May 30, 1961 W. D. MAYNARD 2,986,630

SWITCH MACHINE FOR RAILROADS

Filed July 30, 1956 4 Sheets-Sheet 1

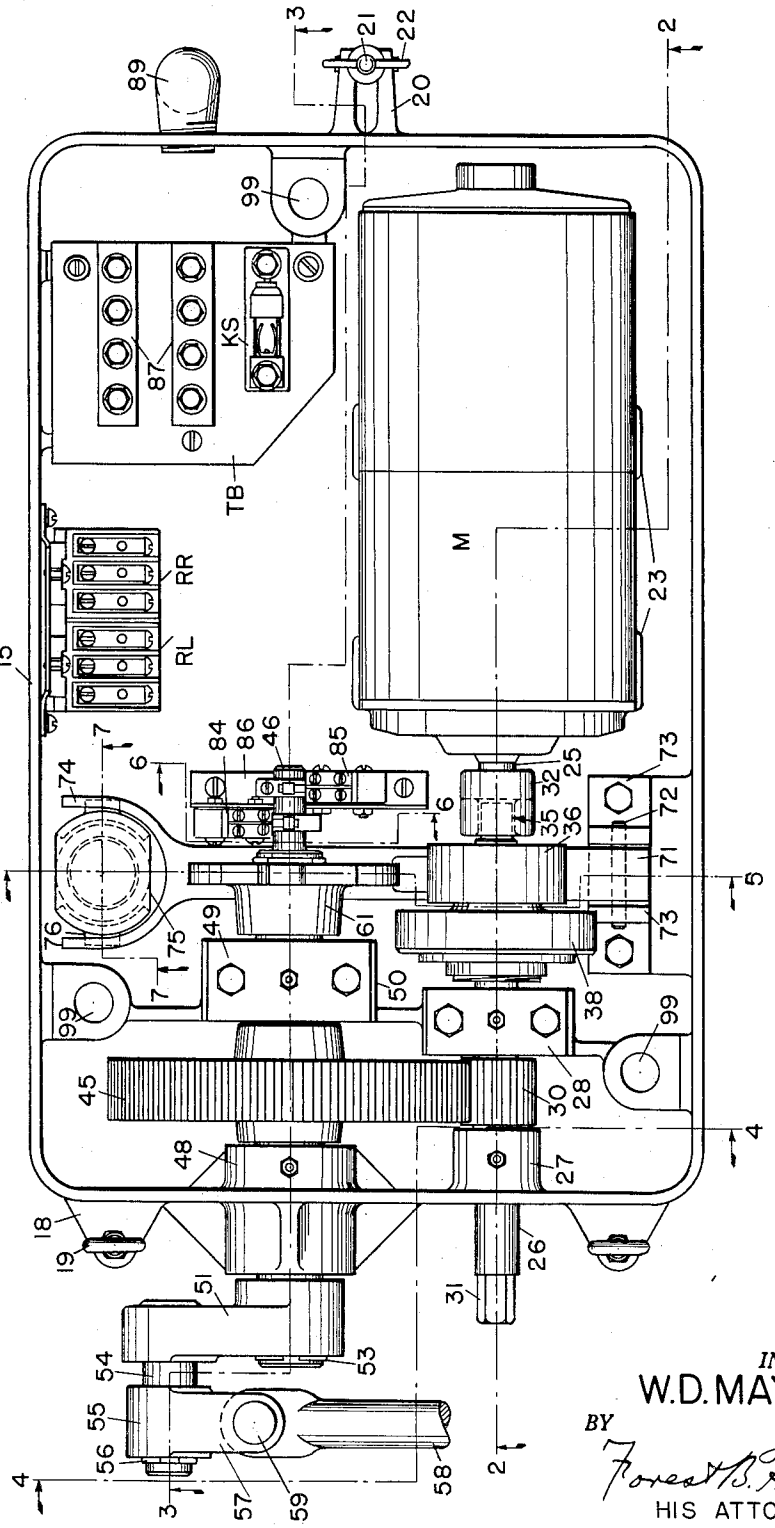


FIG. 1.

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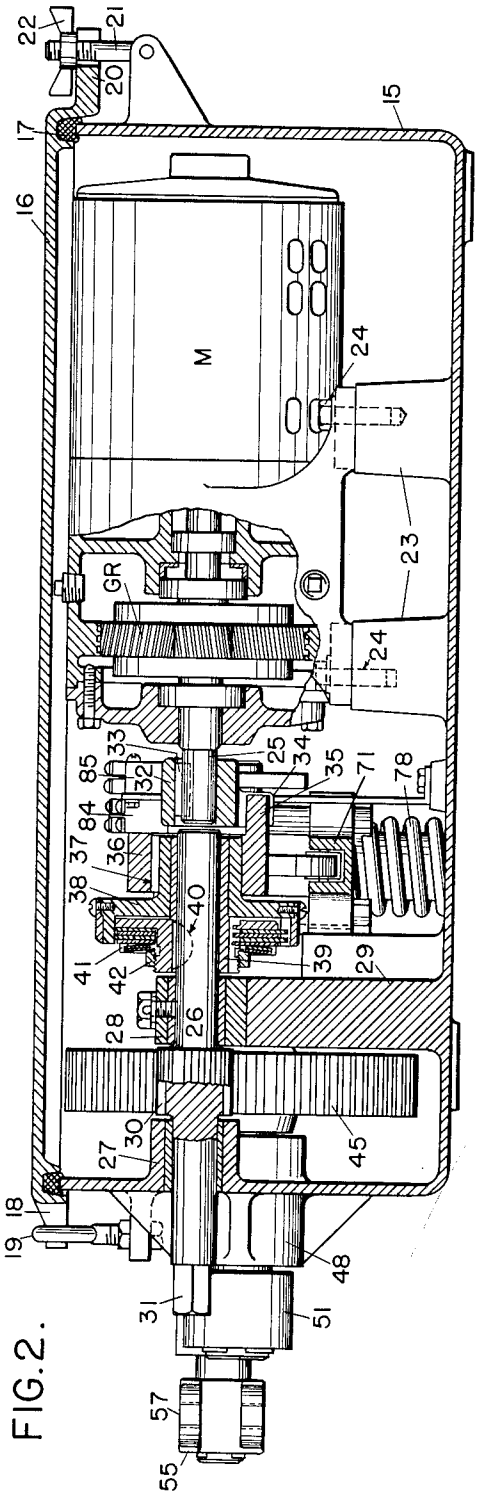


FIG. 2.

