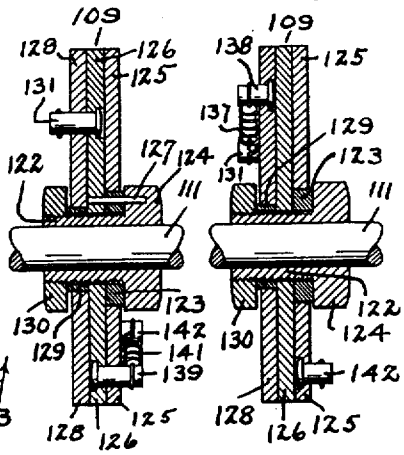


Fig. 13.

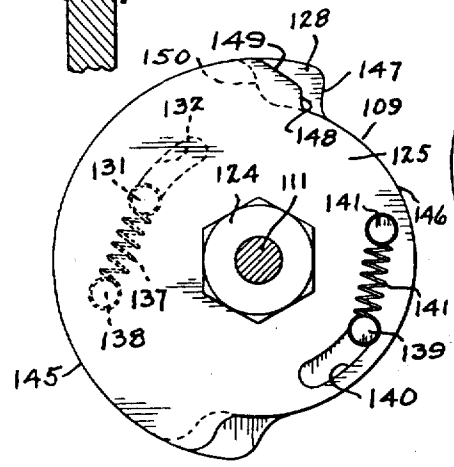


Fig. 14.

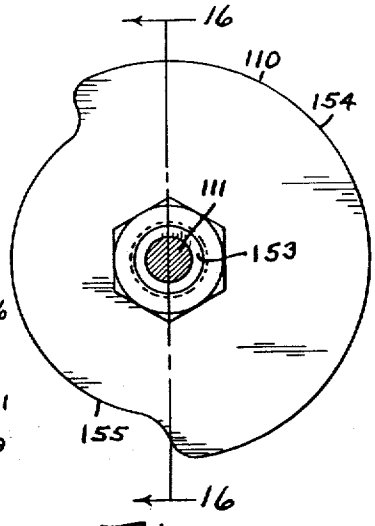


Fig. 15.

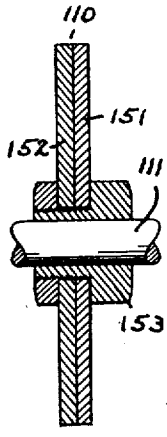


Fig. 16

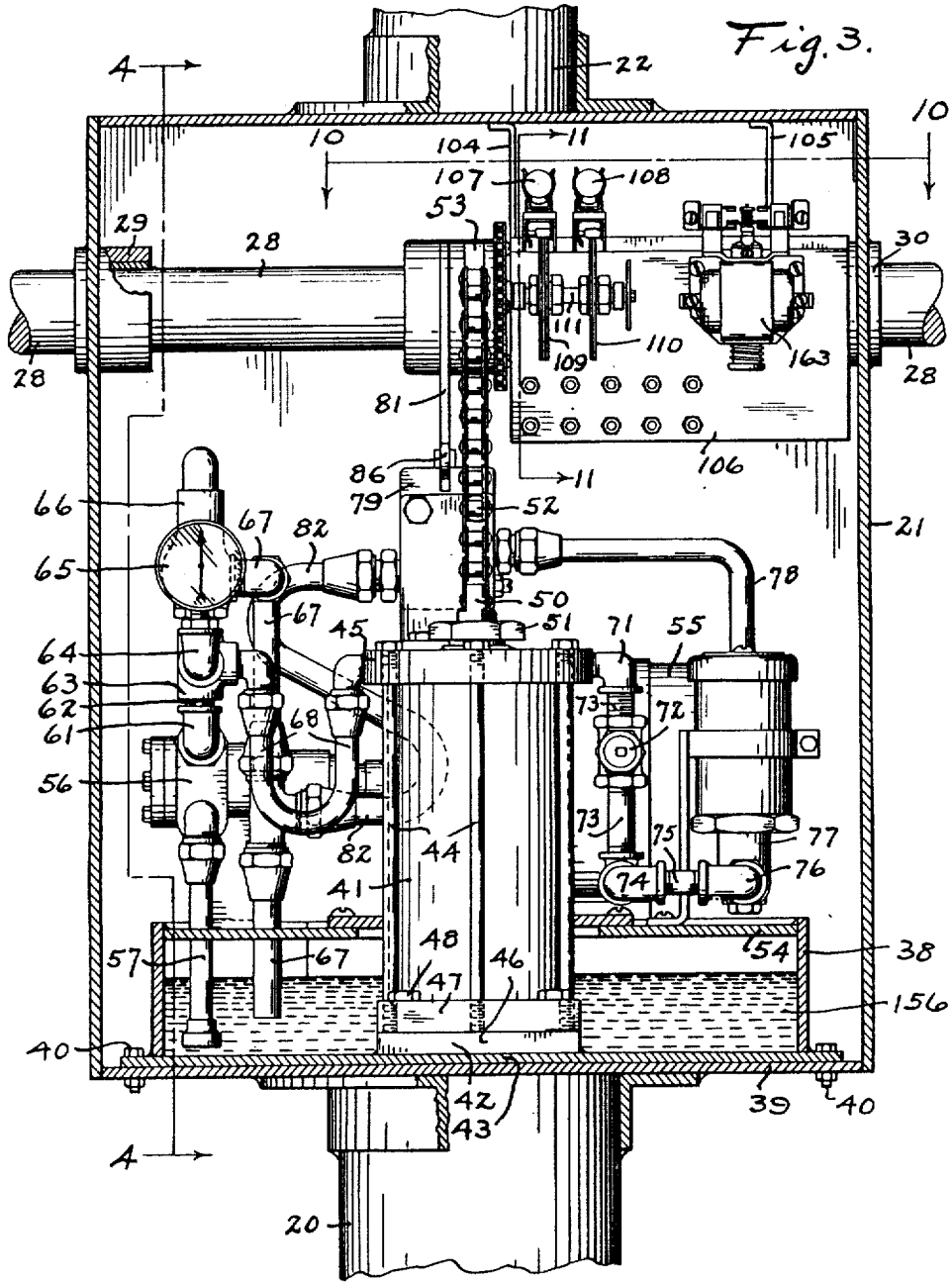
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May 27, 1952 J. H. STALEY 2,598,196

VARIABLE-SPEED SIGNALING CROSSING GATE

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Fig. 3.



