Feb. 17, 1953 M. C. HARROLD 2,629,034

ELECTRICAL APPARATUS

Filed June 2, 1951 2 SHEETS--SHEET 1

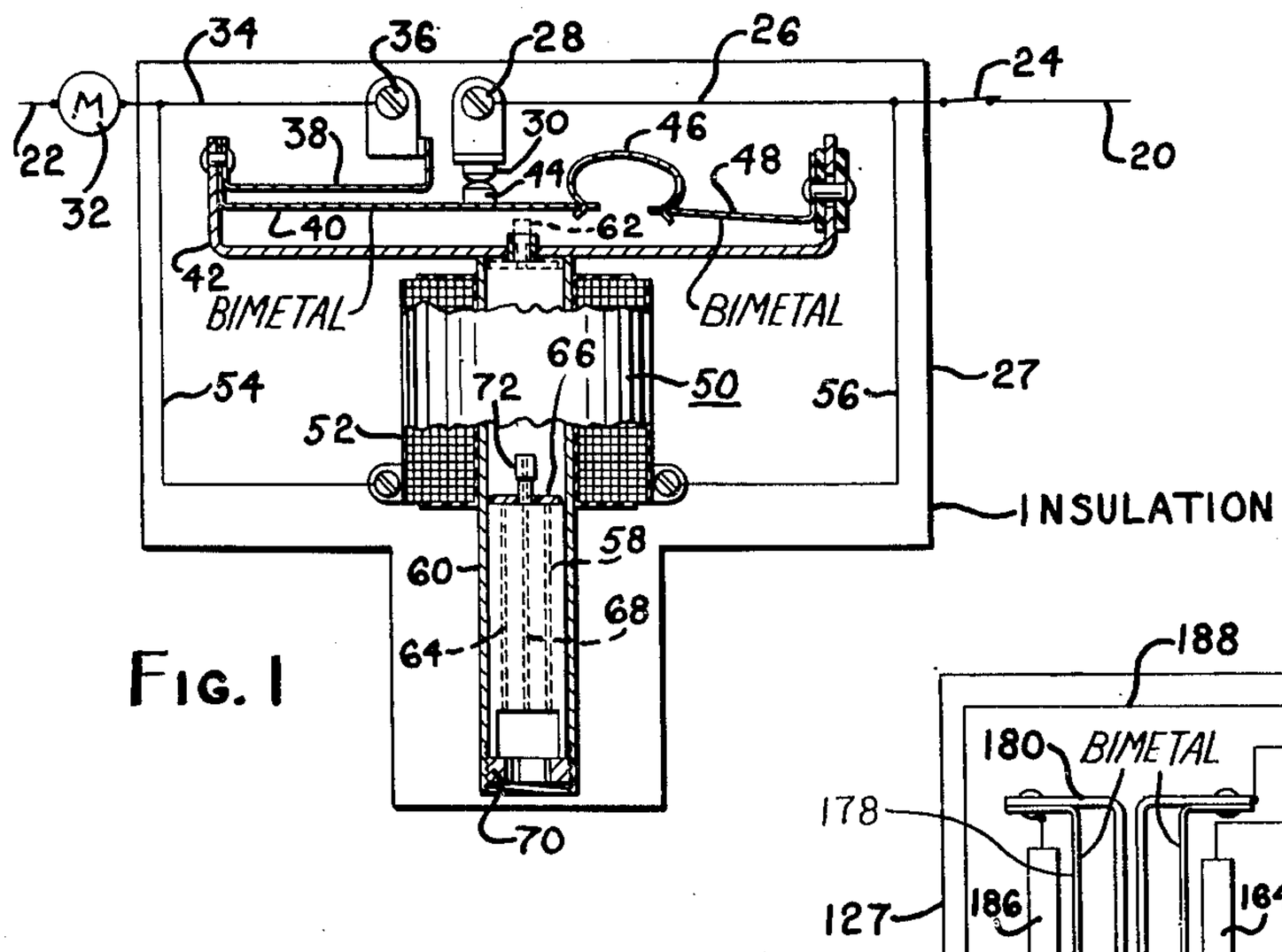

FIG. 1

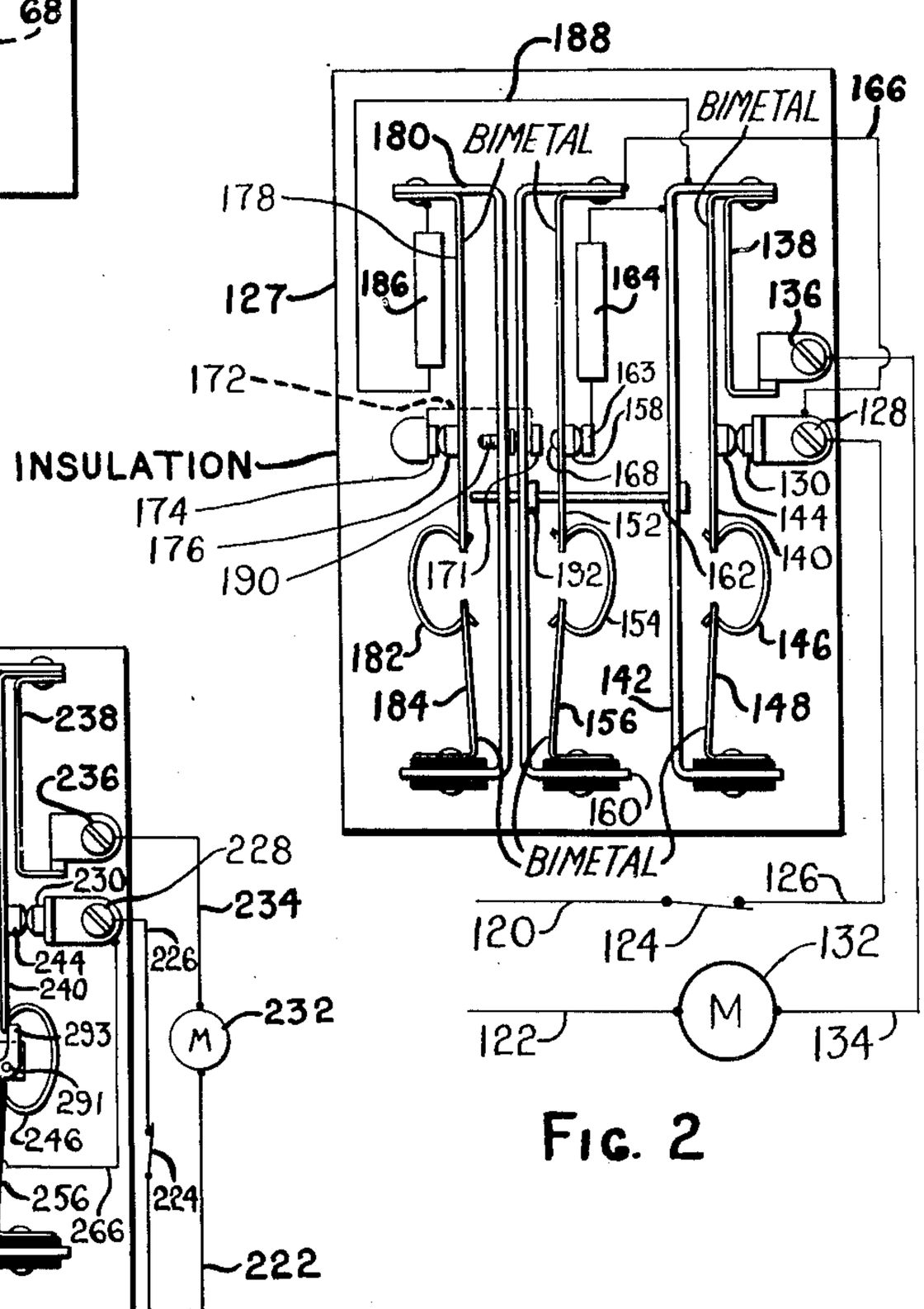

FIG. 2

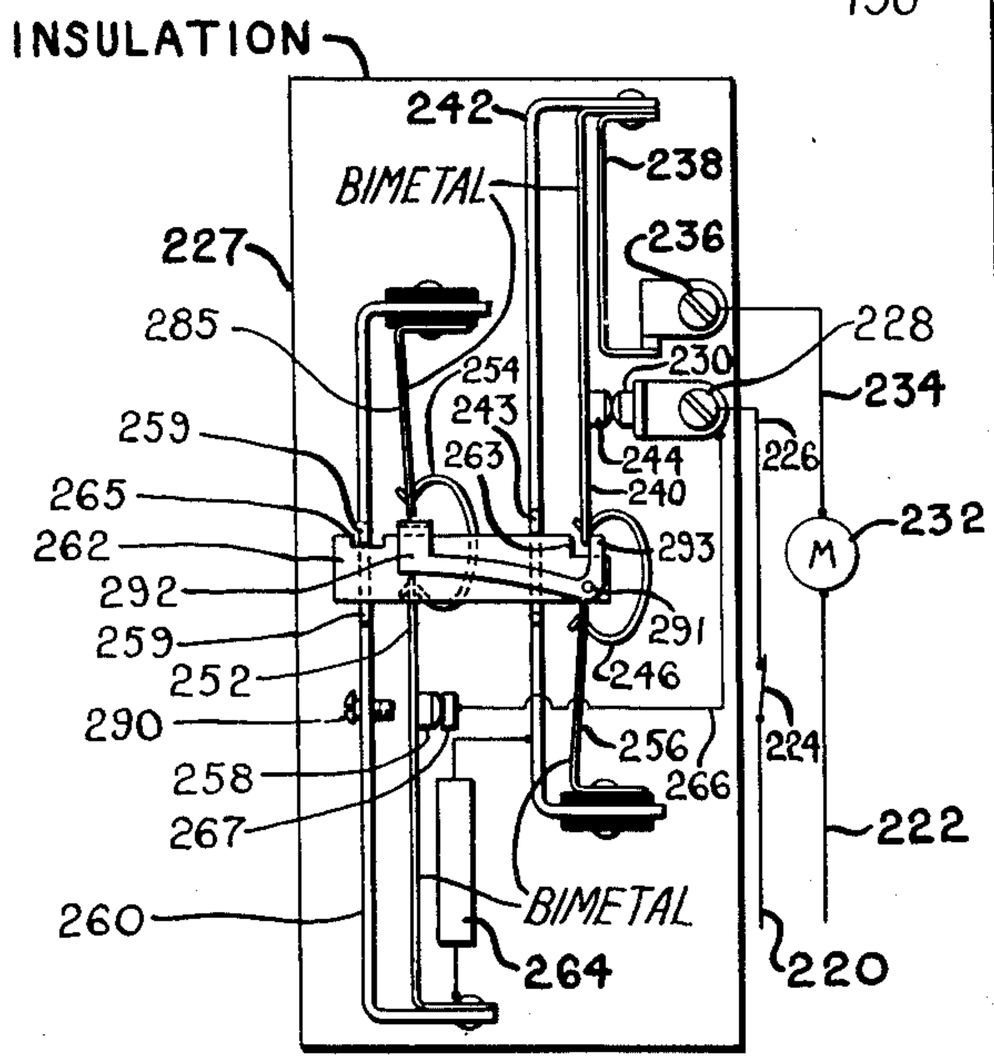

FIG. 3

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ELECTRICAL APPARATUS

Filed June 2, 1951 2 SHEETS--SHEET 2

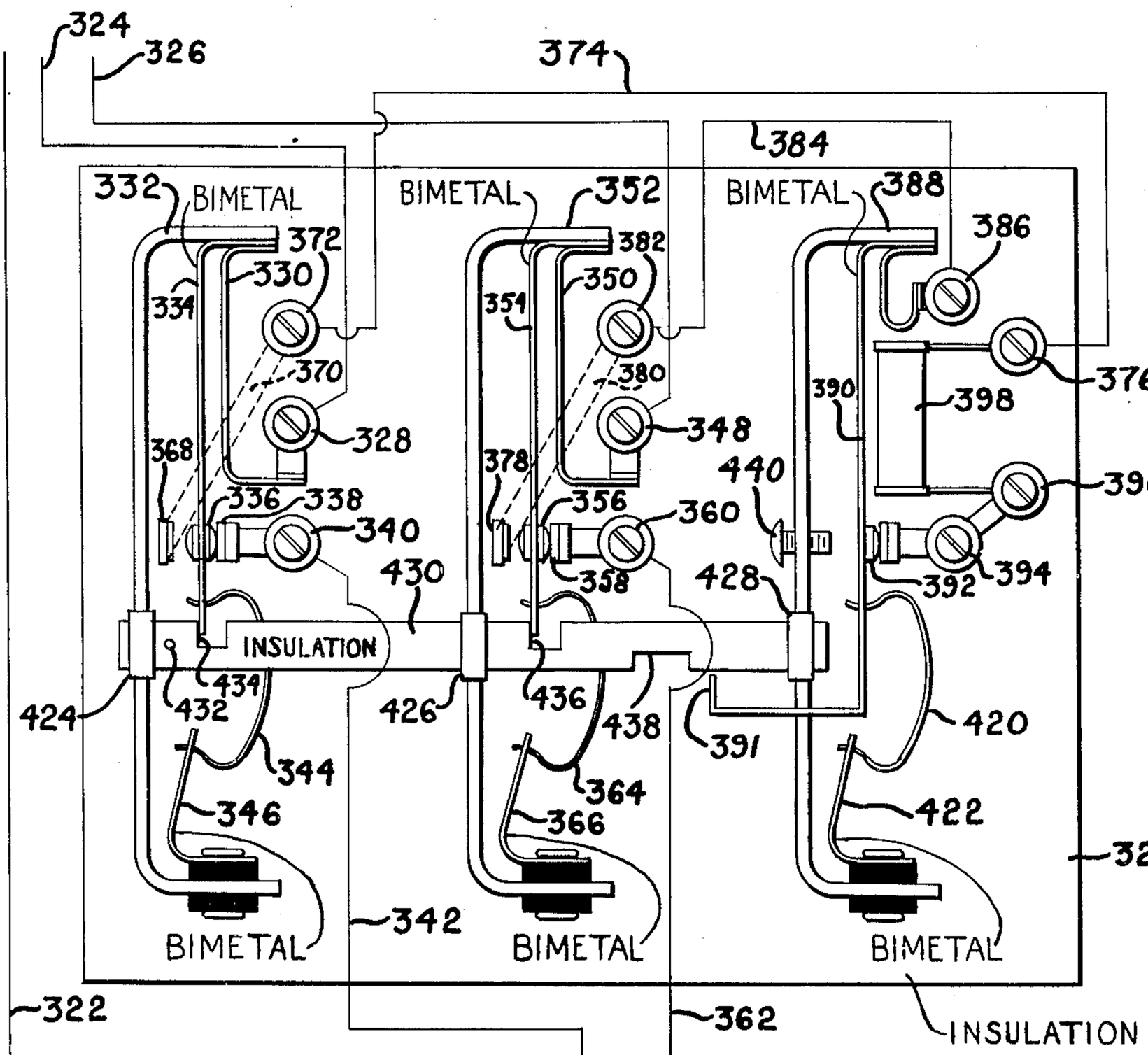

FIG. 4

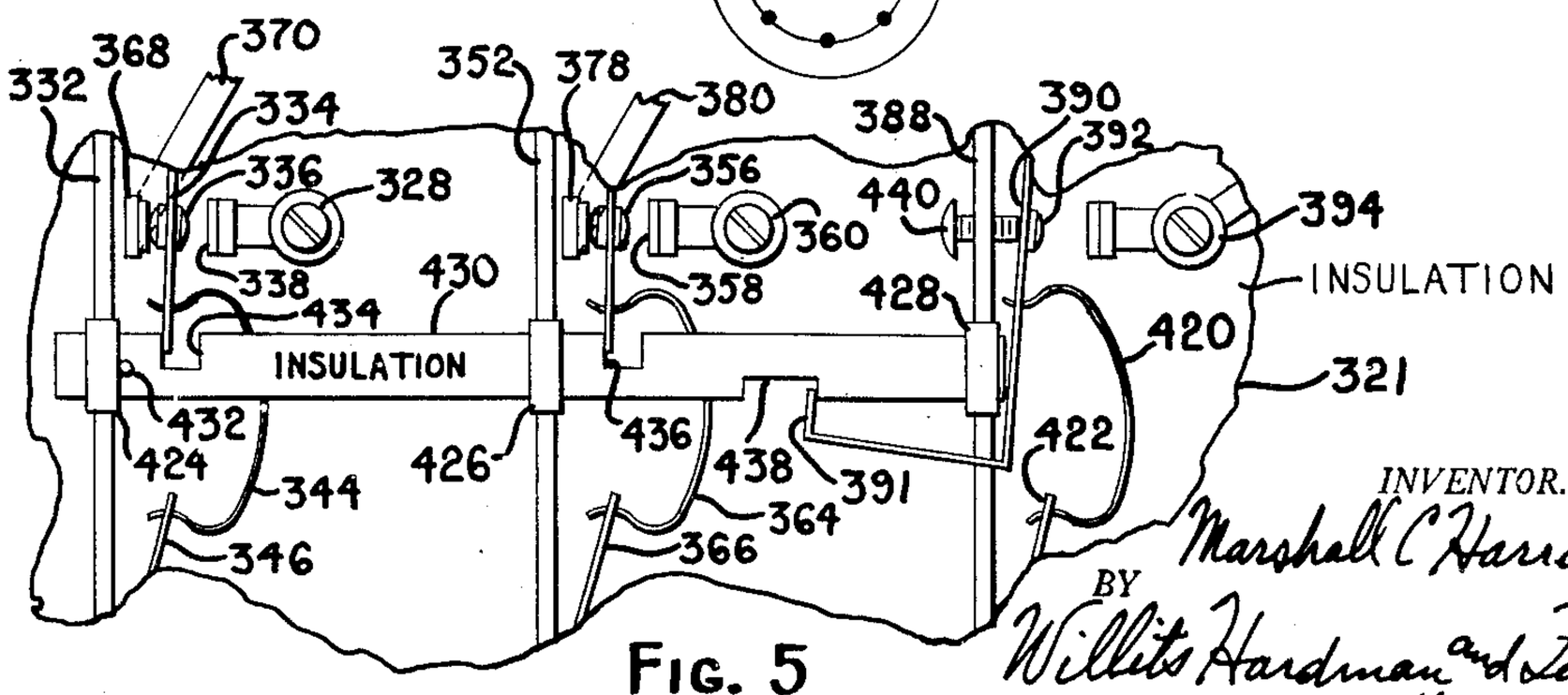

FIG. 5

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ELECTRICAL APPARATUS

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Application June 2, 1951, Serial No. 229,585

8 Claims. (Cl. 200—122)

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This invention relates to electrical apparatus and more particularly to current overload protectors especially intended for large electric motors.

In ordinary current overload protectors, the actuating element used to trip open the protector also is generally used for reclosing. For many applications, such as lighting, heating, and small motor circuits, this is sufficient. However, for larger motors such arrangements are inadequate because a quick tripping protector with a long off or open circuit time is required to cut short the heating of the motor and thereafter cool the large motor to a temperature at which it is safe to reclose the protector to permit a restarting attempt.

