March 18, 1969 A. HUFNAGEL 3,433,917

FAIL-SAFE VITAL RELAY CONTACT ARRANGEMENT

Filed Oct. 25, 1967 Sheet 1 of 2

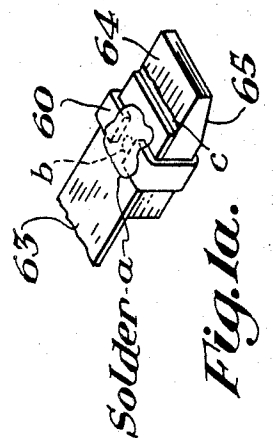


Fig.1a.

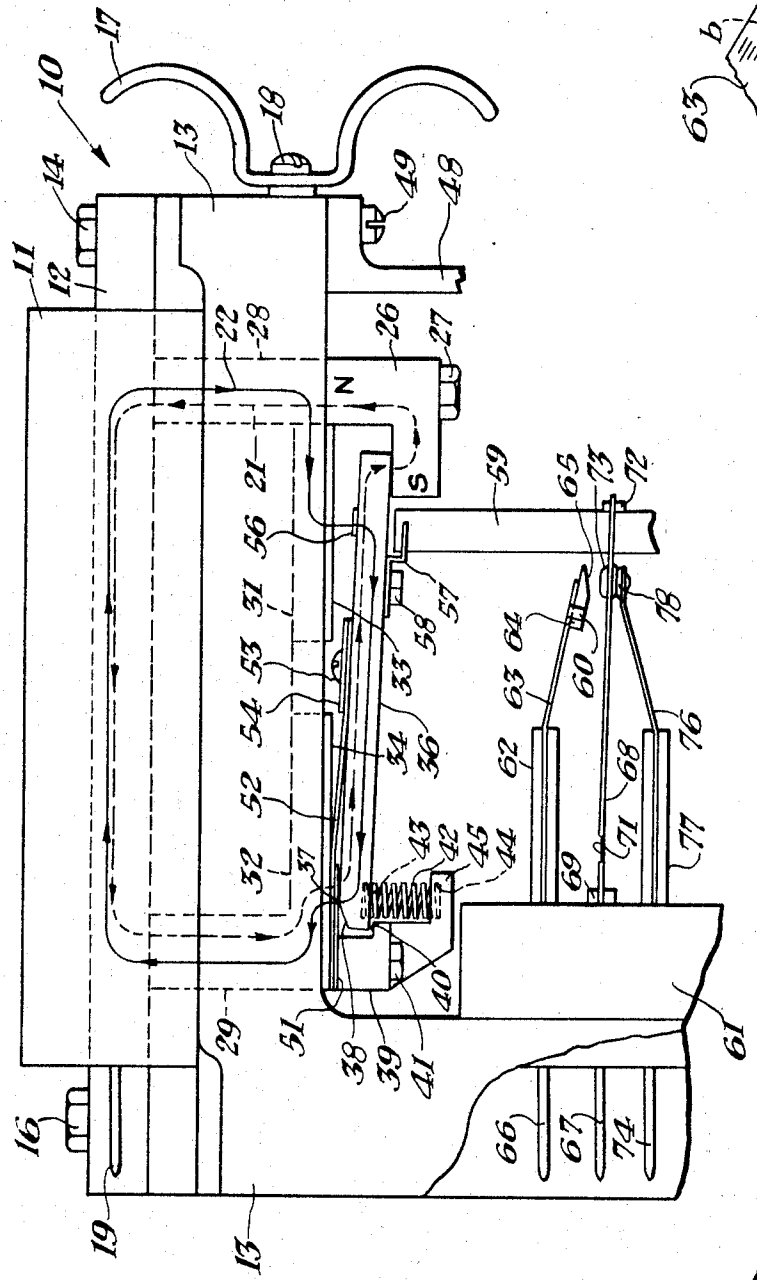


Fig. 1.

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Filed Oct. 25, 1967 Sheet 2 of 2

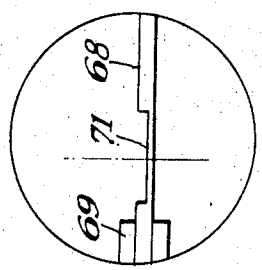


Fig. 4a.

