

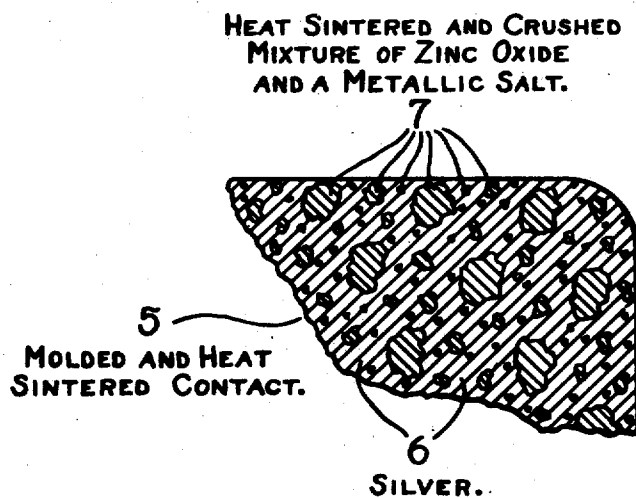
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L. T. RICHARDSON ET AL

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ELECTRICAL CONTACT

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Inventors
Linwood T. Richardson
Merle R. Swinchart
By Mark H. Hubbard
Attorney

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ELECTRICAL CONTACT

Linwood T. Richardson, Wauwatosa, and Merle R. Swinehart, Genesee Township, Waukesha County, Wis., assignors to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

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1

This invention relates to improvements in electrical contacts.

In Patent No. 2,425,052, granted August 5, 1947, to Merle R. Swinehart, and assigned to the same assignee as the present application, there is disclosed a molded and heat sintered powder composition contact comprising essentially a metal of good electrical conductivity and a smaller proportion of a metallic oxide, the latter being in the form of relatively large particles dispersed throughout the mass of metal. In said Patent No. 2,425,052 the preferred embodiment of the invention involved the use of a relatively large proportion (seventy-five per cent to eighty-seven and one-half per cent by weight) of a precipitated silver powder; the remaining twenty-five per cent to twelve and one-half per cent of the composition consisting of either cadmium oxide alone or combined in a specific manner with a metallic salt, such as silver iodide, silver bromide, silver chloride, cadmium chloride or cadmium sulphate; and such a metallic salt, when employed, amounting to from one-tenth of one per cent to ten per cent of the entire mass of the ingredients.

An object of our invention is to provide a composition electrical contact of the general character disclosed in said Patent No. 2,425,052, but differing therefrom specifically in respect of the use herein of zinc oxide as an ingredient of the composition, instead of the cadmium oxide disclosed in said Patent No. 2,425,052; and in respect of a specifically different range of proportionalities, by weight, of the three ingredients (silver, zinc oxide and a metallic salt) here employed, as compared with the range of proportionalities of the ingredients disclosed in said patent.

Another object is to provide novel compositions of silver, zinc oxide and a metallic compound for electrical contacts which are greatly superior to contacts of fine silver or coin silver, in respect of minimizing welding or transfer of material thereof when in use.

Another object is to provide molded and heat sintered electrical contacts, composed of silver, zinc oxide and a metallic compound, which are functionally superior to the well known silver-cadmium oxide contacts (disclosed in Cox Patent No. 2,307,688) in respect of the non-welding and non-transferring characteristics of contacts composed of the ingredients herein contemplated, in the various proportionalities thereof hereinafter set forth.

Other objects and advantages of the invention will hereinafter appear.

The single figure of the accompanying draw-

2

ing is a fragmentary sectional view, highly magnified, of an electrical contact embodying our invention.

In producing a contact of the aforementioned character composed of silver powder, zinc oxide and a metallic compound, we prefer to employ a precipitated silver powder which is characterized by a fibrous texture, extreme whiteness, and unusual ability to cold weld under molding pressure to a tough solid of considerable tensile strength. We may also employ a commercial form of zinc oxide which is initially of such fineness as to pass through a 325 mesh screen. The improved electrical contacts will be obtained if the above mentioned constituents are present within certain defined proportions. These proportions are as follows:

	Per cent
Silver -----	75 to 95
Zinc oxide -----	4.5 to 20
Metallic compound -----	.5 to 5

We prefer to add to and intimately mix with a given quantity of the zinc oxide the desired or required proportionality, by weight, of a metallic compound, of the group consisting of silver iodide, silver chloride, silver bromide and lead hydroxide; to provide the desired proportionality by weight of each of the ingredients zinc oxide and metallic compound, with respect to the percentage of silver in the respective final mixtures hereinafter described.

