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ELECTRICAL PROTECTIVE SWITCH

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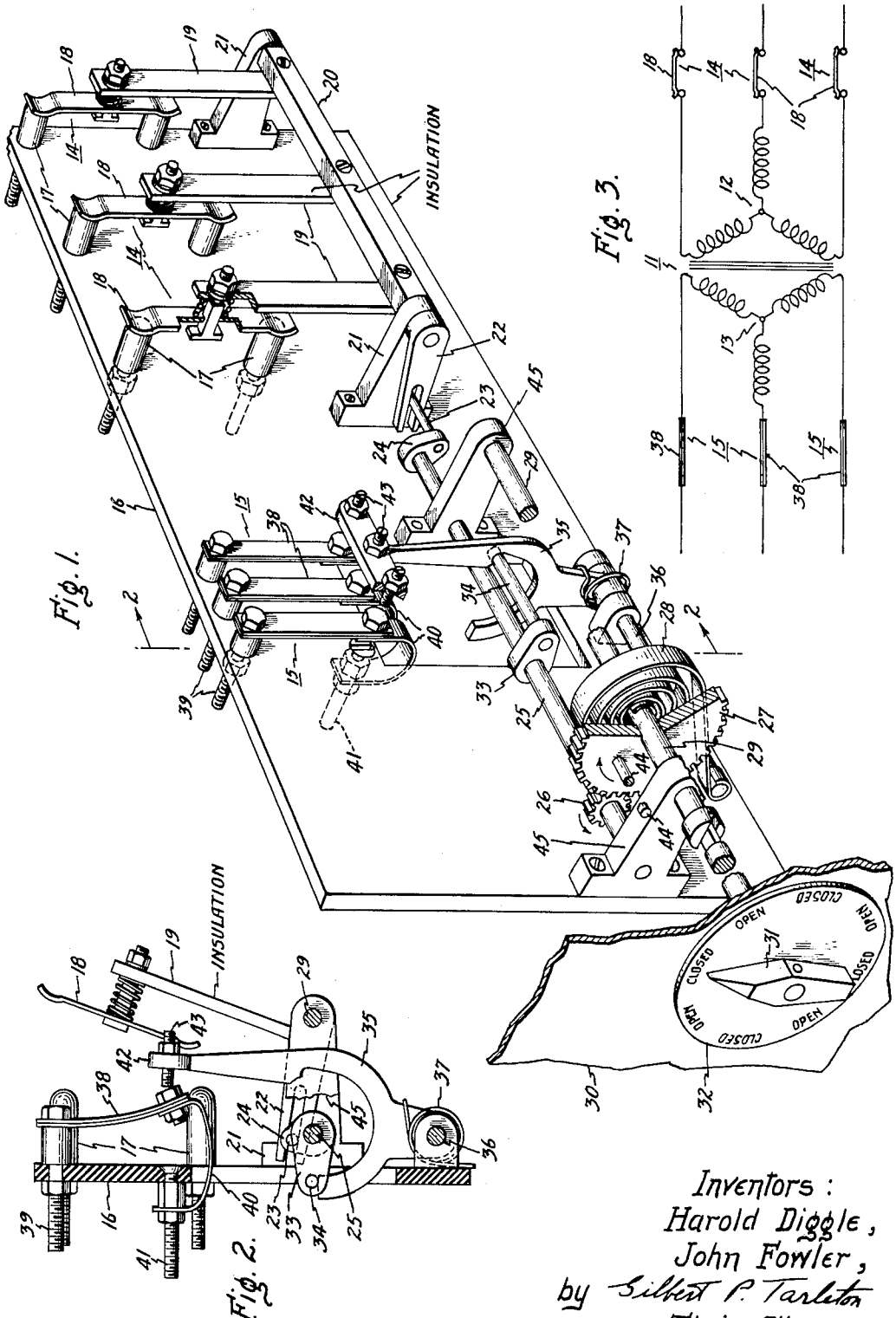

Fig. 1.

Fig. 3.

Fig. 2.

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ELECTRICAL PROTECTIVE SWITCH

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3 Claims. (Cl. 200—114)

This invention relates to an electrical protective switch, and more particularly, this invention relates to an improvement over the transformer protective switch shown in the patent application of Sidney R. Smith, Jr., Serial No. 271,765, filed February 15, 1952, now Patent No. 2,662,137, issued December 8, 1953, and assigned to the General Electric Company.