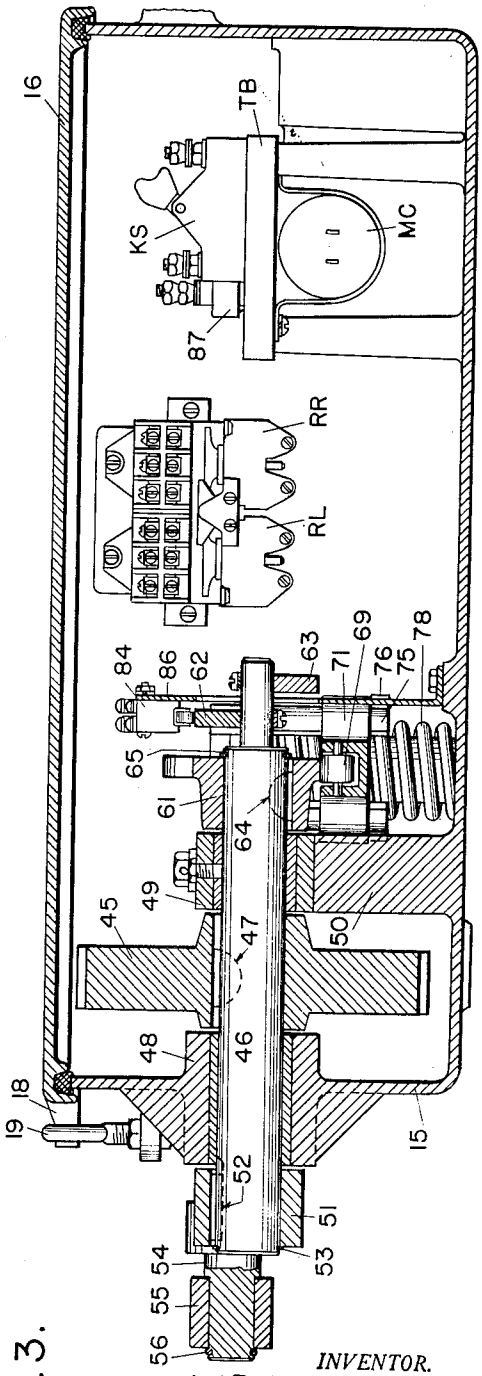


FIG. 3.

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SWITCH MACHINE FOR RAILROADS

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FIG. 4.

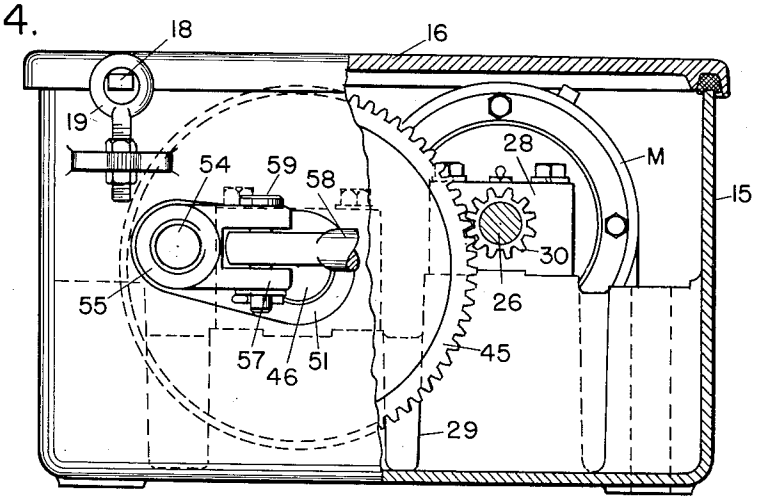


FIG. 5.

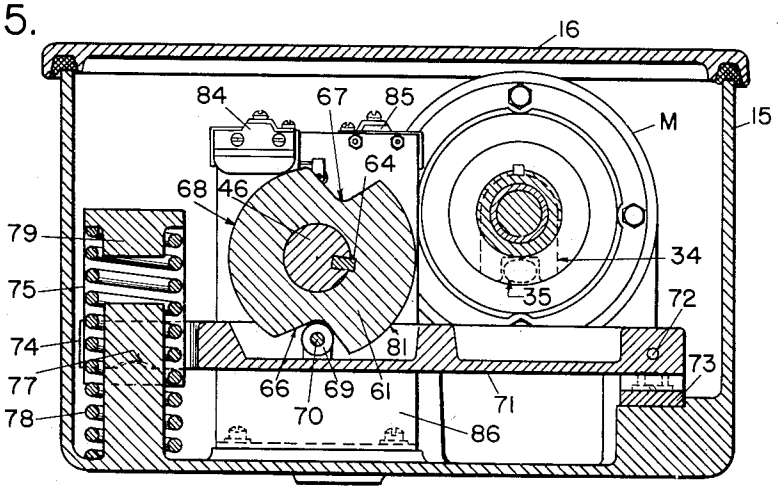


FIG. 6.

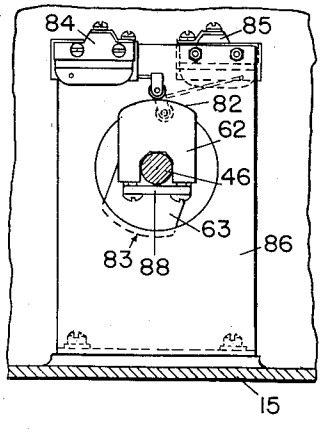
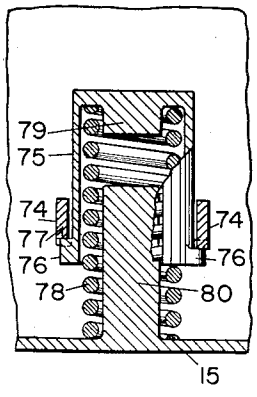


FIG. 7.



