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ELECTRICAL CONTACT ELEMENT

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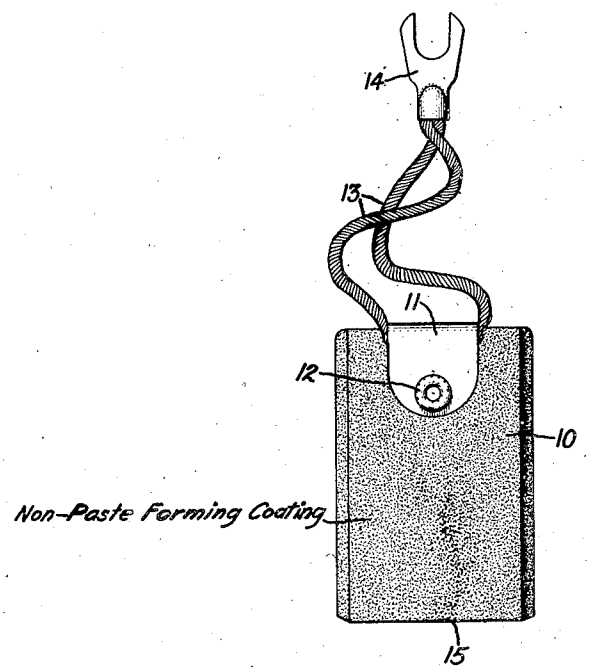

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ELECTRICAL CONTACT ELEMENT

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32 Claims. (Cl. 171—325)

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My invention relates to electrical contact elements and particularly to improved contact brushes and methods of making the same.

An object of my invention is to provide an improved electrical contact element.

Another object of my invention is to provide an improved electrical contact element formed of a porous block of electrically conductive material provided with a lubricant for the contact surface thereof.

A further object of my invention is to provide an improved method of making an electrical contact element.

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

The single figure in the drawing illustrates a contact brush for a dynamo-electric machine embodying my invention and made in accordance with my improved method of construction.

It has been found that under normal atmospheric conditions with average humidity, atmospheric water vapor provides the best known lubricant for the contact surfaces of carbon and metal-graphite brushes. It has also been found that electrical contact elements made of porous blocks of finely divided electrically conductive material, such as carbon or metal and graphite brushes, tend to wear away very rapidly in dry atmospheres. In the past different lubricants have been suggested for minimizing the friction of the contact surface of the brushes and thereby improving the life of the contact element, but so far as is now known, these various lubricants do not prevent brushes from wearing away rapidly in dry atmospheres. Furthermore, most of the lubricants which have been suggested disadvantageously change the electrical characteristics of the brush or combine with the contact element material to form substances which impede the free movement of the contact element on its guide member or brush holder, thereby decreasing the efficiency of operation of the combination. I have found that impregnating a porous block of electrically conductive material with a humectant which has the characteristic of wetting the brush material even in the absence of water in the impregnating material, such as a polyhydric alcohol or alcohol-ether or mixtures of these in at least a portion of the block, to provide a lubricant for the contact surface thereof greatly increases the life of the porous block, especially in dry atmospheres. Furthermore, I have found that under certain conditions and for certain types of materials, the contact element is improved by applying to the sides thereof a coat of relatively thin material which will not form a paste with the impregnant of the contact element when the brush vibrates and moves on its guiding surface.

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In the drawing, I have shown an electrical contact element formed as an electric current collector brush including a porous block 10 of bonded finely divided electrically conductive carbonaceous material, such as carbon, graphite, metal-graphite, or other similar material including a substantial amount of carbon such as is conventionally used in the manufacture of contact elements, such as commutator and slip-ring brushes. A terminal clip 11 is secured to the porous block 10 by a rivet 12 and an electrically conductive pigtail member 13 is secured to the terminal clip 11 and to a connecting terminal element 14 for conducting current between a brush holder connector and the contact element block 10. In order to provide a lubricant to the contact surface 15 of the porous block 10, a portion of the block below the terminal clip 11, or the entire porous block 10, is impregnated with a polyhydric alcohol or alcohol-ether solution. Among the polyhydric alcohols which have been found to provide an efficient lubricant for the contact surface of the brush 10, I have found the ethylene glycols to be particularly efficient. Mixtures of different polyhydric alcohols also have good lubricating properties. These impregnants are highly hygroscopic and water soluble and have a relatively wide liquid state temperature range. Generally, they also have the desirable properties of a relatively high flash point and a relatively low vapor pressure at normal contact element operating temperatures. For certain types of electrically conductive materials, such as carbon, electro-graphitic, or natural graphite brushes, I have found a solution of from 10% to 30% of nonaethylene glycol

$$HOCH_2(CH_2OCH_2)_8CH_2OH$$

in water to be a very efficient impregnant, especially if the metal content of the brush is 50% or less. For contact elements wherein the porous material comprises a very large amount of metal, 60% or more, I have found that an impregnant comprising 40% to 60% nonaethylene glycol and

20% to 30% polyolefin glycol in water is a very efficient lubricant.