In said Sidney R. Smith, Jr. patent application is shown a transformer protective switch for a single phase transformer. Said switch offers the advantage that contacts to be opened upon the occurrence of an overload, though controlled by an overload responsive element, are directly and independently opened by a separate drive means. Said contacts are permitted to make a predetermined number of openings and reclosings after which they lock open, and an external indication is provided not only as to whether the contacts are opened or closed, but also as to the number of openings and reclosings that have occurred. However, as before mentioned, said transformer protective switch is designed to give protection to single phase electrical systems. Inasmuch as much electrical equipment is of the three phase type, it is desirable to provide an electrical protective switch which can be readily utilized to protect either single phase or plural phase electrical equipment.

Accordingly, it is an object of this invention to provide means in said Sidney R. Smith, Jr. transformer protective switch whereby said switch can be used to protect either single phase or plural phase electrical equipment.

Our invention comprises an improved electrical protective switch for a single or plural phase electrical system, said electrical protective switch when used in a plural phase electrical system having normally closed contacts in each phase of said plural phase electrical system, means for opening and closing said contacts comprising a shaft biased for rotation in one direction, said shaft extending substantially midway between the legs of a U-shaped escapement member substantially perpendicular to a plane passing through said legs, one of said legs being longer than the other of said legs and said longer leg having a catch notch therein substantially opposite to the upper end of said other leg, said shaft having a crank arm thereon having a pin extending therefrom substantially parallel to said shaft, said U-shaped member pivoted adjacent a base portion thereof and biased for pivotal movement in one direction whereby said catch notch is moved towards said shaft and said upper end is moved away from said shaft, said pin engaging said notch when said contacts are closed, an overload responsive element positioned in each phase of said plural phase electrical system, said U-shaped member adapted to be pivoted in an opposite direction upon operation of any one of said overload responsive elements wherein said pin is disengaged from said catch notch to permit rotation of said shaft to open said contacts, said pin engaging said upper end when said contacts are open.

The invention will be better understood by considering

the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a partly broken away exploded perspective view of our invention in the contacts closed position. Fig. 2 is a partly broken away sectional view of our invention in the contacts open position, the section being taken along the line 2—2 of Fig. 1. Fig. 3 is an electrical circuit diagram illustrating how our invention is used to protect a three phase transformer apparatus.

Referring to the drawing, and more particularly to Fig. 3, illustrated therein is a three-phase transformer **11** having a high voltage side **12** and a low voltage side **13**. In each of the three phases on the high voltage side **12** there are arranged normally closed contacts **14** which are under the control of overload-responsive elements **15** in each of the three phases on the low voltage side **13** so that upon the occurrence of an overload condition in any one of the three phases on the low voltage side **13** all three sets of contacts **14** will be thrown open on the high voltage side **12**.

Referring now to Fig. 1, it will be seen that a common base board **16** carries on the right-hand side the high voltage contacts **14** and on the left-hand side the low voltage control elements **15**.

The high voltage contacts **14** in each phase consists of a pair of fixed contacts **17** normally bridged by a spring-loaded moving contact bar or bridging member **18**. Each such moving contact bar **18** is carried on the extremity of an individual insulating material switch arm **19**; the three arms **19** being attached to a common rotatable shaft **20** of square cross section carried in bearings **21** on the base **16**. At its left hand end the shaft **20** has fixed to it a forked or slotted crank arm **22**. Riding within a crank pin slot in the arm **22** is a pin **23** carried by a crank arm **24** which in turn is fixed on a rotatable shaft **25**. It will be seen that with the crank arm **24** occupying the position as shown in Fig. 1 the contacts **17—18** are held closed, but that if the shaft **25** is made to rotate counterclockwise then during one complete rotation the switch contacts **17—18** will be caused to execute an opening and reclosing movement once. See also Fig. 2.

For the purpose of effecting such counterclockwise rotation of the shaft **25**, a small pinion **26** fixed upon the left hand end of shaft **25** meshes with a large pinion **27** which under the pressure of a multi-turn torsion spring **28** tends to rotate in a clockwise direction. A shaft **29** extends from the pinion **27** and spring **28** through the side wall **30** of a transformer tank, not shown, to a combined indicator finger and reset lever **31** which is rotatable over the surface of a dial plate **32**.

