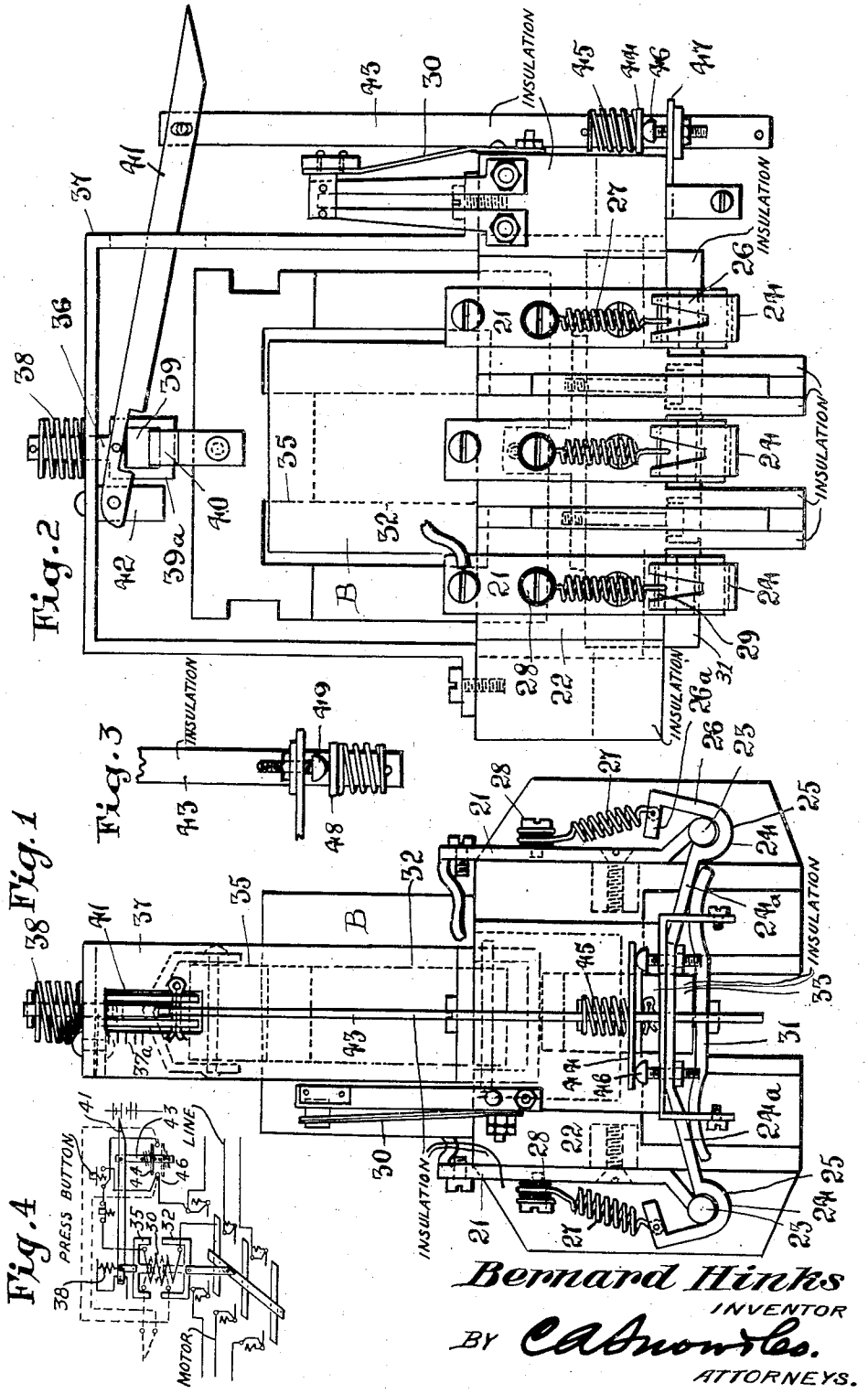
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ELECTROMAGNETIC SWITCH

