Jan. 10, 1956 R. G. PAGE 2,730,594

ELECTRIC CONTACT

Filed Dec. 26, 1952

Fig. 1.

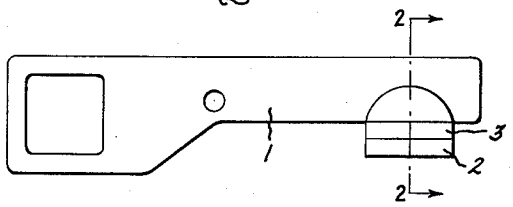
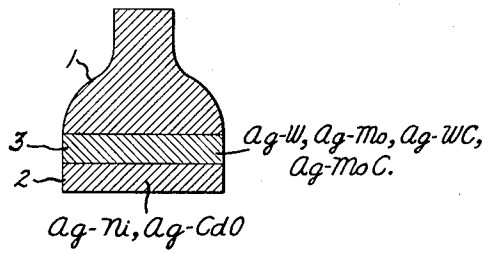


Fig. 2



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United States Patent Office 2,730,594 Patented Jan. 10, 1956

2,730,594

ELECTRIC CONTACT

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Application December 26, 1952, Serial No. 327,993

4 Claims. (Cl. 200—166)

My invention relates to electric contacts for use in making and breaking electric circuits and more particularly to dual purpose contacts suitable for operation on direct and alternating currents.

The duty imposed upon electric contacts when making and breaking direct current circuits is different from that imposed on contacts employed for making and breaking alternating current circuits. It has consequently been the practice to provide electric switching devices with contacts which are particularly suited for one duty or the other, depending upon whether the switching device is to be installed in a direct current circuit or in an alternating current circuit. It has, however, been proposed to use contacts which effect a compromise between the requirements for direct or alternating current duty, but such contacts do not present the most favorable operating characteristics for either duty.

It is an object of my invention to provide electric contacts for switching devices which may be provided with dual ratings for use in both direct current and alternating current circuits.

It is also an object of my invention to provide a composite two-layer contact having a facing layer suitable for direct current operation, but which if used under abnormal alternating current duty, is subject to erosion to exposing a backing layer which has the desired characteristics for both normal and abnormal alternating current operation.

Further objects of my invention will become apparent from the following description taken in connection with the accompanying drawing.

Electric contacts embodying my invention have a facing layer of substantial thickness integrally joined to a backing layer, also of substantial thickness, and the composite contact is mounted on a suitable carrying element to form a component part of a switching device. The facing layer of my contact is formed of a material of low voltage drop and metal transfer characteristics under direct current normal and short circuit duty at the direct current voltage rating and under alternating current normal duty at a higher alternating current voltage rating. It is, however, subject to erosion without sticking or welding to its mating contact under alternating current short circuits to expose the backing layer which has a higher thermal capacity and resistance to arcing than the facing layer, and, consequently, is satisfactory for operation on alternating current normal and short circuit duty at the higher alternating current voltage rating. I thus provide a single switching device with contacts which will provide satisfactory operation when installed in either direct or alternating current circuits, and which by reason of its construction may be transferred from duty in a direct current circuit to duty in an alternating current circuit although it is not suitable for a reverse transfer in duty.

In the accompanying drawing

Fig. 1 is a side view of a switching element provided with a contact embodying my invention; and

Fig. 2 is a cross sectional view along lines 2—2 of Fig. 1.

As shown in the drawing, a switch arm 1 is provided with a two-layer, make and break electric contact having a facing layer 2 integrally united to a backing layer 3 which in turn is mechanically and electrically connected to a supporting area of the switch arm.

The particular switching element illustrated in the drawing is suitable for normal operation at 50 amperes 250 volts direct current or 500 volts alternating current and is capable of interrupting fault or short-circuit currents having a magnitude as great as 5000 amperes. The facing layer 2 of the composite contact is formed of a material suitable for both direct current and alternating current operation and the backing layer 3 is formed of material suitable only for alternating current operation at the current and voltage value above specified. If the contact is subjected to direct current duty, its facing layer 2 will provide satisfactory operation for the rated life expectancy of the switching device. If, however, the contact is subjected to abnormal alternating current duty, the facing layer 2 will be eroded, exposing the backing layer 3 which will thereafter provide satisfactory alternating current operation for the rated life expectancy of the switching device of which it forms a part. When subjected to such alternating current duty, the facing layer 2 is dissipated without sticking or welding to its mating contact and operation proceeds without fault since the contact surface is expendable under such duty until the more durable backing layer 3 is exposed for operating duty. The two layers of the composite contact are each of substantial thickness and suitable in themselves for the respective direct current or alternating current duty for which the contact is rated. Consequently, the facing layer of the contact should be at least $\frac{1}{32}$ of an inch thick, as should the backing layer, although preferably I make the backing layer of a greater thickness. For example, the backing layer may be three times as thick as the facing layer.

For the facing layer of my composite contact, I employ a material which has a low contact resistance and which is resistant to the build-up of high contact resistance when subjected to its rated current carrying capacity. It is important that the contacts operate without filming, since oxidation of the contact surface will result in overheating which, in turn, will increase the oxidizing or filming effect, thus producing a vicious circle, for as the temperature rises this will produce further oxidation and greater heating, and such overheating leads to increased electrical wear and ultimate welding or disintegration and even melting of the contact. The facing layer of my contact must also be characterized by its resistance to metal transfer when carrying direct current and consequently by its low voltage drop. It has been observed that in direct current circuits there is a transfer of metal from one contact to the other. This transfer of metal can produce build-ups on one of the contacts which increase the current concentrations at the conducting areas of the contacts, which in turn is productive of further heating and ultimate destruction thereof, usually through welding or sticking of the contacts.