In forming my improved contact elements, I have found it desirable to degas the porous block by subjecting it to a relatively low pressure and then impregnating the degassed block with the lubricant, after which excess impregnant is removed from the block, and, in certain cases, a relatively thin coating of material, which does not react with the impregnant, is applied to the sides of the dried block. In degassing the porous block, the contact element is immersed in a solution of the impregnant, such as a 20% to 40% solution of nonaethylene glycol in water or benzene, and the block is subjected to a relatively low pressure in this solution for from one to two hours, such that the water or benzene comes to a boil, removing the gas from the porous block. After this treatment, a part or the whole of the porous block is impregnated at substantially atmospheric pressure with the solution of polyhydric alcohol in water or benzene for from one to two hours. Excess impregnant then is removed from the outside of the block in any suitable manner, as by wiping or draining. The block then may be dried at a temperature between 70° and 120° C. to remove water from the brush and to provide the desired concentration of impregnant. As stated above, with certain porous materials, it is desirable to provide a very thin coating of non-paste forming material over the sides of the block. I have found that a thin coating of metal of between 5 and 10 mils thickness applied to the sides of the block by spraying molten metal under pressure, as by the Schoop process provides an efficient low-friction surface which will not form a paste with the impregnant, even after long periods of use and vibration over a supporting or guiding surface. This metal preferably is of relatively high electrical conductivity, such as copper, and may or may not be porous. A metal coating of this type provides a relatively hard guiding surface for the brush on its brush holder and effectively prevents sticking of the brush in the holder.

While I have illustrated and described particular embodiments of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangements disclosed, and I intend in the appended claims to cover all modifications which do not depart from the 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 electrical contact element including a current collector brush formed of a porous block of finely divided electrically conductive carbonaceous material, and a solution comprising ethylene glycol solution in at least a portion of said porous block.

2. A molded electrical contact element including a block of finely divided carbon, and an ethylene glycol solution in at least a portion of said block.

3. An electrical contact element including a current collector brush formed of a porous member of finely divided bonded carbonaceous material, and an ethylene glycol solution in at least a portion of said porous member.

4. An electrical contact element including a porous graphitic block, and an ethylene glycol impregnated into at least a portion of said porous block.

5. A molded electrical contact element including a graphitic block, and having a portion of said block impregnated with an ethylene glycol solution as a lubricant for the contact surface of said element.

6. An electrical contact element including a current collector brush formed of a porous block of electrically conductive carbonaceous material, and having at least a portion of said block impregnated with a solution including a polyhydric alcohol as a lubricant for the contact surface of the element.

7. An electrical contact element including a current collector brush formed of a porous carbonaceous block, and having at least a portion of said block impregnated with glycerol as a lubricant for the contact surface of the element.

8. An electrical contact element including a current collector brush formed of a porous carbonaceous block, and having at least a portion of said block impregnated with a higher boiling point glycol as a lubricant for the contact surface of the element.

9. An electrical contact element including a current collector brush formed of a porous carbonaceous block, and having at least a portion of said block impregnated with polyolefin glycol as a lubricant for the contact surface of the element.

10. An electrical contact element including a current collector brush formed of a porous block of electrically conductive carbonaceous material, and having at least a portion of said block impregnated with a hygroscopic humectant material characterized by the property of wetting said brush material in the absence of water in said impregnating material.

11. An electrical contact element including a current collector brush formed of a porous carbonaceous block, and having at least a portion of said block impregnated with a highly hygroscopic material characterized by the property of wetting said carbonaceous material of said brush in the absence of water in said impregnating material and having a relatively low vapor pressure at normal contact element operating temperatures.

12. A brush element including a porous carbonaceous block of finely divided electrically conductive material, a humectant in at least a portion of said porous block, and means including a relatively thin coating on the sides of said block for preventing the formation of a paste by said humectant and said finely divided material.

13. A molded electrical contact element including a graphitic block, and having a portion of said block impregnated with nonaethylene glycol as a lubricant for the contact surface of said element.

14. A brush element including a porous block of electrically conductive carbonaceous material, and having at least a portion of said block impregnated with an alcohol-ether solution as a lubricant for the contact surface of the element.

15. A brush element including a porous carbonaceous block, and having at least a portion of said block impregnated with a highly hygroscopic material characterized by the property of wetting the porous material of said brush in the absence of water in said impregnating material and having a relatively high flash point.

