May 16, 1967 J. H. MULLEN ETAL 3,320,392

ELECTRIC CONTROL DEVICE WITH IMPROVED CONTACT STRUCTURE

Filed Oct. 15, 1965

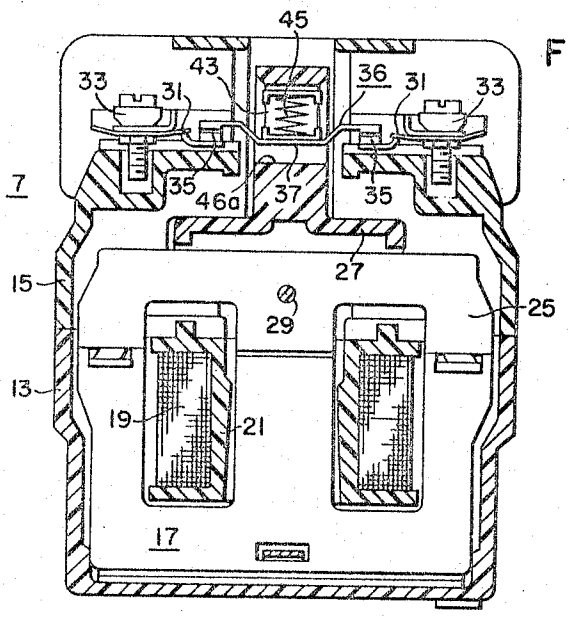

FIG. 1.

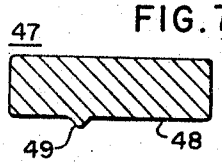

FIG. 7.

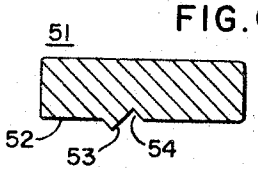

FIG. 6.

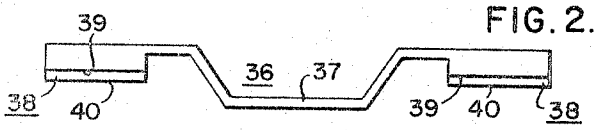

FIG. 2.

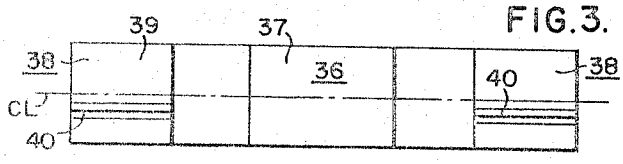

FIG. 3.

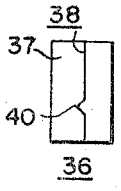

FIG. 4.

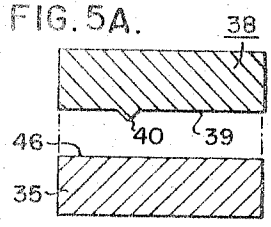

FIG. 5A.

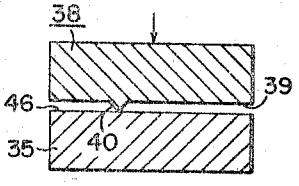

FIG. 5B.

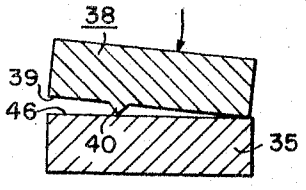

FIG. 5C.

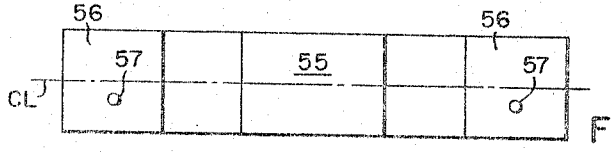

FIG. 8.

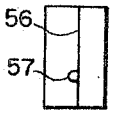

FIG. 9.

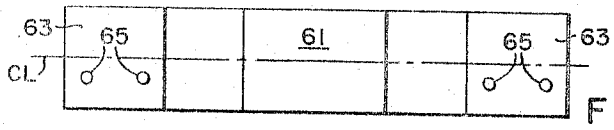

FIG. 10.

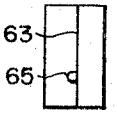

FIG. 11.

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ELECTRIC CONTROL DEVICE WITH IMPROVED CONTACT STRUCTURE

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10 Claims. (Cl. 200—166)

This invention relates generally to electric control devices with improved contact structures and more particularly to electric control devices with improved spring biased bridging contact structures.