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FIG. 8.

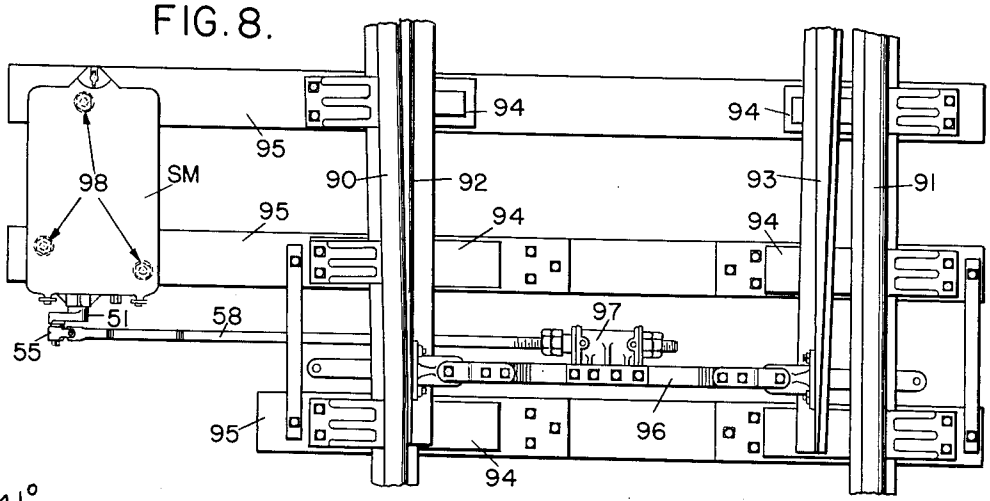


FIG. 9.

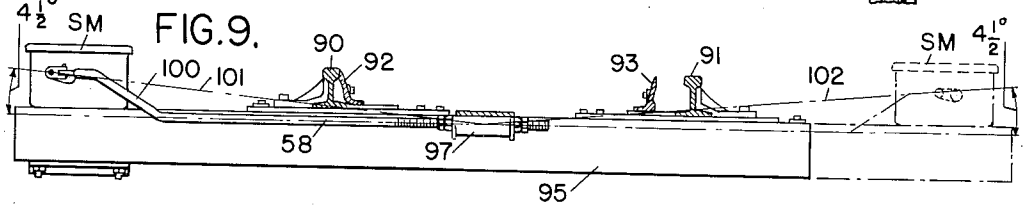


FIG. 11.

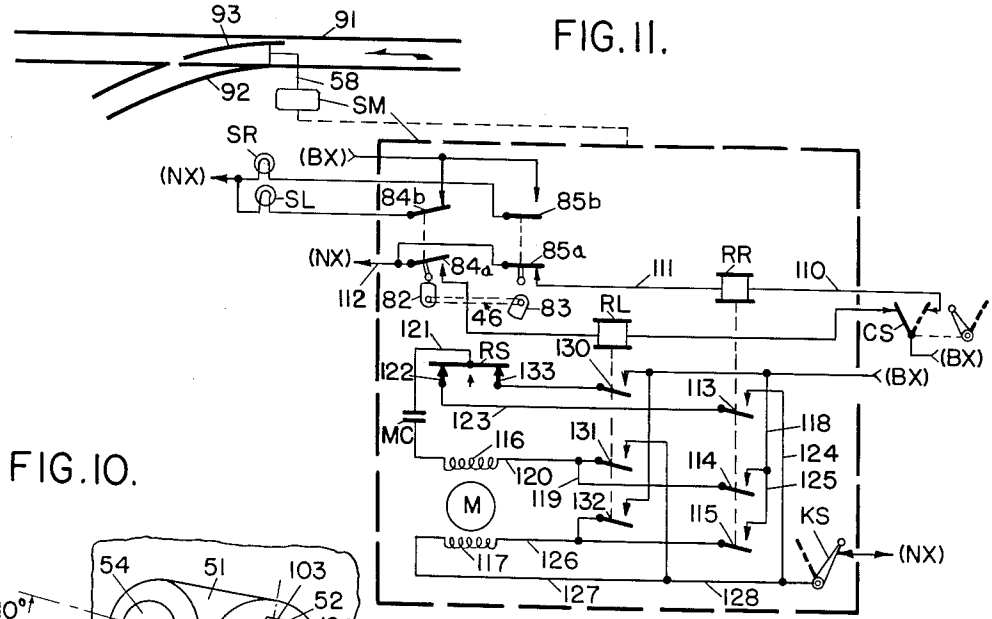
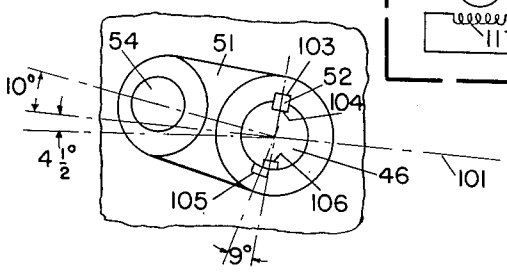


FIG. 10.



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United States Patent Office 2,986,630
Patented May 30, 1961

2,986,630

SWITCH MACHINE FOR RAILROADS

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Filed July 30, 1956, Ser. No. 600,988

4 Claims. (Cl. 246—240)

This invention relates to switch machines for railroads, and it more particularly pertains to electrically operated switch machines of the compact light weight type.

Switch machines of this type are generally used in place of hand operated machines mostly located in railroad yards or at commercial sidings and the like where shorter switches and lighter weight rails are commonly used and where no lock rods, point detectors or the like are required. Operation of the switch machine may be controlled either remotely or locally and provision must also be made for cutting off power locally so that the switch machine may be hand crank operated for purposes of adjustment, maintenance or any other reason. Provision must also be made to assure that the switch machine be retained in a locked-up position after each movement in either direction.