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ELECTROMAGNETIC SWITCH

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This invention relates to electro-magnetic motor starter switches of the type comprising an electro-magnet coil and a divided magnetic yoke one part of which carries contacts which are moved against contacts on the frame of the switch when the coil is energized, the said magnetic yoke part also moving against the other part of the magnetic yoke part, and it has for its object to open the said magnetic coil circuit or prevent the closing of the coil circuit when the contacts are badly worn and require renewing. Thus liability of endangering the motor controlled by the switch by relying on overloads or the like is obviated. A further object is to provide means for indicating the state of corrosion of the contacts without the need for opening the switch. A still further object of the invention is to automatically compensate for the reduction of pressure on the contacts caused by erosion or wear and to increase the life of the contacts. Another object of the invention is to prevent arcing and burning of the contacts caused by bounce at "make" and still another object is to simplify and improve the reliability of the construction of the switch.

In the drawings:

Figure 1 is a side elevation of one form of electro-magnetic switch constructed according to this invention.

Figure 2 is an end elevation.

Figure 3 illustrates a modified form of switch actuated from the yoke of the electro-magnet.

Figure 4 is a circuit diagram of the switch.

According to one form of the invention as shown by Figures 1 and 2, the electro-magnet operating the contacts comprises a magnetic coil B mounted on the insulating frame **22** and the parts **35** and **32** of a divided magnetic yoke are slidably mounted in relation to the coil B and frame **22**, the part **32** carrying the movable contacts. The coil B is in circuit with an electric motor and the circuit is made by a push button switch. When the circuit is made by the movable contact **31** bridging the fixed contacts **24**, the opening and closing of the circuit is controlled by an auxiliary switch, the effective operation of which is controlled by the position of the complete magnetic yoke. A terminal strip **21** is mounted on each side of an insulating frame member **22** and is shaped to form a cylindrical rib **23** extending across the width of the strip and the "fixed" contact **24** is pivotally mounted on this cylindrical rib **3** and comprises a metal strip which is curved near the centre to form a curved socket **25** for swivelling on the cylindrical rib **23**. One end of the strip extends from the socket inwardly to form a contact

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arm or blade **24***a*, whilst the other end extends upwardly from the socket to form an arm **26** for connection to a helical spring **27**. One end of the helical spring is fixed on an insulating bush mounted on a pin **28** fixed to the terminal strip **21**, whilst the other end of the spring is mounted on a cross pin **29** bridged across a slotted portion of the said upwardly directed arm of the "fixed" contact strip. The helical spring **27** pulls the contact strip on to the cylindrical rib and normally swivels the contact spring until the inturned end **26***a* of the said upwardly directed arm **26**, forming a stop, moves against the terminal strip. The contact **31** for bridging two resiliently supporting "fixed" contacts **24** is mounted on the magnetic yoke portion **32** through the medium of an insulating block **33** and the end portions or blades of this bridge contact are curved. The bridge contact **31** is loosely fitted on the fixing pin so that it will automatically adjust itself on the contacts **24**. When the current is passed through the coils B of the electro-magnet, the yoke portion **32** is pulled upwardly and the bridge contact **31** strikes the contact arms **24***a* of the fixed contacts **24** and such arms are pivoted upwardly by swivelling the contacts on the cylindrical ribs **23**. The initial turning movement of each fixed contact stretches the helical spring **27** and the spring is so arranged that as the angular movement increases so the rate of extension of the spring increases to a greater extent, that is to say, the spring resistance to movement increases at a greater rate than the angular movement. The upper portion of the magnetic yoke **35** is held in an outward position by a spring or the like, so that when the magnetic coil is energised the yoke portion **35** is pulled inwardly against the force of the spring. For this purpose the magnetic yoke **35** is secured to the spindle or slide **36** slidably mounted in the U-shaped frame **37** fixed to the frame of the switch. The spindle **36** has a spiral spring **38** thereon which bears against a head on the spindle and against the frame **37** to normally urge the spindle outwardly. The inner end of the spindle has a head with a rectangular opening **39** therein and the yoke **35** is secured to the frame **39***a* by means of a U-shaped piece **40** engaging in the opening **39** so that the yoke **35** is capable of upward movement on the part **39***a*. The upper yoke portion **35** is of less weight than the lower yoke portion **32** and when the lower yoke portion is electro-magnetically attracted to the upper portion and the two contact, the upper portion is free to move upwardly, the upper portion is raised until the springs acting on the pivoted fixed contacts **24**