It is an object of my invention to provide a simple relatively inexpensive overload protector in which the reset time may be made very long and the tripping time very short.

It is another object of my invention to provide a simple relatively inexpensive overload protector in which the reset time and the tripping time may be selected entirely independent of each other.

It is another object of my invention to provide a simple relatively inexpensive overload protector in which the reset arrangement constitutes a separate independent control which is separate from the tripping control.

Several modifications of the invention are disclosed to illustrate the manner in which these objects are obtained. In one form, there is illustrated a simple current heat actuated snap-acting toggle bimetal overload device which is not self-resetting. It is reset by an electromagnet device connected in shunt with the protector contacts so that it is energized as soon as the protector contacts open. The electromagnet device is provided with a pneumatic time delay for prolonging the resetting time. To do this, the armature operates within a cylinder substantially closed at one end and the armature acts as a piston within the cylinder. The movement of the armature is slowed down because the trapped air must pass through a metered orifice in the armature before the armature can move a sufficient distance to move the protector from the open position to the closed position for resetting.

In a second form, a similar bimetal overload protector device is provided which cannot reset itself. The resetting is only accomplished after two separate bimetal devices each are heated in succession and the second is used to reset the main protector elements. In a third form, a

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similar bimetal overload protector is used which does not reset itself but the reclosing of this protector is prevented until another bimetal arrangement is heated and then when it cools, it resets the protector contacts. A fourth form is provided for three phase motors and if there is an overload in any of the phase conductors, this will cause one or two of the protector elements to trip open. The opening of one protector element will electrically cause the opening of the secondary protector element through the relationship between the phases in a three phase motor. The reclosing of both protectors is controlled by first the heating and then the recooling of an additional electrically heated bimetal element.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view and wiring diagram of a thermally tripped magnetically reset overload protector embodying one form of my invention;

Fig. 2 is a diagrammatic view and wiring diagram of a thermal trip thermal reclosing overload protector embodying a second form of my invention;

Fig. 3 is a diagrammatic view and wiring diagram of a thermal trip single element thermal reset overload protector embodying a third form of my invention;

Fig. 4 is a diagrammatic view and wiring diagram of my invention particularly adapted for three phase motors; and

Fig. 5 is a fragmentary view illustrating the open circuit position of the protector shown in Fig. 4.

Referring now to the drawings and more particularly to Fig. 1, there is shown a motor circuit including supply conductors **20** and **22**. The conductor **20** is connected by a control switch **24** to a conductor **26** connecting with the terminal **28** upon which is mounted a stationary protector contact **30**. The entire protector apparatus may be mounted upon a base **27** of electrical insulating material. The conductor **22** connects directly to one of the terminals of an electric motor **32**. While any size and type motors or any electric appliance may be used for the purpose of illustrating the invention, it is preferred to illustrate the invention by a large electric motor such as one taking 10,000 watts when stalled.