Generally speaking, the switch machine comprising the present invention is powered by an instantly reversible gear-head motor which provides an approximate twenty-to-one speed reduction to its output shaft. This motor output shaft is connected to a pinion shaft through a dog type flexible coupling and a torque-limiting clutch. The pinion shaft in turn drives a switch machine drive shaft through a single pinion and gear reduction at approximately one-sixth speed. Both the pinion shaft and the drive shaft each have one end extending through the switch machine housing. The outside portion of the pinion shaft is adapted to receive a ratchet type crank to facilitate hand operation of the switch machine; whereas, the outside portion of the drive shaft is fitted with a crank arm having a pivotally mounted jaw connector thereon to facilitate connection to a switch point operating rod.

An inside portion of the drive shaft is provided with a detent cam which cooperates with a spring biased detent device to comprise a means for locking the switch machine in either one of its extreme operated positions. The inside end of the drive shaft is provided with a double cam and contact switch arrangement which operates to cut-off motor energy as the switch machine movement approaches either one of its locked-up fully operated positions. Appropriate mechanically interlocked relay type contactors, a control switch and a terminal board are mounted within the switch machine casing to facilitate the control of the switch machine.

Due to railroad yard conditions where the roadbed is level with the tops of the ties, yard switch machines are usually mounted on top of the ties to keep them above ground level. Also, where space is limited, it may be necessary to mount the switch machine on either side of the switch without reversing the direction of its mounting. The switch machine of the present invention is adaptable to these varying mounting conditions, the crank arm having different mounting positions to assure the proper alignment with respect to the switch point operating rod.

An object of the present invention is the provision of a power operated switch machine for railroad yard use which is sturdy and compact in design, which is economical to build and maintain, and which is quick acting and instantaneously reversible.

Another object of the present invention is the provision of a power operated switch machine of the crank arm type which is provided with a spring biased detent device to lock-up the switch machine movement in either of its extreme operated positions, this lock-up means becoming effective shortly before the switch machine movement passes its crank toggle dead center position.

Another object of the present invention is the provision of a double cam and contact arrangement which permits the switch machine movement to control its own motor power cut-off and establish suitable completion of stroke indications at the appropriate time.

A still further object of the present invention is the provision of optional crank arm mounting means to permit universal mounting of the switch machine in various operating positions with respect to its associated switch operating rod and switch points.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings and in part pointed out as the description progresses.

In describing the invention in detail, reference will be made to the accompanying drawings in which similar reference characters will be used to designate corresponding parts throughout the several views, and in which:

Fig. 1 is a top plan view of the switch machine of the present invention with the cover removed to show the organization of the various parts of the movement;

Fig. 2 is a side elevational sectional view of the switch machine of the present invention taken substantially on the line 2—2 of Fig. 1 as viewed in the direction of the arrows and shows mainly the alignment of the pinion and motor shafts and their component parts;

Fig. 3 is a side elevational sectional view of the switch machine of the present invention taken substantially on the line 3—3 of Fig. 1 as viewed in the direction of the arrows and shows the drive shaft and its component parts as well as the relay and terminal board mounting;

Fig. 4 is an end elevational view of the switch machine of the present invention partly shown in section as indicated by the line 4—4 of Fig. 1 as viewed in the direction of the arrows;

Fig. 5 is an end elevational sectional view of the switch machine of the present invention taken substantially on the line 5—5 of Fig. 1 as viewed in the direction of the arrows and shows the spring biased cam and detent device in its left hand operated locked-up position;

Fig. 6 is an end elevational view taken substantially on the line 6—6 of Fig. 1 as viewed in the direction of the arrows and shows the cam and contact arrangement operated by the drive shaft;

Fig. 7 is a partial sectional view taken substantially on the line 7—7 of Fig. 1 as viewed in the direction of the arrows and shows the spring bias mounting of the detent lock-up arrangement;

Fig. 8 is a plan view of the entrance end of a typical switch layout showing the switch machine of the present invention mounted on the left hand side of the track switch and connected to the switch points;

Fig. 9 is an end view of the apparatus shown in Fig. 8 drawn at a reduced scale, and also shows in broken lines the switch machine location as it would appear if mounted on the right-hand side of the track switch;

Fig. 10 is an end view of the switch machine crank arm shown mounted on the drive shaft in one of its positions and showing the keyway slots for mounting in its other position; and

Fig. 11 is an illustration of a typical circuit for the

control and operation of the switch machine of the present invention.

Referring now generally to the structure of the switch machine as shown in Figs. 1 to 7 inclusive and more particularly to Fig. 2 of the drawings, the housing comprises a casing **15** and a top cover **16** having sponge rubber or cork inserts **17** fitting over the ridge of the casing **15** to render the inside of the housing weatherproof when closed. The cover **16** is fastened to the casing **15** at one end by means of lugs **18** which cooperate with hook-eye bolts **19** mounted in suitable casing lugs. The other end of the cover **16** is provided with a forked lug **20** which cooperates with a pivoted bolt **21** and a wing nut **22** fastened to a suitable lug on the casing **15**. With the cover **16** in position on the casing **15**, the lugs **18** and hook-eye bolts **19** act as a hinge whereas the pivoted bolt **21** passing through the forked lug **20** with the wing nut **22** on top provides a means for tightening the cover **16** down in place on the casing **15**, thus compressing the gasket inserts **17**.

Upstanding bosses **23** are provided on the inside of the casing **15** upon which is mounted the motor M by means of bolts **24**. The motor M is a conventional instantly reversible gear head type motor having a built-in gear reduction GR comprising a helical planet gear-integral ring gear combination which drives its output shaft **25** at an approximate twenty-to-one speed reduction. This motor M is also provided with a starting winding as well as a running winding and has a capacitor and a centrifugally operated reversing switch in series with its starting winding for operational purposes as will be explained more in detail hereinafter in connection with the control circuit arrangement.