At installations of electric control devices dust or other undesirable matter may collect on the contact surfaces of the control devices. During operation of the control devices resistance films such as oxides or other surface coatings may build up on the contact surfaces. An object of this invention is to provide an electric control device with an improved contact structure constructed in such a manner as to penetrate films that may form on the contact surfaces and to provide a self-cleaning wiping action of the contacts during operation of the control devices.

Another object of this invention is to provide an improved control device comprising a bridging contact structure that is moved with a general rectilinear motion into and out of engagement with a pair of stationary contact members, which bridging contact structure is provided with contact surfaces and spring biasing means constructed and arranged to provide a wiping and film-penetrating action during operation of the control device.

A more general object of this invention is to provide an electric control device having an improved contact structure.

The novel features that are considered of the characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages, will be best understood from the following description when read in conjunction with the accompanying drawings.

In said drawings:

FIGURE 1 is a sectional view of a control device constructed in accordance with principles of this invention;

FIG. 2 is a side elevational view, on an enlarged scale relative to FIG. 1, of the bridging contact member disclosed in FIG. 1;

FIG. 3 is a bottom plan view of the bridging contact member seen in FIG. 2;

FIG. 4 is an end view of the bridging contact member seen in FIG. 3;

FIGS. 5A, 5B, and 5C are sectional views, on an enlarged scale relative to FIG. 1 of a pair of the moving and stationary contacts seen in FIG. 1, illustrating the relative positions of these contacts during operation of the control device;

FIG. 6 is a sectional view of a movable contact structure illustrating a different embodiment of the invention;

FIG. 7 is a view similar to FIG. 6 illustrating another embodiment of the invention:

FIG. 8 is a bottom plan view similar to FIG. 3 illustrating another embodiment of the invention;

FIG. 9 is an end view of the bridging contact member seen in FIG. 8;

FIG. 10 is a bottom plan view similar to FIG. 3 illustrating a further embodiment of the invention; and

FIG. 11 is an end view of the bridging contact member of FIG. 10.

Referring to the drawings, and particularly to FIG. 1, there is shown therein a control device 7, which in this case is a relay, constructed in accordance with the principles of this invention. The relay 7 is of the type that is described in more detail in the patent to Gustov Jakel, Patent No. 3,088,058, issued Apr. 30, 1963.

The relay 7 comprises a housing comprising a base 13 and a cover 15, both of molded insulating material. The housing parts 13 and 15 are firmly held together as a unit by means of suitable bolts (not shown). An E-shaped main magnet or core member 17 is supported with its legs extending upwardly in the housing base 13. An energizing conducting winding, or coil 19, that is disposed on a suitable spool 21 of insulating material, is positioned over the middle leg of the core member 17. An E-shaped armature 25 is provided to cooperate with the core member 17. The armature 25 is connected to an insulating contact carrier 27 by means of a pin 29 that pivotally mounts the armature 25 on the contact carrier 27 for limited rotating movement in the plane of the paper as seen in FIG. 1.

The relay 7 is a multi-pole relay with only one pole unit being disclosed in FIG. 1. Each pole unit comprises two stationary contact structures 31, each of which has a solderless terminal connector 33 connected thereto at its outer end and a stationary contact 35 secured thereto at its inner end. In each pole unit, a bridging contact member 36 is provided to bridge the stationary contacts 35. The bridging contact member 36 comprises an elongated conducting bridging member 37 having opposite contact surfaces 38 (FIGS. 2–4) thereon for cooperating with the stationary contacts 35. Each of the contact surfaces 38 comprises a generally planar surface 39 and an elongated pointed or sharp ridge 40 extending in the direction of elongation of the contact member 37 on the lower side (as seen in FIG. 3) of the center line CL that would run through the member 37 in the direction of elongation of the member 37. The bridging contact member 37 is supported on the contact carrier 27 in an opening 43, and the bridging contact member is maintained in position by means of a spring 45. The spring 45 not only positions the bridging contact member 37, but it also acts to permit a motion of the bridging contact member 37 upon contact engagement to thereby provide that the contacts will mate properly when they are closed. The contacts 35, 38 are normally open contacts although they are shown in FIG. 1 in the closed position. It is to be understood that the contacts can be made normally open or normally closed, in a manner well known in the art, depending upon the particular control requirements. Suitable springs (not shown) are provided to bias the contact carrier 27 upward and away from the closed position seen in FIG. 1 to thereby provide for an opening operation of the relay 7. The relay is a multi-pole relay and each pole unit comprises a contact structure similar to that disclosed in FIG. 1 with the plurality of bridging contact members all being mounted on the one common contact carrier 27 for simultaneous operation.