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VARIABLE-SPEED SIGNALING CROSSING GATE

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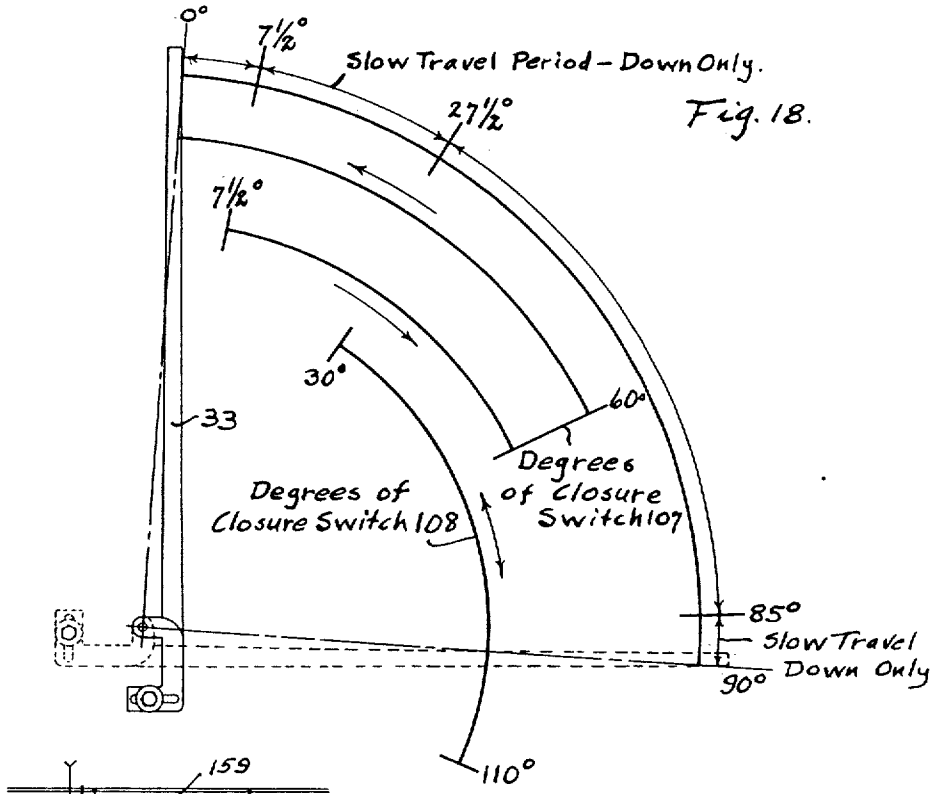


Fig. 18.

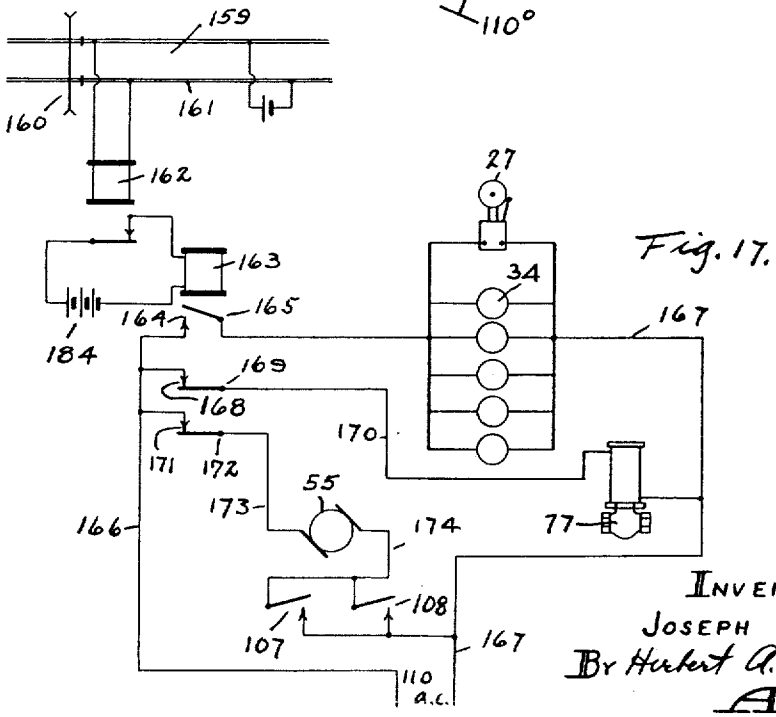


Fig. 17.

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Patented May 27, 1952 2,598,196

UNITED STATES PATENT OFFICE

2,598,196

VARIABLE-SPEED SIGNALING CROSSING GATE

Joseph H. Staley, Columbus, Ind.

Application April 6, 1948, Serial No. 19,316

10 Claims. (Cl. 246—130)

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This invention relates to a crossing gate of the so-called automatic type normally employed at the intersection of a highway with the railroad tracks. It is of that type which is normally in the up or zero position, and then upon the approach of a train toward that highway crossing, the gate is lowered to the 90 degree position extending across in part at least of the highway. Furthermore, upon the departure of the train from that highway, then the mechanism is provided with means to rock the gate back up to the zero position.

It is a primary object of the invention to provide a positive moving visual signal to oncoming highway traffic that the crossing gate is dropping and not just getting ready to drop. Crossing accidents frequently occur with the heretofor used crossing gates for the reason that universally, signals are first energized, warning of the approach of a train, but the gate arm remains stationary for a brief period after the signals start working, thereby creating a thought in the mind of the driver of a vehicle that the gate arm either is not going to come down, or possibly he can get across the tracks before the gate does fall. In that chance taking suggested by no immediate gate travel, the train and driver arrive on the crossing at the same time.

The present invention eliminates that hazard because the warning signals are energized only as the gate arm leaves the clear position. That is, the arm starts traveling down immediately the red lights flash on, whereby those lights are moving. Then further to emphasize that the arm is moving, the speed of down travel is relatively slow in an initial upper arc, save for possibly a few degrees of starting travel which give a quick swinging of the lights. Then after that slow arc length of travel, the gate is speeded up in its down travel to discourage the driver trying to beat across the tracks ahead of the gate arm. In other words, the arm is caused to travel immediately the signals are energized, and the arm travel is made more evident visually and impressively by the change in speed. Of course, with the upper slow speed travel of the arm, any traffic actually on the crossing or too close to stop, may safely get across during that slow speed interval, but other traffic farther away is discouraged from following, because of the following increase in speed of the arm. The difference in the "slow" and "fast" speeds is made to be such to provide for those contingencies.

A primary object of the invention is to provide a crossing gate structure and a method and means of operation which are extremely simple. Furthermore, it is a primary object of the invention to provide the actual operating means in a single unit which may be placed in and removed from a cabinet at the crossing gate, generally on a standard adjacent the tracks, so that

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any adjustments or repairs that might be necessary can be made on the unit when it is removed and taken to a shop. The procedure is simply that a new unit or a repaired unit is placed in the cabinet after taking out the unit which is to be worked upon. In this regard, the invention is so designed that there is a minimum number of parts to be loosened such as bolts in the base of the unit and a single chain connection.

