Dr: Ulrich Ringleb 10.08.2011

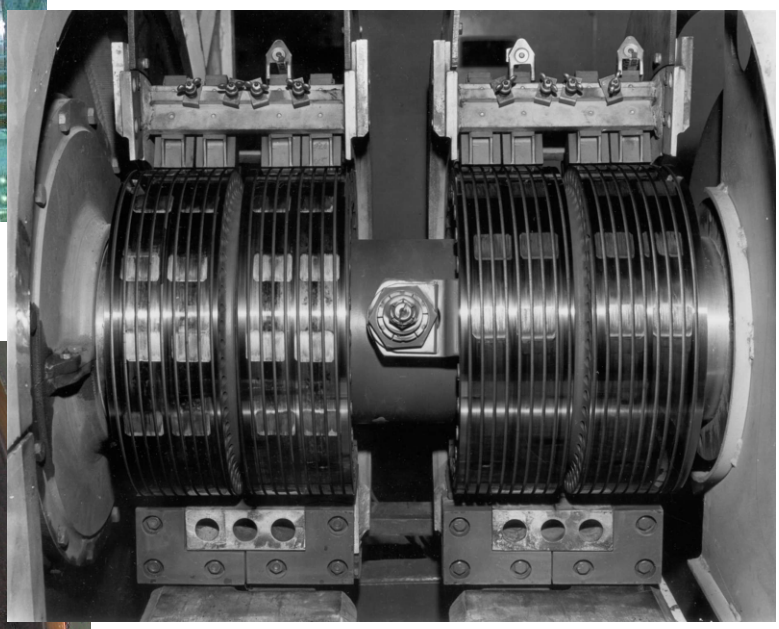
Standstill marks, standstill corrosion

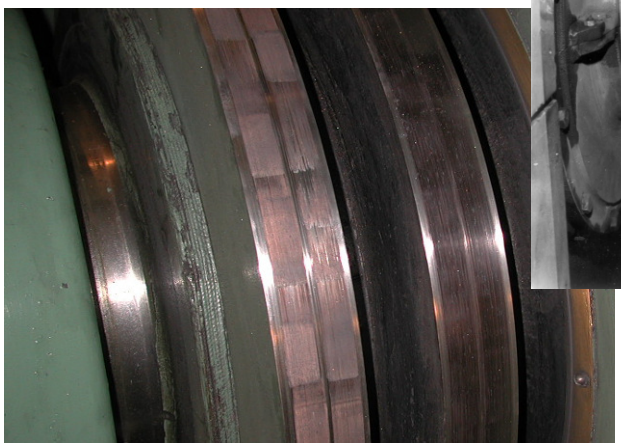
What does a carbon brush if it is doing nothing?

Can carbon brushes on electric machines during standstill remain on the commutator or slip ring or should they be removed ? That question is frequently asked to our field engineers.

First some pictures of so called standstill marks from the field. .

Standstill marks near-shore.





Standstill marks on synchronous machines

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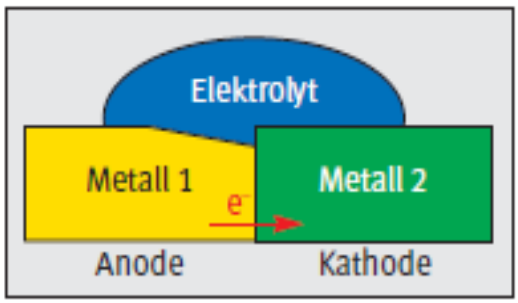
What happens here ? Some background knowledge is necessary for better understanding.
The contact pair carbon brush / commutator or slip ring is a combination of different materials. In case of DC motors that is a combination of carbon and copper, in case of induction or synchronous machines, depending on the ring material, carbon / copper as well or steel / copper / carbon.
Under specific conditions these combinations can lead to corrosion problems at one of the partners. This kind of corrosion is classed as either galvanic corrosion, contact corrosion or nowadays as Bimetal-corrosion.
In this context mentioned the term “electrochemical series” is often mentioned. That is, heavily simplified, a ranking of metal from precious to non-precious. As bigger the difference in the position in this list as higher is the risk that corrosion can appear.

The occurrence of Bimetal-corrosion is attached to:

- A different position in the series
- A conductive connection in between the metals and
- An electrolyt like water.



These three conditions are required if corrosion should appear.
So the phenomenon of standstill corrosion appears on electric drives during long standstill periods, provided that there is some humdity. It is distinguished by corrosive harm of the material underneath the carbon brush. That is visible by marks in brush size on the slip ring or commutator, so called ghost marks.
In the presence of water as an electrolyt a difference in potential is built up between collector and carbon brush. *This potential difference is in the range of 300mV for carbon – copper and in the range of 950mV for carbon – iron. That means: Even*

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during standstill some current is passing through carbon brushes and a slip ring.
On steel slip rings the difference in potential is 3 times bigger than on copper or copper alloys. Therefore the form of that effect is much bigger on steel rings.
On synchronous drives the phenomenon is particularly distinct. It happens mainly on the plus-ring, which is less protected by a patina. At high humidity conditions or near-shore after some days of motor standstill brush marks in brush size can be seen. It can also be a problem on slip rings of doubly fed induction generators for wind turbines if by some reasons the turbines are stopped for months. Saline air speeds up the corrosion.
If the machine is started after a long standstill time, brush sparking comes up at the damaged spots and the damages will very fast get more severe. As a result the ring or the commutator can be seriously damaged.

To avoid serious harm of slip rings or commutators during longer standstill phases the only safe method is to remove the carbon brushes from the holder box or to separate them from the collector surface by putting an insulating foil or a piece of paper underneath the carbon brush.

Facts
• Even during standstill of an electric machine some current passes through carbon brush and collector • Very pronounced on steel rings • During longer stand still periods the carbon brushes should be

Heuchelheim, August 2011