

Technical Information

Shaft grounding

"Modern AC-Motors don't need carbon brushes and are maintenance free "

Until some years ago this thrilling statement could be heard from motor OEM's. Nowadays SCHUNK supplies carbon brushes and brush holders for such brushless motors - carbon brushes for shaft grounding.

Carbon brushes for shaft grounding are used

- in turbo-generators,
- in distinct AC- and DC motors and as a special application
- in Ships.

Shaft voltages can be caused by

- Asymmetry in the magnetic circuit of rotating electrical machines.
- Build-up of static charges within the shaft,
- capacitative coupling of voltages in static exciting systems

If current goes via the bearings of an electrical machine, high current densities may occur on the small contact points within the bearing, which can result in a local melting of the metal surfaces. The consequence is the formation of small craters and serrations. They increase the friction within the bearing. By the increased temperature and worse lubrication this will lead to the damage of the bearing. Generally a shaft voltage of max 500mV is regarded as compatible for rolling bearings.

The OEM's of AC motors are nowadays very often confronted with short life times of the bearings. The common counter measure is the electrical insulation at least of one bear-

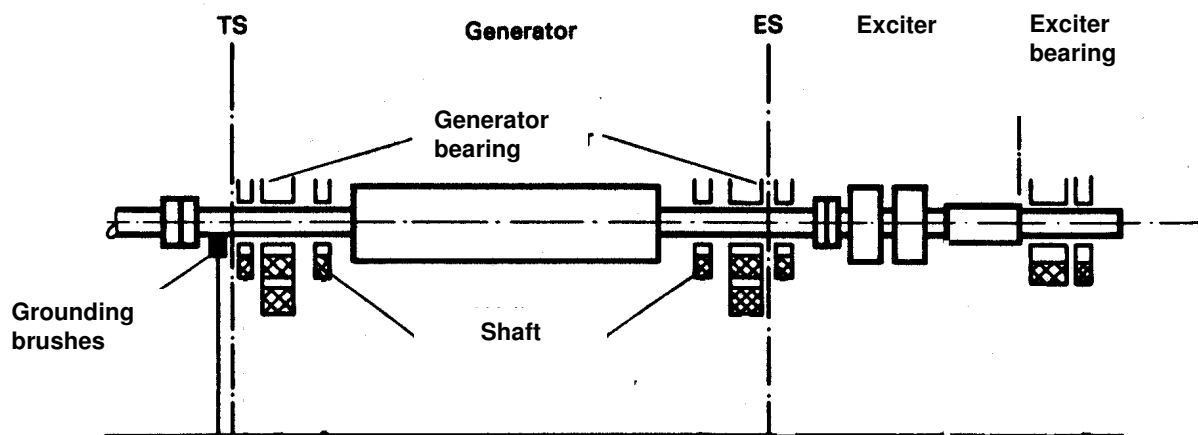
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ing. That is an expensive solution and is in some cases not sufficient. Then comes the hour of the grounding brushes.

Shaft grounding in turbo generators

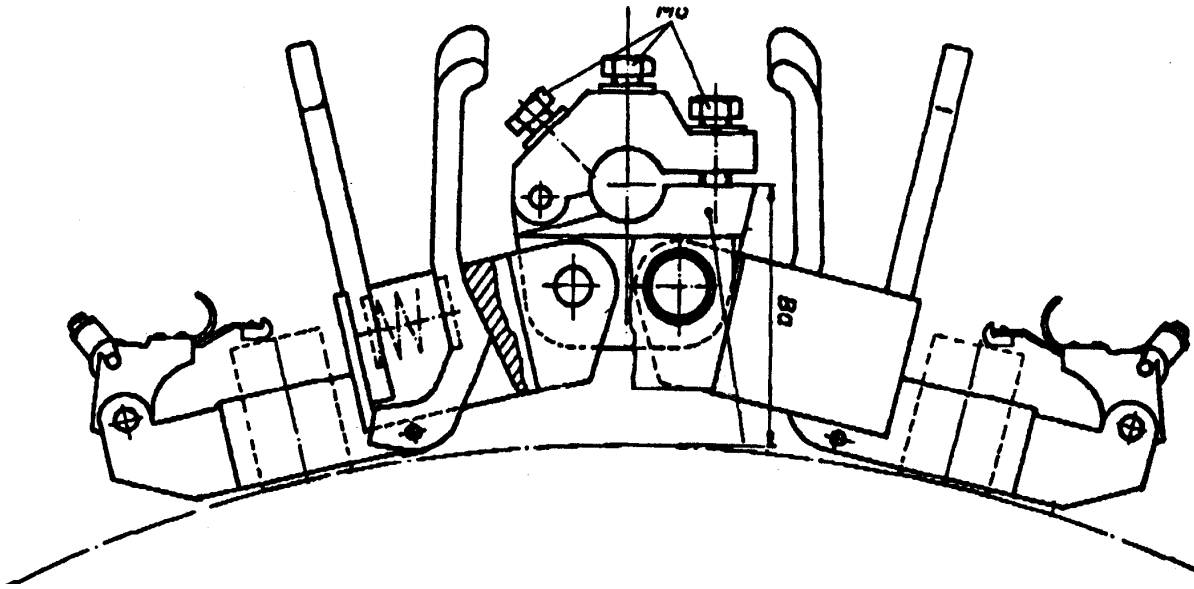
At the boundary layer between the metallic turbine blades and the superheated steam a static charge is formed by means of the friction between these media. If the shaft, e.g. by an oil film within the bearings, is insulated against zero potential an immediate neutralisation of these charges can't take place. The charges are distributed from the shaft to the generator. The voltage level can be some hundred Volt. Then the a breakdown can take place and the bearings can be seriously damaged.