A further important object of the invention is to provide an operating mechanism which permits the gate to automatically drop to the 90 degree position upon power failure particularly in the track circuit itself.

Furthermore, there is a primary object of automatically restoring the gate to a zero position during the absence of a train in the block of the track which controls the mechanism whereby any tendency of the gate to start to fall from the zero position is corrected within a few degrees and the gate restored to that zero position.

A still further important object of the invention is to provide a structure wherein there will be no electric current flow during the down or closed position of the gate with the exception of the operation of the warning signals.

These and many other objects and advantages of the invention will become apparent to those versed in the art in the following description of the invention as illustrated in the accompanying drawings, in which,

Fig. 1 is a view in side elevation of a structure embodying the invention with the gate arm in the zero position;

Fig. 2, a view in end elevation;

Fig. 3, a view in vertical section on an enlarged scale on the line 3—3 in Fig. 1;

Fig. 4, a view in vertical section on the line 4—4 in Fig. 3;

Fig. 5, a detail in top plan of a flow pipe control valve;

Fig. 6, a vertical section on the line 6—6 in Fig. 5;

Fig. 7, a vertical section on the line 7—7 in Fig. 5;

Fig. 8, a horizontal transverse section on the line 8—8 in Fig. 4;

Fig. 9, a detail in vertical section on the line 9—9 in Fig. 8;

Fig. 10, a detail in section on the line 10—10 in Fig. 3;

Fig. 11, a detail in vertical section on the line 11—11 in Fig. 3;

Fig. 12, a section on the line 12—12 in Fig. 11;

Fig. 13, a section on the line 13—13 in Fig. 11;

Fig. 14, a side elevation of the cam from the reverse side as shown in Fig. 11;

Fig. 15, a side elevation of the cam controlling a second switch;

Fig. 16, a section on the line 16—16 in Fig. 15;

Fig. 17, a wiring diagram; and

Fig. 18, a schematic diagram of the mechanical operation of the gate traveling between the zero and 90 degree positions.

Referring to the drawings in which like characters of reference indicate like parts throughout the several views, there is provided a short section of a mast 20 securely anchored to a base 19 which is usually located adjacent the side of the highway near the crossing of the highway over the railroad track. Mounted on this lower standard section 20 is the control containing box or cabinet 21. Then there is a continuation of the standard in the form of a tubular mast 22 which has its lower end secured to the top of the box 21. This upper portion 22 carries in the normal installation the flashing signal lamps 23 and 24; the indication of the number of tracks herein shown on the board 25; and the cross arms 26 indicating the railroad crossing itself. Also in the present showing, there is an audible signal in the form of a bell 27 mounted on the top end of the standard portion 22.

A gate arm supporting shaft 28 is rotatably mounted in the upper substantially central portion of the box 21 to have the ends of the shaft extend outwardly therebeyond. The shaft 28 is mounted in suitable bearings 29 and 30. Secured to the shaft 28 on these outer end portions are the legs 31 and 32 which straddle the box 21 from its sides. These legs 31 and 32 are carried around and finally join and connect with the gate arm 33. This arm 33 carries in the usual practice a number of warning lamps 34, the exact number being immaterial in so far as the present invention is concerned. Part of these lights 34 may be of the intermittent flashing type if desired, and some of the lights 34 may be of the fixed type, all as may be desired to attract the attention of the operator of the approaching vehicle.

Attention is directed to the fact that these arms 31 and 32 are offset to one side of the box 21, relatively to the rear thereof, by the mounting brackets 35 and 36. As indicated in Figs. 1 and 2, these brackets 35 and 36 are generally U-shaped to mount the legs to the rear of the box 21 so that there is a decided leverage afforded whereby the gate arm 33 will tend to drop around from the mast portion 22, counter clockwise in relation to the mast 22 as viewed in Fig. 1. Then on the lower portions of these brackets 35 and 36 are provided weights 37 which may be variably shifted along the lower end of the bracket to give the desired degree of biasing of the gate. In other words, the weights are supplied to counteract in part the pull by gravity. Thus by shifting the weights 37 or by decreasing or increasing their mass, the desired torque is produced.

Referring now to Figs. 3, 4, and 8, inside of the box 21 there is mounted an oil reservoir tank 38. In the form herein shown, this tank 38 is rectangular in shape and quite shallow in proportion to its length and breadth. This tank 38 is detachably secured to the floor 39 of the box 21 by any suitable means, herein shown as by a series of bolts 40 around an out turned flange of the tank 38. Toward the front central portion of the tank 38 there is mounted a cylinder 41 to have its axis vertically disposed. The cylinder is mounted on a base 42 which is welded or otherwise fixed securely to the floor 43 of the tank 38. Then the cylinder 41 is clamped down against the base 42 by means of bolts 44 extending through the top cylinder head 45 and screw-threadedly engaging the base 42. For sake of convenience, the base 42 is divided into two parts,

the lower part 46 which is actually welded to the floor 43 and an upper portion 47 which is bolted to the lower portion 46 by the bolts 48. In Fig. 9, there is a vertical section shown through this cylinder 41 and its attached parts.

Within the cylinder 41 is placed a piston 49 secured to the lower end of a piston rod 50. This piston rod 50 extends through the upper head 45 through a packing gland 51 and has secured to its outer exposed end the lower end of a chain 52, herein shown as of the roller type. The chain 52 extends substantially vertically upwardly to have its upper end secured to a wheel segment 53 that is fixed on the gate arm shaft 28. The segment 53 is so arranged that when the piston 49 is in its lowermost position, Fig. 9, the segment is rocked around to that position as shown in Fig. 4, and the gate arm is in the extreme up or zero position. Upon down travel of the gate, the segment 53 will turn in a counter clockwise direction in relation to Fig. 4, to have the chain 52 wrap around on its periphery. This periphery as indicated is a part of the circumference of a circle having its center at the center of the shaft 28.

The tank 38 has a top closure 54 through which the cylinder 41 extends. Behind the cylinder 41 there is mounted a motor 55 in fixed position on the top cover 54. A pump 56 is directly mounted on the end of the motor 55 to be driven thereby. There is a pipe 57 dropped through the cover 54 and down inside of the tank 38 to serve as the intake pipe to the pump 56.

In the particular piping arrangement herein shown, there is a close nipple 58 connected to the discharge part of the pump 56 and interconnecting with a check valve 59, this valve being arranged to permit discharge from the pump 56, but not return flow through the valve back to the pump. Then there is a close nipple 60 connected to the outlet end of the valve 59 and in turn connected to an L 61 which has an end turned upwardly to receive a close nipple 62 in turn connected to a T 63. From the horizontal outlet of the T 63 leads an L 64 turned upwardly to receive a pressure gauge 65.