Also mounted inside the casing **15** in concentric alignment with the motor output shaft **25** is a pinion shaft **26**. This pinion shaft **26** is rotatably mounted in two bushed bearings **27** and **28**. The bearing **27** is formed in the casing **15** whereas the bearing **28** is a block which is bolted to an upstanding boss **29** provided in the inside of the casing **15**. The pinion shaft **26** has a pinion gear **30** formed integral therewith. When mounted, the pinion gear **30** is positioned between the two bearings **27** and **28** so that the pinion shaft **26** is held in proper linear alignment. The left-hand end of the pinion shaft **26** extends through the bearing **27** to the outside of the casing **15** and is provided with a hex head **31** for receiving a ratchet type hand crank.

The motor output shaft **25** and the pinion shaft **26** are connected together by means of a flexible coupling comprising a jaw and lug type connector and a torque-limiting plate type clutch. The bifurcated jaw **32** is keyed to the motor output shaft **25** by means of a key **33** inserted in suitable keyways so that it turns in either direction with the motor output shaft **25**. The bifurcated portion **34** of the jaw **32** co-acts with a lug **35** which projects from a collar **36**. This collar **36** is connected by means of a key **37** to the outer clutch casing **38** which is rotatably mounted on the inner clutch casing **39**. The inner clutch casing in turn is keyed to the pinion shaft **26** by means of a key **40**. Suitable clutch plates **41** are interposed between the two clutch casings **38** and **39** and these clutch plates **41** are alternately keyed to the two clutch casings **38** and **39** in the usual manner. An adjusting nut **42** and suitable spring washers on the inner clutch casing **39** provides a means for adjusting the clutch plate pressure. Thus, the drive from the motor output shaft **25** to the pinion shaft **26** is through the clutch plates **41**.

The pinion gear **30** meshes with and drives at an approximate six-to-one speed reduction a spur gear **45** which is keyed to a drive shaft **46** by means of a key **47**. This drive shaft **46** is mounted in a pair of bushed bearings **48** and **49** (see Fig. 3) with the gear **45** positioned between the two bearings. The bearing **48** is formed in the casing **15** whereas the bearing **49** is a block which is

bolted to an upstanding boss **50** provided on the inside of the casing **15**. The left-hand end of the drive shaft **46** extends through the bearing **48** to the outside of the casing **15** where a crank arm **51** is keyed thereto by means of a key **52**, a split ring **53** holding the crank arm **51** in place. The free end of the crank arm **51** is provided with a pivot pin **54** upon which is journalled a switch rod connector **55** which is held in place by a split ring **56**. This switch rod conductor **55** is provided with a bifurcated jaw portion **57** to which one end of a switch connecting rod **58** is attached by means of a pin **59**. The other end of the switch connecting rod **58** is connected to the switch points as shown in Figs. 8 and 9, and described more in detail hereinafter.

The inner end portion of the drive shaft **46** is provided with one cam **61** which is part of a detent locking arrangement and two adjustable contact operating cams **62** and **63**. The cam **61** has an enlarged hub and is keyed to the shaft **46** by means of a key **64** and is held in place by a split ring **65**. This cam **61** is provided with two recessess or detents **66** and **67** (see Fig. 5) which are located two hundred degrees apart around its periphery and designate the prescribed extreme locked-up positions of movement of the drive shaft **46** and its associated crank arm **51**. It is obvious that the extreme linear movement of the crank arm **51** is through an arc of one hundred eighty degrees which may be termed the toggle or dead center points and these two cam detents **66** and **67** define the locked-up positions of the crank arm **51** which in this case will be ten degrees past toggle center in each extreme position. As the normal position of the switch machine would be either one of its extreme operated positions, the various parts have been shown in their left-hand operated positions for the purpose of illustration.

The cam recesses or detents **66** and **67** as well as the cam surface **68** cooperate with a roller **69** which is journalled on a pin **70** mounted on a spring biased lever arm **71**. This lever arm **71** is substantially U-shaped in cross section and extends lengthwise across the width of the casing **15** and is located directly under the cam **61**. The right hand end of the lever arm **71** is journalled on a pivot pin **72** and is mounted in a bracket **73** which is suitably bolted to the base of the casing **15**. The left hand end of the lever arm **71** is forked into two arms **74** to form a U-shaped extremity which partly surrounds an inverted cylindrical cup shaped spring housing **75**. The two arms **74** bear on two projecting lugs **76** formed integral with the spring housing **75**, as more clearly shown in Figs. 1 and 7, the bearing surfaces **77** providing suitable pivot points.

The spring housing **75** rests on top of and surrounds a compression coil spring **78**, the spring housing **75** having a downwardly extending boss **79** which fits inside the compression spring **78**. The compression spring **78** in turn fits over and is positioned by an upstanding boss **80** formed integral with the base of the casing **15**. When assembled, the compression spring **78** is placed under initial compression so that the roller **69** always bears against the surface of the cam **61** even when the roller **69** is in one of the detents **66** or **67** as shown in the drawings. In effect, the construction provides a form of saddle for the free end of the lever arm **71**, the compression spring **78** providing an upward bias. A downward movement of the lever arm **71** will compress the compression spring **78** to an equal extent, up to a limit, as defined by the spacing between the opposing ends of bosses **79** and **80**. The design of the cam **61** is such that when the cam surface **68** is in contact with the roller **69**, the lever arm **71** will further compress the spring **78** but there will still be a slight clearance between the bosses **79** and **80**. However, the unused surface **81** of the cam **61** is of greater radii than that of the cam surface **68** so that if for any reason, as explained hereinafter, the cams **61** should continue to be turned, the bosses **79** and **80**

(see Figs. 5 and 7) would come together and stop all movement before the top portion of the rear incline of the detents **66** and **67** could ride past the roller **69**.