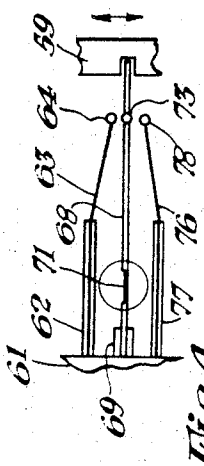


Fig. 4.

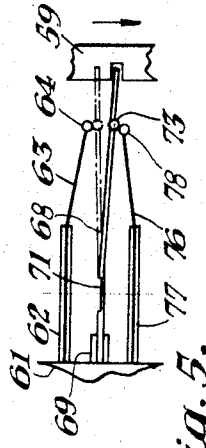


Fig. 5.

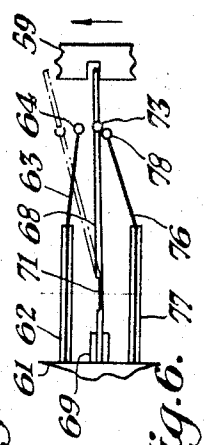


Fig. 6.

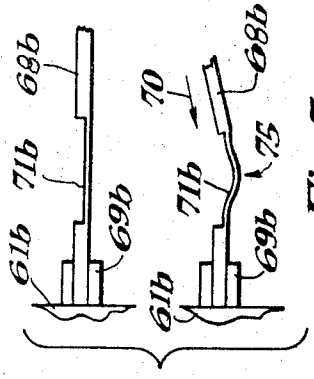


Fig. 7.

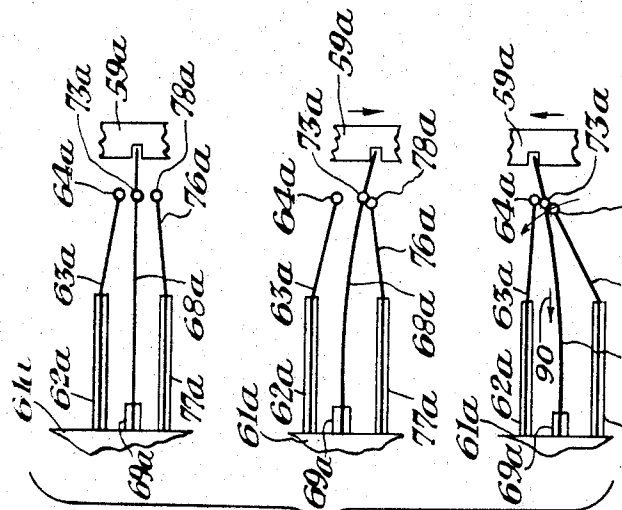


Fig. 2.

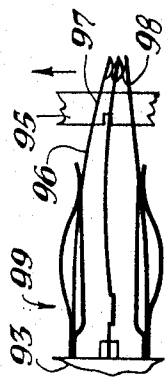


Fig. 3.

Prior Art.

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United States Patent Office 3,433,917
Patented Mar. 18, 1969

3,433,917

FAIL-SAFE VITAL RELAY CONTACT ARRANGEMENT

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Filed Oct. 25, 1967, Ser. No. 677,928
U.S. Cl. 200—166 6 Claims
Int. Cl. H01h 3/00

ABSTRACT OF THE DISCLOSURE

This invention relates to a fail-safe vital relay contact arrangement. The construction of the front, heel, and back contact members is such that should the back and heel contacts become welded together during operation of the relay, they will never be able to make additional contact with the front contact member because the heel contact member is constructed to include a notched region which only allows pivotal flexure coupled with column rigidity of the remaining portion of the heel contact member to prevent the physical excursion of the welded contacts sufficient to make electrical contact with the front contact.

This invention relates to an improved vital relay contact arrangement.