A pressure relief valve 66 is connected to the top outlet of the T 63 and the exhaust from this valve 66 is carried through a tube 67 that is bent around and carried downwardly to have the lower end thereof carried through the cover 54 of the tank 38. The T 63 has a second horizontal outlet to which by one end is connected a tube 68, the other end of this tube 68 is connected to the cylinder head 45 so that there may be a fluid passageway from the T 63 through the tube 68, and into the head 45 to discharge through the passageway 69 therein, Fig. 9. The head 45 is provided with another passageway 70 which leads to the outer peripheral portion thereof and into which passageway is connected a fitting 71, herein shown as an L. From this L 71 leads through a valve 72, hand-operated in the present showing, a pipe 73 which drops downwardly to interconnect through the L 74, nipple 75, and L 76 with a solenoid controlled valve 77. This valve 77 is of that type wherein it is normally open and is closed only upon current flow through the coil controlling the action of the valve.

Then from the valve 77 there is carried a tube 78 around and upwardly to connect into a flow restricting valve 79. This valve 79 is of special construction and is herein shown as supported from the cylindrical head 45 to have an operat-

ing roller 86 in the path of a cam 81 which in turn is fixed on the shaft 28. From the valve 79 there is carried a discharge pipe 82 which interconnects with the pipe 67 so that there is a discharge flow made available from the valve 79 directly back into the tank 38.

Referring to this cam 81, this cam has two lobes 83 and 84 projecting beyond the generally circular surface 85, which surface is a part of a circle of a common radius from the center of the shaft 28. The location of the lobes 83 and 84 around the surface 85 is important with respect to the operation of the gate arm. To begin with, referring to Fig. 4, the roller 86 which serves as a cam follower is spring pressed from the valve 79 to ride against the cam surface. In the initial position, that is the zero position of the gate arm, this roller 86 rests against a continuation of the surface 85. The lobe 83 is spaced from this initial line of contact of the roller 86 against the cam a distance of 7½ degrees so that by the time gate arm has started to fall that travel of 7½ degrees is required before the roller 86 is pushed downwardly by reason of the lobe 83 coming thereagainst. The circumferential length of the lobe 83 is made to be 20 degrees in the present showing. Then following the travel of the lobe 83 past the roller 86, the roller 86 is pressed against the major length of the surface 85 so that the gate arm travels on around until the lobe 84 eventually comes against the roller 86. The distance between lobes 83 and 84 is 57½ degrees. That is, the gate arm has travelled from the zero position a total distance of 85 degrees when the lobe 84 comes against and pushes the roller 86 downwardly. The length of the lobe 84 is made to be such that the roller 86 remains in contact therewith during the remainder of the travel of the gate to the horizontal or 90 degree position.

Referring now to the construction of the valve 79, reference is made to Figs. 5, 6, and 7, wherein the interior parts are shown in the positions which will prevail when the gate arm is in the 90 degree position. The valve 79 is provided with an internal bore 87 vertically therethrough, the upper portion of which has a slightly reduced diameter in comparison to the lower portion. Within this bore 87 there is slidingly carried a piston 88. The upper end of this piston 88 carries the roller 6 to have the roller travel vertically within a slot 89 so that the piston 88 can not revolve within the bore 87. The piston 88 enters into the lower larger diameter bore 90 where the piston is enlarged into the head 91 to form a sliding fit with that wall of the bore 90. The enlarged end 91 is bored vertically to provide a passageway 92, and then from that passageway 92, there is a lateral bore 93 terminating above the enlarged end 91 so that there may be a bleed action from the top of the enlarged portion 91 within the bore 90 so that the piston 88 is free to travel upwardly within the valve 79 to carry the enlarged end 91 to the extreme upper end if necessary of the bore 90.

In the lower end of the bore 90 there is engaged a pipe plug 94 and between this pipe plug 94 and the lower face of the enlarged end 91 there is positioned a compression spring 95 so that the piston 88 is normally urged to the uppermost end of its permissible travel as determined by the enlarged end 91 striking the upper end of the bore 90. It is this spring 95 which normally urges the roller 86 into rolling contact with the contour of the cam 81.

The inlet pipe or tube 78 screw threadedly engages through proper connections with the valve 79 to be in communication with the transverse bore 97 which opens into the upper portion of the bore 90. The discharging tube 82 is in communication with the lower transverse bore 98 which likewise is in communication with the bore 90 but at an elevation below that of the transverse bore 97. Normally the inner end of the bore 98 is uncovered by the enlarged head 91, but the inner end of the bore 97 is closed off by this enlarged head 91 when the lobe 84 or the lobe 83 is pressing the roller 86 downwardly. The height of each of these lobes 83 and 84 in reference to the surface 85 is made to be such that the travel of the piston 88 will bring this enlarged head 91 down to this shut off position, that position being indicated in Figs. 6 and 7. A by-pass is provided through the valve 79 around the head 91 when that head is in the closed position. This by-pass in the present form comprises the vertical passage 99 and the interconnecting horizontal passageway 100 which opens into the lower portion of the bore 90 just above the pipe plug 94. Then in order to control the travel of fluid through this by-pass, there is provided a needle valve 101 which may be adjusted from the outside of the valve 79 by head 102 and then locked into position by the nut 103, all as is shown in Fig. 6.

All the foregoing construction thus far described with the exception of the cams 53 and 81 as fixed on the shaft 28 may be removed from the cabinet 21 simply by removing the cap screws 40 and sliding the oil pan out from the cabinet. The chain 52, of course, is disconnected from the cam 53, otherwise there is no interconnection between all of this operating mechanism as carried by the oil pan and the operated shaft 28.

Supported from the top side of cabinet 21 by means of the brackets 104 and 105 is a terminal panel 106. On the front face of this panel 106 is mounted an electric controlling device carrying two mercury switches 107 and 108 which are actuated by revolving cams 109 and 110 respectively. These cams 109 and 110 are mounted on a transverse shaft 111, on the end of which is fixed a small sprocket 112 to receive therearound a roller chain 113. This chain 113 is carried back around a larger sprocket 114 which is fixed to the shaft 28 to be revolved therewith. Incidentally, the sprocket 112 is turned three times to one revolution of the sprocket 114. This difference in speed is selected in order to prevent having to make any delicate adjustments in the opening and closing of the two switches 107 and 108. Both switches 107 and 108 are carried in identical rocking devices, as indicated in Fig. 11 in reference to the switch 107, so that a description of the supporting and carrying device in respect to the switch 107 will suffice for the switch 108. The switch 107, being of the metallic wall type in the present showing, is supported between the two end spring clips 115 and 116 which in turn are fixed to a base 117. This base 117 is preferably made out of an insulating material and is supported upon an arm 118 that is pivoted on the pin 119 on the fixed bracket 120 that is in turn supported by the panel 106. The forward end of the arm 118 carries a roller 121 which is in the path of the contour surface of the cam 109. It is by the variation in the contour of the cam 109 that this arm 118 is lifted and dropped in order to rock the switch 107 from the closed to the open positions and vice versa.

