A NEW RANGE OF D.C. AND A.C. PANCAKE MOTORS

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1. INTRODUCTION

Robots and manipulators are equipped with servomotors having cylindrical or disc-shaped rotors. However, the use of pancake motors with disc-shaped rotors is predominant in this area today.

These motors have a low rotor inertia and are short axially. Depending on their design and size, theoretical accelerations of up to 80 000 rad/s^2 can be achieved.

Of the basic principles of electrical machines, d. c. motors and brushless permanent magnet synchronous motors lend themselves to the design of disc-shaped rotors.

2. D. C. PANCAKE MOTORS

D. c. disc-shaped armatures can be built in two different ways:

- armatures with printed or stamped windings. These can have up to 8 layers of bare conductors which are separated by discs of insulating material and which are connected on the inner and outer edge of the disc. The commutator is formed by part of the inner area of the topmost conductors. The thermal overload capacity and the mechanical stability is severely limited by the thinness of the conductors (0,2 - 0,3 mm). Due to restricted heat transfer from the inner layers of conductors, the permissible impulse current duration is quite limited.

- wire-wound armatures with locally concentrated windings depending on the manufacturing method and cylindrical or flat commutators having comparatively large segments. The armature is assembled from pre-manufactured and bandaged single coils or else wound in one operating cycle on a jig specific to the motor size. Connecting the winding and commutator requires a relatively complex operation in the case of single coils; in the case of continuously wound armatures, this can be made much easier by using hook-shaped commutator risers. Eddy current losses in the conductors can be reduced by dividing the conductors and paralleling them at the commutator segments. After pretesting the armature, it is stabilized mechanically by encapsulating it with resin which may contain fibers for reinforcement.

Comparing the two methods, it becomes evident that there are restrictions when designing armatures with stamped windings, since there must be no crossover of the bare windings of one layer.

Wire-wound armatures have a higher thermal capacity than stamped windings since their copper mass is higher. Their rotor inertia is also higher. This, however, need not be detrimental to the dynamic behaviour of the drive since the permissible impulse current duration is also higher.

The advantages of both basic armature designs can be combined if a wire-wound armature is designed in which the wires are evenly distributed and in which only two layers exist in order to facilitate heat transfer. A robust cylindrical commutator can then be used.

This approach is being persued by BOSCH.

The basic element of this novel armature winding consists of a star-shaped wire configuration. The winding is assembled by posing such elements next to each other until two layers of wires have been completed. Fig. 1 shows the arrangement of four basic elements for a 10 pole winding.

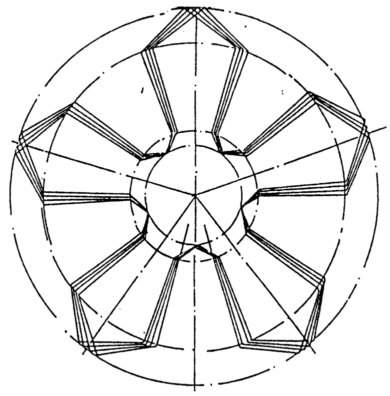

Fig. 1: Elements of Armature Winding

In the area of the inner winding overhang, the wires are led to the commutator.

A completed disc armature is shown in fig. 2.

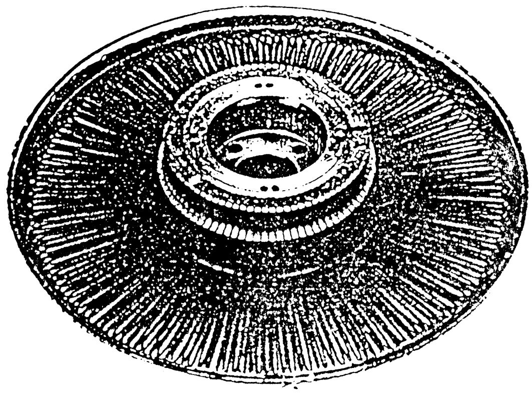

Fig. 2: Completed D.C. Disc Armature