The second terminal of the motor **32** is connected by the conductor **34** to a terminal **36**. The terminal **36** connects to a ribbon type heater **38**, the other end of which is connected along with the cantilever type main operating bimetal **40** to a wide U-shaped frame **42**. The main operating bimetal **40** carries the movable primary contact **44** shown in Fig. 1 as being in engagement with the stationary contact **30**. The free end of the operating bimetal **40** is connected by a C-shaped toggle spring **46** with the free end of a cantilever type compensating bimetal **48** anchored by an electrical insulating mounting to the opposite end of the U-shaped frame **42** from that which the main operating bimetal **40** is anchored.

When there is an excessive current flow through the motor **32**, the flow of current through the ribbon heater **38** as well as the current flow through the main operating bimetal **40** will quickly heat the bimetal **40** to a sufficient temperature that the bimetal **40** will bow away from the stationary contact **30** to open the motor circuit. The compensating bimetal **48** is deflected in accordance with changes in environment temperatures to compensate for the effect of the changes in environment temperatures upon the main operating bimetal **40**. The main operating bimetal **40** has sufficient travel that in the open circuit position it is carried beyond the adjacent end of the compensating bimetal **48** a sufficient distance that the angularity of the toggle spring **46** is sufficiently great that the mere cooling of the main operating bimetal **40** is not sufficient for it to overcome the opposing toggle force applied by the toggle spring **46**.

The resetting of the main operating bimetal **40** is only accomplished by the electromagnet device **50**. This device **50** includes an electromagnet coil **52** having one of its terminals connected by the conductor **54** to the conductor **34** on one side of the protector contacts **30** and **44**, while the second terminal of the coil **52** is connected by the conductor **56** to the conductor **26** on the opposite side of the protector contacts **30** and **44**. Thus, as soon as the contacts **30** and **44** are opened, the electromagnet coil **52** is energized. Because of the low wattage required by the coil **52** no extensive wiring is required, but a simple shunt connection is adequate since the current is so low that it can be carried through the motor circuit without any damage.

The electromagnet coil **52** is provided with an armature **58** slidably mounted within a cylinder **60** having its upper end closed by the yoke of the frame **42**. Operating through a concentrically located aperture in the frame **42** is an operating pin **62**. This operating pin **62** keeps the aperture in the frame **42** substantially closed. The armature **58** fits the cylinder **60** well enough that air is trapped between the top of the armature **58** and the top of the cylinder **60** which is formed by the adjacent portion of the frame **42**.

The armature **58** is provided with a number of air passages **64** which extend through it from top to bottom. All except the central passage are closed by a normally closed check valve **66** provided on top of the armature. The central passage **68** also passes completely through the armature **58** from top to bottom but it also continues through the peg **72** on which the check valve **66** is mounted so that it is never closed by the check valve **66**. The bottom of the cylinder **60** is provided with an adjustable threaded member **70** which is threaded into the bottom

of the cylinder **60** so as to support the lower end of the armature **58** in any selected position when the electromagnet coil **52** is deenergized to adjust the reset time to various selected values. The threaded member **70** is provided with a large aperture to permit the movement of air into and out of the cylinder **60**.

When the electromagnet coil **52** is energized by the opening of the protector contacts **30** and **44**, the armature **58** will be immediately attracted and a lifting force will immediately be present. The rapid lifting of the armature **58** is prevented, however, by the trapping of the air in the top of the cylinder **60**. This air can only escape by leakage around and through the armature **58** as well as the pin **62**. This rate is relatively slow and serves as a dash pot time delay for slowing up the movement of the armature **58**. The central passage **68** and the leakage around the armature **58** and the pin **62** are sufficiently slow that it takes several minutes before the armature **58** reaches its uppermost position. In this uppermost position, the peg **72** upon the top of the armature engages the pin **62** and moves the pin upwardly to engage and move the main operating bimetal **40** from its open position to its closed position when the protector contact **44** is again in engagement with the stationary contact **30**.

With this type of control, the tripping characteristics are governed entirely by the heating of the bimetal **40** and the elements which cooperate with it. The reclosing of the protector contacts and the main operating bimetal **40** is governed entirely by the characteristics of the electromagnet device **50** which can be adjusted to vary the reset time by adjusting the threaded member **70**. The tripping of the protector can be adjusted by bending either of the bimetals or by bending the ribbon heater **38** to provide varying tripping characteristics.

In the form shown in Fig. 2, no electromagnet device is used. The device may be mounted upon a base **127** of electrical insulation indicated diagrammatically by dot and dash lines. The device includes similar protector contacts **130** and **144**. The contact **130** is mounted upon a terminal **128** connected by the conductor **126** and the switch **124** to the supply conductor **120**. The contact **144** is mounted upon the free end portion of the cantilever bimetal **140** which is anchored to the U-shaped frame **142**. Similarly anchored to the frame **142** is a ribbon heater **138** extending parallel to and adjacent the bimetal **140**. The ribbon heater **138** is connected to the terminal **136** which in turn is connected by the conductor **134** to one terminal of the motor **122**, the other terminal of which is connected to the supply conductor **122**. The C-shaped toggle spring **146** extends between the free end of the main operating bimetal **140** and the compensating bimetal **148**. The position and characteristics of the compensating bimetal **148** and the toggle spring **146** are such that the main operating bimetal **140** will trip quickly to the open circuit position when a safe current flow is exceeded. However, these factors are also arranged so that when the main operating bimetal **140** does move to the open position, the bimetal **140** does not have sufficient power to move itself out of that position even though cooled.

