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(54) **A contactor**

(57) A contactor has two contact elements (1, 2) each having a contact member (11, 12) adapted to bear against the contact member of the other contact element for enabling an electric current to flow between the two contact elements. Means are arranged for moving a movable (2) of the contact elements with contact member

apart from and into contact with a contact member (11) of the other contact element being fixed. The contact member (12) of the movable contact element is made of a hard contact material having a hardness HV above 70 and the contact member (11) of the fixed contact element is made of a soft contact material having a hardness HV below 30.

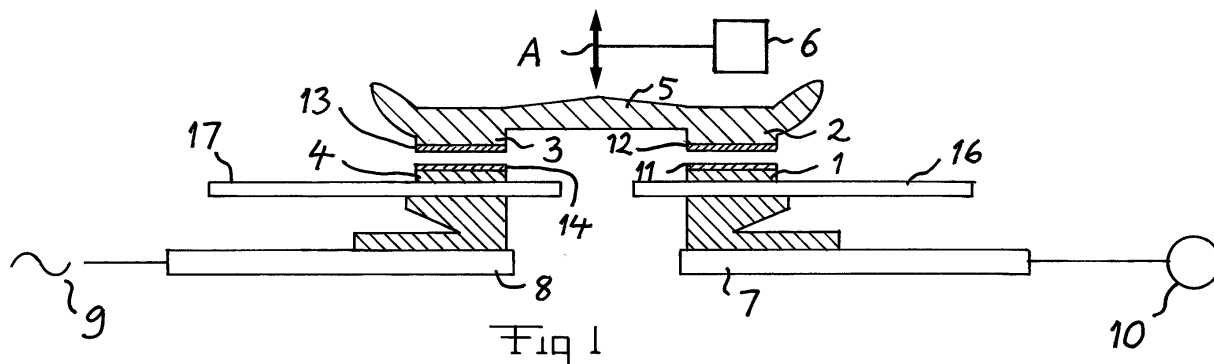


Fig 1

Description

TECHNICAL FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a contactor having two contact elements each having a contact member adapted to bear against the contact member of the other contact element for enabling an electric current to flow between said two contact elements, the contactor further comprising means for moving a movable of said contact elements with contact member apart from and into contact with a contact member of the other contact element being fixed for breaking and enabling, respectively, a said electric current flow between said two contact elements.

[0002] "Contactor" is here defined to comprise all types of devices having these characteristics. Thus, contactors being normally in closed contact making position enabling an electric current to flow between the two contact elements thereof, and in which the two contact elements are not intended to be separated as long as a device, an apparatus or a plant to which the contactor belong operates correctly, are comprised. The invention is also directed to such contactors of the type intended to establish and break an electric current flow between the two contact elements during normal operation state of the contactor as well as contactors being in the opened state more than in the closed state enabling an electric current flow between the two contact elements.

[0003] Furthermore, the contactor may have more than two contact elements and each contact element may have more than one said contact member. In fact, they have often six contact elements, two per phase of a three-phase network, with one contact member each. All movable contact elements may in such a case be arranged on the same body for being moved together to contact fixed contact elements, although other structures are possible.

[0004] The different types of operation of such contactors are normally indicated by using the standard IEC 947-4-1, in which for instance AC1 is an operation in which the contactor is connected to resistive loads and is normally in the closed state and AC3 is an operation in which the contactor is connected to motors and is opened and closed more often and where the risk of welding of the contacts is higher. The invention is particularly directed to contactors of the latter type without being restricted thereto.

[0005] Furthermore, the invention is not restricted to any particular range of electric currents intended to flow between the two contact elements in the closed state of the contactor, but it is particularly directed to contactors designed to have an electric current flow between the contact elements exceeding 5 A.

[0006] There are different requirements which contactors have to fulfil to function well. One such requirement is that a contactor has to offer a low and continuously

good contact resistance under rated current conditions. Another is that the contact members have to have a long life time and withstand a high number of opening and closing operations without being destroyed due to for instance high temperatures, which means that they have to show a behaviour of low arc erosion and welding. Good arc erosion is opposed to low contact resistance, since the arc erosion behaviour is improved with an increase of the melting point of the contact material, and the melting point is increased when the hardness of the material is increased and by that the contact resistance with normally also increase. Different type of materials also shows different welding behaviours, which means that a weld of different strength will be formed between two contact elements in the closed state of the contactor, and it is essential that this weld may be broken without destroying the contact members when the contactor has to be opened. Thus, the material for the contact members of such a contactor has been chosen as a compromise between welding behaviour, contact resistance (conductivity) and arc erosion resistance. Optimizing for example the contact resistance may for example result in a larger arc erosion during breaking and by that a shorter life time of the contactor.

