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INFLUENCE OF VARIATIONS IN THE AIR GAP ON THE NO-LOAD CURRENT OF INDUCTION MOTORS

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In induction motors the reluctance of the air gap amounts to 70-80 percent of the total reluctance of its magnetic circuit. Hence, it may be assumed that 70-80 percent of the no-load reactive power taken by an induction motor is due to the reluctance of the air gap.

Since, on an average, this reactive power constitutes 60 percent of the total reactive power supplied to industrial enterprises, it may be concluded that the air gaps of induction motors account for about half the total reactive power balance. This is a very imposing figure. It indicates the necessity of introducing into maintenance and operating procedures strict control over the dimensions of the air gap, inasmuch as it predetermines the amount of reactive power in the motor.

To obtain the best operating characteristics (power factor and efficiency) modern induction motors of low or average power -- which constitute a majority of present-day electric motors -- are built with as small an air gap as possible depending upon various mechanical factors: shaft vibration; permissible shaft deflection; accuracy in surfacing the rotor and stator; and allowances for wear and sag of the bearings. This "design" size of the air gap in various types of motors with different powers and with rated rpm's of 3,000, 1,500, 1,000, and 750, varies within wide limits -- 0.25 to 1.75 millimeters.

Consequently, in regulating the air gaps in each concrete case, one must be guided by the "design" size of the gap and not by "average" values which often exceed these "design" sizes.

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It should be noted that, in practice, motors are often found in which the air gaps are considerably enlarged as a result of wear on the rotor surface, and the "permissible" wear in these cases is largely based upon the "average" values for air gaps.

Analysis of curves showing the variation in no-load current as a function of air gap reveals that reactive no-load power increases quite rapidly as the gap enlarges. Therefore, in view of the importance of this factor to power economy, and the general lack of systematized published data on the various motors in use, an extensive table of air-gap dimensions has been compiled to serve as a guide. /Note: nominal air gap, motor type, rpm, and power range for over 100 induction motors, the majority for two or three rated speeds, are available in original document in CIA./

At the Scientific and Technical Session of the Moscow Scientific and Technical Society of Power Engineering on Maintainance of Electric Equipment of Industrial Enterprises, held in Moscow in 1946, it was pointed out that the advisability of repairing motors whose air gaps had increased by more than 15 percent was open to question. Undoubtedly, this statement is too cautious. The operation of motors with sharply increased air gaps leads to a correspondingly inadmissible deterioration in the technical and economic characteristics of electric power utilization, and should, therefore, be permitted only in special cases.

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