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ELECTRIC CONTACT COMBINATION

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This invention relates to electric contacts.

An object of the invention is to improve the compositions and combinations of compositions for electric make-and-break contacts for applications such as voltage regulators, relays and the like.

Other objects of the invention will be apparent from the following description taken in connection with the appended claims.

The present invention comprises the combination of elements, methods of manufacture, and the product thereof brought out and exemplified in the disclosure hereinafter set forth, the scope of the invention being indicated in the appended claims.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the combination of elements without departing from the spirit of the invention.

In voltage regulators or relays the contacts should be non-fusing, have a low contact resistance with a relatively small contact pressure and be capable of maintaining low resistance in service after a large number of operations.

It is of importance in contact applications to consider the type of current load placed upon the contacts. This load will normally be through a resistive circuit in voltage regulators. For relay applications, on the other hand, the load may vary from purely resistive to purely inductive. It may be a combination of resistance and inductance. It may also include capacitative loads as well.

It has been found that contacts in such services as mentioned above frequently fail on account of excessive material transfer. This transfer is a function of the electrical conditions at the time of make or break and it is also dependent upon the materials which are used for the contacts. It is well known that different metals and different alloys have widely different characteristics in their ability to withstand transfer.

I have discovered that the tendency of the contact materials to transfer and of the contacts to fail is also dependent upon the contact polarity. That is, if one material is used for the positive contact and another material for the negative contact in a D. C. circuit the tendency to contact failure will be different from a combination in which the materials of the positive and negative contacts are reversed. This is apparently dependent upon the characteristics of the different materials in the composition, including such factors as the arcing voltages, ionization potentials, sticking or non-fusing characteristics and the like.

According to the present invention I propose the use of contact combinations for D. C. purposes embodying two silver alloys wherein the contact on the positive side is characterized by the presence of an appreciable quantity of an element of the nature of cadmium and the contact on the negative side is practically free of such element.

I have found the most suitable materials for the positive side to be alloys of silver and cadmium with or without additions of copper, nickel, cobalt, iron or manganese. In some cases other elements of the nature of cadmium, such as zinc, for instance, can be substituted for part or all of the cadmium, particularly where only small amounts are used.

For most applications, the contacts for the positive side may be formed of alloys in the following range of compositions:

	Per cent
Cadmium	0.5 to 25
Nickel, cobalt, iron or manganese—traces to	10
Copper	0 to 50
Silver	Balance

The preferred contact materials for the negative side are fine silver or an alloy of silver with a nobler metal, for instance taken from the palladium-platinum group or gold. The contacts may also contain additions of small percentages of other ingredients which do not deleteriously affect its operations. Such elements may be, for instance, nickel, cobalt, iron or manganese. Cadmium or zinc should be preferably absent.

For most uses the negative contacts may be formed of alloys having their ingredients present in the following ranges of proportions:

	Per cent
Palladium and/or platinum and/or gold	0 to 50
Nickel, cobalt, iron, or manganese	0 to 5
Silver	Balance

Examples of preferred compositions for use according to the invention are—

Positive side:		Per cent
a.	Cadmium	16 to 22
	Nickel	0.5 to 3
	Silver	Balance
b.	Cadmium	14 to 22
	Nickel	0.5 to 3
	Copper	4 to 15
	Silver	Balance
c.	Cadmium	7 to 14
	Nickel	0.5 to 5
	Copper	16 to 28
	Silver	Balance
d.	Cadmium	1 to 6
	Nickel	0.25 to 1.5
	Copper	8 to 15
	Silver	Balance

Negative side:		
a.	Palladium or platinum	2 to 5
	Silver	Balance
b.	Silver substantially	100

In comparison tests of one of the preferred combinations of the present invention with other contact combinations the following results were obtained showing the marked advantage attained by following my invention. In all cases a substantial number of contact pairs were tested under identical operating conditions and for the same length of test period.

The results are here tabulated:

Combination	Contact composition	Polarity	Percentage failures
1	Fine silver	Negative	100
	do	Positive	
2	Ag-Cd-Ni	Negative	85
	Ag-Pd	Positive	
3	Ag-Pd	Negative	85
	do	Positive	
4	Ag-Cd-Ni	Negative	35
	do	Positive	
5	Ag-Pd	Negative	5
	Ag-Cd-Ni	Positive	

The marked advantage of the present invention is evident from the above results. Only 5% of failures were recorded for combination 5, which is in accordance with my invention, whereas 35% to 100% failures occurred for the other combinations. As an indication of the importance of polarity it will be noted that combination 2, which is just the reverse of combination 5, showed 85% failures.

While the present invention as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. In combination, a co-operating pair of electric make-and-break contacts for D.C. operation, the positive contact being formed of a silver alloy containing a substantial amount of an element of the nature of cadmium and the negative contact being formed from metals comprising silver and compositions of silver with noble metals of the gold, platinum and palladium family of the periodic system.

2. An electric contact combination for D. C. operation, the contact on the positive side of said combination having the composition

	Per cent
Cadmium	0.5 to 25
Nickel, cobalt, iron or manganese—traces to	5
Copper	0 to 40
Silver	Balance

and the contact for the negative side being formed from metals comprising silver and compositions of silver with noble metals of the gold, platinum, and palladium family of the periodic system.

3. An electric contact combination for D. C. operation, the contact on the positive side of said combination being formed of a metal composition containing appreciable proportions of cadmium and the contact on the negative side having the composition

	Per cent
Palladium, platinum or gold	0 to 50
Silver	Balance

4. An electric contact combination for D. C. operation, the contact on the positive side of said combination being formed of a silver alloy containing appreciable proportions of cadmium and the contact on the negative side having the composition

	Per cent
Palladium, platinum or gold	0 to 50
Silver	Balance

5. The combination of claim 1 wherein the alloy on the positive side contains small proportions of metal selected from the group consisting of copper, nickel, cobalt, iron and manganese.

6. The combination of claim 1 wherein the alloy on the negative side contains small proportions of metal selected from the group consisting of nickel, cobalt, iron and manganese.

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