The two contact operating cams **62** and **63** are alike and are mounted on a reduced end portion of the drive shaft **46** so that their cam surfaces **82** and **83** are spaced approximately two hundred degrees on their centers to correspond to the spacing of the detents **66** and **67** in the cam **61**. These cams **62** and **63** are held in position on the shaft **46** by a structure comprising a cutaway portion in the cam block and a cross plate **88** screw fastened to the cam block in a manner whereby the structure surounds the shaft **46** and is clamped thereto when the screws are tightened down. The cam surface **82** of the cam **62** contacts a suitable normally closed snap acting contactor **84** when the switch machine is in its left hand position as shown; whereas, the cam surface **83** of the cam **63** will contact another normally closed snap acting contactor **85** when the switch machine is operated to its right hand position. The edges of the cam surfaces **82** and **83** are spaced approximately one hundred and sixty degrees apart so that they operate their respective contactors **84** and **85** prior to the entrance of the roller **69** into the cam detents **66** and **67**, as will be explained more in detail hereinafter. These snap acting contactors **84** and **85** are mounted on an upstanding angle bracket **86** which is bolted to the bottom of the casing.

These cam operated contactors **84** and **85** are provided with two sets of contacts which control the current to the motor M and suitable indication signals as will be explained hereinafter. The cams **62** and **63** are adjustable on the drive shaft **46** and are preferably so adjusted that the motor current is cut off at the contactors at about the same time the roller **69** is about to enter one of the detents **66** or **67**, just before the end of the stroke of the switch machine movement. The overrun of the motor M and the trapped pressure of the spring **78** will now permit the switch machine movement to be forced into its locked up position wherein the roller **69** is spring biased into one of the cam detents **66** or **67**. At the same time, an indication signal is lighted by a normally open micro-switch contact to indicate that the switch machine movement has completed its stroke.

Having thus described the mechanical organization of the switch machine of the present invention, it is believed that a brief description of the operational movements of the switch machine as it travels through a cycle of operation will facilitate a better understanding of the mechanism. As previously stated, the switch machine has been shown in a so-called left-hand position, that is, with its drive shaft **46** operated to its full clockwise position, as viewed in Figs. 4, 5 and 6.

Assuming now that the switch machine is to be operated to its right-hand position, the motor M is energized causing its output shaft **25** to rotate clockwise at a 20 to 1 speed reduction due to its built-in gear reduction GR. The output shaft **25** drives the jaw and lug type connector which comprises the bifurcated jaw **32**, the lug **35** and the collar **36**. The collar **36** drives the outer clutch casing **38** which in turn drives the inner clutch casing **39** through the clutch plates **41**. As the inner clutch casing **39** is connected to the pinion shaft **26**, the pinion **30** drives the spur gear **45** and its drive shaft **46** at an approximate six to one speed reduction in a counter-clockwise direction.

As the drive shaft **46** turns, it will rotate its associated detent cam **61**, the two adjustable contact operating cams **62** and **63** and the crank arm **51**. The initial movement of the drive shaft **46** will operate the crank arm **51** through its 10° past toggle center position and start the linear movement of the throw rod **58**. At the same time, the cam **61** will be moving out of its locked-up position wherein the lever arm roller **69** is positioned in the cam detent **66**, thus forcing the lever arm **71** downward against the bias of the compression spring **78**. As the drive shaft **46** continues to turn, the crank arm **51** will be going through its operating movement and the cam surface **68** will be bearing against the roller **69**, thus holding the lever arm **71** down against the bias of the spring **78**. At about the same time that the edge of the detent **67** in the cam **61** reaches the roller **69**, the cam surface **83** of the contact operating cam **63** will come in contact with the operating arm of the contactor **85**, thus cutting off current to the motor M. The kinetic energy of the motor M and the momentum of the switch machine movement along with the trapped pressure in the compression spring **78** will continue to rotate the drive shaft **46** so that the spring biased roller **69** will enter the cam detent **67**. The trapped pressure of the compression spring **78** will also force the lever arm **71** upward causing the roller **69** to bear against the bottom of the detent **67**, wherein the switch machine movement will again be in a locked-up position. Any overrun movement of the drive shaft **46** in a counterclockwise direction is opposed by the bias of the compression spring **78** as any attempt of the roller **69** to ride up the back inclined surface of the detent **67** will tend to compress the spring **78** still further.

The switch machine casing **15** also houses double unit relay contactors RL and RR, a suitable terminal board TB, a knife switch KS, and a motor capacitor MC. The relay contactors RL and RR are mounted on the side wall of the casing **15** and they have their armatures mechanically interlocked so that under any condition only one contactor can close its contacts at a given time. The terminal board TB is of the usual type insulation board and supplies a mounting for the wire connecting terminal blocks **87**, the knife switch KS and the motor capacitor MC. These relay contactors RL and RR, the knife switch KS, and the motor capacitor MC are used to control the motor circuit as will be explained more fully hereafter. A conduit fitting **89** is provided in the casing **15** to facilitate the entrance of external wiring.

Referring now more particularly to Figs. 8 and 9, there has been shown a simple typical railroad switch layout with the switch machine of the present invention connected thereto in operational position, the switch machine as a whole being referred to and designated as SM. The switch layout comprises the two main rails **90** and **91** and the two switch points **92** and **93** which rest on and are fastened to the tie plates **94** and ties **95**. The switch points **92** and **93** are fastened together at their free ends by suitable switch lugs and a switch rod **96** which has a switch rod connector **97** mounted thereon. The other ends of the switch points **92** and **93** are hingedly connected to anchored stock rails (not shown) so that the free ends of the switch points may be moved back and forth between the main rails **90** and **91**. The adjustable switch connecting rod **58** is then connected between the switch machine SM and the switch rod connector **97** as previously mentioned, so that operation of the switch machine crank arm **51** will move the switch points **92** and **93** to set up the proper track route.

As previously mentioned the switch machine has been shown in its left-hand operated position and has also been shown mounted on the left-hand side of the switch layout. The switch layout has been shown to correspond with the position of the switch machine, that is, with the switch point **92** against the main rail **90**, which is its left-hand operated position. Also, as previously mentioned, the switch machines for use in railway yard layouts are usually mounted on top of the ties to keep them above ground level. This mounting is accomplished by having two of the ties **95** extending outward from the main rail **90** and bolting the switch machine SM thereto by means of bolts **98**. These bolts **98** preferably pass through holes **99** located in the base of the switch machine casing **15** (see Fig. 1), but it should be understood that lugs could be provided on the outside of the switch machine casing **15** for mounting purposes.