The relay or contactor 7 is shown in the energized position in FIG. 1 in which position the coil 19 is energized by a suitable power source to attract the armature 25 to the position wherein the two outer legs of the armature 25 engage the two outer legs of the core member 17. When the contact carrier 27 is in the lower position shown in FIG. 1 the bridging contact structure 36 closes a circuit between the associated stationary contacts 35. Upon deenergization of the coil 19, spring means (not shown) will operate to move the armature 25 and contact carrier 27 upward to move the bridging contact structure 36 (and the other bridging contact structures of the multipole relay) upward to the open-circuit position. As was previously set forth, the stationary contact members 31, 35 and bridging contact structures 36 can be readily adapted to provide for a normally closed contacts rather

than normally open contacts in a manner well known in the art.

The operating movement of the bridging contact structure **36** is a generally rectilinear movement normal to the plane of the generally planar contact surface part **39** and generally normal to the planes of the generally planar contact surfaces **46** of the contacts **35**. The movement of the bridging contact structure **36** is illustrated in three positions in FIGS. 5A, 5B and 5C. As the movable contact structure moves from the open (FIG. 5A) position toward the fully closed (FIG. 5C) position the pointed ridges **40** of the contact structure **36** first engage the contact generally planar contact surfaces **46** of the spaced stationary contacts **35**. This initial engagement is illustrated in FIG. 5B. Since the ridges **40** are pointed ridges the ridges can cut through undesirable film or surface material on the generally planar surfaces **46** of the stationary contact members **35**. With the two ridges **40** (FIG. 3) elongated in the direction of elongation of the bridging contact structure **36** on the same side of the center line CL of the bridging contact structure **36** the bridging contact structure **36** is free to rock or pivot from the position illustrated in FIG. 5B to the fully closed position illustrated in FIG. 5C. This pivotal movement provides a wiping or abrasive action between the ridge **40** and the surface **46** of the stationary contact member **35** which wiping action tends to keep the contact surfaces between the ridge **40** and surface **46** clean for effective conduction. As can be understood with reference to FIG. 5C in the closed position there are two line-type contacts between the members **38** and **35** with one of the line contacts being the contact between the ridge **40** and surface **46** and the other of the line contacts being the contact between the one end part of the surface **39** and the contact surface **46**. After the contacts **38, 35** reach the position seen in FIG. 5C additional movement of the bridging contact carrier **27** (FIG. 1) will serve to additionally charge the spring **45** to provide spring biased contact pressure in the closed position of the contacts. During opening operations of the relay **7** the spring **45** will first discharge until the bridging contact structure **48** engages a ledge **46***a* on the contact carrier **27**, and thereafter the movable contact **36** will be moved upward to move the movable contacts **35** from the position illustrated in FIG. 5C to the position illustrated in FIG. 5B and thereafter to the open position illustrated in FIG. 5A. The relay **7** will then be prepared for another contact closing operation in the same manner hereinbefore described.

There is shown in FIG. 7 a contact structure **47** comprising a contact surface **48** that is generally planar and that is formed with a rounded ridge **49** to illustrate that the ridge **49** need not necessarily be a pointed or sharp ridge as is the case in the preferred embodiment. The contact structure **47** is constructed otherwise in the same manner as the contact structure **36**. The contact structure **47** seen in FIG. 7 will function in the same general manner as the contact structure **36** during operation of the relay **7**. The ridge **49** will resist breakage better than the ridge **40** although the ridge **49** will not be as effective as the ridge **40** in cutting through films on the contact surfaces.

A contact structure **51** having a contact surface **52** and a ridge **53** thereon is disclosed in FIG. 6. This contact is disclosed in order to illustrate the type of contact surface that can be produced by forming the contact with the use of a chisel to gouge a notch **54** in a generally planar contact surface **52** to thereby force material up to form a sharp or pointed edged ridge **53**. The bridging contact structure **51** will operate in the same manner as was hereinbefore described with reference to the preferred embodiment of this invention.