Such mixture of zinc oxide and metallic compound is then preferably densified by molding the same, at a pressure of about 100,000 pounds per square inch, into the form of pellets or slugs of approximately five-eighths inch diameter. Said pellets are then sintered for about one-half hour at a temperature of about 1600 degrees F. The sintered pellets are then ground, in any well known manner, until all the powder particles will pass through a 100 mesh screen. The grinding is preferably so controlled that at least fifty per cent of the particles so passed through a 100 mesh screen will be retained upon a 300 mesh screen.

Here, as in said Swinehart Patent No. 2,425,052, the addition of one or another of the metallic compounds specifically mentioned above (or combinations of two or more of such metallic compounds) has been found to improve to a marked degree the anti-welding or non-sticking characteristics of a contact including the two major ingredients, silver and zinc oxide, above mentioned, in the relative proportions, or ranges of proportions, by weight, herein contemplated, thus

increasing the current controlling capacity of the contacts. Such metallic compounds when thus employed also insure a more even wear of the cooperating contacts of each pair, thus prolonging the life of the contacts.

The granular powder composed of predetermined proportions by weight of zinc oxide and a metallic compound of the group aforementioned is intimately mixed in any well known manner with a predetermined quantity, by weight, of silver powder (such as the aforementioned precipitated silver powder), and such mixture of powders is then cold molded at a pressure of about 40,000 pounds per square inch to provide preforms of, say, three-fourths of an inch in diameter. Thereupon said preforms are subjected to a temperature of approximately 1800 degrees F. for about twenty minutes. After such heat treatment said preforms are subjected to a molding pressure of about 100,000 pounds per square inch to produce the finished contacts.

As a result of extensive experiments and tests in respect of electrical contacts produced by us in accordance with the invention herein disclosed, we have reached the following conclusions:

(a) Zinc oxide is useful in combination with silver, in electrical contacts, to prevent welding and/or transfer of material.

(b) Certain metallic compounds (particularly silver iodide when used in contacts for control of direct current circuits, and silver chloride when used in contacts for control of alternating current circuits) enhance the non-welding and non-transfer characteristics of silver-zinc oxide contacts, and, in addition, presence of the metallic compounds herein mentioned in such silver-zinc oxide composition contacts results in a reduction in the contact resistance build-up of the contacts.

(c) The contacts herein disclosed (composed of silver, zinc oxide and a metallic compound of the group specified) are much better than contacts composed of fine silver or coin silver, in respect of the non-welding and non-transfer characteristics thereof.

(d) Contacts composed of silver, zinc oxide and a metallic compound (of the group herein specified) are much better than contacts composed of silver and cadmium oxide (as disclosed in Cox Patent No. 2,307,668, granted January 5, 1943, and assigned to the same assignee as the present application) in respect of use thereof for control of alternating current circuits.

Contacts composed of various proportionalities of silver, zinc oxide, and one of the aforementioned metallic compounds, and produced in the manner aforescribed, were subjected by us to tests on direct current by incorporating sets of such contacts in magnetic contactors, which were operated to control a 200 ampere circuit by making and breaking a 28 volt resistive load at the rate of sixty cycles of operation per minute for 50,000 operations, to ascertain the contact resistance and material transfer characteristics of such contacts. The following are examples showing the results of such tests on contacts having various different compositions:

(a) Contacts composed of ninety-five per cent by weight of silver, four and one-half per cent of zinc oxide, and one-half of one percent of silver iodide, when so tested, resulted in very good surface on the contacts after 50,000 operations of the contactor; the average millivolt drop between the contacts of the respective sets at the test cur-

rent of 200 amperes was 25 mv. at the start, and 17 mv. at the end of the test.

(b) Contacts composed of ninety per cent of silver, eight per cent of zinc oxide, and two per cent of silver iodide, when subjected to such test, resulted in only a slight general transfer of material between the contacts of the respective sets; the average initial millivolt drop at said test current was 25, and 29 mv. at the end of the test.

(c) Contacts composed of ninety per cent of silver, nine per cent of zinc oxide, and one per cent of silver chloride, when so tested, resulted in good surfaces of the contacts of each set at the end of the test; the average initial millivolt drop at said test current was 28, and 150 mv. at the end of the test.

(d) Contacts composed of ninety per cent silver, nine per cent of zinc oxide, and one per cent of silver bromide, when so tested, resulted in only a slight general transfer of material between the contacts of the respective sets; the average initial millivolt drop at said test current was 24, and 60 mv. at the end of the test.

(e) Contacts composed of eighty-seven and one-half per cent of silver, eleven and one-fourth per cent of zinc oxide, and one and one-fourth per cent of lead hydroxide, when so tested, resulted in very smooth surfaces on the contacts; the average initial millivolt drop at said test current was 55, and 400 mv. at the end of the test.