More specifically this invention relates to a fail-safe vital relay contact arrangement which includes a front contact member, a heel contact member, a back contact member and a heel contact member driver. Fail-safe cooperation is provided between the heel contact of the heel contact member, the front contact of the front contact member and a back contact of the back contact member if the heel contact and the back contact become welded to each other during operation of the relay. This is accomplished by providing the heel contact member with a structure that has uniform thickness throughout its length with the exception of a reduced thickness region near the end of the heel contact member where the heel contact is secured at the relay frame. The reduced thickness portion has a length dimension such that there can only be a pivotal flexure in the region of the reduced thickness region due to the combined column regidity present in the uniform thickness portion and the absence of column buckling in the reduced thickness portion. In the event that the heel contact and the back contact should weld together, the heel contact member and the related welded contacts are restrained in the total distance they may travel toward the front contact due to the heel contact member's column rigidity and the pivotal flexure present in the reduced thickness region.

In a vital relay should a back contact and a heel contact weld together, they must never be so constructed as to allow the welded pair of contacts to make an electrical connection with a front contact while in this welded condition. To this end many efforts have been expended in the prior art and while success has been achieved it has almost always been accomplished by mechanical arrangements in contact structures that required the utmost precision in manufacture and adjustment during assembly. Escalating costs plague the industries that manufacture such relays. In order to reduce such costs significantly the invention to be described provides a solution with advantages that elevate this contribution into the realm of invention.

It is therefore an object of this invention to provide a fail-safe relay contact structure that guarantees that, should the heel and back contacts become welded, the welded contacts will never make electrical connection with the front contact, all of this to be accomplished by the utilization of a heel contact member configuration which cofunctions with both front and back contact members as well as an armature driven heel contact driver element to thereby establish the protection required.

It is another object of this invention to provide an improved front contact structure that further enhances the fail-safe qualities of the improved contact arrangement.

In the attainment of the foregoing objects the improved vital relay contact arrangement includes a front contact member, a heel contact member, a back contact member and a heel contact member driver of insulating material. The vital relay contact arrangement provides a fail-safe cooperation between a heel contact of the heel contact member, a front contact of the front contact member and a back contact of the back contact member, whenever the heel contact and the back contact become welded to each other during operation of the relay.

The front contact member has a first rigid portion secured at one end to an insulating block and a second resilient portion secured at one end thereof to the first rigid portion and at the other end thereof is a front contact tip. The back contact member has a first rigid portion which is secured at one end to the insulating block and a second resilient portion secured at one end thereof to the first rigid portion and at the other end thereof is a back contact tip.

The heel contact member is disposed intermediate the front and back contact members and is secured to the same insulating block. The second resilient portions of both the front and the back contact members are permanently biased toward each other, whereby the alternate electrical connection between the heel contact and the front and back contacts produces a wiping action between contacts due to the biased condition and the resilient nature of the resilient portions of the front and back contact members.

The heel contact member has a uniform thickness throughout its length with the exception of a reduced thickness region near the end of the heel contact member where the heel contact member is secured to the insulating block. The reduced thickness portion has a length dimension such that there can only be a pivotal flexure in the region of the reduced thickness due to the combined column rigidity present in the uniform thickness portion and the absence of column buckling in the reduced thickness portion.

A heel contact is secured to the heel contact member and the contact driver is drivingly connected to the other end of the heel contact member so that when the drive member is moved during relay operation, the heel contact alternately contacts the back and then the front contact. In the event that the heel contact and the back contact should weld together, the heel contact member is restrained in the total distance it may travel toward the front contact due to the heel contact member's column rigidity and the presence of pivotal flexure in the region of reduced thickness.

It is also significant to note that the heel contact is secured to the heel contact member's portion of uniform thickness at a point intermediate the other end where the heel contact is drivingly connected to the heel contact driver, and the reduced thickness region.

An additional feature of the contact arrangement is a unique front contact which is a silver impregnated, silver plated carbon element which has a portion thereof which has been exposed by machining to present as a contact surface only the silver impregnated carbon. This front contact element is mechanically and metallurgically interconnected to the resilient portion of the front contact

member to thereby provide an integral mechanical and electrical contact arrangement.

Other objects and advantages of the present invention will become apparent from the ensuing description of illustrative embodiments thereof, in the course of which reference is had to the accompanying drawings in which:

FIG. 1 depicts a D.C. vital relay which embodies the invention.

