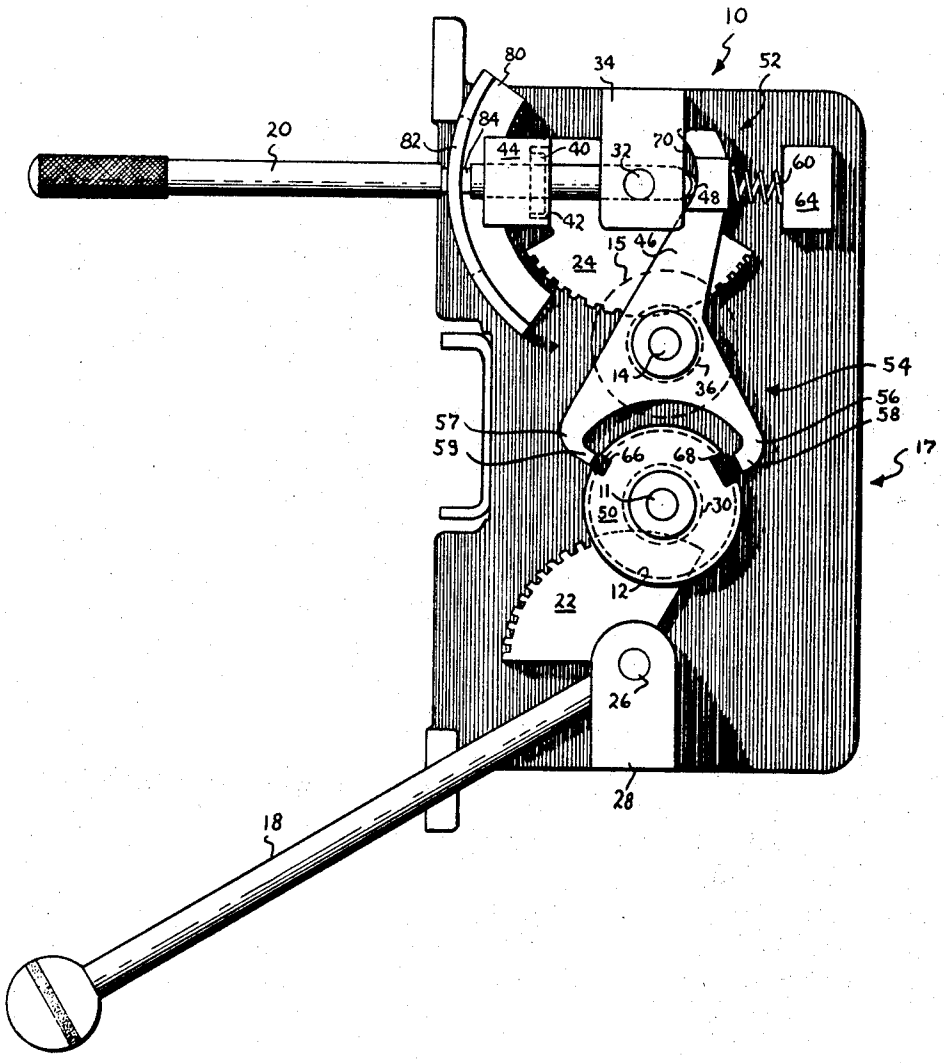
Nov. 12, 1968 D. W. ADAMS ET AL 3,410,151

SAFETY INTERLOCK FOR MASTER CONTROLLER

Filed Feb. 27, 1967



INVENTORS
DONALD W. ADAMS
JOHN P. NADZAM
RALPH E. WALTER
BY
THEIR ATTORNEY

United States Patent Office 3,410,151 Patented Nov. 12, 1968

3,410,151

SAFETY INTERLOCK FOR MASTER CONTROLLER

Donald W. Adams, Erie, John P. Nadzam and Ralph E. Walter, North East, Pa., assignors to General Electric Company, a corporation of New York

Filed Feb. 27, 1967, Ser. No. 618,788
10 Claims. (Cl. 74—483)

ABSTRACT OF THE DISCLOSURE

A safety interlock arrangement for a master controller of the type having two rotable cam-shafts arranged in parallel side-by-side relationship. The safety interlock includes a pivotally mounted locking pawl arranged to cooperate at one end with the end of a removable operating handle of one cam-shaft and at the other end with a notched disc having a first notch on one side of a diameter and a second notch on the other side thereof. The removable operating handle is arranged so that movement thereof to initiate its removal operates to cause movement of the locking pawl in a direction to effect its engagement with the first notch of the notched disc with complete removal of the handle allowing for movement of the locking pawl in the opposite direction to effect its engagement with the second notch. The notched disc is secured to the other cam-shaft and the notches thereof are located so that engagement with the locking pawl can only be effected when the cam-shaft is in a predetermined position.