SUMMARY OF THE INVENTION

[0007] The object of the present invention is to provide a contactor of the type defined in the introduction which provides an improved possibility to combine the essential properties of a contactor of this type.

[0008] This object is according to the invention obtained by providing such a contactor in which the contact member of said movable contact element is made of a hard contact material having a hardness HV (Hardness Vickers) above 70 and the contact member of said fixed contact element is made of a soft contact material having a hardness HV (Hardness Vickers) below 30.

[0009] The invention is based on the idea that the movable contact element with contact member may have different thermal properties than the fixed contact element with contact member, since it is possible and normally also chosen to have the fixed contact element with the contact member arranged close to a large thermal mass of high thermal conductivity, whereas the thermal mass of the movable contact element with contact member will be smaller. Furthermore, it has been realized that this may be utilized by making the contact member of the movable contact element of a hard contact material thus possessing a high arc erosion resistance, whereas the contact member of the fixed contact is made of a soft contact material lowering the contact resistance when the two contact members make contact to each other but still having an acceptable low degradation due to arc erosion thanks to the lower temperature of this contact member with contact element by cooling via thermal conduction. Thus, the hard contact material is used where it is needed with respect to arc erosion behaviour while still

obtaining a low contact resistance of the contactor by using a soft contact material where the arc erosion constitutes a smaller problem.

[0010] According to an embodiment of the invention said hard contact material comprises AgSnO_2 with a content of SnO_2 exceeding 10 percentage by weight, advantageously being 12-19 percentage by weight and preferably being 13-17 percentage by weight. This hard contact material has a high arc erosion resistance resulting in a long electric life time thereof enabling closing and breaking a current through the contactor for instance in the order of 500 000 times or more.

[0011] According to another embodiment of the invention said soft material comprises AgSnO_2 with a content of SnO_2 being max 5 percentage by weight, preferably 2-5 percentage by weight. By choosing such a silver tin oxide with a low tin oxide content the contact resistance of the contactor may be reduced substantially with respect to contact materials normally used for the contact members of contactors of this type while still withstanding arc erosion in a satisfying way thanks to the possibility of better cooling via thermal conduction of the fixed contact element.

[0012] According to another embodiment of the invention said soft contact material is Ag.

[0013] According to a still further embodiment of the invention said hard contact material comprises AgCdO with a content of CdO exceeding 10 percentage by weight, advantageously being 12-22 percentage by weight and preferably being 14-20 percentage by weight. This hard contact material has a high arc erosion resistance resulting in a long electric life time thereof enabling closing and breaking a current through the contactor for instance in the order of 500 000 times or more.

[0014] According to another embodiment of the invention the contactor comprises an arc extinguishing plate mounted closely to the contact member of said fixed contact element. The arc extinguishing plate will besides the arc extinguishing feature also contribute to cooling by thermal conduction of the fixed contact element.

[0015] According to another embodiment of the invention the contactor comprises means adapted to press said contact elements with the contact members against each other in a contact making state of said contactor, which reduces the contact resistance of the contactor in the contact making state thereof.

[0016] According to another embodiment of the invention the contactor comprises four said contact elements, two of said elements are fixed and connected to an electric current path at spaced apart locations, and two of said contact elements are movable and connected in series on a body in common for being moved together by moving said body for closing said current path from one fixed contact element to the other by entering into contact with a contact member of a fixed contact element each. This is a favourable design of a contactor of this type, and it may well be adapted to establish and break a connection between a source of electric power, such as a

generator or a power network, and a consumer of electric power, such as an electric motor. The invention is especially suitable for a conductor of this type, for which it is important that a low arc erosion resistance for a long life time is ensured, at the same time as the contact resistance should be kept as low as possible for reducing power losses and by that saving costs when feeding said consumer with electric power.

[0017] According to another embodiment of the invention the contactor is designed to have an electric current to flow between said contact elements exceeding 5 A, advantageously exceeding 50 A, preferably being at least 500 A and most preferred 500 A-5000 A. The characteristics of the contactor according to the invention are particularly favourable for contactors intended to carry such currents in the closed state thereof.

[0018] According to another embodiment of the invention the contactor is of the type intended to establish and break said electric current flow between said contact elements during normal operation state of the contactor, for which contactors the present invention is most interesting, but according to another embodiment of the invention the contactor is of the type intended to be closed for enabling an electric current to flow between said contact elements in the normal operation state thereof.

[0019] Other advantages as well as advantageous features of the invention will appear from the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] With reference to the appended drawings below follows a specific description of an embodiment of the invention cited as an example.