To reset the main operating bimetal **140** after a long definite period of time, there is provided a resetting pin **162** which is slidably supported by the frame **142** as well as the frames **160** and

180 which are likewise U-shaped. The frame 160 has mounted thereon a cantilever operating bimetal 152. Its free end is connected by the C-shaped toggle spring 154 to a cantilever type compensating bimetal 156 which is anchored to the lower end of the frame 160. The operating bimetal 152 carries a movable contact 158 adapted to cooperate and make engagement with a stationary contact 163. This contact 163 is connected by a conductor to a ceramic type resistance heater 164 which is also connected to the frame 142. The U-shaped frame 160 is connected by the conductor 166 to the terminal 128.

By virtue of this arrangement, there is set up a shunt circuit across the contacts 130 and 144 which includes the conductor 166, the bimetal 152, the contacts 158 and 163, the heater 164, the frame 142 and the operating bimetal 140. This shunt circuit is deenergized or shunted out whenever the contacts 130 and 144 are closed. However, when the contacts 130 and 144 are open, full voltage is applied to this shunt circuit. This shunt circuit carries only a relatively small amount of current due to the presence of the ceramic heater 164. This heater 164 heats very slowly. In about three minutes of time after a sufficient quantity of electric current has passed through the heater 164 it will heat the operating bimetal 152 sufficiently to cause it to open. The opening of this operating bimetal 152 will cause its back contact 168 to engage the back contact 171.

The back contact 171 is connected by a conductor 172 shown for the purpose of clarity in dotted lines to a contact 174. This contact 174 is normally engaged by a contact 176 provided upon the free end of an operating bimetal 178. This operating bimetal 178 is of the cantilever type and has one end anchored to the U-shaped metal frame 180. The free end of the operating bimetal 178 is connected by the C-shaped toggle spring 182 to the free end of a compensating bimetal 184 anchored to the opposite end of the U-shaped frame 180. This last named operating bimetal 178 is of the self-resetting type. That is, it is capable of moving by the power of its bimetal to its original position after it has tripped to the open position. The operating bimetal 178 is connected electrically by a conductor to the ceramic resistor 186 which in turn is connected by the conductor 188 to the frame 142.

When sufficient current flows through the heater 138 and the operating bimetal 140, the operating bimetal 140 will be heated sufficiently to open the contacts 130 and 144 and move into engagement with the adjacent end of the pin 162. The tripping of the operating bimetal 140 may be done by an overload in from two to four seconds. This energizes the ceramic resistance heater 164 which, after about three minutes, will have supplied sufficient heat to the operating bimetal 152 to cause it to open the contacts 158 and 162 and close the contacts 168 and 171. This will energize the ceramic heater 186 and after about three additional minutes, the ceramic heater 186 will supply sufficient heat to the bimetal 178 that the bimetal 178 will move to the open circuit position against the adjustable stop 190. At the same time the operating bimetal will engage the adjacent end of the pin 162 and cause the collar 192 which is fixed to the pin 162 to move the operating bimetal 152 back to its original position and also cause the head of the pin 162 to move the main operating bimetal 140 to its original closed position thereby accomplishing the resetting of the protector contacts after about six minutes. It will be seen that the tripping and the resetting of this protector are accomplished by separate mechanisms and they may be separately selected and the trip and reset time for each may be selected independently of each other.

In Fig. 3, there is shown a similar tripping and resetting unit which may be mounted on a base 227 of electrical insulation indicated by dot and dash lines. The unit includes a U-shaped frame 242 which, at the one end carries the ribbon heater 238 and the main operating bimetal 240. The other end of the frame 242 carries the cantilever type compensating bimetal 256. The C-shaped toggle spring 246 is connected between the free ends of the bimetals 240 and 256. The main operating bimetal 240 carries the movable contact 244 while the stationary contact 230 with which it makes engagement is mounted upon the terminal 228. This terminal 223 is connected by the conductor 226 to the switch 224 in turn connected to the supply conductor 220. The ribbon heater 238 is connected to the terminal 236 connected by the conductor 234 with the motor 232 connected to supply conductor 222. The main operating bimetal 240 is provided with operating characteristics similar to the operating bimetals 40 and 140 so that it will trip upon an overload in from two to four seconds but it is not capable of resetting itself. Slidably mounted in the frame 242 and the frame 260 is a resetting bar 262. This resetting bar 262 is guided by projections 243 on the frame 242 and the projections 259 on the frame 260. The resetting bar 262 is provided with a shoulder 263 engaged upon the opening movement by the free end of the main operating bimetal 242 to carry it to the right. This movement is limited by the notch 265 provided in the bar 262 which cooperates with the projection 259 for limiting the movement of the bar 262 in either direction.

The terminal 228 is connected by the conductor 266 to the stationary contact 267. This stationary contact 267 is normally contacted by the contact 253 carried upon the movable end portion of a cantilever type operating bimetal 252. One end of the main operating bimetal 252 is anchored to the lower end of the frame 260 while the other end is connected by a C-shaped toggle spring 254 to the cantilever type compensating bimetal 285. The anchored end of the operating bimetal 252 is connected by an electric conductor to the ceramic resistance heater 264 in turn connected to the frame 242.

This arrangement connects the conductor 266 to contacts 267 and 253, the bimetal 252 and the ceramic resistance heater 264 as well as the frame 242 and the bimetal 240 in shunt circuit arrangement across the main protector contacts 230 and 244 so that whenever these circuits are closed the shunt circuit will be deenergized; whereas when opened, the shunt circuit is fully energized. Because of the ceramic high resistance heater 264 in the circuit only a small amount of electric energy flows when the protector contacts 230 and 244 are open. This slowly heats the operating bimetal 252 so that it takes about three minutes for this operating bimetal 252 to move to the open position against the reset stop screw 299 following the tripping of the main operating bimetal 240. Prior to the time that the operating bimetal 252 moves to its open circuit position, its free upper end supports the end of a trigger lever 292 pivoted by a pin 291 to the bar 262 directly beneath the free end of the main oper-

ating bimetal 240. The trigger lever 292 has an arm 293 extending upon the opposite side of the free end of the main operating bimetal 240 from the shoulder 263. There is provided about a thirty-second of an inch gap between the arm 293 and the shoulder 263.

