be slightly lower because of the increased current.

On one occasion I had a new motor in which the air gap was so small that, when the rotor expanded with heat, it rubbed on the stator and the motor stalled. Only remedy was to take a small cut off the rotor. Alfred St. Laurent, Quebec Power Co, St. Raphael, Quebec.

Don't Do It

BEFORE DISCUSSING what happens in a squirrel-cage motor after the rotor is turned down, let's review some magnetic theory. Air has a reluctance about 1000 to 2000 times greater than iron or steel. Therefore, considerably more ampere turns are needed to force a given amount of flux through air than steel.

If a motor is wound for a given number of ampere turns and the rotor is machined down, it requires more current to force the same flux through the larger air gap. Motor slip would also increase if rotor diameter were reduced.

If the rotor of a motor is removed and full voltage applied to the stator, it draws a large current from the line. Turning the rotor would have a similar effect, and the increased current would cause greater heating. The heating produced by the excess current does not increase in direct proportion, but as the square of the current. If the current is doubled, the heating is increased four times. Power factor of the motor would decrease along with its efficiency.

If a rotor has become damaged because of rubbing, smooth it up with a file but don't turn it down. James J Anderson, St. Paul, Minn.

Stator Winding Overheats

IN GENERAL, it is not advisable to take a cut from the rotor of a squirrel-cage motor. A cut increases the air-gap clearance. This results in a reduced starting torque, efficiency and power factor. Increased stator current would cause overheating of windings to pull the load.

These conditions are brought about by the high reluctance of the air gap. Higher current is required to force the magnetic flux through the longer gap. Unless the manufacturer is consulted, or suitable calculations made to show the effects of increased air-gap clearance, the cut should not be taken.

Better bearing maintenance and repair is an easier and more effective method of eliminating air-gap difficulties. An integrated inspection, maintenance and repair program prevents most bearing failures. Time spent on such work is well spent, since rotor repairs are reduced. Tyler G Hicks, New York City.

Turning Down the Rotor Will Increase Heating

HE ASKS ABOUT turning down motor rotors. My advice is don't do it. Turning down the rotor of an induction motor interferes with the electrical performance in several ways. Cutting action of the tool peens over edges of laminations so they make better electrical contacts with one another. This increases iron losses of the rotor and tends to cause more heating. This effect can be reduced by grinding with a fine wheel, but even this is to be discouraged.

Cutting down the rotor also lengthens the air gap. This increases the magnetizing current and might make the motor useless. Turning down the copper or aluminum rings increases rotor *resistance*. This *decreases* motor efficiency and causes local heating.

If *HE* has rotors that have been damaged as he describes, his money will be well spent if he throws them away and buys new ones. Earl E Norman, manager, City Light and Water Utilities, Kalamazoo, Mich.

Turning Induction Rotor Increases Starting Torque

HE IS FLIRTING with trouble if he makes a general practice of truing squirrel-cage rotors by taking off a cut. No one but the designer can actually tell how much the performance will be altered by machining the rotor. It may be possible to advise *HE* what to expect from a theoretical standpoint, but this may not always apply.

If *HE*'s application isn't critical, he can turn down the rotor. I suggest, however, that he attempt to do his truing by reconditioning the bearings.

Cutting down rotor bars and end rings also reduces copper cross-sectional area, and at the same time increases the air gap. Decreasing copper area increases the rotor resistance, resulting in a greater I^2R loss. With greater loss the operating temperature is higher. The increased I^2R loss results in a lower efficiency.

Maximum torque occurs at higher values of slip because of the increased rotor resistance. The starting torque will be relatively greater since at standstill slip is maximum. The rotor reactance is lower because of the larger air gap and the increased rotor resistance. Maximum torque occurs when rotor re... sistance is equal to rotor reactance. This condition is approached when the rotor is turned down because the original reactance is decreased and the rotor resistance is increased. K B Hoffman, electrical engineer, Tenafly, N. J.

Consult the Manufacturer

THERE IS NO OBJECTION to turning down the rotor if *HE* is prepared to accept the changes in operating characteristics. Increasing the air gap will increase the no-load current, slip and power factor and also decrease the torque per ampere.

The most satisfactory way to approach the problem is to present all details to the manufacturer, who can state definitely what the actual results will be. C O von Dannenberg, Brooklyn, N. Y.

Avoid Reducing Air Gap

INDUCTION MOTORS are designed with as small an air gap between rotor and stator as is consistent with good practice. By "good practice," I mean having enough clearance between the two elements so there is no danger of rotor rubbing on stator because of wear in the bearings. The current in the primary of an induction motor produces a rotating field, which travels around the stator. This flux links with conductors on the rotor and pulls them along, thus causing rotation.

The air gap has a high magnetic reluctance so that some magnetic lines do not cross into the rotor. In a wide gap, more of these magnetic lines fail to connect. Because fewer magnetic lines enter the secondary the power factor of the motor will decrease. Lower power factor means that more current is required to carry a given load resulting in increased motor heating. Before the war, some induction motors of European design were found to have extremely high power factor. The air gaps were found to be so small that unusual care and attention were required in checking the air gap from time to time to make sure the rotor did not rub on the stator.

With a transformer, there is no movement of secondary with respect to primary. Consequently, the primary and secondary coils can be interconnected with less magnetic leakage than is ever possible with an induction motor. As a result, we find that a 100-hp 1800-rpm induction motor has a pf of 88% whereas a comparable transformer might have a pf of 98%. R F E

(*Continued on page 148*)