

Sept. 10, 1957

O. RÖMER

2,806,113

ELECTRIC CONTACT DEVICES

Filed Nov. 19, 1954

Fig. 1

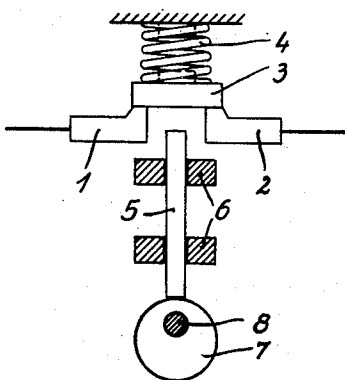
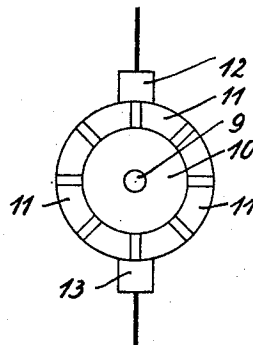


Fig. 2



Inventor:

Otto Römer

1

2,806,113

ELECTRIC CONTACT DEVICES

Otto Römer, Berlin, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin-Siemensstadt and Munich, Germany, a German corporation

Application November 19, 1954, Serial No. 470,059

Claims priority application Germany November 21, 1953

2 Claims. (Cl. 200—166)

My invention relates to electric contact devices and, in a more particular aspect, to the electric contact pieces in frequently operating switching devices such as commutators, slip rings, contact rectifiers, contactors or other switches for periodic or frequently repeated performance.

The electric contacts in such devices are often subject to trouble originating from the switching action as such. During the striking together of the contacts and due to the friction resulting therefrom, the contact surfaces become deformed and some of the contact surface is abraded resulting in the formation of a fine dust containing layers of absorbed gas. This metal dust is not as resistant to corrosion and oxidation as the original contact material. As a consequence of the continual impacts during the operation of contact devices and the friction at the contact faces, the metal dust is forced into the contact surfaces. This results in frictional oxidation causing an increase in contact resistance. Moreover, the contacting action may convert the conductive crystal lattice of the contact material into an amorphous layer of poor conductance. Electrical contact surfaces, altered and roughened by these phenomena, are more readily subject to corrosion and oxidation, and this promotes the formation of a coating from molecules of volatile substances liberated from insulating materials, lacquers, dyes as well as other materials and present in the ambient air. Such conditions result in a substantial increase in contact resistance and produce a particularly unfavorable effect in electric circuits having weak loads, such as audio circuits, high-frequency circuits, measuring and signalling circuits as well as in all contact circuits in which sparking at the contacts is prevented by spark-suppression means so that the above-mentioned detrimental coating cannot be burned away by sparking.

In the case of sliding contacts, the afore-mentioned difficulties may occur to an even more pronounced extent, and additional contact deficiencies are often caused by grease on the contact surfaces and the deposition of other surface coatings, such as films of water on oxygen, that produce burnished contact surfaces which likewise have a high resistance. It is particularly disadvantageous if the surface deformations due to frictional contact action are irregularly distributed and of different magnitudes. The wear due to electrical and mechanical action is no longer uniformly distributed over the entire gliding surface so that, for instance, with a rotating contact, the continued operation causes the rotating area to lose its round shape. The pressure which the sliding contacts exert against each other becomes non-uniform whereby the current conductance is disturbed and the electrical and mechanical wear is still further increased. Additional corrosion, especially in an acid atmosphere, will accelerate the destructive effect.

It is an object of my invention to eliminate the above-described deficiencies and to devise a material for frequently operating contact devices that is free of the tendency to form abrasive metal dust or to oxidize due to friction.

2

To this end, and according to my invention, I form one or both of the mutually engageable contact pieces of an electric contact device of an alloy whose bulk consists of one of the usual contact materials and which, in addition, contains generally 0.1 to 40%, and preferably about 1 to 20% by weight of indium. The basic contact material to which the indium is admixed, may consist of silver and/or copper, alloys of copper or silver or other metals and metal compounds.

According to a preferred embodiment, the contact material consists of an alloy comprising about 1% to about 9% of indium, the remainder being a highly-conductive metal or alloy preponderantly of silver and/or copper.

According to still another feature of the invention, the bulk of the contact composition consists of high-melting heavy metal or a conductive salt thereof, namely of tungsten, molybdenum, tantalum or their carbides, borides or nitrides; and the additional metal, such as indium, is alloyed therewith.

The alloys of contact material according to the invention are formed either by melting the indium together with the bulk of the contact material thus producing a homogeneous alloy. The alloy, however, may also be formed by powder metallurgical methods. Accordingly, the indium and the bulk of the contact material are mixed in powder form, pressed and molded, and then agglomerated and solidified by sintering. Moreover, the indium may be applied by electrodeposition or by means of cathodic vaporization to be alloyed with, or diffused into, the contact material by subsequent treatment.

