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A. PALME ET AL
ELECTRIC SWITCH CONTACT

2,547,658

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Fig.1.

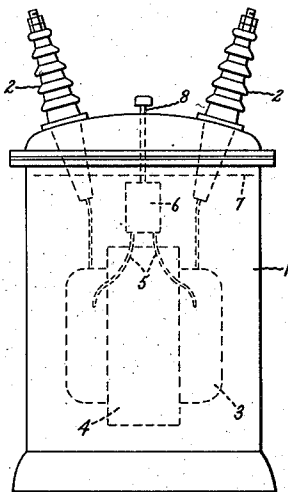


Fig.2.

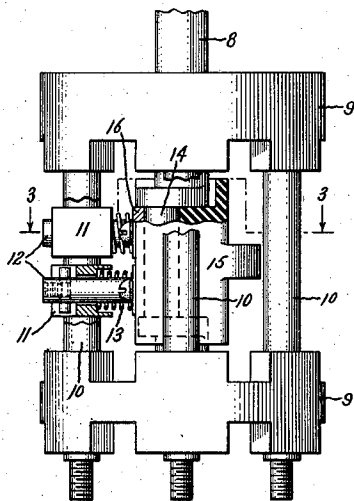


Fig.4.

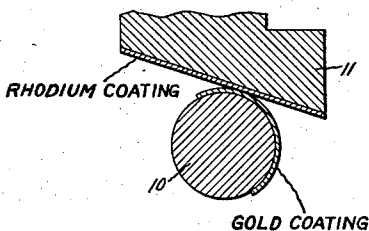


Fig.3.

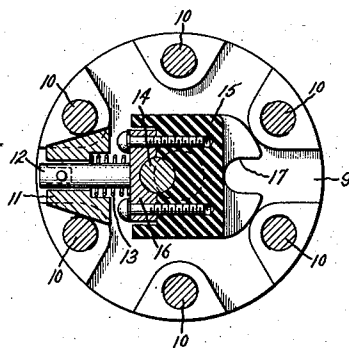
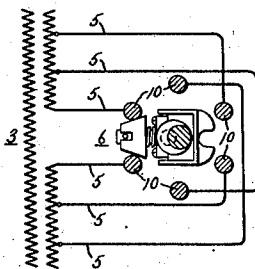


Fig.5.



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UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH CONTACT

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3 Claims. (Cl. 200—166)

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This invention relates to electric switch contacts and more particularly to improvements in tap changing switches which are adapted to operate submerged in hot mineral oil. A typical tap changing switch of the non-arcing duty ratio adjuster type is described in Patent No. 2,255,501, granted September 9, 1941, on an application of L. F. Blume and assigned to the present assignee. Such a switch is used for changing the ratio of a transformer and it is usually mounted in the transformer tank below the surface of the insulating and cooling liquid with which the tank is usually substantially filled. In many cases, this liquid is high quality refined mineral oil. The contacts of the switch are usually made of silver or are silver plated because such material has long been considered one of the best for this purpose. However, long experience with such ratio adjuster as shown with the silver contacts in time became coated with a black scale which eventually peels off the surface and is replaced by a new layer of scale. This has been found to be caused by traces of sulphur in the mineral oil which combine with the silver to form silver sulphide. The silver sulphide flakes which are thus formed have been known to cause short circuits or arcovers of the switch by forming a conducting path between the fixed contacts.

The obvious solution to this problem would be to eliminate the sulphur in the mineral oil but investigation has proved that this is impractical because it would be prohibitively expensive.

Another solution is to find a suitable contact material which will not be affected by the sulphur and will not form sulphides or the like which will cause deleterious effects. Such material must be immune to tarnish in hot oil, that is to say it must be immune to sulphurizing, oxidizing or saponifying. It must also have good electrical conductivity. Furthermore, its ohmic resistance and therefore its watt loss in contact with its companion member must be steady over a long period of years. It must have good mechanical wearing properties so as to withstand repeated heavy pressures of 40 to 75 lbs. with sliding or rubbing motion with its companion member.

In accordance with this invention, it has been discovered that the combination of gold and rhodium as the two engaging contact surfaces is a highly satisfactory combination from all standpoints.

An object of the invention is to provide improvements in switch contacts.

Another object of the invention is to provide an improved combination of switch contact materials for use in hot mineral oil.

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Another object of the invention is to improve the operation of tap changing switches.

The invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a side elevation view partly in phantom of a transformer provided with a ratio adjuster switch; Fig. 2 is a side elevation view of the switch shown in Fig. 1; Fig. 3 is a sectional view taken on line 3—3 of Fig. 2; Fig. 4 is an enlarged view of a pair of abutting contacts of the switch taken in the plane of Fig. 3, and Fig. 5 is a circuit diagram showing how the switch contacts are connected to a winding.