The cam 109 is of a peculiar construction which

forms the subject matter of another application for a patent filed by me. It is sufficient for the present showing to described this cam 109 as follows. On the shaft 111 there is fixed a hub 122. A washer 123 is slipped over the hub 122 to rest against the head 124 of the hub 122 and revolubly carried therearound is a cam 125. A cam 126 is placed over the hub 122 to bear by its innermost portion against the face of the washer 123, and this cam 126 is held against rotation around the hub 122 by any suitable means, herein shown as by a pin 127 carried through the cam 126, the washer 123, and into the head 124, Fig. 12. Then a third cam 128 is revolubly mounted on the hub 122 to ride on a bushing 129 placed around the hub and inside of the center of the cam 128. Then to secure the assembly, a nut 130 is screw threadedly engaged with the outer end of the hub 122 to compress the bushing 129 against the center cam 126 and consequently against the washer 123 and in turn against the head 124. This construction leaves the outermost cams 125 and 128 free to turn in respect to the hub 122, and consequently in respect to the shaft 111.

The cam 126 has a post 131 fixed thereto and extending through a slot 132 out through the cam 128. A spring 137 is fixed to the outer end of this post 131 and in turn to a post 138 that is fixed to the cam 128. The cam 126 carries a second post 139 which extends therefrom on the opposite face of the cam to extend through a slot 140 to be engaged by one end with a spring 141 which in turn is fixed to a post 142 carried by the cam 125. These springs 137 and 141 are under tension so as to pull the cams 128 and 125 respectively around to those positions wherein the cams are so positioned as indicated in Figs. 11–14.

Each of these cams 125, 126, and 128 has a circumferential surface approximately 180 degrees long of a common radius. Then each of these three cams likewise has a circumferential surface of a common lesser radius between the maximum extended circumferential surface. For sake of convenience, this maximum surface will be designated by the numeral 145 and the lesser surface 146. Referring to Fig. 11, the shaft 111 and likewise the cam 109 turns in the direction of the arrow indicated, a counter clockwise direction as viewed in that figure, when the gate arm shaft 28 is turning in that position travelling from the zero to the 90 degree position of the gate. In this position of the various parts as shown in Fig. 11, the roller 121 has been lifted up on to the surface 145 of the combined three cams 125, 126, and 128 following an initial travel of the shaft 28 of 7½ degrees. Normally when the shaft 28 is in that position to hold the arm in the zero position, the roller 121 is resting on the surface 146, this being the position of the switch 107 wherein the circuit through it is broken by the flow of mercury as is well known to those versed in the art.

Assuming that the roller 121 is in that position resting against the surface 146, rotation of the shaft 111 will carry the combined cams 125, 126 and 128 around toward that roller 121. The cam 128 is provided with a radial surface 147 which is brought against the roller 121. By reason of that substantially radial surface 147, the roller 121 does not relatively lift up thereover, and the consequence is that the cam 128 is held stationary while the spring 137 stretches to hold that surface 147 against the roller 121 as the shaft 111 continues to turn. Then upon continued rotation of the shaft 111, the cam 125 comes against

the roller 121 by a short radial surface 148 which is approximately of that height equal to slightly more than the radius of the roller 121. From the top of that surface 148, the cam 125 is sloped around by a substantially straight line 149 to terminate in the outer surface 145. Thus when the cam 125 is carried around against the roller 121, it likewise is held stationary for the time being while the cam 126 continues to turn toward the roller 121. The surface of the cam 126, between the lower surface 146 and the upper surface 145, has an intervening slope surface 150. The slope of this surface 150 is such that when it is brought against the roller 121, the roller 121 is lifted to elevate it from the surface 146 to the surface 145. However in this process of going up over the surface 150, the roller 121 has been lifted above the initial surface 148 of the cam 125 to allow the slope portion thereof, that portion 149, to come under the roller 121, whereupon the spring 141 kicks that cam 125 around forwardly to lift the roller 121 quickly up to the surface 145 and permit the cam 128 to be revolved on under the roller 121 to its initial position as determined by the spring 137. The net result of all of this action is that the length of the surface 145 is increased by that distance, Fig. 11, where the roller 121 is then resting on the surface 145 around counter clockwise to the beginning of that downturned surface 147. In other words, the length of the surface 145 is automatically increased approximately 7½ degrees after the roller 121 is brought up on to the surface 145.

The switch cam 110 is of a composite type having the two cam sections 151 and 152 both mounted on the hub 153 which in turn is fixed to the shaft 111. These sections 151 and 152 are adjusted one circumferentially in reference to the other to give the desired cam length in respect to the major surface 154 and in respect to the minor surface 155.

Operation

The tank 38 contains a fluid 156 which will have the desired viscosity throughout the range of atmospheric temperatures to which the mechanism will be subjected when in operation. For the sake of convenience, without limiting the invention thereto in any way, this liquid 156 will be termed an oil. As indicated in Fig. 9, the cylinder 41 has its lower head 47 which is a part of the base 42 submerged in the oil 156 within the tank 38 so that through the passageway 157, there is afforded a supply of oil 156 at all times into the cylinder 41 below the piston 49. Referring to the wiring diagram, Fig. 17, no attempt is made to indicate the control which is commonly employed in railway signaling practice to interconnect the gate operation with both sides of the track 159 in respect to the highway crossing 160. For the sake of convenience, the control of the gate is indicated as being made from one side of that crossing only. In the normal condition, when there is no train in the block 161, the track operated relay 162 is normally energized to in turn hold the relay 163 energized through the battery 184. As herein shown, Fig. 3, the relay 163 is mounted on the terminal panel 106 inside of the cabinet 21.

This control relay 163 controls in effect three different circuits. First, there is the circuit including the signal lamps 34 and the audible or bell signal 27, this circuit normally being open. This circuit comprises the relay contacts 164, 165, the lamps 34, and the bell 27, and the conductors

166 and 167 which lead from a source of current supply, such as the usual 110 volt alternating current. Then there is a second circuit controlled by the contacts 168 and 169 through the conductor 170, to include the winding of the solenoid valve 77, and including the conductors 166 and 167 to the 110 volt source of current. This circuit is normally closed. The third circuit starting with the relay contacts 171, 172, includes the conductor 173, the motor 55, the conductor 174, and the two mercury switches 107 and 108 in parallel connection, the conductor 166 and the conductor 167 to the 110 volt source of current. This circuit is also normally closed.