As a result of adding indium to contact materials used in lift-, plug-, clamp- and sliding-contact devices, mechanical deformation of the contact faces and particularly the formation of metal dust due to mechanical abrasion as well as the formation of burnished layers is virtually eliminated. This improves the properties of the contact material to such an extent that sliding contacts, for example, will steadily slide against each other without sticking or abrading and that any slight deformation of the contact faces that may still occur will not result in formation of metal dust. A constantly clean and smooth gliding movement is attained which minimizes corrosion of the sliding and/or lifting contact surfaces thus eliminating any oxidation due to friction securing a permanent resistance against electric attack and against wear due to material migration and material consumption (burning). In lifting contacts, fusion or sticking does no longer occur. The trouble-free action of the switching operation also diminishes contact bouncing, which likewise reduces electrical wear.

Contact materials according to this invention can be used to particular advantage for slip rings, commutators and other electric contact devices called upon to operate periodically or in frequent repetition. Examples of such devices are schematically illustrated on the drawing showing in Fig. 1 a synchronous contact device for a mechanical rectifier, and in Fig. 2 a commutator of a dynamo.

The rectifier according to Fig. 1 comprises two stationary contacts 1, 2 bridged by a movable contact 3 under pressure of a spring 4. A tappet 5 is slidably mounted in guides 6 and is reciprocated by an eccentric 7 to periodically open and close the contact device. The shaft 8 of the eccentric 7 is driven in synchronism with an alternating line voltage to be rectified. Consequently, the contact device operates at a switching frequency of 50 or 60 cycles per second. The present invention relates particularly to the contacts 1, 2 and 3 of the device and, as described, secures a long life of trouble-free operation.

The commutator shown in Fig. 2 comprises a shaft 9, a cylindrical insulating body 10 fastened to the shaft, and a plurality of commutator contacts 11 mounted on the cylindrical body in insulated relation to each other. The

3

respective stationary limit contacts are denoted by 12 and 13.

Aside from improving such and other contact devices in the respects afore-mentioned, the invention has the further advantages of greatly lessening the detrimental influence of acid upon the contacts of oil switches and of generally improving the contact devices for use in the tropics.

As mentioned, the indium may be applied as an alloying constituent to one of the usual highly-conductive materials on the basis of silver or copper. These contact materials are either silver alone, copper alone, alloys of silver and copper, and alloys of either silver or copper or both with one or more components of cadmium, magnesium, manganese, aluminum, gold, palladium, platinum, beryllium. The addition, according to the invention, of indium to a silver or copper alloy containing such alloying components has the further effect of greatly reducing acidic attacks when using the contacts in oil as is the case with oil-containing circuit breakers. The materials according to the invention are also improved as regards their stability in tropic climates.

The invention is further illustrated by the examples of particularly useful compounds according to the invention presented in the following three tables, the ratio of the various constituents being given in percent by weight.

Table I, below, lists a number of alloys produced by melting the contact material together with the additional metal.

Table I

Contact Material						Additional Metal			
Ag	Au	Cu	Pt	Pd	Ni	Zn	Sn	Cd	In
96-99	---	---	---	---	---	---	---	---	1-4
26-28	70	---	---	---	---	---	---	---	2-4
20-22	70	4-6	---	---	---	---	---	---	4
---	91	---	---	---	5	---	---	---	4
---	---	96-98	---	---	---	---	---	---	2-4
4-8	---	88-94	---	---	---	---	---	---	2-4
---	---	90	---	---	8	---	---	---	2
62-69	---	---	---	30	---	---	---	---	1-8
20	70	6	---	---	---	---	---	3	1
22	70	---	---	---	---	---	---	4	4
92-96	---	---	---	---	---	---	---	3-6	1-2
---	---	52-59	---	---	17	23	---	---	1-8
---	---	50-59	---	---	---	40	---	---	1-9
---	---	82-89	---	---	---	---	10	---	1-8

4

Table II relates to contact materials comprising compositions prepared by compressing and sintering respective pulverulent amounts of contact material and additional metal.

Table II

Contact Material						Additional Metal
W	Mo	Ni	Ag	Cu	Pd	In
60-70	---	---	21-39	---	---	1-9
60-70	---	---	---	21-39	---	1-9
---	---	26-34	60	---	5	1-9
---	---	26-34	60	5	---	1-9
---	52-56	3	40	---	---	1-5

As apparent from the tables, cadmium or zinc can be used in combination with indium. The preferred limits for indium are about 1% to 9%.

I claim:

1. A contact member for an electric contact device, formed of a composition of highly-conductive contact material and 0.1 to 40% by weight of indium, said contact material forming substantially the remainder of the composition and being selected from the group consisting of tungsten and its alloys, carbides and borides.

2. A contact member for an electric contact device, comprising a body formed of highly-conductive contact material, and a surface layer on said body forming a diffusion zone with said body, said layer and zone consisting of a composition of said material with 0.1 to 40% of indium.

References Cited in the file of this patent

UNITED STATES PATENTS

1,776,276	Williams	Sept. 23, 1930
1,847,941	Gray	Mar. 1, 1932
2,119,965	Schwarzkopf	June 7, 1938
2,189,755	Hensel	Feb. 13, 1940