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Upton, L.I., N.Y.

AGS DIVISION TECHNICAL NOTE

No. 39

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July 14, 1967

LINE HARMONICS

Eric Forsyth, in two memos dated 3/24/67 and 4/11/67, has outlined the problem of harmonics appearing on our three phase ac line as a result of the large number of nonlinear loads (primarily experimental power supplies). I would like to outline a possible method of reducing these harmonics by means of a rotating filter.

If an induction motor with 2n poles is rotated by a synchronous motor with 2n poles, the rotating field of the fundamental line frequency applied to the stator of the induction motor is in synchronism with the rotor. That is, the rotor cuts no field lines of the stator, except for end effects.

It, therefore, presents a high impedance to the three phase line. Every harmonic, however, develops a rotating field asynchronous to the rotor and there is, in effect, the equivalent of a large slip frequency, and large eddy current effects in the rotor. Thus, the device presents a low impedance to the three phase line. The overall effect is that of a shunt resonant circuit, with its resonant frequency set at 60 Hz.

In order to increase the equivalent "Q" of the circuit, the rotor should be made solid with a copper jacket to greatly increase the eddy currents. In addition the air gap should be minimized and all construction

techniques which reduce leakage reactance should be applied.

For the device to function, the impedance to the harmonic frequencies must be significantly less than the source series impedance at the same frequencies. Placing the device on the 480 volt line would provide the added impedance of 13800/480 transformer to the source impedance yielding additional filtering.

Although no actual information is available on the capabilities of such a device, it does provide filtering of all asynchronous frequencies on a non-exclusive basis regardless of the character or size of the device creating the harmonic problem. If large harmonic powers are present, then the size of the synchronous driving motor must be large enough to keep the units in synchronous rotation. Water cooling of the rotor of the dissipative machine may also be required.

For analysis purposes it would be desirable to know the source impedance of the 480 volt lines at the various harmonic frequencies. This data may be made available by our consultants from the University of Toronto who are studying the overall problem.

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