Assuming that a train is in the block 161, the track control relay 162 is de-energized and therefore the relay 163 is de-energized also. This means that the contacts 164 and 165 close; the contacts 168 and 169 open; and the contacts 171, 172 also open. The first thing that happens visibly upon the closure of the contacts 164, 165 is that the lamps 34 are energized and the signal 27 is also energized. It is to be remembered that the gate arm 33 is maintained in the zero position only as long as there is sufficient pressure in the cylinder 41 to hold the piston 49 down in the lowermost portion thereof, Fig. 9. This means that the perssure has to be maintained by operation of the motor 55, but the motor 55 can only operate when either one or both of the switches 107 and 108 are in the closed positions.

As indicated in the operation diagram, Fig. 18, the switch 107 does not close until the gate arm 33 has dropped through the initial 7½ degrees. This length of travel is, of course, made to be arbitrary and can be changed slightly one way or the other. However, this initial travel of the gate is at the speed induced by the weight of the arm 33 as it overbalances the weights 37. It is to be remembered that the gate arm 33 is normally biased to drop downwardly under the influence of gravity at a rather high rate of torque upon any power failure and upon inoperation of the motor 55.

With the train in the block 161, as above indicated, the gate arm 33 starts to rock downwardly from the zero position with the result that the higher lobe 84 of the cam 81 is carried around mechanically to depress the roller 86 to bring the parts in the valve 79 to those positions as indicated in Figs. 6 and 7. As the gate arm 33 travels through this initial 7½ degree period, the piston 49 is pulled upwardly to tend to discharge oil from the cylinder 41 through either of the outlets 69 or 70. Since discharge from the outlet 69 is prevented by reason of the presence of the check valve 59 in the line to which the tube 63 connects, passage through the discharge 70 needs to be considered. In following this discharge from the opening 70 in the head of the cylinder 41, the oil is pushed from the cylinder 41 by the up-travel of the piston 49 to cause a flow to be set up around through the valve 72 and across through the solenoid control valve 77, this valve then being in the open condition by reason of its winding not being energized. From the valve 77, the flow is through the tube 78 and then into the valve 79. During the initial 7½ degree travel, the piston head 88 is in the elevated position by reason of the pressure of the spring 95, and this means that there is a free passageway afforded between the inlet tube 78 and out through the discharge passage 62 which leads back down into the tank 38 through the pipe 67. In other words, the oil has been allowed to flow freely except as controlled by the valve 72 from the cylinder 41 back into the tank 38. At the 7½ degree travel position of the gate arm 33, the cam lobe 83, as above indicated, pushes the piston 88 downwardly to intercept the flow between the pipes 78 and 82. There is left, however, the bypass flow from the pipe 78 around through the passageway 99 and around the needle valve 103 and thence across into the passageway 82. The length of the cam lobe 83 is made to be such that the piston 88 is held in the lowered position, Figs. 6 and 7, for a travel up to 27½ degrees of the gate arm 33. Then the lobe 83 is carried on past the roller 86 to allow the roller 86 to come back up again against the surface 85 to restore the piston 88 to its uppermost position to give the free interconnection between the passageways 78 and 82. In other words, there is a slow initial travel of the gate arm 33 between the 7½ and 27½ degree points of travel. Then from the 27½ degree travel of the gate arm, the oil may flow freely across through the valve 79 to permit the faster down travel of the gate arm until the other lobe 84 comes over and pushes down on the roller 86 to restrict the flow of the oil between the pipes 78 and 82. The cam 83 is spaced from the cam 84 57½ degrees so that the cam 84 strikes the roller 86 after the gate arm has travelled downwardly approximately 85 degrees. Then from the 85 degree position, the gate arm 33 is slowed up to come to a stop at the 90 degree position. This is the position obtained when the piston 49 reaches the top end of the cylinder 41 to bear against the cylinder head 45.

Now in that down travel of the gate arm 33, the swtiches 107 and 108 have been closed, but since their respective contacts at the relay 163 are open, the motor 55 remains idle. This 90 degree position of the gate arm is maintained simply by weight of the arm and without any operation of the motor 55.

Then when the train leaves the block 161, the track relay 162 is again energized to in turn cause the relay 163 to be energized to bring the contacts back to the normal positions as indicated in Fig. 17. With the gate arm in the 90 degree position, switch 108 is in a closed position, the respective sections of its cam control being so arranged as to accomplish that purpose. This switch 108 is closed between the positions of 110 degrees, 20 degrees below the normal horizontal position of the gate arm, and up to the 30 degree position in the up-travel of the gate arm, this 30 degree position being measured downwardly from the vertical or zero position. Thus when the switch 108 is closed, the motor 55 is energized so that oil is then pumped from the tank 38 by the pump 56 and back up through the connections to flow through the pipe or tube 68 and through the head 45 into the top end of the cylinder 41 and thus tend to force the piston 49 downwardly. The gate arm, of course, travels upwardly then at a substantially constant rate of speed, the valve 77 then being closed, with no oil discharging through it and the valve 79 until the piston is returned to the bottom of the cylinder 41. It is to be noted that the switch 107 is closed by its cam control in an overlapping relation in respect to the switch 108. In other words, on the up-travel of the gate arm 33, the switch 107 is in a closed position from the 60 degree position back up to the zero position so that the motor 55 remains energized after the switch 108 is opened at the 30 degree position. This insures that the gate arm

33 is returned to its zero position. The switch 107, as above indicated, remains closed until the gate arm reaches the zero position, at which position the cam 109 opens the switch 107.

Now should the gate arm for any reason start to fall in the absence of a train being in the track block 161, after the initial 7½ degree down travel of the arm, the switch 107 is closed by the cam 109 so that the pump 56 is immediately set into action to restore the pressure on top of the piston and return the gate arm back to its normal zero position.

The function of the valve 72 is to provide an initial adjustment which thereafter remains constant. This adjustment is to control the over-all rate of descent and ascent of the gate arm 33, the speed of which may be so adjusted in accordance with the desired results.

In order to prevent the "pumping" action of the gate arm 33 in going from the zero to the 7½ degree position of travel, when there is no train in the block 161, the solenoid control valve 77 comes into play. It is to be remembered that this valve is closed only upon being energized. Since the normal condition of the relay 163 is to be energized and cause the contacts 168 and 169 to be closed, a circuit is thus maintained normally through the winding of the valve 77 so as to completely cut off flow of the oil from the cylinder 41 when the gate arm is in its zero position. However as above indicated, should there be any power failure or any leakage in the hydraulic system, then the motor 55 will restore the gate arm to the zero position automatically.