Thus, when the spring **28** is permitted to cause rotation of the shaft **25** and crank arm **24**, partial rotation in opposite directions is imparted to shaft **20**. Rotation of shaft **25** is permitted by an escapement mechanism associated with the overload responsive elements now to be described.

Fixed upon the shaft **25** is a crank arm **33** carrying a pin **34** which in the rotation of shaft **25** moves in the path of a U-shaped escapement member **35** which is urged in a counterclockwise direction about its pivot shaft **36** by means of a torsion spring **37**. In the position shown in Fig. 1 and corresponding to closure of contacts **14**, the pin **34** is up against a catch notch on the right hand limb of the escapement member **35**; while upon movement of the escapement member **35** clockwise, the pin **34** is released and a counterclockwise movement of the shaft **25** is permitted until the pin **34** is brought up against the upper extremity of the left hand limb of the escapement member **35**. In this position, almost diametrically opposite from the former, the contacts **14** are open as is indicated in Fig. 2.

The means by which clockwise displacement of the escapement member 35 is brought about consists of three bimetallic strips 38 which are the elements most nearly to be identified with the overload responsive elements 15 of Fig. 3, that is to say, each one is arranged in one phase on the low voltage side 13, the circuit passing from terminal 39, over the bimetal strip 38 and a flexible connector 40, to the terminal 41. The strip 38 is mounted with its upper end fixed in the terminal 39 and with its lower end free to flex towards the longer leg portion of escapement member 35 as the strip becomes heated. The longer notched leg portion of the escapement member 35 carries a cross piece 42 within which are three adjustment screws 43 against which the free end of a bimetal strip 38 bears when the strip is sufficiently flexed upon an overload.

By reason of the step-down gearing 26, 27 between the shaft 25 and the shaft 29, each half-rotation of the shaft 25, from contacts closed to contacts open, or from open to closed, results in a one-eighth rotation of indicator 31. The sequence of opening and closing can occur three times, upon a fourth opening a stop pin 44 on the pinion 27 will have come to rest against the under side of one of the bearings 45 for the shafts 25 and 29, and the switch will remain locked out. To reset the switch the indicator and reset lever 31 is turned back counterclockwise to its original position, thus winding up the spring 28 and closing the contacts 14.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and that it is intended by the appended claims 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. An electrical protective switch for three phase electrical apparatus comprising three pairs of spaced stationary electrically conductive contacts, three movable switch arms, each of said arms carried at one end thereof by a rotatable shaft, the other ends of said arms having an electrically conductive bridging contact member thereon, said bridging contact members adapted to span each of said pairs of spaced contacts to complete an electrical circuit therebetween, said shaft having a slotted crank arm connected at one end thereof to said shaft, the other end of said slotted crank arm having a crank pin slot therein, another rotatable shaft for imparting motion to said switch arm carrying shaft, said another rotatable shaft having a crank arm connected at one end thereof to said another rotatable shaft, said crank arm having a pin projecting from another end thereof substantially parallel to the axis of said another shaft, said pin positioned within said crank pin slot, means continuously urging said another rotatable shaft for rotation in one direction, means for alternately releasing said another rotatable shaft for rotation in said one direction and for restraining said another rotatable shaft from rotation whereby said bridging contact members alternately disengage and engage said pairs of stationary contacts comprising a U-shaped escapement member, said U-shaped member having one leg thereof longer than the other leg thereof, said one leg having a catch notch therein disposed approximately opposite to the upper end of said other leg, said another rotatable shaft extending substantially normal to a plane passing through the legs of said U-shaped member and aligned approximately midway of said upper end and catch notch, said another rotatable shaft having another crank arm connected at one end thereof to said another rotatable shaft, said another crank arm having a pin extending from another end thereof substantially parallel to said another shaft, said another crank arm pin alternately engageable with said catch notch and upper end to retain said bridging contact members engaged and disengaged with said pairs of stationary contacts, said U-shaped member pivoted adjacent a base portion thereof and means continuously urging said U-shaped member for pivotal movement in one direction whereby said catch portion lies in the path of movement of said another crank arm pin, said one leg having a cross piece thereon extending substantially normal to said plane, three electrically conductive bimetallic elements, each of bimetallic elements adapted for connection in one phase of said three phase electrical apparatus and each of said pairs of stationary contacts adapted for connection in one phase of said three phase electrical apparatus, each of said bimetallic elements adapted for movement towards said cross piece to pivot said U-shaped member in another direction whereby said upper end lies in the path of movement of said another crank arm pin.