With the switch machine SM mounted on top of the

ties **95** and the switch rod **96** located below the base of the rails **90** and **92**, it is obvious that the switch connecting rod **58** must be provided with a downward offset as shown at **100** in Fig. 9. This places the line of thrust, which is shown by a line **101** drawn between the two connected ends of the switch operating rod **58**, on an upward angle of 4½° with respect to the horizontal. This line **101** designates the toggle center position of the crank arm **51** and the locked up position of this crank arm **51** is 10° past the toggle center position. Therefore, with the switch machine movement and the crank arm **51** in their left-hand locked-up positions, the angle position of the crank arm as shown in Figs. 4, 9, and 10 is actually 14½° with respect to the horizontal.

Assume now that the track layout conditions demand that the switch machine SM be mounted on the right-hand side of the switch layout as indicated by broken lines in Fig. 9. This would call for a different angular position for location of the crank arm **51** as the line **102** which designates the toggle center position of the crank arm **52** would place the crank arm **51** on a downward angle of 4½° with respect to the horizontal. This obviously makes a difference of 9° in the angular location of the crank arm **51** when the switch machine SM is moved from one side of the track switch to the other. Provision is made for changing the angular position of this crank arm **51** by providing two sets of keyways in the crank arm **51** and its drive shaft **46**. As shown in Fig. 10, the key **52** is placed in the keyways **103** and **104** in the crank arm **51** and the drive shaft **46** respectively when the crank arm is assembled on a switch machine for use on the left-hand side of the track switch as shown on the drawings. The additional keyways **105** and **106** provided in the crank arm **51** and the drive shaft **46** respectively are spaced 9° apart with respect to each other. When it is desired to mount the switch machine SM on the right-hand side of the track switch, it is only necessary to remove the key **52** from the keyways **103** and **104**, turn the crank arm 9° in a counterclockwise direction and place the key **52** in the keyways **105** and **106**. This will permit the crank arm **51** to assume its toggle center position on a downward angle of 4½° with respect to the horizontal and allow the crank arm **51** to operate to its locked-up position which is 10° past toggle center position, the drive shaft **46** and the balance of the switch machine mechanism remaining unchanged.

Referring now to Fig. 11, there has been shown a typical circuit for the operation of the switch machine of the present invention. This circuit illustrates the electrical components of the switch machine SM in a conventional manner and includes the two relay contactors RL and RR, the two cam operated snap acting contactors **84** and **85**, the knife switch KS, the motor M and its associated windings, the motor capacitor MC and a motor operating centrifugal reversing switch RS. This centrifugally operated reversing switch RS is of a type wherein the motor, after attaining a certain speed, will cut out the circuit for the starting winding for that particular direction of rotation only. The circuit for the starting winding remains closed for the other direction of rotation so that when the motor is instantly reversed it will find the starting winding circuit closed.

Assume now that the switch machine SM is in its last operated position, which is the left-hand position as shown on the drawings, and it is desired to operate the switch machine SM and the track switch to their other locked-up right-hand positions. Upon operation of the remote control switch CS to its right-hand position, a circuit will be established through the winding of the relay contactor RR which may be traced from a source of alternating current supply BX, remote control switch contact CS, wire **110** to the winding of relay contactor RR, wire **111**, contact **85***a* of the contactor **85** and wire **112** to the common return NX. With the relay contactor RR energized, its contacts **113**, **114** and **115** are picked up thus establishing energizing circuits for both the starting winding **116** and the running winding **117** of the motor M. The circuit for the starting winding **116** may be traced from the alternating current source BX, wire **118**, contact **114** of the relay contactor RR, wires **119** and **120**, starting winding **116** of the motor M, motor capacitor MC, wire **121** to the common connection to the reversing switch RS, contact **122** and wire **123** to the contact **113** of the relay contactor RR, wire **124** to the knife switch KS and thence to the common return NX. The circuit for the running winding **117** may be traced from the same alternating current source BX, wires **118** and **125**, contact **115** of the relay contactor RR, wire **126** to the running winding **117** of the motor M, wires **127** and **128** to the knife switch KS and thence to the common return NX. Energization of both of the motor windings will cause the motor to speed up rapidly until a certain speed is attained, whereupon its centrifugal unit will open the reversing switch RS at contact **122**, thus cutting out the starting winding.

With the motor M energized, it will drive the switch machine mechanism and its cam operating shaft **46** to their right-hand posiitons until such time as the cam **83** opens the contact **85***a*, whereupon the relay contactor RR will become deenergized and open its contacts, thus cutting off current to the motor M. As previously explained, at this point of the operation of the switch machine mechanism, the spring biased roller **69** is about to enter the cam detent **67** so that even though the kinetic energy of the motor and the momentum of the switch machine movement will help, the trapped pressure of the compression spring **78** alone would be great enough to carry the switch machine movement on through to the end of its stroke.

During the movement of the cam operating shaft **46** just described, it should be noted that the cam **82** has moved away from the contact **84***a*, thus allowing it to close its circuit to the relay contactor RL and condition said relay contactor for the next operation of the switch machine to a left-hand position. Also, with the motor stopped, the reversing switch contact **122** will again be closed. Suitable indication or signal lamps are provided to indicate the position of the switch machine and the track switch. As shown on the drawing, with the switch machine and track switch in their left-hand operated positions, the contact **84***b* is closed and the signal lamp SL is lighted through an obvious circuit. During the movement of the switch machine and track switch to a right-hand position as just described above, the contact **84***b* was opened thus extinguishing the lamp SL, whereas the contact **85***b* was closed to light up the lamp SR.