This invention relates to electric circuit controllers for electrically propelled vehicles and, more particularly, to a safety interlock arrangement therefor.

In electric circuit controllers for electrically propelled vehicles, such as diesel-electric locomotives, for example, it is customary to remove the operating handle from the controller to prevent unintentional movement of the vehicle as well as to prevent any meddlesome or malicious interference with the vehicle from resulting in its operation. Further, it is important that all controlled circuits be in preselected states of energization or deenergization when the operating handle is so removed.

It is a primary object of this invention therefore, to provide a simple and reliable interlock arrangement which prevents operation of the controller upon removal of an operating handle and wherein removal of the operating handle can only be effected when the controller is in a predetermined operating condition.

It is a further object of this invention to provide an interlock arrangement for an electric circuit controller which occupies a minimum of space and requires a minimum of movable parts.

Briefly stated, in accordance with one aspect of this invention, there is provided a new and improved safety interlock arrangement for an electric circuit controller of the type wherein first and second cam-shaft means are journaled in parallel, side-by-side relationship between spaced-apart end frame members. A first operating handle is provided operably associated with the first cam-shaft means to provide for the rotation thereof and a second operating handle is provided operably associated with the second cam-shaft means for causing its rotation and which second operating handle is adapted for removal from the controller. There is also provided a locking means mounted for rotation with the first cam-shaft means and a locking pawl mounted for pivotal movement and with a first end thereof arranged for cooperation with an end of the second operating handle and with a second end thereof arranged for cooperation with the locking means. A spring means is provided for urging the first

end of the locking pawl in the direction toward and into contact with the end of the second operating handle so that movement of the second operating handle to initiate removal thereof is operative to cause movement of the locking pawl in one direction and movement of the handle to complete its removal is operative to allow for movement of the locking pawl in the opposite direction. First and second means are provided on the locking means with the first means arranged for cooperation with the locking pawl to allow for movement of the pawl in the one direction only when the first cam-shaft means is in a predetermined position and with the second means arranged for cooperation with the locking pawl when the locking pawl is moved in the opposite direction upon removal of the second operating handle which cooperation is operative to prevent rotation of the first cam-shaft means.

The novel features believed characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof as well as its organization and method of operation can best be understood by reference to the following description taken in conjunction with the accompanying drawing wherein the sole figure thereof is an end view of an electric circuit controller.

Although specific terms are used in the following description for clarity in describing the invention, these terms are intended to refer only to the arrangement illustrated in the drawing and are not intended to define or limit the scope of the invention. Also, although the invention will be described in detail with the operating handle associated with the reverser cam-shaft means being removable, it is to be understood that either operating handle may be arranged to be the removable one as desired.

As is well known electric circuit controllers, often referred to in the art as "master controllers" are switching devices for controlling the application and direction of electric power for electrically propelled vehicles. A typical application for such a master controller is on a diesel-electric locomotive to control the speed and direction of operation as well as to control dynamic braking if the locomotive is so equipped. Briefly, the controller of the type with which the present invention is incorporated includes a throttle cam-shaft, a reverse cam-shaft, cams, interlocks and switches. Conveniently, the various components of the controller are assembled into an open-mounted frame including spaced-apart end frame members suitably interconnected to side frame members. Since the general construction and organization of the basic components of the master controller per se are not part of the present invention and are well known in the art, a complete detailed description of such controller is not deemed necessary to a full understanding of the invention.

Accordingly, in the drawing only one end of an electric circuit controller, generally designated at **10**, has been shown. Controller **10** includes a throttle cam-shaft means **11** having cams **12** suitably mounted thereon and a reverse cam-shaft means **14** having cams **15** similarly mounted thereon. Cam-shaft means **11** and **14** are arranged in parallel, side-by-side relationship and suitably journaled at one end frame member **17** and at the other end is a similar end frame member (not shown). The cams associated with cam-shaft means **11** and **14** are operative to control the actuation of switch means (not shown) operably associated therewith.

Since usually only a limited amount of travel is allowed for the "throttle" and "reverser" operating handles, shown at **18** and **20** respectively, to produce essentially 360° of travel of their associated cam-shaft means, such cam-shaft means are conveniently arranged

to be driven through suitable gear means including sector gears **22** and **24**, respectively. For some applications, of course, the operating handles may be connected so as to directly drive their associated cam-shaft means.