Therefore, it is to be seen that I have provided an unusually simple construction in an automatically operated highway crossing gate. Furthermore, it is to be seen that for operating maintenance, the unit which does the actual controlling of the gate arm may be removed and taken to the shop for repair while a standby unit or a replaceable unit is placed in the control cabinet to keep the gate in operation. The gate arm 33 is intended to operate to the closed position under considerable torque so that it will be positive in action even though there be freezing weather or high winds. The lifting mechanism as embodied within the operating piston 49 within the cylinder 41 is extremely sturdy and capable of operating against high pressures. While I have herein shown the invention in the one particular form in minute detail, it is obvious that mechanical changes may be made in the structure and also changes made in the electrical circuits all without departing from the spirit of the invention, and I therefore do not intend to be limited to that precise showing beyond the limitations which may be imposed by the following claims.

I claim:

1. In a railroad track crossing gate normally falling of its own weight to a substantially horizontal position and power raised responsive to track block circuit conditions, the combination with a hydraulic system characterized by a piston operatively connected with the gate and carried in a cylinder, a motor driven fluid pump connected to the cylinder for flow from the pump to the cylinder against that side of the piston to cause travel thereof to lift the gate upon energizing the motor, and a fluid discharge line from the cylinder from the same said side of the piston; of a speed control valve in said discharge line normally biased to an open position for free flow through said line; a cam moving with gate travel and shaped to actuate said valve after an initial down travel of the gate to restrict flow in said line and hold said restriction through a second range of gate down travel, and then open the valve for a third range of down travel to the gate barrier position; a normally closed shut-off valve in said discharge line, said speed control valve being between said cylinder and said shut-off valve; electrical means for opening said shut-off valve; a signal circuit normally open including a source of energy; a shut-off valve circuit including said electrical means and a source of energy, normally closed; a pump motor circuit including a source of energy; switching means in said motor circuit operated by travel of the gate and holding said motor circuit open with the gate in its fully raised position and closing the circuit in lower positions; a block circuit controlled switch in said motor circuit; said block circuit operating to hold said signal circuit open, said shut-off valve means circuit closed, and said motor circuit block controlled switch closed in the absence of a train in said block, and operating to reverse those circuit conditions with a train in the block.

2. In a railroad track crossing rockable gate normally falling of its own weight and power raised, both in response to a track block circuit, the combination with a hydraulic system having a cylinder, a piston in the cylinder interconnected with the gate, a fluid pump for delivering fluid to said cylinder to that side of said piston which will tend to move the piston to raise the gate, a motor for driving the pump, and a fluid discharge line from the cylinder from said piston side, the piston being shifted by fall of the gate to evacuate fluid through said line, of a gate speed control valve in said line normally biased to an open position; a cam driven by travel of the gate to reciprocate therewith; and an actuating member connected with said speed control valve and in the path of said cam; said cam having a contour which will allow the cam to travel on down gate travel a predetermined limited number of degrees with no change in the condition of said valve, which will operate said actuating member to shift the valve to a restricted flow condition at the end of said predetermined travel and restore the valve to its full flow condition during a predetermined number of degrees of further gate down travel, and which following the last period of travel, will operate to return the valve to a restricted flow condition as the gate approaches its barrier position; whereby the rate of discharge fluid flow from the cylinder is varied at specific periods of fall of the gate to vary accordingly rate of speed of the gate.

3. In a railroad track crossing rockable gate normally falling of its own weight and power raised, both in response to a track block circuit, the combination with a hydraulic system having a cylinder, a piston in the cylinder interconnected with the gate, a fluid pump for delivering fluid to said cylinder to that side of said piston which will tend to move the piston to raise the gate, a motor for driving the pump, and a fluid discharge line from the cylinder from said piston side, the piston being shifted by fall of gate to evacuate fluid through said line, of a gate speed control valve in said line normally biased to an open position; a cam driven by travel of the gate to reciprocate therewith; and an actuating member connected with said speed control valve and in the path of said cam; said cam having a con-

tour which will allow the cam to travel on down gate travel a predetermined limited number of degrees with no change in the condition of said valve, which will operate said actuating member to shift the valve to a restricted flow condition at the end of said predetermined travel and restore the valve to its full flow condition during a predetermined number of degrees of further gate down travel, and which following the last period of travel, will operate to return the valve to a restricted flow condition as the gate approaches its barrier position; whereby the rate of discharge fluid flow from the cylinder is varied at specific periods of fall of the gate to vary accordingly rate of speed of the gate; a shut-off valve normally open in said line between said speed control valve and the discharge end of the line; electro-magnetic means for closing said shut-off valve; and a circuit including a source of energy and said electro-magnetic means, said circuit being controlled by said block circuit to energize said means upon absence of a train in the block, and to deenergize said means upon the presence of a train in the circuit.

4. In a railroad track crossing rockable gate normally falling of its own weight and power raised, both in response to a track block circuit, the combination with a hydraulic system having a cylinder, a piston in the cylinder interconnected with the gate, a fluid pump for delivering fluid to said cylinder to that side of said piston which will tend to move the piston to raise the gate, a motor for driving the pump, and a fluid discharge line from the cylinder from said piston side, the piston being shifted by fall of the gate to evacuate fluid through said line, of a gate speed control valve in said line normally biased to an open position; a cam driven by travel of the gate to reciprocate therewith; and an actuating member connected with said speed control valve and in the path of said cam; said cam having a contour which will allow the cam to travel on down gate travel a predetermined limited number of degrees with no change in the condition of said valve, which will operate said actuating member to shift the valve to a restricted flow condition at the end of said predetermined travel and restore the valve to its full flow condition during a predetermined number of degrees of further gate down travel, and which following the last period of travel, will operate to return the valve to a restricted flow condition as the gate approaches its barrier position; whereby the rate of discharge fluid flow from the cylinder is varied at specific periods of fall of the gate to vary accordingly rate of speed of the gate; a shut-off valve normally open in said line between said speed control valve and the discharge end of the line; electro-magnetic means for closing said shut-off valve; and a circuit including a source of energy and said electro-magnetic means, said circuit being controlled by said block circuit to energize said means upon absence of a train in the block, and to deenergize said means upon the presence of a train in the circuit; a motor circuit including said motor, a source of energy, and a switch controlled by said block circuit to be closed in the absence of a train in the block and opened in the presence of a train therein; and switch means in said motor circuit actuated by travel of said gate, open when the gate is in its fully raised condition, and closed when the gate falls through said first predetermined number of degrees.