[0021] In the drawings:

Fig. 1 is a very schematic view illustrating a contactor according to the invention in an opened state, and

Fig. 2 is a view of a part of the contactor according to Fig. 1 in a closed state.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0022] Fig. 1 shows very schematically a contactor according to the present invention in an opened state. The contactor has four contact elements 1-4 of which two 2, 3 are arranged on a body 5 in common being movable in the direction of the arrow A through means 6 according to a substantially rectilinear path towards and away from the other two contact elements 1, 4 being fixed for transferring the contactor to a closed and opened state, respectively. Said contact elements 1-4 are made of a material with a high electric conductivity, such as Cu.

[0023] The fixed contact elements 1, 4 are connected to an electric current path, such as to an end of a respec-

tive conductor rail 7, 8, at spaced apart locations. One fixed contact element 4 is in this way connected to an electric power source 9, whereas the other fixed contact element 1 is connected to an electric motor 10. The electric motor 10 will be connected to the power source 9 by movement of the movable contact elements in contact with the fixed contact elements.

[0024] Each contact element has a contact member 11-14 in the form of a layer of a contact material adapted to bear against the contact member of another contact element for enabling an electric current to flow between the contact elements. Means 15 schematically indicated in Fig. 2 are arranged for pressing the contact elements with the contact members against each other in a contact making state of the contactor for making a good contact therebetween.

[0025] The contact members 12, 13 of the movable contact elements 2, 3 are made of a hard contact material having a hardness HV (Hardness Vickers) above 70, while the contact members 11, 14 of the fixed contact elements 1, 4 are made of a soft contact material having a hardness HV (Hardness Vickers) below 30.

[0026] The material of the contact members 12, 13 may be AgSnO_2 with a content of SnO_2 exceeding 10 percentage by weight, advantageously being 12-19 percentage by weight and preferably being 13-17 percentage by weight. Another possibility is that these contacts are of a hard contact material comprising AgCdO with a content of CdO exceeding 10 percentage by weight, advantageously being 12-22 percentage by weight and preferably being 14-20 percentage by weight. Such a hard contact material having a hardness HV above 70 will have a high arc erosion resistance and by that a long electric life time.

[0027] The contact members 11, 14 of the fixed contact elements 1, 4 are made of a soft contact material having a hardness HV (Hardness Vickers) below 30. This soft contact material may comprise AgSnO_2 with a content of SnO_2 being max 5 percentage by weight, preferably 2-5 percentage by weight. Another possibility is that the soft contact material is Ag. A contact member of such a soft contact material will be able to make a very intimate contact to the corresponding movable contact member, so that a low contact resistance results.

[0028] Each fixed contact element 1, 4 is further connected to an arc extinguishing plate 16, 17, the function of which will be described below.

[0029] The function of the contactor will be as follows. When the contactor is in the closed state shown in Fig. 2 and a current is flowing through the contact elements and the contact members thereof and the movable contact elements are moved away from the fixed ones by moving the body 5 according to the arrow A an arc will be created between the opposed surfaces of two contact members, such as 11 and 12 and 13 and 14. This arc will stand between these contact members for some milliseconds, i.e. up to about 4 ms. This arc will have a more severe thermal impact on the contact members 12, 13

of the moving contact elements than upon the contact members 11, 14 of the fixed contact elements 1, 4, since the latter are close to a large thermal mass in the form of the arc extinguishing plates 16, 17 and the mass of the fixed contact elements of high thermal conductivity, so that the contact members 11, 14 will have a lower temperature by cooling via thermal conduction than the contact members 12, 13. Thanks to the fact that the contact members of the fixed contact elements are close to a larger thermal mass than the contact members of the moving contact elements and of a high thermal conductivity they will be better cooled and can withstand the arc erosion in a better manner. Thus, it will in this way be possible to combine the advantageous features of a hard contact material with those of a soft contact material in a favourable way.

[0030] The invention is not in any way restricted to the embodiment described above, but many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the basic idea of the invention as defined in the appended claims.