FIG. 1*a* illustrates in detail a front contact embodying certain aspects of the invention.

FIG. 2 is a series of schematic illustrations of a basic mechanical problem which the invention overcomes.

FIG. 3 sets forth a prior art contact arrangement.

FIG. 4 schematically illustrates a contact arrangement embodying the invention and FIG. 4*a* is an enlarged view of a portion of a heel contact member.

FIG. 5 schematically illustrates the mode of operation of a contact arrangement embodying the invention.

FIG. 6 shows a contact ararngement embodying the invention where a heel contact and a back contact have become welded during operation.

FIG. 7 depicts in exaggerated fashion a structural consideration involved in the application of the invention.

A description of the above embodiment will follow and then the novel features of the invention will be presented in the appended claims.

Reference is now made to FIG. 1 in which there is illustrated a portion of a D.C. neutral relay embodying the invention. Basically, this relay functions in a similar manner to the relay shown and described in great detail in Letters Patent of the United States No. 2,836,774, granted to Harry E. Ashworth, on May 27, 1958, for Magnetic Hold-Down Devices. Basically, the D.C. neutral relay has a coil **11** which has passing therethrough a core member **12**. This coil **11** is electrically connected to a coil terminal finger **19**. The electrical interconnection between this coil and terminal finger **19** is not shown but it is to be understood that when this plug-in type relay is pressed into position and the coil terminal finger **19** engages a terminal socket, the D.C. power supply will be connected to the coil **11** and accordingly produce a magnetic field within the core **12**. The coil **11** and core **12** are mounted upon a relay frame **13** made of a nonmagnetic material, and the core **12** is secured by bolts **14** and **16** to the relay frame **13**. In order that this relay may be readily removed from the plugged-in position and reinserted there is provided a handle **17**, which handle **17** is secured by a screw **18** to the relay frame **13**.

In addition, there is provided in this type of relay a permanent magnet structure **26**, here shown as a single element for purposes of illustration and explanation. The permanent magnet **26**, whose function will be described hereafter, is secured to the frame **13** by a bolt **27**.

Within the frame **13** and shown in dotted outline are a pole piece **28** and a pole piece **29**, each of these pole pieces respectively having pole piece extensions **31** and **32**. The under surface of the pole piece extension **32** has a pole face **34**, and the pole piece extension **31** has a pole face **33**. Immediately beneath the pole faces there is an armature structure **36**. This armature **36**, its construction and mode of operation are described in greater detail in my copending application for Letters Patent of the United States, Serial No. 677,924, filed October 25, 1967, for Improved Relay Armature Arrangement. The armature **36** has at its left-hand portion a fulcrum point **37**. This fulcrum point **37** has been formed by the beveling of a surface on the left-hand end of the armature **36**. The beveled surface **38**, as it meets with the upper surface of the armature, provides the fulcrum point **37** about which this armature will pivot.

Also secured to the frame **13** is a hinge block **39**, which hinge block **39** has a depending ledge portion **44** which extends underneath the end of the armature **36**. The hinge block **39** is secured to the frame by a bolt **41**, and there is an extending portion **45** of the hinge block **39** which also extends underneath the end of the armature **36**. There is provided a helical compression spring **42** between the armature **36** and the hinge block extending portion **45**. This helical spring **42** is maintained in position by spring retaining opening **43** in the armature **36** and by spring retaining opening **44** in the hinge block extending portion **45**. This helical compression spring provides substantially all of its force directed through the fulcrum point **37** of the armature **36** and forces the armature toward the coil and core structure **11–12** which forms an electromagnetic means.

The armature **36** has sandwiched between its fulcrum point and the pole face **34** of the pole piece extension portion **32** a spacer **51** as well as a flat, plate-like hinge spring **52**. The flat, plate-like hinge spring **52** is secured at one end to the armature **36** by a screw **53**. Between the screw **53** and the hinge spring **52** is a spacer **54**. The hinge block **39** has also sandwiched between the pole face **34** and the hinge block **39**, the spacer **51** as well as the hinge spring **52**.