Despite of constructive measures shaft voltages cannot totally be prevented. Beside an insulation of the shaft between generator and exciter a grounding of the shaft between turbine and generator is necessary.



For the grounding on the turbine side two earthing brushes mounted in an 90° angle are used. .

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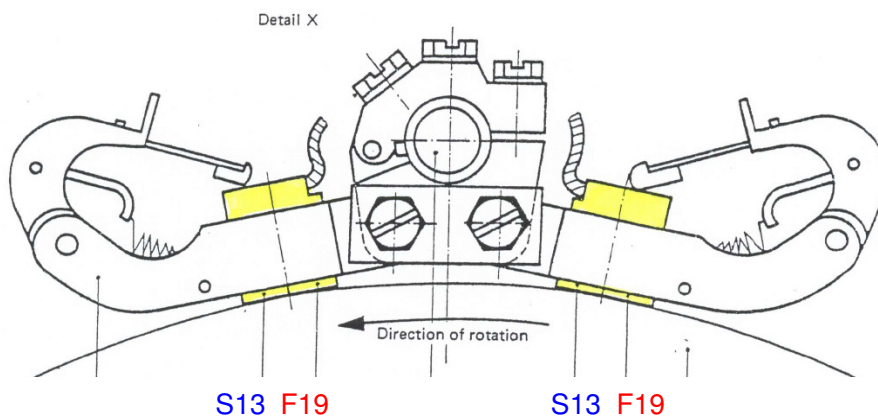
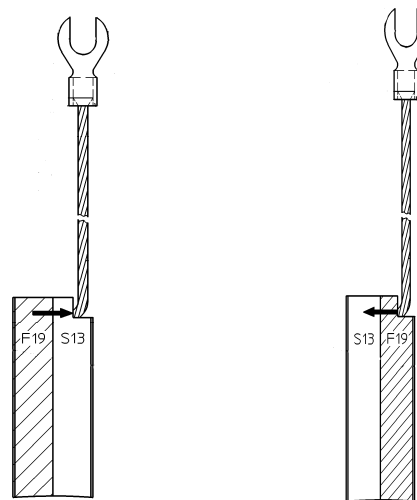


For this holder layout the well known sandwich brushes made by silver- and graphite grades in a "left" and a "right" design are in service.

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The silver grade is responsible for the voltage transfer and guarantees the derivation even of the lowest currents. With its mineral ingredients the graphite grade takes care for the removal of potential oil layers from the shafts surface. So a safe current transfer is guaranteed.

There are two different brush designs. It has to be guaranteed, that in the direction of rotation the graphite layer (F19) is always on the leading side of the brush.



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This design can be used only for unidirectional operation. For bi-directional operation alternative solutions have to be used.

SCHUNK - Standard combination is **-S13 / F19-**. For applications with difficult ambient conditions special combinations are available.

Shaft grounding of DC- and AC-Motors / Generators

Bearing currents in asynchronous motors are a well known phenomenon. They are caused by an asymmetry in the magnetic circuit, which can be related with the design of the motor or by manufacturing tolerances. By means of this asymmetry a voltage is induced in shaft, bearings, end shield and stator housing which drives a current.

There are additional so called capacitive bearing currents In modern Thyristor fed motors - an additional stress for the bearings.