To this end, throttle operating handle **18** is secured in any suitable manner, such as welding, to the sector gear **22** which is suitable rotatably mounted. Conveniently, sector gear **22** is secured in any suitable manner to a stub-shaft **26** which is journaled at one end in end frame member **17** and at the other end in an extending support member **28**. Sector gear **22** is arranged to mesh with a pinion gear **30** secured to the cam-shaft means **11**. Similarly, sector gear **24**, operably associated with handle **20**, is suitably mounted for rotation with a shaft means **32** journaled at one end in end frame member **17** and at the other end in the extending support member **34**. Sector gear **24** is arranged to mesh with the pinion gear **36** mounted on cam-shaft means **14**.

From the foregoing, it will be evident that movement of the operating handles **18** or **20** causes rotation of the cam-shaft means operably associated therewith through their meshing sector and pinion gears which rotation is operative to cause the selective actuation of their cam-operated switches to thereby control the electric circuits associated therewith in well known manner.

In accordance with this invention, a simple and foolproof safety interlock arrangement having a long operating lifetime is provided which interlock becomes operative upon removal of reverser operating handle **20** to prevent rotation of throttle cam-shaft means **11** but which handle removal can only be effected when cam-shaft means **11** and **14** are in predetermined relative positions; specifically, when throttle cam-shaft means **11** is in its "idle" position and reverser cam-shaft means **14** is in its "off" position represented in the drawing by operating handle **18** in the extreme down position and operating handle **20** in the mid-position.

To this end, reverser operating handle **20** is arranged to be readily removable. This may be conveniently accomplished, as shown, by providing handle **20** with a pin **40** adapted to be positioned in a locking slot **42** provided therefor in a suitably slotted block **44**. Removal of handle **20** may then be easily accomplished by causing such handle to be moved inwardly and thereafter turned on its own axis, so that pin **40** disposed therein will be released from locking slot **42** in block **44** which is mounted to the hub of sector gear **24**. Block **44** is provided with a suitably enlarged bore which allows the handle **20** with its extending pin **40** to pass through and be completely withdrawn from the controller.

A locking pawl **46** is pivotally mounted and adapted to cooperate at one end with the inner end **48** of reverser operating handle **20** and at the other end with a suitable locking means, shown as a notched disc **50**, which is secured to cam-shaft means **11** for rotation therewith. For example, the pivotally mounted locking pawl **46** is arranged with a first end **52** disposed for cooperation with the end **48** of the handle **20**, and a second end **54** of the locking pawl is arranged for cooperation with the locking means so that movement of the handle **20** in a direction to begin the removal thereof (inwardly for the arrangement illustrated) operates to cause movement of locking pawl **46** in one direction and movement of handle **20** in the direction to complete its removal operates to allow movement of locking pawl **46** in the opposite direction. Thus, locking pawl **46** may be arranged for movement parallel with or perpendicular to the plane of the end frame member **17**.

Conveniently, locking pawl **46** may be mounted, as illustrated, for movement parallel with the plane of end frame member **17** by being rotatably mounted on an extension of the shaft of cam-shaft means **14** so that the end **52** thereof cooperates with the end **48** of operating handle **20** and the end **54** thereof is adapted to cooperate with the locking means. That is, the locking means is provided with first and second means which selectively cooperate with the locking pawl **46** when the pawl is moved in different directions. Thus, when the locking means is a notched disc **50** as illustrated, the first means may be the notch **68** thereof which is disposed on one side of a diameter of disc **50** and the second means may be the notch **66** disposed on the other side of such diameter. Accordingly, the notch **68** is arranged for engagement with the end **58** of the locking pawl **46** to allow for movement of such locking pawl in one direction (clockwise for the arrangement shown) only when the first cam-shaft means **11** is in a predetermined position since only then is notch **68** in alignment with end **58**. Also, the second means provided by notch **66** is arranged for engagement with the end **59** of locking pawl **46** when such locking pawl is moved in the opposite direction (counter-clockwise for the arrangement shown); engagement of the end **59** with notch **66** being operative to prevent rotation of the first cam-shaft means **11**.

Movement of locking pawl **46** in the direction to cause engagement of its end **59** with the notch **66** is provided by a suitable bias means, shown as the spring means **60**. Spring means **60** is disposed as shown between the end **52** of locking pawl **46** and a suitable member **64** which extends from end frame member **17**. The spring means **60** urges the end **52** toward the end **48** of removable handle **20** which end is so located that as long as handle **20** is in place, locking pawl **46** is in its inoperative position with the ends **58** and **59** out of engagement with the notched disc **50**.

