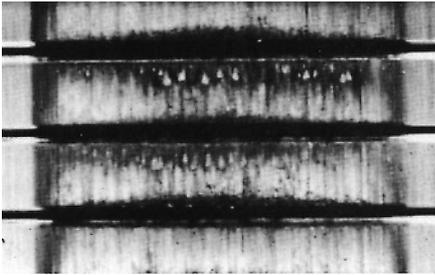


SPOTS or PERFORATIONS of the SKIN

SPECIFIC CHARACTERISTICS



Sometimes there is seen on the commutators of DC traction and stationary machines, especially reversing machines, small clear spots about the size of a pin head which may, or may not, leave a trail similar to the tail of a comet.

The position of these small spots changes from time to time and their distribution along the bars of the commutator is indefinite. Their number can vary to a great extent in accordance with the work schedule of the machine concerned.

The very special appearance which these spots give to the commutator skin brings to mind certain human skin ailments. The names of measles or small pox of commutators might describe this fault where the rash on the skin consists of small spots which in reality are small perforations of the skin.

CAUSES

Copper oxide, in a thin continuous layer on the commutator copper, is to a certain extent the "basis of the tint" of the skin.

Due to its semi-conductive and dielectrical properties, this layer cracks under substantial chatter "stress", controlled not only by the thickness of the layer and of its rigidity but also of its temperature, the brush contact pressure, and the gradient of the electrical field... also by those parameters which influence the method of flow of the electrical load across the layer by the "true points of contact" between the carbon of the brush and the copper oxide of the commutator. Particularly, the load can penetrate the dielectric by the creation of bridges of liquid copper of minuscule section, forming on the surface of the oxide bed micro craters of ephemeral character, exactly as small pockets of gas are formed which crack the surface of metal during fusion.

The oxide layer regenerates very soon afterwards, it only shows visible and more or less lasting signs- these are the spots - if the transfer of the load takes a disruptive form, that is to say, when two conditions are simultaneously applied :

- Significant residual commutation voltages linked to rapide variations di/dt of the current in the brush.
- Too low or badly defined pressure on the brushes, varying in time between considerable margins.

These conditions are found simultaneously on reversing machines - demanded by such drives as rolling mills, machines tools, ice-breakers, to which very considerable and very brutal variations of power are applied at the same time (also rapid or emergency braking, corresponding to the values di/dt in brushes of 1,000 In/s or more), and which, also, are subjected to shock that is sufficiently violent to upset the seating of the brush on the track.

Because the coincidence of electrical and mechanical causes is always of very short duration, the fault is only limited dimension.

EFFECTS

The spots are only superficial and only affect the skin. When the cause disappears the skin reforms normally and quickly without any traces of scars remaining.

Consequently, contrary to burning during commutation which result in noticeable sparking, and which is localised and permanent, these spots do not mark the copper to any depth, and as their position is constantly changed, they do not present any serious danger to the commutator.

On the other hand, sometimes they cause rather high wear ratio to the brushes. More precisely, their appearance may coincide with a high wear ratio, but the relation of cause and effect has not yet been clearly established.

REMEDIES

Any actions which tend to improve the conditions of brush contact on the commutator by multiplying the "true points of contact" act as a deterrent to the development of this fault.

Thus, with this aspect in mind, the following are advantageous modifications:

- strenghtening of the pressure,
- split brushes, with shock-absorber, to replace the monobloc brushes,
- soft materials, with integral shock absorber are important in place of hard materials.

Also, any intervention taken with the following aims in view will effectively limit the number of spots on the skin:

- absorb more effectively the shock transmitted to the brushes,
- reduce the size and frequency of the variation in load imposed on the machine, when it is possible to do so.



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