40°C/cm.

About one thousand watts of power was sufficient to obtain and mentain 1540°C.

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4. X-Ray Studies on the Cast Structure of High Purity Aluminium in the Light of Anisotropy of the Rate of Crystal Growth

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It was assumed by one of the authors that the [001] direction would be the direction of far easier growth than other directions in the case of preparing of single crystals of nickel and low silicon steel, oriented in any crystallographic direction. In the light of this anisotropy of the rate of crystal growth, an X-ray examination was previously performed with the specimens cut off from one part of the ingot of four percent silicon steel (930 kg in weight) produced at the Kawasaki Iron Mfg. Co. However, as the used specimen contained many impurities and gases and its cast structure was very complex, the analysis was very difficult. So in this investigation, the high purity aluminium (99.993 %) was melted and cast in vacuum and a method in which the bottom of the stainless steel mould was simultaneously water-cooled after casting the molten metal in it, was devised so as the columnar crystals were developed perpendicularly to the bottom of ingot.

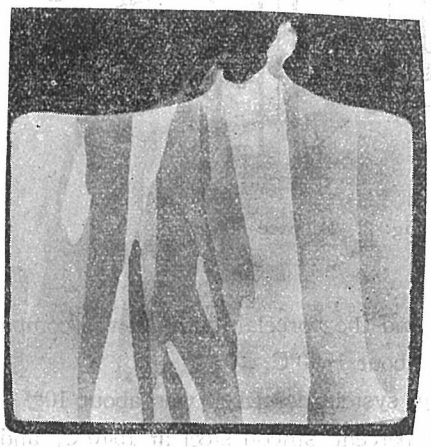

Fig. 1, Longitudinal section.

Fig. 2. Transversal section.

The vacuum obtained by the rotary pump alone was about $10^{-1}\sim10^{-2}$mm. of Hg in the molten state.

The columnar crystals contained in the specimen used for the X-ray analysis are shown in Figs. 1 and 2, of which the former shows the arrangement of the crystals contained in the longitudinal section cut off perpendicularly to the bottom of ingot and the latter shows that of the transversal section parallel to the bottom of ingot.

The approximate speed of the crystal growth at the centre of this ingot was about 68 mm/min, calculated from the cooling curves.

The following results were obtained from the X-ray Laue analysis for the specimens :

(1) In the centre portion of the ingot, the favorably situated crystals oriented near to the [001] direction (direction of easy growth) survived by crowding out the unfavorably situated crystals. On the other hand, in the outer portion of the ingot,

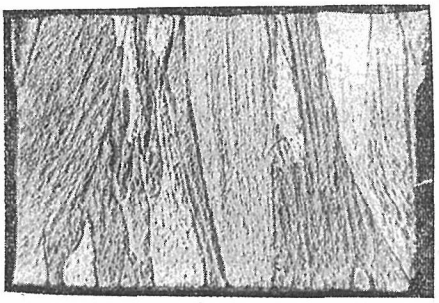

Fig. 3. Ridge structure.

even the unfavorably situated crystals were unexpectedly developed, probably owing to the difference of the cooling speed between the outer portion and the centre of the ingot.

(2) Each columnar crystal was found to exhibit a fibrous structure which manifested itself as parallel ridges on the longitudinal section etched with the dilute hydrochloric acid for a very long time (Fig. 3).

From the X-ray back reflection Laue analysis, it was found that the orientation differences of about 1 degree exist in the ridge structures. It seemed also that the perfectly visible ridge lines found on the favorably situated crystals were approximately parallel to the [001] direction.