For the facing layer of my composite contact, I prefer to employ a composition comprising a mixture of silver and a semi-refractory material selected from the group consisting of nickel and cadmium oxide. The silver-nickel composition preferably contains 15%, by weight, nickel and the silver cadmium oxide combination preferably contains 10%, by weight, cadmium oxide, although percentages as low as 5% by weight may be employed. It is, of course, apparent that greater percentages of the cadmium oxide and nickel may be

used, but it is desirable to keep the major percentage of the composition high in silver in order to secure the desired predominant features of low contact resistance and consequent surety of making contact. The semi-refractory materials, nickel and cadmium oxide, impart to the contact material the desired characteristics of resistance to wear, welding, and metal transfer, which it is desirable to have for direct current contacts.

The backing layer of my composite contact is preferably made of a mixture of silver and a refractory material selected from the group consisting of tungsten, molybdenum, and carbides of these metals. I prefer to employ compositions containing 35–50% silver and 50–65% tungsten, 50% silver and 50% molybdenum, and carbide compositions containing about the same percentage of silver as those given for tungsten and molybdenum. The silver content of the backing layer of my composite contact provides the desired current carrying capacity thereof, while the refractory materials make this backing layer highly resistant to arcing and welding, and consequently, resistant to erosion. This backing layer, however, would not be suitable for long periods of use in carrying direct current, since the refractory materials would readily oxide forming a high contact resistance, and, furthermore, there would be an undesirable transfer of material from one contact to the other, resulting in the disadvantages considered above.

Since the materials of which the facing and backing layers of my composite contact are formed will not alloy with one another, they are usually prepared by mixing the powdered materials, pressing the mixture, and hot or cold working the pressed product into suitable formation from which the contacts may be prepared. The compositions may also be prepared by impregnating the refractory or semi-refractory materials with molten silver. The composite contact is preferably made by assembling layers of facing and backing material by brazing using hard solders such as the silver solders for making the joint. In view of the non-wetting properties of the compositions containing nickel and cadmium oxide, the assembly may be made by employing resistance brazing or induction heating, and where large quantities are involved, by furnace brazing in an inert atmosphere. It is, of course, apparent that the integral two-layer contact of my invention may be formed in one operation, when employing the methods above described, by providing layers of the desired mixtures, if means are employed to secure a definite plane of demarcation between the two layers of material, such as may be obtained by employing separators while assembling the charge and removing these separators prior to the sintering or impregnation steps of the process employed.

The composite two-layer contacts above described may be employed in pairs, or one of these contacts may be used with a mating contact of a different composition. Thus, it is possible to use one of my composite two-layer contacts with a cooperating contact comprising a mixture of silver and about 5%, by weight, graphite, since such a combination provides very desirable operating characteristics. Silver graphite contacts possess high conductivity and good frictional properties when used opposite other contact materials. Furthermore, they offer a great protection against welding.

The facing layer of my composite two-layer contact will provide satisfactory operation on either alternating current or direct current normal duty and on direct current short circuits. On alternating current short circuits, however, this facing layer will erode, leaving the backing layer to perform satisfactorily on alternating current normal duty and short circuits. The facing layer provides low contact resistance over long periods of operation and high electric and thermal conductivity. It is also resistant to metal transfer when subjected to direct current duty which in itself is very important.

On the other hand, the backing layer is highly resistant to arcing and, at the same time, resists erosion since it is not subject to metal transfer occasioned by the passage of direct current through its contacting surface. By employing contacts in accordance with my invention, it is possible to have a single switching device employing these contacts which may be rated for both direct and alternating current duty since the contact in its original condition is suitable for direct current operation and rapidly erodes under abnormal alternating current conditions to provide a contact which is suitable for alternating current duty.

While I have shown and described particular embodiments of my invention, it is quite obvious to those skilled in the art that many changes and modifications may be made therein without departing from my invention in its broadest aspects, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An integral two-layer make and break electric contact suitable for direct current duty at one voltage rating and an equivalent alternating current duty at a higher voltage rating, said contact having a facing layer of at least 1/32" in thickness and formed of a composition comprising a mixture of silver and a semi-refractory material selected from the group consisting of nickel and cadmium oxide and a backing layer of a composition comprising a mixture of silver and a refractory material selected from the group consisting of tungsten, molybdenum, and carbides of these metals.

2. A composite two-layer make and break contact having a facing layer at least 1/32" in thickness integrally united to a backing layer of substantial thickness, said facing layer being formed of a composition comprising a mixture of silver and a semi-refractory material selected from the group consisting of nickel and cadmium oxide and said backing layer being formed of a composition comprising a mixture of silver and a refractory metal selected from the group consisting of tungsten, molybdenum, and carbides of these metals.

3. An integral two-layer make and break electric contact suitable for direct and alternating current duty, said contact having a facing layer of at least 1/32" in thickness formed of a composition comprising a mixture of silver and from 5 to 15%, by weight, of a semi-refractory material selected from the group consisting of nickel and cadmium oxide and a backing layer formed of a composition comprising a mixture of silver and from 50 to 65%, by weight, of a refractory metal selected from the group consisting of molybdenum and tungsten.

4. An electric circuit making and breaking device having cooperating contacts, one of which is formed of a composition comprising a mixture of silver and about 5%, by weight, of graphite, and the other of which is formed of two layers of substantial thickness integrally united with one another to provide a facing layer of at least 1/32" in thickness and of a composition comprising a mixture of silver and from 5 to 15%, by weight, of a semi-refractory material selected from the group consisting of nickel and cadmium oxide and a backing layer of a composition comprising a mixture of silver and from 50 to 65% by weight, of a refractory metal selected from the group consisting of tungsten and molybdenum.

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