Discussion: Inductive reactance, and the operation of large submerged-arc furnaces*

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J. MEINTJES†

I read the above paper with considerable interest. I would like to point out, however, that it is fallacious to conclude that the adverse effects of a high inductive reactance on furnace operation can be cancelled by connecting capacitors in series – or for that matter, in shunt – with the power supply. I would refer the authors to the paper[1] I presented at INFACON 74.

1. MEINTJES, J. A comparison of power-factor correction on submerged-arc furnaces by capacitors in shunt and series. INFACON 74. *Glen, H. W. (ed.)*. Johannesburg, South African Institute of Mining and Metallurgy, 1975. pp. 149-155.

Authors' reply

If a capacitor is put in series with an inductance in an a.c. circuit, the voltage phasor E across both elements is related to the current I by

$$E=j(X_L-X_C).I,$$

where X_L is the reactance of the inductance and X_C is the reactance of the capacitor. Clearly, any value of X_C between zero and X_L will reduce the magnitude of E, and this is what we mean by capacitive reactance cancelling the inductive reactance. The equivalent circuit of a submerged-arc furnace with series capacitors is shown in Fig. 1, and the resulting circuit that is obtained when the capacitive reactance exactly cancels the inductive reactance is shown in Fig. 2. Obviously, if inductive reactance causes certain problems in a furnace circuit, then the circuit in Fig. 2 will not exhibit these problems because there is no inductive reactance left. However, this does not mean that the use of capacitors is not without other problems, and Mr Meintjes has indeed covered most of these other problems very well in his INFACON 74 paper.

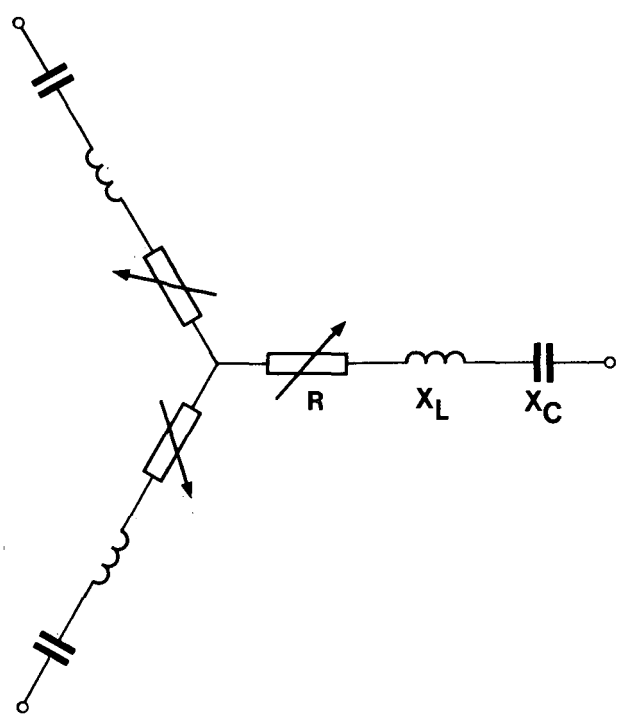

Fig. 1—Equivalent circuit of a submerged-arc furnace with series capacitors (the actual series capacitors on the primary side are transformed to equivalent capacitors on the secondary side for the purposes of the equivalent circuit)

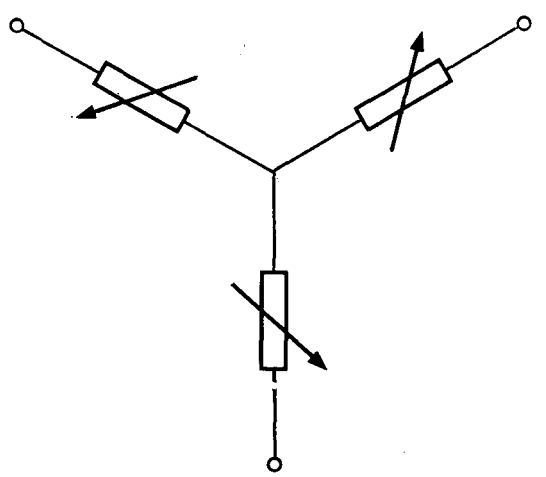

Fig. 2—Equivalent circuit in Fig. 1 reduces to this when $X_L=X_C$

The point that we were making in our paper about the use of series capacitors is that they are one way of overcoming the problems that are caused by inductive reactance in a circuit. It is important to note that by far the most serious of these problems arise because the furnace is a three-phase circuit with interactions between the phases, and that these problems do not occur in a single-phase circuit. Unfortunately, Mr Meintjes in his INFACON 74 paper considered the furnace from the point of view of a single-phase circuit only, and thus what he pointed out in his paper was only part of the story.

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