The end **52** of locking pawl **46** is provided with a suitable contour shown as concave recess **70**, so that movement of handle **20** during operation does not cause sufficient movement of locking pawl **46** to cause engagement of either of the ends **58** or **59** with the notches **66** or **68** of notched disc **50**. That is, spring means **60** causes the end **52** of locking pawl **46** to be urged into contact with the end **48** of operating handle **20** and during operating movement of handle **20** the ends **58** or **59** of locking pawl **46** must not be caused to be moved into engagement with the notches of notched disc **50**, which would prevent rotation of cam-shaft means **11**. To allow for free movement of handle **20**, the end **48** thereof may be provided with a suitable roller so as to be in rolling rather than sliding contact with the surface of concave recess **70**.

It is also desirable to provide means to assure that reverser operating handle **20** cannot be moved readily in a continuous motion between its positions on either side of the "off" position. For example, typically one direction of movement of reverser operating handle **20** from the "off" position provides for forward motoring and braking while the other direction of movement provides for reverse motoring and braking. Obviously, it is not desirable to allow for an inadvertent rapid change from the forward to the reverse direction.

To this end, a locking ring **80** is provided having a Z-type slot **82** therein in which an undercut section **84** of operating handle **20** moves. Thus, movement of operating handle **20** from the "off" position requires an additional movement to cause it to clear the shoulder of the Z-type slot **82**. For example, movement of handle **20** from the "off" position toward a downward position (for the orientation of the controller shown) must be accompanied by movement thereof outwardly of the plane of the drawing so that the shaft of the handle can clear the shoulder of the Z-type slot. Similarly, movement of handle **20** from the "off" position toward an upward position must be accompanied by movement thereof into the plane of the drawing to allow it to clear such shoulder.

In operation, the controller is arranged to be "locked" by removal of reverser operating handle **20**. This is accomplished by pushing handle **20** inwardly against the force of spring means **60** until the pin **40** is clear of the locking slot **42** in block **44**, after which handle **20** is rotated on its own axis 90° for removal through the en-

larged bore provided in block **44**. Observation of the drawing will illustrate, however, that unless the notch **68** of notched disc **50** is in alignment with the end **58** of locking pawl **46**, handle **20** cannot be pushed inwardly a sufficient distance to allow pin **40** to clear the locking notch **42** thereby preventing rotation of handle **20** on its own axis. Accordingly, the notch **68** is arranged to be in alignment with the end **58** of locking pawl **46** only when the throttle cam-shaft means **11** is in the "idle" position. Also, to assure that reverser operating handle **20** is in its "off" position when it is removed, an undercut portion **84** of handle **20** is arranged to move in the Z-type slot **82** of the locking plate **80**. Slot **82** is arranged to be large enough to allow for free movement of the undercut portion **84** of handle **20** but not large enough to allow the full dimension of the shaft thereof to pass except at the mid-position of the slot **82** which represents the "off" position of the reverser cam-shaft means **14**.

Accordingly, only when operating handle **20** is in the "off" position and throttle operating handle **18** is in the "idle" position, is it possible to move operating handle **20** inwardly a sufficient distance to allow pin **40** to clear the slot **42** and be rotated on its own axis for removal from the controller. Also, since the end **58** of locking pawl **46** is in alignment with the notch **68** of disc **50**, locking pawl **46** is allowed to be rotated clockwise by the action of the end **48** of handle **20** as the handle is pushed inwardly. The pawl **46** may be rotated until the end **58** thereof fully engages the slot **68** which is sufficient to allow the pin **40** to clear the slot **42**. A 90° rotation of handle **20** on its own axis places pin **40** in the enlarged bore portion of the block **44** and the handle may be merely withdrawn.

Once reverser operating handle **20** has been removed, the end **48** thereof is no longer in contact with the end **52** of locking pawl **46** so that spring means **60** causes counter-clockwise rotation of locking pawl **46**. This counterclockwise rotation causes the end **59** of locking pawl **46** to engage the notch **66** of notched disc **50** and to remain so engaged by action of the spring means **60** until handle **20** is replaced. With the end **59** of locking pawl **46** engaged in the notch **66** of notched disc **50**, cam-shaft means **11** is locked thereby and is prevented from being rotated without application of excessive force to the handle **18**. As shown, notch **66** is made smaller than the end **58** of locking pawl **46** so that engagement between notch **66** and end **58** is prevented under the condition when notch **66** rather than notch **68** is in alignment with such end. Removal of handle **20** is therefore not possible in such a case.