5. The combination with a railway crossing gate arm mounted to be reciprocable vertically about a horizontally disposed axis, biased to fall under the influence of gravity toward a horizontal position; electric motor driven pump actuated hydraulic means interconnected with said arm to raise the arm, said means tending to be evacuated through a discharge outlet by falling of said arm; and an electric power source circuit: of suitable means responding to absence of traffic on said railway to connect normally said pump motor into said circuit to actuate said hydraulic means to lift said arm to a clear position; a second switch means actuated by arm travel and interconnecting said motor with said circuit through said first switch means, said second switch closing and opening responsive to a predetermined length of initial travel of said arm from and toward said clear position; electro-magnetic controlled means maintaining said outlet in closed condition during said traffic absence; an outlet control valve; and a valve operating cam shiftable with travel of said arm, said cam having a lobe of a length partially closing said valve during said arm initial travel plus a farther limited arm travel therebelow, and a second lobe spaced from the first lobe of a length to partially close said valve at approximately the horizontal arm position, said cam being relieved between said two lobes to have said valve fully opened for maximum rate of arm falling travel.

6. The combination with a railway crossing gate arm mounted on a horizontally disposed axis to swing in a vertically disposed plane, and normally biased to fall from an upper clear position to approximately a horizontal position; electric motor driven pump actuated hydraulic means to raise to and hold said arm in the clear position under fluid pressure, said hydraulic means having a discharge outlet, through which said pressure may be relieved to let the arm fall; and an electric power source current: means responsive to absence and presence of railway traffic interconnecting and disconnecting respectively said pump motor with said circuit; secondary means disconnecting and reconnecting said pump motor with said circuit through said first interconnecting means, said secondary means being actuated by travel of said arm in an upper limited length of travel from said clear position: valve means responsive to said absence of traffic holding said outlet closed, and opening the outlet in response to presence of traffic on the railway; a cam travelling with said arm; and a cam actuated valve controlling flow through said outlet; said cam having spaced lobes conditioning the valve to partial fluid flow therethrough in arm positions in both said limited length of travel and adjacent said horizontal position, the cam leaving said actuated valve in full flow condition between those two positions.

7. The combination with a railway crossing gate arm mounted on a horizontally disposed axis to swing in a vertically disposed plane, and normally biased to fall from an upper clear position to approximately a horizontal position; electric motor driven pump actuated hydraulic means to raise to and hold said arm in the clear position under fluid pressure, said hydraulic means having a discharge outlet, through which said pressure may be relieved to let the arm fall; and an electric power source current: means responsive to absence and presence of railway traffic interconnecting and disconnecting respectively said pump motor with said circuit; secondary means disconnecting and reconnecting said pump motor with said circuit through said first interconn-

necting means, said secondary means being actuated by travel of said arm in an upper limited length of travel from said clear position; valve means responsive to said absence of traffic holding said outlet closed, and opening the outlet in response to presence of traffic on the railway; a cam travelling with said arm; and a cam actuated valve controlling flow through said outlet; said cam having spaced lobes conditioning the valve to partial fluid flow therethrough in arm positions in both said limited length of travel and adjacent said horizontal position, the cam leaving said actuated valve in full flow condition between those two positions; and a third means actuated by arm travel reconnecting said motor with said circuit through said first means at said arm horizontal position.

8. The combination with a railway crossing gate arm mounted on a horizontally disposed axis to swing in a vertically disposed plane, and normally biased to fall from an upper clear position to approximately a horizontal position; electric motor driven pump actuated hydraulic means to raise to and hold said arm in the clear position under fluid pressure, said hydraulic means having a discharge outlet, through which said pressure may be relieved to let the arm fall; and an electric power source current: means responsive to absence and presence of railway traffic interconnecting and disconnecting respectively said pump motor with said circuit; secondary means disconnecting and reconnecting said pump motor with said circuit through said first interconnecting means, said secondary means being actuated by travel of said arm in an upper limited length of travel from said clear position; valve means responsive to said absence of traffic holding said outlet closed, and opening the outlet in response to presence of traffic on the railway; a cam travelling with said arm; and a cam actuated valve controlling flow through said outlet; said cam having spaced lobes conditioning the valve to partial fluid flow therethrough in arm positions in both said limited length of travel and adjacent said horizontal position, the cam leaving said actuated valve in full flow condition between those two positions; and a third means actuated by arm travel reconnecting said motor with said circuit through said first means at said arm horizontal position; said secondary and said third means operating in overlapping relation between arm positions in said horizontal position and the lower end of said limited upper travel.

9. The combination with a railway crossing gate arm mounted on a horizontally disposed axis to swing in a vertically disposed plane, and normally biased to fall from an upper clear position to approximately a horizontal position; electric motor driven pump actuated hydraulic means to raise to and hold said arm in the clear position under fluid pressure, said hydraulic means having a discharge outlet, through which said pressure may be relieved to let the arm fall; and an electric power source current: means responsive to absence and presence of railway traffic interconnecting and disconnecting respectively said pump motor with said circuit; secondary means disconnecting and reconnecting said pump motor with said circuit through said first interconnecting means, said secondary means being actuated by travel of said arm in an upper limited length of travel from said clear position; valve means responsive to said absence of traffic holding said outlet closed, and opening the outlet in response to presence of traffic on the railway; a cam travelling with said arm; and a cam actuated valve controlling flow through said outlet; said cam having spaced lobes conditioning the valve to partial fluid flow therethrough in arm positions in both said limited length of travel and adjacent said horizontal position, the cam leaving said actuated valve in full flow condition between those two positions; and a third means actuated by arm travel reconnecting said motor with said circuit through said first means at said arm horizontal position; said secondary and said third means operating in overlapping relation between arm positions in said horizontal position and the lower end of said limited upper travel; said secondary means being characterized by remaining inoperative during the down travel in said upper limited arm travel and being operative at the beginning of and during arm travel a distance below the lower end of said limited travel and remaining operative to said clear position at which it becomes inoperative.

10. The combination with a railway crossing gate arm mounted to be reciprocable vertically about a horizontally disposed axis, biased to fall under the influence of gravity toward a horizontal position; electric motor driven pump actuated hydraulic means interconnected with said arm to raise the arm, said means tending to be evacuated through a discharge outlet by falling of said arm; and an electric power source circuit: of suitable means responding to absence of traffic on said railway to connect normally said pump motor into said circuit to actuate said hydraulic means to lift said arm to a clear position; a second switch means actuated by arm travel and interconnecting said motor with said circuit through said first switch means, and second switch closing and opening responsive to a predetermined length of initial travel of said arm from and toward said clear position; electromagnetic controlled means maintaining said outlet in closed condition during said traffic absence; an outlet control valve; and a valve operating cam shiftable with travel of said arm, said cam having a lobe of a length partially closing said valve during said arm initial travel plus a farther limited arm travel therebelow, and a second lobe spaced from the first lobe of a length to partially close said valve at approximately the horizontal arm position, said cam being relieved between said two lobes to have said valve fully opened for maximum rate of arm falling travel; and a third switch means actuated by arm travel, in open circuit condition during the falling of said arm through said initial travel and interconnecting through said first switch means said motor with said circuit when the gate is in its horizontal position.

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