The armature **36** also has at its right-hand end an armature stop pin **56**, the function of which will be explained hereafter. Secured on the bottom side of the armature **36** is a contact driver bracket **57**, which bracket **57** is secured by a screw **58** to the bottom of the armature **36**. There is connected to the bracket **57** a heel contact driver **59** of insulating material, which heel contact driver moves in unison with the armature **36** whenever the relay coil and core have been energized in a manner to be described hereafter. Secured to the frame **13**, by means not shown, is an insulating contact block **61**. Passing through the insulating contact block **61** is a rigid front contact portion **62**. The rigid front contact portion **62** has sandwiched within the front contact portion a front contact spring which has an extending front contact spring portion **63**, or resilient portion as it may be termed, which terminates in a silver impregnated carbon front contact tip **64**. While not shown in this figure, it will be understood that the front contact spring **63** is electrically integral with a front contact terminal finger **66** shown to the left of the contact block **61**.

There is also depicted here a heel contact terminal finger **67**, as well as a back contact terminal finger **74**, each of which is respectively electrically connected to a heel contact and a back contact to be now described. The heel contact has a rigid portion **69** through which passes the heel contact member **68**. This heel contact member **68** has a machined slot **71** in a surface thereof adjacent the rigid portion **69**. The function of this slot is explained in detail when FIGS. 4 through 7 are described hereafter. At the end of the heel contact member **68** is a heel contact **73** and the heel contact member **68** is secured to the heel contact driver **59** by a bendable clip **72**. The back contact terminal finger **74** passes through the block **61** and is electrically secured to the back contact spring portion **76**, or resilient portion as it may be termed, which spring is secured within the rigid back contact portion **77**. The spring **76** terminates with a back contact **78**.

The entire mechanism just described is housed within a housing **48**, a portion of which is shown here. It is to be understood that the housing **48** completely surrounds the mechanism to maintain the relay free from dust and contamination. The housing **48** is a transparent plastic cover and is secured to the frame **13** by a screw **49**. The relay shown here is in its rest condition. By this it is meant to convey the concept that when the relay is in its deenergized position the armature **36** is at rest upon a portion of the permanent magnet **26**. The armature **36** is at rest upon the permanent magnet **26**, due to the magnetic field present in the permanent magnet **26**. The magnetic field created by the permanent magnet is depicted by the dashed lines **21** which show the permanent magnetic field passing upwardly through the pole piece **28**, through the core **12** of the electromagnetic means, down through the pole piece **29**, through a portion of

the pole piece extension **32**, and down through the hinge spring **52** and the fulcrum point area **37**, into the armature **36**, along the armature **36**, and back into what is designated as a south pole of the permanent magnet **26**. The designations S and N shown in this figure are for purposes of illustration to explain the relative polarity of the magnet **26**.

When the relay has been plugged in and a D.C. voltage energizes the coil **12**, the electromagnetic field thereby created will take on the direction shown by the solid lines **22** which contain arrows depicting the relative direction of the electromagnetic field, and it will be appreciated that as the electromagnetic field increases in strength, the magnetic lines of force, namely, the electromagnetic field as shown by the arrows **22** and the permanent magnetic field shown by the arrows **21**, will oppose each other. When the electromagnetic field exceeds the permanent magnetic field, the path of the electromagnetic field will be downwardly from the core **12** through the pole piece **28**, through a portion of the pole piece extension **31**, into armature **36**, along the armature **36**, upward to the fulcrum point area **37**, and into the pole piece extension **32** and pole piece **29**, and finally back into the core **12**. Of course, when the coil **11** is deenergized, the electromagnetic field collapses and the permanent magnetic field, shown by the dotted lines **21**, becomes of a strength sufficient to pull the armature **36** back into its rest position on the permanent magnet **26**, as is depicted here.

Reference is now made to FIG. 2 which illustrates in schematic form a relay contact arrangement without the employment of the invention and the problems that arise as a result of excluding the invention that is to be described more fully hereafter.