resist the upward movement when the parts will come to rest in a position balanced by the said springs 27. When the magnetic coil is energised the upper yoke 35 is also attracted downwardly towards the lower yoke portion 32 against the tension of the spring 38 and when the yoke portions contact, the complete yoke is brought to rest by the pull of the spring 38 in one direction and the pull of the springs 27 in the opposite direction. The downward or inward movement of the yoke 35 is utilised to close an auxiliary switch. For this purpose a lever 41 is pivoted on the fitting 42 fixed to the frame 37 and this lever is connected to the spindle 36 so that the upward and downward movement of the spindle pivots the lever 41 upwardly and downwardly. A bar 43 is pivotally connected to the end of the lever 41 and such bar carries a bridge contact 44 which is slidably mounted on the bar 43 against the pressure of the spring 45. The fixed contacts 46 of the auxiliary switch are mounted on an insulating bracket 47 fixed to the frame of the main switch and the bar 43 is slidably guided in a slot through the bracket 47. When the electro-magnet is energised and the yoke 35 is moved downwardly, the auxiliary switch is closed to maintain the energising current through the electro-magnetic coil. Should the contact arm 24*a* and a bridge contact 31 become worn by corrosion, the thickness will be reduced and consequently the lower yoke 32 would have to be raised a higher distance to place the same tension on the springs 27 as when the contacts are not worn and the full thickness. The tension of the springs 27 being balanced by the tension of the spring 38, if a less tension is placed on the springs 27 less tension will also be placed on the spring 38 and the contacting yoke parts 35 and 32 will be brought to rest at a higher level and consequently the downward movement of the yoke 35 will be less and the pivotal movement of the lever 41 will also be less. When the contact 24*a* and 31 have been reduced to a predetermined thickness by corrosion, the movement of the bar 43 will not be sufficient to close the auxiliary switch. The spring 27 is placed in tension when the blade of the movable contact bears on the blade 24*a* of the "fixed" contact which tension reacts against the magnetic force controlling the position of the complete magnetic yoke 35—32 and the blades are so arranged that the place of contact is positioned in relation to the yoke so that any reduction in thickness taken from the contacting surfaces alters such relative position and consequently the pressure of the spring 27. The magnetic yoke therefore comes to rest at a new position with the springs 27 and 38 balanced.

The arm 41 passes through a slot in the frame member 37 and a scale 37*a* is marked at the side of the slot to indicate the condition of the contacts. The bottom marking will indicate the position when the contacts are not worn and the top marking will indicate when the contacts are in an un-safe condition. Intermediate markings will also indicate the state of wear or thickness of the contacts. Therefore the condition of the contacts can be noted at any time from the outside of the switch. In some instances the auxiliary switch operating as described cannot be used, such as for instance when a float controls a switch for electric motors driving pump sets. In such case an auxiliary switch is used which normally opens and when the contacts have become worn to a dangerous condition, the auxiliary switch is closed. As shown by Figure 3, a convenient form of switch is similar to the auxiliary switch aforedescribed, but with its position reversed, that is to say, the bridge contact 48 closes on the fixed contacts 49 on the upward movement of the bar 43 which is arranged similarly as the bar 43 of Figure 2. When the auxiliary switch is closed, a secondary circuit including a secondary coil wound on the electromagnet is closed and heats a bimetal strip 30 and after the time delay during the heating of the metal strip, such strip opens the magnet coil circuit and so opens the main switch. Standard overloads as now used on existing switches can be used in lieu of the thermal trip as shown.