16. An electrical contact element including a porous block of finely divided electrically conductive carbonaceous material, at least a portion of said block being impregnated with a highly hygroscopic lubricant for the contact surface of

said element, and means including a relatively thin coating on the sides of said block for preventing the formation of a paste by said impregnant and said finely divided material.

17. An electrical contact element including a porous block of finely divided electrically conductive material, at least a portion of said block having a liquid lubricant therein for the contact surface of said element, and means including a coating on the sides of said block having the characteristics of a coating applied by spraying under pressure on the sides of said block for preventing the formation of a paste by said impregnant and said finely divided material.

18. An electrical contact element including a porous block of finely divided electrically conductive carbonaceous material, at least a portion of said block being impregnated with a polyhydric alcohol solution providing a lubricant for the contact surface of said element, and means including a relatively thin coating on the sides of said block for preventing the formation of a paste by said impregnant and said finely divided material.

19. An electrical contact element including a porous block of finely divided electrically conductive material, at least a portion of said block having a lubricant therein for the contact surface of said element, and a metallic coating on the sides of said block having the characteristics of a coating applied by spraying under pressure on the sides of said block.

20. An electrical contact element including a porous block of finely divided electrically conductive carbonaceous material, at least a portion of said block being impregnated with a polyhydric alcohol solution providing a lubricant for the contact surface of said element, and a metallic coating on the sides of said block.

21. A brush element including a porous block of electrically conductive material, and an impregnant in at least a portion of said block comprising a solution of nonaethylene glycol and polyolefin glycol in water.

22. A brush element including a porous block of electrically conductive material, and an impregnant in at least a portion of said block comprising a solution of substantially 50% nonaethylene glycol and substantially 25% polyolefin glycol in substantially 25% water.

23. A brush element including a porous block of electrically conductive material, and an impregnant in at least a portion of said block comprising a solution of substantially 30% nonaethylene glycol in water.

24. The method of making an electrical contact element including forming a porous block, degassing the porous carbonaceous block, and impregnating at least a part of the degassed porous block with a polyhydric alcohol solution.

25. The method of making an electrical contact element including forming a porous block, impregnating at least a part of the porous block with a polyhydric alcohol solution, and applying to the sides of the impregnated block by spraying under pressure a relatively thin coating of material non-paste forming with the impregnant.

26. The method of making an electrical contact element including forming a porous block, degassing the porous block, impregnating at least a part of the degassed porous block with a polyhydric alcohol solution, and applying to the sides of the impregnated block a relatively thin coating of material non-paste forming with the impregnant.

27. The method of making an electrical contact element including forming a porous block, impregnating at least a part of the porous block with a polyhydric alcohol solution, and applying by spraying under pressure a relatively thin coating of metal to the sides of the impregnated block.

28. The method of making an electrical contact element including forming a porous block of electrically conductive material, degassing the porous block by subjecting it to a relatively low pressure, impregnating at least a part of the degassed porous block with nonaethylene glycol, removing excess impregnant from the block, and applying to the sides of the dried block a relatively thin coating of material non-paste forming with the impregnant.

29. The method of making an electrical contact element including forming a porous block of electrically conductive material, degassing the porous block by subjecting it to a relatively low pressure, impregnating at least a part of the degassed porous block with a polyhydric alcohol solution, removing excess impregnant from the block, and applying a relatively thin coating of metal to the sides of the dried block.

30. The method of making an electrical contact element including forming a porous block of electrically conductive material, degassing the porous block by subjecting it to a relatively low pressure, impregnating at least a part of the degassed porous block with a solution of nonaethylene glycol and polyolefin glycol, removing excess impregnant from the block, and applying to the sides of the dried block a relatively thin coating of from 5 to 10 mils thickness of material non-paste forming with the impregnant.

31. The method of making an electrical contact element including forming a porous block of electrically conductive material, degassing the porous block by subjecting it to a relatively low pressure for from one to two hours, impregnating at least a part of the degassed porous block with a solution of nonaethylene glycol in benzene for from one to two hours, removing excess impregnant from the block by draining and by drying at a temperature between 70° and 120° C., and applying to the sides of the dried block a relatively thin coating of from 5 to 10 mils thickness of material non-paste forming with the impregnant.

32. The method of making an electrical contact element including forming a porous block of finely divided metallic and graphitic electrically conductive material, degassing the porous block by immersing in a 20% to 40% solution of nonaethylene glycol in water and subjecting the block for one to two hours to a relatively low pressure such that the water of the solution boils, impregnating at least a part of the degassed porous block at substantially atmospheric pressure with a 20% to 40% solution of nonaethylene glycol in water for from one to two hours, removing excess impregnant from the block by draining and by drying at a temperature between 70° and 120° C., and applying to the sides of the dried block a relatively thin coating of from 5 to 10 mils thickness of material non-paste forming with the impregnant.

ROBERT H. SAVAGE.