The first arrangement at the top of FIG. 2 shows a front contact **63***a*, heel contact member **68***a*, and back contact member **76***a*. In this portion of the figure, as well as other portions of the figure, wherever reference numerals denote similar parts as those described with reference to FIG. 1, the character *a* has been added in order to designate the fact that they pertain only to the environment shown in FIG. 2. Accordingly, there is a contact block **61***a* to which is secured the front contact rigid portion **62***a* as well as the back contact rigid portion **77***a*. The heel contact rigid portion **69***a* is also disposed in a manner similar to that rigid portion shown in FIG. 1.

The first illustration at the top of FIG. 2 shows a situation where a heel contact driver **59***a* is in a neutral position. At this point the heel contact **73***a* is shown midway between the front contact **64***a* and the back contact **78***a*. The resilient portions of the front contact member **63***a* and the resilient portion **76***a* of the back contact are biased in the direction of the heel contact **73***a* which is carried by the heel contact member **68***a*.

In the second illustration, which appears in the middle of FIG. 2, there is depicted the situation where the back contact **78***a* and the heel contact **73***a* have been moved into electrical connection by the movement of the heel contact driver **59***a* downwardly as the arrow depicts in this portion of the figure. As one may appreciate from a study of this middle portion of FIG. 2, the heel contact member is of uniform thickness and would bend in a general arc downward toward the back contact **78***a* under the influence of the movement of the heel contact driver **59***a*. This operation of course would be perfectly satisfactory except for the situation that arises when, as shown in the lower portion of FIG. 2, the heel contact **73***a* becomes welded to the back contact **78***a*. Under this situation when the heel contact driver **59***a* moves upward, the heel contact driver **59***a* will attempt to move the welded contacts **73***a* and **78***a* upward toward the front contact **64***a*. Since the element **76***a*, namely, the resilient portion of the back contact member, cannot be stretched under the type of loadings that exist here, the end of the contact **78***a* is limited in its basic movement into an arc shown by the arrow which passes through the back contact **78***a*. Since the spring element or resilient portion **76***a* of the back contact cannot stretch and must pivot in the manner shown, the only way that the combined fused contacts **73***a* and **78***a* may come into electrical contact with the front contact **64***a* is for the heel contact member **68***a* to buckle. This buckling action is induced by the force as shown by arrow **90**, and the presence of this force and the buckling of the column-like structure of heel contact member **68***a* reduces the distance between the heel contact **73***a* and the rigid portion **69***a* of the heel contact member. In so doing the back contact **78***a* which is fused thereto may in fact pass through the arcuate travel shown by the arrow through the welded contact arrangement, and in so doing allow the heel contacts **73***a* and **78***a* to cause a failure when they mutually come into electrical contact with the front contact **64***a*. The obvious solution to this problem, of course, might be to increase the thickness of the heel contact member **68***a*. When this is done the rigidity of the heel contact member **68***a* gets to a point where the force required to flex the heel contact member **68***a* about the point where the heel contact enters the rigid portion **69***a* creates an overall structure that will be too stiff, and therefore this approach becomes unacceptable.

In FIG. 3, there is shown a prior art arrangement in which a thicker heel contact element **97** is employed and in which there has been a notch made in the heel contact member **97** near the base of the heel contact member adjacent the insulating block **93**. Note here that in this arrangement which is shown in Letters Patent of the United States No. 2,258,122, granted to J. F. Merkel, on October 7, 1941, for a Relay, and described in great detail therein, the driver contact member **95** is positioned intermediate the contacts that are at the end of the front contact member **96** and the back contact member **98**, as well as the heel contact member **97**, between the contacts of these members and the base **93**. When the contacts of the heel contact and the back contact are fused, the upward movement of the heel contact driver causes the heel contact member to flex in the middle, as shown, and while the action is not one of buckling it actually may allow the fused back contact and heel contact to come into electrical connection with the front contact of the front contact member **96**.

Note also that this prior art arrangement requires a multitude of spring arrangements **99** on the back contact as well as the front contact. These springs, of course, over long usage create problems of wear and adjustment as resiliency changes with time and the number of flexures experienced spans many years of use.