Referring now to the drawing and more particularly to Fig. 1, there is shown a conventional transformer tank 1 provided at its top with high voltage bushings 2 whose inner ends are connected to a transformer winding 3 on a magnetic core 4. Taps 5 brought out from the winding 3 are connected to a ratio adjuster switch 6. The tank 1 is substantially filled with mineral oil up to the level indicated by 7. This mineral oil during operation of the transformer is raised to a temperature substantially above that of the ambient temperature, the temperature rise being typically 50–70° C. The switch 6 is operated from outside the tank by an operating shaft 8. The details of the switch 6 are shown in Figs. 2 and 3. Referring now to these figures, the switch comprises a pair of end members 9 of insulation between which extend a plurality of parallel contact rods or bars 10. Adjacent pairs of these rods are interconnected selectively by a bridging contact member 11 in the shape of a wedge. Any desired number of wedges may be used, there actually being two of these wedge members, one above the other, as shown in Fig. 2.

The wedges 11 are carried on rods 12 and springs 13 are provided for forcing the wedges between the adjacent pairs of fixed contact rods. The switch is operated by a crank arm or member 14 on the main shaft 8. The crank 14 is embraced by a pair of members 15 and 16 which are held together by screws. The member 15 is provided with a notch 17 for engaging the various contact rods 10 during the operation of the switch.

The operation of the switch is as follows: Assume that shaft 8 is rotated clockwise as viewed from above. This will cause the crank 14 to rotate clockwise as viewed in Fig. 3, thus causing the assembly which is carried by the crank to pivot about the point of contact of the wedge 11 with the rods 10 and thereby cause the right

hand notched end of the member 15 to move upwardly as viewed in Fig. 3. When the shaft has made about one-fourth of a revolution, the notch 17 is about in line with the rod 10 which in Fig. 3 occupies approximately the position of the numeral 2 on the face of a clock. Further rotation of the shaft 8 causes the crank 14 to back the wedge out from between the contact rods 10 to move the notch 17 into embracing relation with the previously mentioned rod 10. Further rotation of the shaft will then cause the wedge assembly to pivot about the notch 17 and finally, when the shaft has made almost one complete revolution, the wedge will be driven between the next lower-most pair of adjacent contact rods. This completes one cycle of the operation and it will be seen that for a little less than one complete revolution of the operating shaft 8 in either direction, the wedge will be moved in the opposite direction from between one pair of adjacent contact rods to the next pair of adjacent contact rods.

In Fig. 3, the heavy shading of the contact surfaces indicates the gold and rhodium coatings. This is shown enlarged in Fig. 4. The gold coating is on the fixed contact rods 10 and the rhodium coating is on the wedge 11. One reason for this is that rhodium is substantially more expensive than gold and as there is considerably more contact surface on all the fixed rods 10 than on the wedge 11, it is more economical to use rhodium on the wedge than on the rods. The use of gold on both the wedge and the rods has been tried but the gold is so soft it produces a galling action and the contact surfaces do not wear properly. Rhodium to rhodium also does not operate satisfactorily from a mechanical wear standpoint and, of course, it is also very much more expensive than the rhodium-gold combination described above.

The at present preferred way of applying the coatings is by electroplating. Only the actual contact surface need be plated during the plating operation. The test of the surfaces may be masked in a well known manner.

Fig. 5 illustrates one way in which the contact rods 10 may be connected to taps 5 of the winding 3. This winding may be either the primary or secondary winding of the transformer.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications can be made without departing from the invention and therefore it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States:

1. In an electric switch for operation submerged in hot mineral oil containing traces of sulphur, a plurality of insulated fixed contact members normally subjected to a potential difference, and a movable contact member for selectively and slidably engaging said fixed contact members at pressures of 40 to 70 pounds, the surfaces of said fixed contact members which are engaged by said movable contact member having a gold coating, the surface of said movable contact member which engages said fixed contact members having a rhodium coating.

2. In combination, heat evolving electrical apparatus having a mineral oil filled enclosing casing, said oil containing traces of sulphur, a control switch for said apparatus, said switch being submerged in said oil, said switch having a plurality of relatively fixed contact members the surfaces of which have a gold coating, and a movable contact member the surface of which has a rhodium coating for slidably engaging the contact surfaces of said relatively fixed contacts at pressure of 40 to 70 pounds, said fixed contacts being connected respectively to different potential points in said apparatus.

3. A non-arcing duty ratio adjuster switch for use in an oil filled transformer comprising, in combination, a plurality of parallel cylindrical contact members symmetrically distributed around a common axis, and a wedge contact member for selective slidable bridging insertion between adjacent cylindrical contact members at contact pressures of 40 to 70 pounds, the contact surfaces of said cylindrical contact members having a gold coating, the contact surfaces of said wedge contact having a rhodium coating.

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