Claims

1. A contactor having two contact elements (1-4) each having a contact member (11-14) adapted to bear against the contact member of the other contact element for enabling an electric current to flow between said two contact elements, the contactor further comprising means (6) for moving a movable (2, 3) of said contact elements with contact member apart from and into contact with a contact member of the other contact element (1, 4) being fixed for breaking and enabling, respectively, a said electric current flow between said two contact elements, **characterized in that** the contact member (12, 13) of said movable contact element is made of a hard contact material having a hardness HV (Hardness Vickers) above 70 and the contact member (11, 14) of said fixed contact element is made of a soft contact material having a hardness HV (Hardness Vickers) below 30.
2. A contactor according to claim 1, **characterized in that** said hard contact material comprises AgSnO_2 with a content of SnO_2 exceeding 10 percentage by weight, advantageously being 12-19 percentage by weight and preferably being 13-17 percentage by weight.
3. A contactor according to claim 1 or 2, **characterized in that** said soft contact material comprises AgSnO_2 with a content of SnO_2 being max 5 percentage by weight, preferably 2-5 percentage by weight.
4. A contactor according to claim 1 or 2, **characterized in that** said soft contact material is Ag.

5. A contactor according to any of claims 1, 3 or 4, **characterized in that** said hard contact material comprises AgCdO with a content of CdO exceeding 10 percentage by weight, advantageously being 12-22 percentage by weight and preferably being 14-20 percentage by weight. 5

6. A contactor according to any of the preceding claims, **characterized in that** it comprises an arc extinguishing plate (16, 17) mounted closely to the contact member (11, 14) of said fixed contact element (1, 4). 10

7. A contactor according to any of the preceding claims, **characterized in that** it comprises means (15) adapted to press said contact elements (1-4) with the contact members (11-14) against each other in a contact making state of said contactor. 15

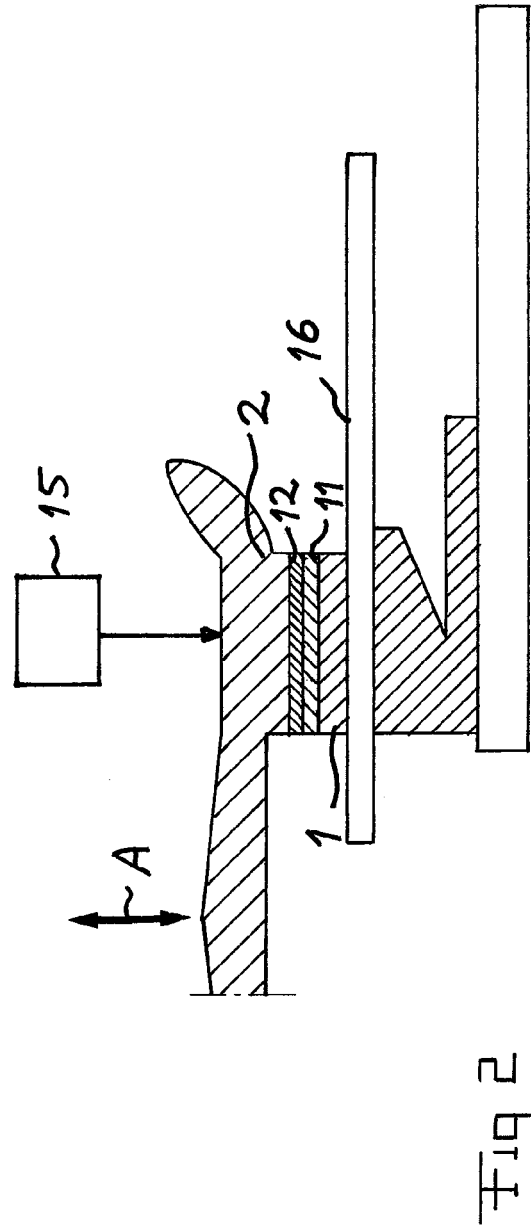
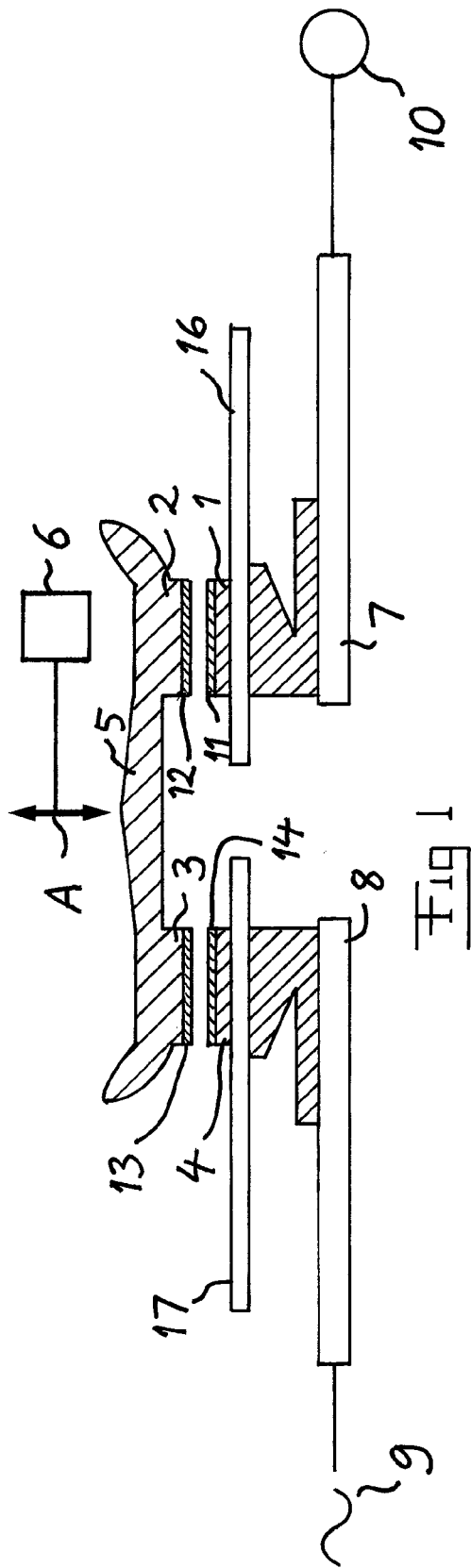
8. A contactor according to any of the preceding claims, **characterized in that** it comprises four said contact elements (1-4), that two (1, 4) of said elements are fixed and connected to an electric current path at spaced apart locations, and that two (2, 3) of said contact elements are movable and connected in series on a body (5) in common for being moved together by moving said body for closing said current path from one fixed contact element to the other by entering into contact with a contact member of a fixed contact element each. 20
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9. A contactor according to any of the preceding claims, **characterized in that** it is adapted to establish and break a connection between a source (9) of electric power, such as a generator or a power network, and a consumer (10) of electric power, such as an electric motor. 35