Reference is now made to FIGS. 4 through 7. In these figures there is depicted in schematic form the basic elements of the improved contact arrangement. Wherever the reference numerals are directed to portions that were heretofore described with reference to FIG. 1, these reference numerals will be used again. It will therefore be seen in FIG. 4 that secured to the insulating block **61** are both the front contact rigid portion **62** and the back contact rigid portion **77**, as well as the heel contact rigid portion **69**. The front contact member has the biased resilient portion **63** which has at the end thereof a front contact **64** schematically shown as a simple contact structure. The back contact member has a biased resilient portion **76** and at its end a back contact **78**. The heel contact member **68** as shown schematically at its right-hand end a contact driver **59** which causes the heel contact member to move upward and downward into and out of contact with the front contact **64** and the back contact **78**, as the heel contact **73** makes respective contacts with the afore noted contacts.

Shown within a circled portion of the heel contact member is a slot or opening or space that has been machined in the surface of the heel contact member **68**. This has been designated by the reference numeral **71** and

shown in expanded detail in FIG. 4*a* where the presentation in FIG. 4*a* shows a magnified view of this portion of the heel contact member. There is also shown in FIG. 4*a*, as well as FIGS. 5 and 6, a dot and dash center line which passes through the middle of the slotted portion **71**. It is about this center line which the heel contact member **68** pivots and is about which point the pivotal flexure necessary to allow the contact member **68**, as well as its contact **73**, to move in what will be a fail-safe manner.

Note when FIG. 5 is viewed that the heel contact member **68**, while shown in this figure in intimate electrical contact with the back contact **78**, is actually straight and that the flexing that occurs is actually in a pivotal fashion about the center line depicted through the slotted portion **71**. The heel contact member does not bend in the conventional sense in that it is bowed but actually moves in a straight column between the front contact position shown in dotted outline and the back contact position shown in solid lines. It is this column-like pivoting flexure of this member that allows this arrangement to provide the fail-safe operation afore noted. For it will be appreciated as FIG. 6 is viewed that the slot **71** in the heel contact member **68** coupled with the column rigidity of the heel contact member **68**, as it co-functions with the heel contact driver **59**, creates a situation where the heel contact member **68** has sufficient column strength to resist the column buckling of the type depicted in FIG. 2. Since the heel contact member cannot enter into a column buckling mode when the heel contact **73** becomes welded to the back contact **78**, the heel contact driver **59** is limited in its upward movement. In fact, it has been found that the heel contact **73**, when welded to the back contact **78**, can go no further in its upward movement than that shown in this FIG. 6. Therefore, once these two contacts become welded the column strength of heel contact member **68** is such that it will not buckle, and since the back contact resilient portion **76** will not stretch under the force imposed thereon by the welded contacts **73** and **78**, the relay switch remains as it is shown in FIG. 6 without the failure that has transpired in both of the situations depicted in FIG. 2 and FIG. 3.

Reference is now made to FIG. 7 in which the base portion of a heel contact is shown. To these reference numerals there has been added the character *b* designating the fact that this figure is intended to show a physical configuration that differs from FIG. 1 and FIGS. 4 through 6. This configuration should be avoided at all costs. Note that if the slotted portion **71***b* of the heel contact member **68***b* is made of too great a length, then, as shown in the bottom portion of FIG. 7, the forces that appear downwardly along the heel contact member **68***b*, as shown by the reference arrow **70***b*, can cause the slotted portion if it is too long to experience a buckling action as shown by the reference numeral **75**. If this buckling action should ensue because the slot is made too long, then the fact that there is a pivotal action present, coupled with the buckling action shown designated by the reference numeral **75**, will allow the shortening of the heel contact member **68***b* and therefore allow a failure of the type shown in the bottom portion of FIG. 2. Therefore, it is important to recognize that the slotted portion that appears in the heel contact member must not be so long as to permit a physical buckling of this during the operation of the relay contacts when there is a welded condition experienced due to malfunctioning. The slot must only be of a width sufficient to allow the pivotal flexure of the heel contact member as is shown in FIG. 6.