As described previously, when the main operating bimetal 240 trips to the open circuit position it engages the shoulder 263 and carries the reset bar 262 to the left until the shoulder at the one end of the notch 265 engages the projection 259. There ensues a heating period of about three minutes after which the operating bimetal 252 trips to its open circuit position into contact with its resetting stop screw 290. At this time the extreme upper end of the operating bimetal 252 has moved beyond the end of the trigger lever 292 so that this end of the trigger lever 292 then drops down into the position vacated by the free end of the operating bimetal 252.

The operating bimetal 252 and the ceramic resistance heater 264 then slowly cool. After about three minutes, the operating bimetal 252 has acquired sufficient force due to cooling that it is powerful enough to overcome the resistance of the toggle spring 254 as well as the toggle components of the main operating bimetal 240 to move the main operating bimetal 240 to its closed position to complete the resetting operation. As soon as the resistance to the closing movement ceases, the main operating bimetal 240 will engage the arm 293 to lift the trigger lever 292 so that the operating bimetal 252 can move beneath it to the position shown in Fig. 3. The operating bimetal 252 thus moves to its closed position so that the resetting is accomplished after an interval of about six minutes after tripping.

In Fig. 4 there is shown a protector of a similar type for three phase circuits. It may be mounted on a base 321 of electrical insulating material. In this figure, there is shown diagrammatically a three phase motor 320 supplied with electric energy from the supply conductors 322, 324 and 326. The supply conductor 322 connects directly to the motor 320. The supply conductor 324, however, connects with a terminal 328 connecting to one end of a ribbon heater 330. The opposite end of the ribbon heater 330 is connected to the U-shaped frame 332 which also supports the anchored end of an operating bimetal 334. The free end of this operating bimetal 334 carries a dual contact 336 which is normally in engagement with the stationary contact 338 connected to the terminal 340. The terminal 340 is connected by the conductor 342 to the central terminal of the three phase motor 320. The free end of the main operating bimetal 334 is connected by a C-shaped toggle spring 344 through the compensating bimetal 346 anchored to the opposite end of the U-shaped frame 332.

The supply conductor 326 is connected to a terminal 348 connecting to one end of a ribbon type heater 350. The other end of the ribbon type heater 350 is connected to the U-shaped frame 352. This frame also carries a cantilever type main operating bimetal 354 carrying near its free end a dual contact 356 which is normally in engagement with the stationary contact 358 connected to the third terminal of the three phase motor 320. The free end of the operating bimetal 354 is connected by a C-shaped toggle spring 364 with the free end of a cantilever type compensating bimetal 366 anchored to the lower end of the U-shaped frame 352.

Both of these overload protecting devices are the type which rapidly trip to the open circuit

position upon an overload within two to four seconds. Their toggle arrangement is such that they will not reset themselves. If there is an overload in one of the conductors, for example, either the conductor 342 or 362, its protector will quickly trip to the open circuit position in from two to four seconds. This will then effectively provide the motor 320 with a current supply which is the equivalent of only a single phase supply which will throw an additional load upon the supply conductors 322 and 362 which will rapidly cause the operating bimetal 354 to move to its open circuit position.

When the operating bimetal 334, because of an overload in the conductor 342, trips to the open circuit position, the contact 336 will engage the back contact 368. This back contact 368 is connected by a conductor strip 370 to a terminal 372 connected by the conductor 374 with a terminal 376. When an overload in the conductor 362 causes the operating bimetal 354 to trip to the open circuit position, the dual contact 356 will engage the back contact 378 connected by a conductor strip 380 with a terminal 382. This terminal 382 is connected by the conductor 384 with a terminal 386. The terminal 386 is connected by a conductor strip with the frame 388 of the reset operating mechanism. The upper end of this U-shaped frame 388 carries the anchored end of a cantilever operating bimetal 390 carrying the movable contact 392. This contact 392 is adapted to be normally in engagement with a contact provided upon the adjacent end of the terminal 394. This terminal 394 is connected to another terminal 396. Connected between the terminals 376 and 396 is a ceramic electric high resistance heater 398 located adjacent the reset operating bimetal 390 in heat transfer relationship therewith. The reset operating bimetal 390 is connected by a C-shaped toggle spring 420 with the free end of a cantilever type compensating bimetal 422, anchored by an insulating mounting to the lower end of the frame 388.

Each of the frames 332, 352 and 388 are provided with similar bearing members 424, 426 and 428 which slidably support the reset operating bar 430 made of a suitable electrical insulation material. This bar 430 is provided with a stop pin 432 for limiting its movement to the left. It is also provided with a notch 434 which receives the free end of the main operating bimetal 334. The reset bar 430 has a single notch 436 for receiving the free end of the main operating bimetal 354. The opposite side of the bar 430 also has an additional notch 438.

When both of the operating bimetals 334 and 354 trip to the open circuit position, the bar 430 will be moved to the left with a stop pin 432 against the bearing member 424 as shown in Fig. 5. At the same time, the contact 336 will engage the contact 338 and the contact 356 will engage the contact 378. This will close the circuit which includes the conductor 324, the ribbon heater 330, the bimetal 334, the contacts 336 and 368, the conductor strip 370, the conductor 374, the ceramic heater 398, the contact 392, the bimetal 390, the conductor 384, the conductor strip 380, the contact 378, the bimetal 354, the ribbon heater 350 and the conductor 326. The circuit will energize the ceramic heater 398 while the motor 320 will be deenergized. After a period of time, such as three minutes, for example, the ceramic heater 398 and the reset operating bimetal 390 will be heated sufficiently to move the contact 392 away from the contact on the terminal 394. This will

cause the bimetal **390** to move with a snap action into contact with the adjustable stop screw **440**. It will also cause the bimetal **390** to move substantially into engagement with the adjacent end of the reset bar **430**.