10. A contactor according to any of the preceding claims, **characterized in that** it is designed to have an electric current to flow between said contact elements exceeding 5 A, advantageously exceeding 50 A, preferably being at least 500 A, and most preferred 500 A-5000 A. 40
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11. A contactor according to any of the preceding claims, **characterized in that** it is of the type intended to be closed for enabling an electric current to flow between said contact elements (1-4) in the normal operation state thereof. 50

12. A contactor according to any of claims 1-10, **characterized in that** it is of the type intended to establish and break said electric current flow between said contact elements (1-4) during normal operation state of the contactor. 55





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 5477

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 40 24 939 A1 (SIEMENS AG [DE]) 20 February 1992 (1992-02-20) * column 1, line 3 - line 47 *	1-12	INV. H01H1/0237 H01H1/04 H01H1/02
Y	KARL-HEINZ SCHRÖDER: "Werkstoffe für elektrische Kontakte und ihre Anwendungen" 1997, EXPERT VERLAG, 71272 RENNINGEN-MALMSHEIM, XP002405901 * page 86 - page 87 *	1-12	
Y	EP 1 387 370 A (INOVAN GMBH & CO KG METALLE UND [DE]) 4 February 2004 (2004-02-04) * paragraph [0021] *	4	
Y	EP 0 059 476 A2 (MITSUBISHI ELECTRIC CORP [JP]) 8 September 1982 (1982-09-08) * page 9, line 34 - page 11, line 13; figure 3b *	6,8	
Y	FR 2 394 164 A1 (CUTLER HAMMER WORLD TRADE INC [US]) 5 January 1979 (1979-01-05) * page 5, line 25 - line 27; figure 2 *	7	TECHNICAL FIELDS SEARCHED (IPC)
A	CH 217 329 A (HERMES PATENTVERWERTUNGS GMBH [DE]) 15 October 1941 (1941-10-15) * page 1, line 1 - page 2, line 57 *	1-12	H01H
A	US 2003/057073 A1 (SMITH RICHARD G [US]) 27 March 2003 (2003-03-27) * page 1, paragraph 19 - paragraph 29 *	1-12	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 November 2006	Examiner Drabko, Jacek
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 11 5477

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4024939	A1	20-02-1992	NONE
EP 1387370	A	04-02-2004	NONE
EP 0059476	A2	08-09-1982	DE 3268213 D1 13-02-1986 US 4459445 A 10-07-1984
FR 2394164	A1	05-01-1979	DE 2824592 A1 07-12-1978 GB 1588285 A 23-04-1981 JP 54003277 A 11-01-1979 SE 440566 B 05-08-1985 SE 7806558 A 07-12-1978 US 4195212 A 25-03-1980
CH 217329	A	15-10-1941	NONE
US 2003057073	A1	27-03-2003	NONE