Referring to FIGS. 8 and 9, there is shown therein a bridging contact structure **55** similar to the contact structure **36**. The bridging contact structure **55** comprises oppositely disposed generally planar contact surfaces **56** each of which contact surfaces **56** is provided with a projection or nib **57** for cutting through film on the contact surface of the associated stationary structure. With both of the nibs **57** being disposed on the lower side of the center line CL of the elongated contact structure **55** the bridging contact structure **55** will pivot in the same manner disclosed in FIGS. 5B–5C to provide a wiping self-cleaning action during operation of the relay. The engagement in the closed position between the bridging contact structure **55** and the associated stationary contacts will comprise point-type contacts between the nibs **57** and the surfaces of the stationary contacts and also line-type contacts between the end parts of the contact surfaces **56** and the surfaces of the stationary contacts in the same general manner as that illustrated in FIG. 5C and hereinbefore described with reference to the contact structure **36**.

A bridging contact structure **61** similar to the bridging contact structure **55** is disclosed in FIGS. 10 and 11. The bridging contact structure **61** comprises opposite generally planar contact surfaces **63**. Two nibs **65** are provided on each of the contact surfaces **63** on the lower side of the center line CL of the contact member **61** to cut through the film on the stationary contact surfaces during closing operations of the bridging contact structure **61**. The engagement in the closed position between the bridging contact structure **61** and the associated stationary contacts will comprise point-type contacts between the nibs **65** and the surfaces of the associated stationary contacts and also line-type contacts between the end parts of the contact surfaces **63** and the surfaces of the stationary contacts in the same general manner as that illustrated in FIG. 5C and hereinbefore described with reference to the contact structure **36**.

Except as otherwise described the contact structures **47, 51, 55** and **61** will operate in the relay **7** in the same manner as was hereinbefore described with reference to FIGS. 1–4.

From the foregoing, it can be understood that there is provided by this invention an improved electric control device comprising an improved contact structure that is constructed in such a manner as to penetrate films that may form on the contact surfaces and to provide a self-cleaning wiping action during operation of the control device.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given as reasonably broad an interpretation as is permitted in view of the prior art.

We claim as our invention:

1. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, said stationary contacts comprising a pair of spaced first contact surfaces, a contact carrier mounted for generally rectilinear movement relative to said support means, an elongated bridging contact member supported on said contact carrier, said bridging contact member comprising an elongated conducting member having a pair of second contact surfaces each of which second contact surfaces is disposed at a different one of the opposite ends of said conducting member, one of said pairs of first and second contact surfaces comprising a pair of main contact surfaces and a ridge projection extending from each of said main contact surfaces, each of said ridge projections being elongated in the direction of elongation of said conducting member, said contact carrier being movable rectilinearly to move said bridging contact member toward said stationary contacts to a closed position in engagement with said stationary con-

tacts and away from said stationary contacts to an open position spaced from said stationary contacts, one of said pairs of first and second contact surfaces being movable relative to the support thereof, during closing operations of said control device said projections first engaging said first contact surfaces and thereafter the one of said pairs of said first and second contact surfaces that is movable relative to the support thereof moving to the fully closed position wiping said projections against said first contact surfaces, in said fully closed position said projections engaging said first contact surfaces and a part of each of said main contact surfaces engaging the associated first contact surface.

2. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, a contact carrier mounted for movement relative to said support means, an elongated bridging contact member supported on said contact carrier, said bridging contact member comprising an elongated conducting member and a contact surface at each of the two opposite ends of said conducting member, each of said contact surfaces comprising a main contact surface and a projection extending from the main contact surface, said projections being disposed on the same side of a center line that extends through said bridging contact member in the direction of elongation of said bridging contact member, means for moving said contact carrier to move said bridging contact member to a closed position in engagement with said stationary contacts and to an open position spaced from said stationary contacts, during closing operations of said control device said projections first engaging said stationary contacts and thereafter said bridging contact member moving to a fully closed position wherein a part of each of said main contact surfaces engages the associated stationary contact during which movement to the fully closed position said projections wipe against said stationary contacts.

3. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, a contact carrier mounted for generally rectilinearly movement relative to said support means, an elongated bridging contact member mounted on said contact carrier for resilient movement on said contact carrier, said bridging contact member comprising an elongated member having a contact surface at each of the two opposite ends thereof, each of said contact surfaces comprising a main contact surface and a ridge projecting from the main contact surface, each of said ridge projections being elongated in the direction of elongation of said conducting member, said contact carrier being rectilinearly movable to move said bridging contact member to a closed position in engagement with said stationary contacts and to an open position spaced from said stationary contacts, during closing operations of said control device said ridge projections first engaging said stationary contact and thereafter said bridging contact member moving to the fully closed position wherein said ridge projections engage said stationary contacts and wherein another part of each of said contact surfaces engages the associated stationary contact, during said movement to the fully closed position said ridge projections wiping against said stationary contacts.

4. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, said stationary contacts comprising a pair of first contact surfaces, a contact carrier mounted for generally rectilinear movement relative to said support means, an elongated bridging contact member mounted on said contact carrier for resilient movement relative to said contact carrier, said bridging contact member comprising an elongated conducting member having a second contact surface at each of the opposite ends thereof, each of said second contact surfaces comprising a main contact surface and a ridge projecting from the main contact surface, each of said ridges comprising an elongated ridge elongated in the direction of elongation of said conducting member, said contact carrier being movable rectilinearly to move said bridging contact member to a closed position in engagement with said stationary contacts and to an open position spaced from said stationary contacts, during closing operations of said control device said ridge projections first engaging said first contact surfaces and thereafter said bridging contact member moving relative to said contact carrier to a fully closed position, during said movement of said bridging contact member relative to said contact carrier each of said ridge projections wiping against the associated first contact surface.

5. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, a contact carrier mounted for generally rectilinear movement relative to said support means, an elongated bridging contact member mounted for resilient movement on said contact carrier, said bridging contact member comprising an elongated conducting member having a contact surface at each of the two opposite ends thereof, each of said contact surfaces comprising a generally planar main contact surface and a projection projecting from the main contact surface, said projections being disposed on the same side of a center line thta extends through said elongated conducting member in the direction of elongation of said conducting member, said contact carrier being movable generally rectilinearly to move said bridging contact member into closed and open positions relative to said stationary contacts, during closing operations of said control device said projections first engaging said stationary contacts and thereafter said bridging contact member rocking to the fully closed position wherein said projections and another part of each of said main contacts engage said stationary contacts, and during said rocking movement of said bridging contact member to the fully closed position said projections wiping against said stationary contacts.

6. A control device constructed in accordance with claim 5 wherein each of said projections comprises an elongated ridge elongated in the direction of said center line.

7. A control device constructed in accordance with claim 5 wherein each of said projections comprises an elongated ridge elongated in the direction of said center line and generally parallel to said center line which ridges are in alignment.

8. A control device comprising support means, a pair of stationary contacts mounted on said support means in a spaced relationship, a contact carrier mounted for movement relative to said support means, an elongated bridging contact member supported on said contact carrier, a pair of movable contacts on said bridging contact member in a spaced relationship, each contact of a first pair of said pairs of contacts comprising a main surface and a projection extending from the main surface, means for moving said contact carrier to move said bridging contact member generally rectilinearly toward said stationary contacts to a closed position and away from said stationary contacts to an open position, resilient means backing said bridging contact member on said contact carrier such that during closing operations when said movable contacts engage said stationary contacts said contact carrier can move a further distance in the closing direction to a fully closed position during which further movement of said contact carrier said resilient means is charged to provide contact pressure between said movable contacts and said stationary contacts, and said pairs of contacts and the supports thereof being constructed and arranged such that during closing operations said projections of said first pair of said pairs of contacts will first engage the second of said pairs of contacts and as said contact carrier moves to the fully closed position charging said re-

silient means said bridging contact member will rock until another part of said first pair of contacts engages said said second pair of contacts to thereby provide a wiping action of said projections against said second pair of contacts.

9. A control device according to claim **8** wherein the contacts of said first pair of contacts are said movable contacts and wherein the contacts of said second pair of contacts are said stationary contacts.

10. A control device according to claim **9** wherein said projections are elongated ridges on said movable contacts elongated in the direction of elongation of said bridging contact member.

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