From the foregoing description, it will be appreciated that there has been provided a simple interlocking arrangement which is rendered operative upon removal of the reverser operating handle **20** which permits the spring biased locking pawl to engage the notch **66** of the notched locking disc **50** thereby locking up the throttle cam-shaft means **11**. Since the reverser operating handle **20** must be free to be pushed inwardly, a sufficient distance to allow it to clear a locking slot so that the handle may be rotated on its own axis, such handle removal is possible only if the throttle cam-shaft means is in the "idle" position and the reverser cam-shaft means is in the "off" position. If the throttle cam-shaft means is out of position, the notches of the notched locking disc **50** are not aligned with the ends of the pawl **46** thereby restricting the inward travel of the reverser operating handle **20**. Also, a locking ring **80** is provided having an opening therein for the handle **20** which is so dimensioned that the handle **20** can only be moved inwardly when it is in its "off" position.

While only preferred features of the invention have been shown and described by way of illustration, many changes and modifications will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a revolving cam electric circuit controller of the type wherein first and second cam-shaft means are arranged in parallel, side-by-side relationship and journaled in spaced-apart end frame members and wherein at least one of the operating handles for causing rotation of said cam-shaft means is removable, the combination with such controller of interlock means for preventing rotation of one cam-shaft means upon removal of the operating handle associated with the other cam-shaft means and wherein said handle can be removed only when said first and second cam-shaft means are in predetermined positions comprising:

(a) locking means mounted on said first cam-shaft means for rotation therewith;

(b) a pivotally mounted locking pawl having one end arranger for cooperation with an end of the removable handle associated with said second cam-shaft means and the other end arranged for cooperation with said locking means so that one portion of the movement associated with the removal of said handle is operative to cause movement of said locking pawl in one direction and another portion of the movement associated with the removal of said handle is operative to allow for movement of said locking pawl in the opposite direction;

(c) spring means for urging movement of said locking pawl in said opposite direction; and

(d) first and second means associated with said locking means, said first means being arranged and adapted for cooperation with said locking pawl to allow for movement thereof in said one direction only when said first cam-shaft means is in a predetermined position and said second means being arranged and adapted for cooperation with said locking pawl when said locking pawl is allowed to move in said opposite direction and being operative to prevent rotation of said first cam-shaft means.

2. The combination of claim **1** wherein said locking means is a notched disc and said first and second means associated therewith are respectively a first notch disposed on one side of a diamter of said disc and a second notch disposed on the other side thereof.

3. The combination of claim **2** wherein said locking pawl is pivotally mounted for rotation about an axis perpendicular to the plane of said notched disc.

4. The combination of claim **3** wherein said locking pawl is provided at one end with a concave recess adapted to be engaged by said one end of said removable operating handle so that normal operating movement of said handle does not result in any significant movement of said locking pawl and provided at its other end with spaced-apart leg portions, one of said leg portions having its free end directed and dimensioned to be engaged within said first notch when said locking pawl is caused to be removed in said one direction and the other leg portion having its free end directed and dimensioned to be engaged within said second notch when said locking pawl is allowed to move in said opposite direction.

5. The combination of claim **4** wherein the free end of said first leg portion is dimensioned so as to be larger than the opening provided by said second notch.

6. The combination of claim **2** wherein said locking pawl is mounted for rotation about an extending end of the shaft of said second cam-shaft means.

7. The combination of claim **2** wherein said removable handle is arranged to be removed by a first movement portion parallel with the longitudinal axis thereof and in a direction toward said one end thereof, a second movement comprising a rotation about said longitudinal axis and withdrawal of said handle by movement parallel with said longitudinal axis.

8. The combination of claim 7 wherein movement of said handle in the direction toward said one end thereof is operative to cause movement of said locking pawl in said one direction and withdrawal of said handle is operative to allow for movement of said locking pawl in said opposite direction.

9. The combination of claim 2 wherein said first and second notches are disposed for cooperative engagement with said locking pawl only when said first cam-shaft means is in a predetermined position.

10. The combination of claim 9 wherein said ramovable handle means is operably associated with means to prevent said one portion of the movement associated

with the removal of said handle unless said second cam-shaft means is in a predetermined position.

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FRED C. MATTERN, JR., *Primary Examiner.*

C. F. GREEN, *Assistant Examiner.*