Even DC-drives with thyristor converter with fast switching frequency are endangered.

Trams in Great Britain and in the USA driven by DC drives were fitted with special earthing contacts by SCHUNK. Due to a lack of space the modules are fitted nearby the rotor blades of the fan.

In traction the traditional earthing contacts from SCHUNK protect the bearings against current flow.

On some stationary machines, e.g. by Siemens, similar axle end contacts are in service.

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Small AC motors are sometimes assembled with small tubular-brush-holders with earthing brushes in grade -B24-; a much cheaper solution than insulated bearings. The brush life time is 20.000 hours which is similar to the life time of the bearings

These earthing units are suitable for bi-directional service.

In rolling mills where sometimes up to three motors are mounted on one shaft also earthing brushes in sandwich design are in use.

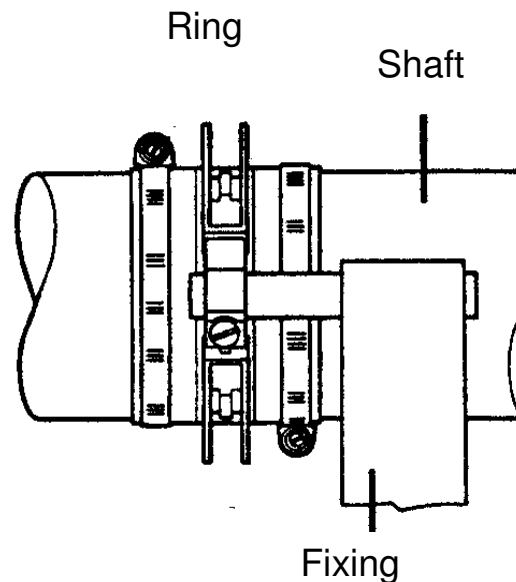
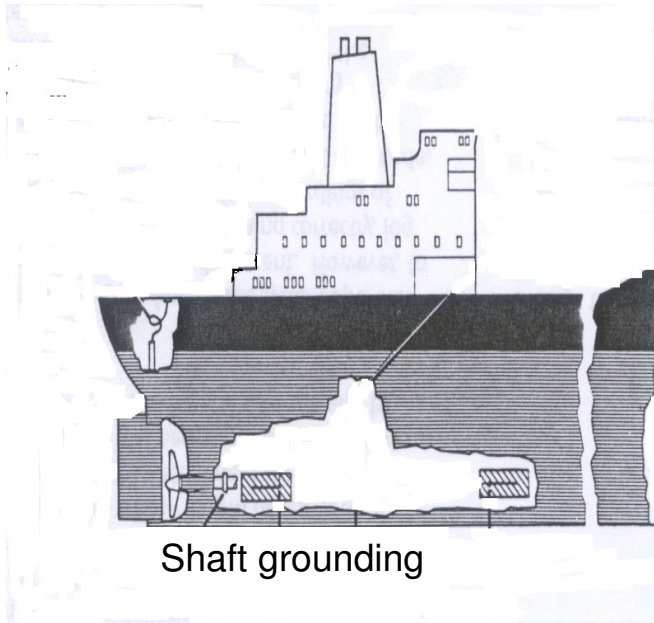
Wind turbines are a further domain of the sandwich-brushes. There are actual trends to allow two directions of rotation of the shaft by means of changes in the gear box. For this bidirectional grounding SCHUNK supplies brushes in high metal containing grades.

Some windmill manufacturers use additionally carbon brushes mounted between rotor and gear box for lightning protection.

Shaft grounding in ships

A largely unknown segment is shaft grounding in ships. Different metals are used for the construction of ships. The hull is made by steel, the propeller made of brass or bronze. The shaft is grounded to avoid electrochemical phenomenon, fed by the conductive salt water. The propeller and the shaft are grounded to the hull structure with a shaft slip ring, making them electrically common with the hull, and the rudder is also grounded with a flexibly cable. This assembly ensures good electrical contact between the propeller and propeller shaft and the ship's hull. This, in turn, inhibits dezincification of brass propellers and provides a level of protection to propellers made of other materials. It also protects the shaft bearings from corrosion.

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The assembly comprises a silver inlaid copper band, clamped to the shaft, and a brush assembly. High silver content brushes running on the silver strip provide electrical continuity with the hull. - .

Compact

- Earthing brushes prevent current flow via the bearing
- They prevent damages of the bearings
- Main applications:
 - turbogenerators in power plants
 - large DC- and AC - motors
 - AC and DC motors with fast switching frequencies
- Shaft grounding also in ships