The extreme end portion of the reset bimetal **490** is provided with a hook-shaped extension **391** which is a sufficient distance in the direction perpendicular to the blade **490** and has a sufficient hook at its end to engage the notch **438** in the bar **430** as shown in Fig. 5 when it is at its tripping temperature. There now ensues a cooling period during which the bimetal **390** and the ceramic heater **398** slowly cool. This takes a constant period of time such as three minutes before the bimetal **390** acquires sufficient power to overcome the toggle spring **420** and the toggle force connected with the bimetals **334** and **356** to move the bar **36** to the right to the original position shown in Fig. 4 to reset the bimetals **334** and **354**. At the same time, the bimetal **390** will have sufficient power to overcome its own toggle spring **420** and return to its closed circuit position shown in Fig. 4. The bimetal **390** and its heater **398** and its toggle arrangement is sufficient as to provide slow tripping and slow return while the bimetals **334** and **354** and the toggle mechanisms are of such characteristics as to provide quick tripping without being capable of resetting themselves. This arrangement provides excellent protectors for three phase motors which are usually made in very large sizes and therefore require a protector with a very quick trip and a very long resetting time.

It should be noted that all forms are compensated for variations in the environment temperature. In each of the forms, the current required for the resetting device is so low that it can be carried through the motor circuit without any damage thereby making possible the use of a simple shunt connection and therefore no extensive wiring is required.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position, said switch means including current responsive means responsive to an overload in said circuit for causing movement from the closed to the open position upon a quantitative current flow, and a current operated timing means normally disconnected from said switch means and said current responsive means and connected only for moving said switch means from the open position to the closed position, said timing means having a timing arrangement energized in response to the opening of said switch means for timing the movement of said switch means from the open to the closed position entirely independently of the tripping time.

2. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position, said switch means including current responsive means responsive to an overload in said circuit for causing movement from the closed to the open position upon a quantitative current flow, a snap acting bimetal means normally disconnected from said switch means and said current responsive means, means for heating said bimetal means in response to the opening of said switch means, and means operated by said bimetal means for moving said switch means from the open position to the closed position.

3. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position, said switch means including current responsive means responsive to an overload in said circuit for causing movement from the closed to the open position upon a quantitative current flow, a snap acting thermally operable switch means normally disconnected from said toggle switch means and said current responsive means, an electric heating circuit portion arranged in heat transfer relationship to said thermally operable switch means and connected in shunt circuit relationship to said toggle switch means for opening said thermally operable switch means in response to the opening of said toggle switch means, and means controlled by said thermally operable switch means for closing said toggle switch means.

4. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position, said switch means including current responsive means responsive to an overload in said circuit for causing movement from the closed to the open position upon a quantitative current flow, a snap acting thermally operable switch means normally disconnected from said toggle switch means and said current responsive means, an electric heating circuit portion arranged in heat transfer relationship to said thermally operable switch means and connected in shunt circuit relationship to said toggle switch means for opening said thermally operable switch means in response to the opening of said toggle switch means, a second snap acting thermally operable switch means having means effective upon its opening movement for reclosing said toggle switch means, and a second electric heating circuit portion arranged in heat transfer relationship to said second thermally operable switch means and connected in shunt circuit arrangement to said first mentioned thermally operable switch means for opening said second thermally operable switch means.

5. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting switch means having current responsive means responsive to an overload in said circuit for causing its movement from the closed position to the open position upon a quantitative current flow, means normally disconnected from said switch means and said current responsive means, for

delaying the reclosing of said switch means including a thermally operable means and an electrically energized heating means, means for energizing said heating means when said switch means moves to the open position, means for deenergizing said heating means when said thermally operable means is heated, and means operated in response to the cooling of said thermally operable means for assisting in the reclosing of said switch means.

6. A self-resetting current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a current responsive tripping mechanism responsive to an overload in said circuit for opening the protector upon a quantitative current flow and a separate independent timing resetting mechanism operable in response to the tripping of said tripping mechanism for resetting said protector after a measured period of time.

7. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position constituting the sole restraining means in the operation of the switch means, said switch means including current responsive operating means responsive to an overload in said electric circuit for causing movement without restraint except for the toggle means from the closed to the open position upon a quantitative current flow, and a timing resetting means normally disconnected from said toggle switch means and said operating means, said timing resetting means including an electrically powered resetting means connected in electrical shunt circuit arrangement with said switch means and having means effective only when the switch means is in the open position for engaging and moving said toggle switch means from the open position to the closed position.

8. A current overload protector for an electric circuit having an independent quick tripping mechanism and an independent slow resetting mechanism timed entirely independent of the tripping mechanism including a snap acting toggle switch means having a toggle means for biasing it into either the open or closed position constituting the sole restraining means in the operation of the switch means, said switch means including current responsive operating means responsive to an overload in said electric circuit for causing movement without restraint except for the toggle means from the closed to the open position upon a quantitative current flow, and a timing resetting means normally disconnected from said toggle switch means and said operating means, said resetting means including a snap acting bimetal means and a resetting actuator engageable with said switch means only when said switch means is in the open position, said resetting means also including an electric heating circuit for said bimetal means connected in shunt circuit arrangement with said switch means.

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