With the switch machine SM operated to its right-hand position as just described, remote control switch CS will be in its right-hand position, the relay contactors RL and RR will both be deenergized, the contact **85***a* is open and **85***b* is closed; whereas, the contact **84***a* is closed and **84***b* is open. A movement of a remote control switch CS to its left-hand position will now operate the switch machine SM to its left-hand position through circuits similar to those described above in connection with a right-hand operation and it is not believed necessary to describe these circuits in detail. It should be understood, of course, that in this left-hand movement, the relay contactor RL will be energized and its contacts **130**, **131**, and **132** will be closed. Also, the motor starting winding **116** will be cut out due to the centrifugally operated reversing switch contact **133** being open. During the operation of the switch machine movement, contact **85***a* will be closed whereas contact **84***a* will be opened.

The manually operated knife switch KS, as previously mentioned, is mounted on the terminal board TB inside the switch machine casing **15** and is accessible only when the cover **16** is removed. This knife switch KS is in series with the motor circuit and is used primarily when maintenance work s being done on the switch machine or when it is found necessary to hand crank the switch machine.

In such event, or possibly for other reasons, it is advisable to cut out the motor circuit so that the switch machine motor can not be operated from a remote source while an authorized person may be working on the switch machine. It should be understood that an automatic type of cut out switch could be used, as for example, a switch which would automatically cut off the motor circuit when the cover was removed. Hand cranking of the switch machine is accomplished by applying a ratchet type crank wrench to the hex head **31** on the pinion shaft **26**, whereby the switch machine drive shaft **46** may be rotated through approximately 180° by several hitches of the hand crank wrench.

With reference again to the spring housing **75**, the compression spring **78** and the two extending bosses **79** and **80** located within the compression spring **78** as shown in Fig. 5, as previously explained, the two bosses **79** and **80** provide a positive stop for the switch machine movement beyond either of its extreme locked-up positions. Such a movement would tend to occur, for example, due to the failure of a motor cut-out contactor **84** or **85**, thus allowing the motor M to continue to drive. In this instance, the detent cam **61** would continue to rotate past the center of its detent position thus forcing the roller **69** and the lever arm **71** downward against the force of the compression spring **78** until the two bosses **79** and **80** came together and stopped the movement. No damage would occur to the motor M, the switch machine mechanism or the track switch as the torque-limiting clutch would now permit slippage with the motor still rotating. A time elemen relay could also be provided to cut off the motor energy after a certain set time interval to prevent burning out the clutch.

Having thus described one specific embodiment of the present invention, as applied to the control of a track switch, it is desired to be understood that the form shown has been shown and described more for the purpose of illustrating the principles and mode of operation involved rather than for indicating the scope of the present invention, and it is to be further understood that the various modifications, adaptations, and alterations may be applied to the specific form shown within the scope of the present invention, except as limited by the appending claims.

What I claim is:

1. In a switch machine for railroads, a drive shaft and a motor operated driving means therefor, a detent locking device co-operating with said drive shaft comprising a detent cam mounted on said drive shaft having two spaced detents in its cam face and a spring biased lever arm having a roller thereon which co-operates with said cam face, two contact operating cams adjustably mounted on said drive shaft to co-operate in sequence with two contact devices which control the motor current, said roller being forced into one of said detents and an associated contact operating cam operating an affiliated contact switch when said drive shaft is operated to either one of its locked-up positions, said contact switches cutting off the motor current prior to the entrance of said roller into one of said detents; whereby, the overrun of said motor operated driving means and the biasing force of said lever arm carries the movement through to its extreme position as determined by said roller bearing against the bottom of one of said detents.

2. In a switch machine for railroads, a drive shaft driving means comprising, an instantly reversible motor having a self-contained gear reduction, a pinion shaft connected to the motor shaft by a dog type flexible coupling and a torque-limiting clutch, a pinion gear on said pinion shaft meshing with a spur gear on said drive shaft to produce a gear reduction drive, said drive shaft having a

crank arm, a detent cam and two contact operating cams mounted thereon, said detent cam having two spaced detents therein and co-operating with a roller mounted on a spring biased lever arm, said two contact operating cams co-operating each with a contactor to make and break the motor circuits, said crank arm having a connector rod journalled thereon which is connected to a railroad track switch, a positive stop effective to limit the movement of said drive shaft; whereby, said crank arm and said detent cam are driven within the limits of the spacing of said detents in said detent cam as determined by the motor circuit breaking point caused by said contact operating cams operating said contactors, whereupon the overrun of said driving means and the spring bias of said lever arm will force said roller into a cam detent and lock up said driving means and said track switch, said positive stop preventing movement of said driving means beyond said locked-up position.

3. In a switch machine for operating a railroad track switch, a drive shaft and a motor operated driving means therefor, a locking device for at times locking said drive shaft comprising a detent cam mounted thereon with two spaced detents therein and a spring biased lever arm having a roller thereon which cooperates with said two cam detents when said drive shaft is in its extreme operated positions, said detents in said detent cam determining the locked positions of said drive shaft, two contact operating cams mounted on said drive shaft which act to cut off the current to said motor when said drive shaft reaches an extreme operated position, a crank arm having at least two set mounted positions on said drive shaft and connected to said track switch, the particular position of the mounting of said crank arm with respect to said drive shaft being selected so that the dead center position of said crank arm can always be on the line of thrust regardless of which side of the track switch said switch machine is mounted.

4. In a switch machine for operating a track switch on a railroad, a reversible motor having a self-contained gear reduction, a pinion shaft connected at one end to the motor by a flexible coupling and a torque limiting clutch, a pinion gear on said pinion shaft, a drive shaft having mounted thereon a spur gear meshing with said pinion gear to produce a gear reduction drive, a toggle drive arm on said drive shaft connected to the track switch, a detent locking device for holding said drive shaft in its extreme operated positions comprising a cam mounted on said drive shaft having two spaced detents on its face, said cam face having a greater radius on one side than on the other side, a lever arm having a roller mounted thereon and pivoted at one end, a spring at the other end of said lever arm biasing said lever toward said cam and said roller against said cam face, said spring biased lever arm forcing said roller into the corresponding one of said detents when said drive shaft is operated to either of its extreme positions, a stop located beneath said other end of said lever to prevent movement of said cam beyond said extreme positions when said roller begins to pass onto said cam face of greater radius, whereby said track switch is positively operable to its extreme positions.

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