In the case of a 15 ton, 2,500 horse-power furnace, the extra cost of the dynamo above a standard type will only be about £2,000, affecting the price of the steel with about 0·15 sh. per ton if melted steel is treated.

Why is single-phase preferable to polyphase current?—As will be shown later on, in the economy of an electric furnace mainly depending on the degree to which radiation-losses are reduced, these losses are 80 to 92 per cent of the total.

As now the amount of heat radiated increases with increasing surface, other conditions being equal, it is important not to unnecessarily increase this surface.

The smallest possible surface and radiation loss is obtained with only one ring-shaped crucible.

To utilize a two- or three-phase current, two or three ring-shaped crucibles are necessary, and increase the radiating surface by more than 30 per cent.

The only advantage of a three-phase current is, that the price of the dynamo is lower, but this lower first cost is outbalanced by the higher power consumption, unless the power is very cheap.

It may, exceptionally, be wanted to connect the electric furnace, if of small capacity, to an existing three-phase plant; but as a rule it is preferable to have separate dynamos for the furnaces, so that the power consumption can be regulated by influencing the excitation of the dynamo, without interfering with other consumers.

The simplest combination is one engine for each furnace.

If a separate dynamo has to be used, it is of no use to complicate the furnace, but to stick to the simpler system of mono-phase current.

Efficiency and power consumption.—The electrical energy, delivered to the furnace, is spent on:—

(1) Losses in the primary coils and in the magnetic iron core. These may be called electrical losses, and can be kept down by using ample dimensions. They generally amount to 4 to 5 per cent.

(2) Heat losses, either conveyed from the bath through the walls to the outer surfaces, and radiated to the surroundings, or directly radiated from the steel through openings in the furnace.

These losses depend on the temperature of the steel; on the thickness and insulation of the walls; and on the size of the radiating surface.

The approximate radiation loss from a Frick furnace can be expressed by:—

$$W_r = 60 + 8 \text{ to } 10 \times G.$$

W_r = radiation loss in kilowatts at a steel temperature of 1500°.

G = capacity of furnace in tons.

A furnace producing high-carbon steel from cold material, has a lower mean temperature than a furnace for the production of low-carbon steel, requiring a higher casting-temperature.

Likewise the mean temperature of a furnace in treating previously melted steel is higher than in melting cold material.

The radiation loss increases very nearly as the square of the temperature.

(3) Theoretical heat, required for the melting of the steel and of the slag, and by the various reactions, taking place in the furnace.