2. An electrical switch comprising a rotatable shaft, a plurality of switch arms carried by said shaft, said switch arms connected at one end thereof to said shaft, the other ends of said switch arms having an electrically conductive bridging contact member thereon, each of said bridging contact members adapted to engage and disengage a pair of spaced stationary electrically conductive contacts upon partial rotation of said shaft in opposite directions, means for imparting partial rotation to said shaft in opposite directions comprising another rotatable shaft continuously urged for rotation in one direction, said another shaft having a crank arm connected at one end thereof to said another shaft, another end of said crank arm having a pin projecting therefrom substantially parallel to said another shaft, a slotted crank arm connected at one end thereof to said switch arm carrying shaft, the other end of said slotted crank arm having a crank pin slot therein, said another shaft crank arm pin positioned in said crank pin slot, and means for alternately permitting and prohibiting rotation of said another shaft comprising another crank arm carried at one end thereof by said another shaft, another end of said another crank arm having a pin extending therefrom substantially parallel to said another shaft, a pivotally mounted U-shaped escapement member having two leg portions and a base portion, one of said leg portions being longer than the other of said leg portions, said longer leg portion having a catch notch therein substantially opposite to the upper end of said other leg portion, said another shaft extending between said leg portions approximately normal to a plane passing through the leg portions of said U-shaped member and approximately midway of said upper end and catch notch whereby said another crank arm pin will alternately engage said catch notch and upper end upon pivotal movement of said U-shaped member in opposite directions, said U-shaped member pivoted adjacent said base portion and continuously urged for pivotal movement in one direction whereby said upper end lies without the path of movement of said another crank arm pin and said catch notch lies in said path of movement for engagement of said catch notch and another crank arm pin whereby said bridging contact members and pairs of stationary contacts are retained in engaged relationship, and means for pivoting said U-shaped member in an opposite direction comprising a cross piece carried by said longer leg portion and extending substantially parallel to said another shaft, and a plurality of electrically conductive bimetallic elements, each of said elements adapted to abut said cross piece and pivot said U-shaped member in an opposite direction whereby said catch portion lies without the path of movement of said another crank arm pin and said upper end lies in said path of movement whereby said upper end and another crank pin engage to retain said bridging contact members and pairs of spaced contacts disengaged.

3. An electrical switch comprising a pair of spaced stationary electrically conductive contacts, a switch arm carried at one end thereof by a rotatable shaft, an elec-

trically conductive bridging contact member carried by another end of said switch arm adapted to engage and disengage said pair of contacts upon partial rotation of said shaft in opposite directions, another shaft continuously urged for rotation in one direction for imparting partial rotation to said switch arm carrying shaft in opposite directions, said another shaft having a crank arm connected at one end thereof to said another shaft, another end of said crank arm having a pin thereon extending substantially parallel to said another shaft, a slotted crank arm connected at one end thereof to said switch arm carrying shaft, another end of said slotted crank arm having a crank pin slot therein, said another shaft crank arm pin protruding into said crank pin slot, means for alternately permitting and prohibiting rotation of said another shaft to alternately engage and disengage said bridging contact member and pair of contacts comprising a U-shaped escapement member having two leg portions and a base portion, said another shaft extending between said leg portions substantially normal to a plane passing through said leg portions, said U-shaped member pivoted adjacent said base portion for pivotal movement in opposite directions, one of said leg portions being longer than another of said leg portions, said longer leg portion having a catch notch therein approximately opposite to an upper end of said another leg portion, said another shaft positioned substantially midway of said upper end and catch notch, means continuously urging said U-shaped member for pivotal movement in one direction whereby said catch notch is moved towards said another shaft and said upper end is moved away from said another shaft, an electrically conductive bimetallic element adapted to be moved from an out of contact position with respect to said longer leg portion towards said longer leg portion for abutment therewith wherein said U-shaped member is pivoted in an opposite direction whereby said catch notch is moved away from said another shaft and said upper end is moved toward said another shaft, said another shaft having another crank arm connected at one end thereof to said another shaft, another end of said another crank arm having a pin extending therefrom substantially parallel to said another shaft adapted to alternately abut said catch notch and upper end to alternately retain said bridging contact member engaged and disengaged with said pair of contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

2,652,465	Jackson	Sept. 15, 1953
2,674,672	Alter	Apr. 6, 1954