MAGNETIC DRUMS

Magnetic drums for computers are usually made of aluminum alloys. The speed of their rotors is characteristically high, attaining 6000 rpm. In order to raise the efficiency of the magnetic heads the operating clearance between them and the drum must be made as small as possible, with a static clearance (when the rotor is stationary) amounted to 20-30 μ.

This clearance may be reduced under dynamic conditions, when the drum is turning, to such an extent that the magnetic heads may touch the rotor, thus damaging the expensive drum. Hence, a study of the dynamic condition of an operating clearance is of considerable practical interest.

Experience has shown that a reduction in the clearance between the rotor and the measuring head is due to three basic causes:

a) the dynamic expansion of the rotor under the effect of centrifugal forces;

b) the greater heating up of the turning rotor as compared with that of the drum plate;

c) dynamic wobble and vibrations.

An experimental investigation of this problem should include measurements of the variation in the mean and minimum clearance with time from the starting instant up to a steady-state operation. Data on the minimum clearance which may occur in a transient or steady-state condition are of the greatest practical interest.

The author of this article has designed a measuring circuit which has been used for evaluating the clearance between the rotor and the magnetic drum heads of a "Ural-1" computer (see block schematic in Fig. 1).

The schematic of the measuring head is shown in Fig. 2.

Two capacitive transducers are connected to the high-frequency generator circuit and used as sensing elements for measuring the clearance. In order to provide the measuring circuit with minimum stray parameters, the transducers are connected in series, i.e., the measuring capacitance is made up of two series-connected capacitances, namely that between the first transducer and the drum rotor, and that between the drum rotor and the second transducer. The drum is grounded, and the transducers are made in the form of brass pins which carry the induction coil.

In order to raise the sensitivity, the gap between the transducer and the rotor is set at several tens of microns, thus providing each transducer with a capacitance of several picofarads. The generator frequency is made rather high, of the order of 20 Mc, in order to raise the amount of detuning with variations in the clearance.

Variations in the clearance between the rotor and the transducers change the capacitance of the tuned circuit and hence the generator frequency.

Variations in the generator frequency can be measured directly with sufficient accuracy by a heterodyne wave-meter. However, certain frequency variations may occur during the experiment due to the heating of the circuit.
components and other causes. Hence, the evaluation of the test generator frequency is replaced, in order to avoid the effect of external conditions, by the measurement of the frequency difference between the test generator and an auxiliary fixed frequency generator, which operates under the same conditions as the test generator.

The generators are tuned to frequencies which are as close to each other as possible. The minimum frequency difference is determined by the design and must be large enough to avoid "pulling" between the two generators.

In the above circuit the frequency difference amounts to 200 kc. The raising of this frequency up to 1 Mc does not in practice produce any additional errors. The signals from the generators are fed to the mixer control and suppressor grids, respectively, and the difference frequency appears on its anode and is measured with a wavemeter by means of zero beats. The latter are heard on an earphone. From the wavemeter the signal is fed to a narrow-band amplifier with a negative feedback, and a filter provides a bandwidth of 800 cps. The amplifier circuit and its frequency characteristic are shown in Figs. 3 and 4, respectively.

The measuring head uses miniature type 6Zh1B tubes which make its mounting on the recorder head block of the "Ural-1" recorder possible and provide a variation in the clearance between the transducers and the drum rotor similar to that between the magnetic heads and the rotor. The generator induction coils are placed in the space normally occupied by the magnetic heads, and are separated from each other by screens. The remaining part of the circuit is mounted in an aluminum box, 72 x 72 x 28 mm, above the block.

The frequency of the generators is set roughly by means of tuning capacitors. The fixed frequency generator is adjusted accurately by means of a screw which is accessible from the top of the box and varies the inductance of the circuit within narrow limits.

1. The transducers are made of brass, have a diameter of 5 mm and are placed horizontally at a distance of 10 mm from each other on a ceramic plate.

2. The magnetic drum is tested in a location with little extraneous noise, in the following sequence.

1. The measuring head is placed on the drum. The clearances between the two transducers and the drum rotor must be equal.

2. The supply source is switched on. The tubes are heated for five min, the anode voltage is then connected to the measuring head, and the circuit components heated for one hour.