Fixed contacts hereinbefore referred to, are contacts mounted on a stationary part of the switch.

The curved ends of the bridge contact wipe over the blades 24*a*, and will come to rest at a place beyond the place of any initial arcing.

Figures 1 and 2 show the auxiliary switch in the form of a retaining switch and the bi-metal switch 30 is not in action. When the arrangement of the switch as shown by Figure 3 is used, the bi-metal switch comes into action; this is shown by the diagram, Figure 4, which shows in full lines the circuit when the auxiliary switch is used as a retaining switch, that is to say, when the press button switch is closed, the retaining switch maintains the electro-magnet coil circuit closed and the release of the press button does not open the coil circuit, the dotted lines showing the circuit when the bi-metal switch 30 is used.

I claim:

1. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil on the frame and energised from the electric supply line voltage, a twin divided magnetic yoke comprising a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil, and a second moving yoke portion which yoke portions are attracted into contact to form a complete yoke, "fixed" blade contacts and a spring device adapted to resiliently press the fixed blade contacts on the moving contacts when the switch is switched "on" and form a balancing resistance to the movement of the yoke with the blade contacts thereon inwardly of the coil, a spring device exerting a force on the said second magnetic yoke portion in the reverse direction to the magnetic force so that the complete yoke is floatingly supported in a balanced position between the opposing spring pressure of the said spring devices, and a second switch having a moving contact operated by the movement of the magnetic yoke comprising an auxiliary switch having fixed and moving contacts and mechanical means actuating the movement of the moving contact of the auxiliary switch by a multiplied movement of the said second yoke portion and for setting the position of the auxiliary switch moving contact according to the balanced position of the complete magnetic yoke.

2. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil on the frame, a twin divided magnetic yoke having a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil and a second moving yoke portion which yoke portions are adapted to be attracted into contact, "fixed" blade contacts, a spring device

adapted to resiliently press the fixed blade contacts on the moving contacts when the switch is switched "on," and form a balancing resistance to the movement of the yoke with the blade contacts thereon inwardly of the coil, a spring device exerting a force on the said second magnetic yoke portion in the reverse direction to the magnetic force so that the complete yoke is floatingly supported in a balanced position between the opposing spring pressure of the said spring devices and a second switch having a moving contact operated by the movement of the magnetic yoke and set with the main switch "switched" on at a position according to the balanced position of the complete yoke, comprising an auxiliary switch having a fixed and a moving contact, and mechanical means for actuating the moving contact of the auxiliary switch operated by the movement of the said second yoke portion and to multiply the movement of the latter contact in relation to the movement of the yoke portion, comprising a lever pivoted to the switch frame and connected to the second yoke portion, a bar pivotally connected to said lever and movably mounted in relation to "fixed" contacts of the auxiliary switch and a spring pressed contact slidably mounted on said bar for engaging the last mentioned fixed contacts.

3. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil, having a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil and a second moving yoke portion which yoke portions are attracted towards one another into contact when the coil is energised, "fixed" blade contacts, a spring device adapted to resiliently press the fixed blade contacts on the moving contacts and form a balancing resistance to the movement of the yoke with the blade contacts thereon inwardly of the coil, a spring device exerting a force on the second magnetic yoke portion in the reverse direction to the magnetic force so that the complete yoke is floatingly supported in a balanced position between the opposing spring pressures of the said spring devices when the switch is switched "on" and a second switch having a moving contact operated by the movement of the magnetic yoke and set with the main switch "switched on" at a position according to the position of the complete magnetic yoke comprising an auxiliary switch having fixed and moving contacts, and mechanical means for actuating the moving contact of the auxiliary switch operated by the movement of the said second yoke portion and to multiply the movement of the second yoke portion, comprising a lever pivoted to a stationary part of the switch frame and pivoted to "open" or "close" the auxiliary switch, a member moved inwardly by the inward movement of the second magnetic yoke portion and connected to said lever and a scale over which the lever moves.

4. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil on the frame, a twin divided magnetic yoke having a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil, and a second moving yoke portion which yoke portions are adapted to be attracted into contact when the magnetic coil is energised, "fixed" blade contacts resiliently mounted on the frame of the switch and each comprising a double armed member having a socket portion between the arms, terminal strips on the frame of the switch having a rib on which the said socket portion is pivotally mounted, a helical spring connected to one arm and holding the socket on the rib to form a wiping contact and holding the other arm of the contact in position so that when the moving contact moves thereagainst the spring is placed in tension to form a spring contact and a balancing resistance to the movement of the yoke portion inwardly of the coil and the arrangement being such that as the angular movement increases so the rate of extension of the spring increases to a greater extent, that is to say, the spring resistance to movement increases at a greater rate than the angular movement, and thus balance the extra power of the electromagnet, a spring device exerting a force on the said second yoke portion in the reverse direction to the magnetic force so that the complete yoke is floatingly supported in a balanced position and a second switch having a moving contact operated by the movement of the magnetic yoke comprising an auxiliary switch having a fixed and a moving contacts and mechanical means actuating the movement of the moving contact of the auxiliary switch by a multiplied movement of the said second yoke portion and for setting the position of the auxiliary switch moving contact according to the balanced position of the complete magnetic yoke.

5. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil on the frame, a twin divided magnetic yoke portion having a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil, and a second moving yoke portion which yoke portions are adapted to be attracted into contact to form a complete yoke when the coil is energised, "fixed" blade contacts resiliently mounted on the frame of the switch and each comprising a double armed member having a socket portion between the arms, terminal strip on the frame of the switch having a rib on which said socket portion is pivotally mounted, a helical spring connected to one arm and holding the socket on the rib to form a wiping contact and holding the other arm of the contact in position so that when the moving contact moves thereagainst, the spring is placed in tension to form a spring contact and a balancing resistance to the movement of the yoke portion inwardly of the coil, a slide mounted on the frame of the switch, a spring urging the slide outwardly and with it the said second magnetic yoke portion and adapted to co-act with the said springs of the fixed contacts to floatingly support the complete yoke in a balanced position when the magnetic coil is energised, a bracket fixed to the said second yoke carrying portion and having a slot engaged by the slide so that the spring applies a pull on the second yoke portion when the said coil is energised but permits movement of the yoke portion and the slide to absorb shock, and a second switch having a moving contact operated by the movement of the magnetic yoke comprising an auxiliary switch having a fixed and a moving contacts and mechanical means actuating the movement of the moving contacts of the auxiliary switch by a multiplied movement of the said second yoke portion and for setting the position of the auxiliary switch moving contact according to the

balanced position of the complete magnetic yoke.

6. An electro-magnetic motor starter switch of the type set forth comprising a switch frame, a stationary magnetic coil on the frame, a twin divided magnetic yoke having a moving yoke portion with blade contacts connected therewith and with the contact surfaces substantially at right angles to the axis of the magnetic coil, and a second moving yoke portion which yoke portions are adapted to be attracted into contact when the magnetic coil is energised, "fixed" blade contacts resiliently mounted on the frame of the switch and each comprising a double armed member having a socket portion between the arms, terminal strips on the frame of the switch having a rib on which the said socket portion is pivotally mounted, a helical spring connected to one arm and holding the socket on the rib to form a wiping contact and holding the other arm of the contact in position so that when the moving contact moves thereagainst the spring is placed in tension to form a spring contact and a balancing resistance to the movement of the yoke portion inwardly of the coil and the arrangement being such that as the angular movement increases so the rate of extension of the spring increases to a greater extent, that is to say, the spring resistance to movement increases at a greater rate than the angular movement, and thus balance the extra power of the electromagnet.

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