Contacts having compositions identical with those mentioned in Examples (a) to (e) were subjected to tests at 2000 amperes, making and breaking a 28 volt resistive load at the rate of twenty cycles of operation per minute, until failure, to ascertain the non-weldability characteristics of the respective compositions, as follows:

(f) Contacts composed of ninety-five per cent by weight of silver, four and one-half per cent of zinc oxide, and one-half of one per cent of silver iodide, when so tested, resulted in welding of the contacts after 287 cycles of operation of the contactor.

(g) Contacts composed of ninety per cent of silver, eight per cent of zinc oxide, and two per cent of silver iodide, when subjected to such test, resulted in welding of the contacts after 1698 cycles of operation of the contactor.

(h) Contacts composed of ninety per cent of silver, nine per cent of zinc oxide, and one per cent of silver chloride, when so tested, resulted in welding of the contacts after 1149 cycles of operation of the contactor.

(i) Contacts composed of ninety per cent of silver, nine per cent of zinc oxide, and one per cent of silver bromide, when so tested, resulted in welding of the contacts after 1935 cycles of operation of the contactor.

(j) Contacts composed of eighty-seven and one-half per cent of silver, eleven and one-fourth per cent of zinc oxide, and one and one-fourth per cent of lead hydroxide, when so tested, resulted in welding of the contacts after 590 operations of the contactor.

Contacts composed of seventy-five per cent by weight of silver, twenty per cent of zinc oxide, and five per cent of silver chloride, when incorporated in a magnetic contactor of the character aforementioned, were tested by making and breaking two legs of a star-connected 3000 ampere 60 cycle 120 volt alternating current three-phase thirty per cent lagging power factor load, for one hundred cycles of operation of the contactor. At the end of such test the contacts were found to be only slightly roughened.

5

Under certain conditions, and for certain purposes, we prefer to employ in the composition zinc oxide in the form of the mineral "franklinite," which is an oxide of iron, zinc and manganese, belonging to the spinel group. When "franklinite" is thus employed (instead of the ordinary commercial form of zinc oxide aforementioned) a metallic compound of the aforementioned group is mixed with the silver and "franklinite" as a separate third ingredient; thus departing to some extent from the method of preparing and combining the ingredients hereinabove set forth.

In the single figure of the drawing the numeral 5 designates a fragment, greatly enlarged for purposes of illustration, of an electrical contact embodying our invention. In this sectional view, the numeral 6 designates the base of matrix material, which is shown as consisting of silver; and the numeral 7 designates particles or granules of a mixture of zinc oxide and a metallic compound (of the group consisting of silver iodide, silver chloride, silver bromide and lead hydroxide). The materials in powder form are treated in the manner aforescribed to produce the final article illustrated.

We claim:

1. An electrical contact consisting of seventy-five per cent to ninety-five per cent by weight of silver, from twenty per cent to four and one-half per cent by weight of zinc oxide, and from five per cent to one-half of one per cent by weight of a third ingredient consisting of a metallic salt of the group composed of silver iodide, silver chloride and silver bromide.

2. An electrical contact composition consisting of, by weight, approximately ninety-five per cent silver powder, and a powdered mixture of four and one-half per cent zinc oxide, and one half of one per cent silver iodide.

3. An electrical contact composition consisting of, by weight, approximately ninety per cent silver powder, and a powdered mixture of eight per cent zinc oxide, and two per cent silver iodide.

4. An electrical contact composition consisting of, by weight, approximately ninety per cent silver powder, and a powdered mixture of nine per cent zinc oxide, and one per cent silver chloride.

5. An electrical contact composition consist-

6

ing of, by weight, approximately ninety per cent silver powder and a powdered mixture of nine per cent zinc oxide, and one per cent silver bromide.

6. An electrical contact consisting of a matrix of seventy-five to ninety-five per cent by weight of the entire mass of fine silver, said matrix having particles dispersed therethrough consisting of a mixture of four and one-half per cent to twenty per cent by weight of the entire mass of zinc oxide and one-half of one per cent to five per cent by weight of the entire mass of a metallic compound of the group consisting of silver iodide, silver chloride and silver bromide.

7. An electrical contact consisting of a matrix of seventy-five per cent to ninety-five per cent by weight of the entire mass of silver, said matrix having dispersed therethrough particles all of which will pass through a 100 mesh screen and the major portion of said particles being of a size greater than that which will pass through a 300 mesh screen, said particles consisting of a mixture of four and one-half per cent to twenty per cent by weight of the entire mass of zinc oxide and one-half of one per cent to five per cent by weight of the entire mass of a metallic compound of the group consisting of silver iodide, silver chloride and silver bromide.

8. An electrical contact composition consisting of 90 to 95 per cent by weight of silver powder, $4\frac{1}{2}$ to 8 per cent by weight of zinc oxide, and $\frac{1}{2}$ to 2 per cent by weight of silver iodide.

LINWOOD T. RICHARDSON.
MERLE R. SWINEHART.

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