Reference is now made again to FIG. 1*a* which shows the front contact **64** of the front contact member **63**. This front contact is unique in that it has been produced by the process of taking a piece of silver impregnated carbon and silver plating the entire piece. Then, as can be seen in FIG. 1*a* there is a need for a beveled surface **65** on the front contact. This beveled surface is accomplished by machining through the contact tip **64** to expose a silver impregnated carbon surface. This silver impregnated carbon surface then is the contact surface of the front contact **64**, and the purpose of removing the plating is to expose a carbon surface which, as has been proven by past experience, cannot become welded to a silver contact such as contact **73**. All the remaining surfaces of the front contact are silver plated, as has been noted, and afford maximum electrical and mechanical continuity when this front contact tip is soldered to the resilient front contact member **63**. In addition, there is shown mechanically secured to the front contact tip **64** a bracket **60**, which bracket **60** provides additional mechanical interlocking of the front contact tip **64** to the resilient portion **63**. A solder connection between the front contact resilient portion **63** and the silvered surface of the front contact tip **64**, as well as the mechanical interlocking, provides an extremely reliable contact.

In practice, solder is applied at *a*, which in addition to anchoring the ends of bracket **60**, flows through hole *b* in resilient member **63** and appears at *c*, along the end of resilient member **63**, to indicate that solder has flowed in such a fashion as to properly solder member **63** to the top silver plated surface of front contact tip **64**.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

Having thus described my invention, what I claim is:

1. An improved vital relay contact arrangement in which there is included a front contact member, a heel contact member, a back contact member and a heel contact member driver, said vital relay contact arrangement having a fail-safe cooperation between a heel contact of said heel contact member, a front contact of said front contact member and a back contact of said back contact member, when said heel contact and said back contact become welded to each other during operation of said vital relay,

(a) said front contact member having a first rigid portion and having said first rigid portion secured at one end to an insulating block and a second resilient portion secured at one end thereof to said first rigid portion and having at the other end thereof a front contact tip,

(b) said back contact member having a first rigid portion and having said first rigid portion secured at one end to said insulating block and a second resilient portion secured at one end thereof to said first rigid portion and having at the other end thereof a back contact tip,

(c) said heel contact member disposed intermediate said front and back contact member and secured to said insulating block,

said heel contact member having a uniform thickness throughout its length with the exception of a reduced thickness region near the end of said heel contact member where said heel contact member is secured to said insulating block, said reduced thickness portion having a length dimension such that there can only be a pivotal flexure in the region of said reduced thickness due to the combined column rigidity present in said uniform thickness portion and the absence of column buckling in said reduced thickness portion,

a heel contact secured to said heel contact member and said contact driver drivingly connected to the other end of said heel contact member so that when said drive member is moved during relay operation, said heel contact alternately

electrically interconnects said back and said front contacts, in the event that said heel contact and said back contact should weld together said heel contact member is restrained in the total distance it may travel toward said front contact due to said heel contact member's column rigidity and said pivotal flexure in said region of reduced thickness.

2. The improved vital relay contact arrangement of claim 1 wherein said second resilient portions of said front and said back contact members are permanently biased toward each other, whereby said alternate electrical connection between said heel contact and said front and back contacts produces a wiping action between contacts due to the biased condition and the resilient nature of said resilient portions of said front and said back contact members.

3. The improved vital relay contact arrangement of claim 2 wherein said heel contact is secured to said heel contact member portion of uniform thickness at a point intermediate said other end where said heel contact is drivingly connected to said heel contact driver and said reduced thickness region.

4. The improved vital relay contact arrangement of claim 3 wherein said front contact is a silver impregnated, silver plated carbon element having a portion thereof which has been exposed to present as a contact surface only of said silver impregnated carbon,

said contact element mechanically and metallurgically

interconnected to said resilient portion of said front contact member to thereby provide an integral mechanical and electrical contact arrangement.

5. The improved vital relay contact arrangement of claim 4 wherein said reduced thickness region is a machined slot and said heel contact member has a flat plate configuration of uniform width throughout its length.

6. The improved vital relay contact arrangement of claim 5 wherein said heel contact driver passes through an opening in said heel contact member and is held in driving cooperation with said heel contact member by a single bendable clip.

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U.S. Cl. X.R.

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