cadmium, a c.p.h. metal, in which the local interactions between glide and forest dislocations are supposedly absent.[9] This is true even for magnesium as shown by the data of Conrad *et al.*[11]

Thus it can be concluded that the local interactions between glide and forest dislocations forming junctions may paly a significant role in the process of strain hardening in aluminium.

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ON THE GROWTH OF ZINC MONOCRYSTALS FROM THE VAPOUR PHASE

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SINGLE crystals of metals and semiconducting materials are of substantial value as they have found significant applications in solid state devices. To-date almost all naturally occurring crystals and a number of metal crystals have been grown in laboratories for investigation and a great deal of experimental data has been obtained on the growth of these crystals. During recent years, several reports dealing with developments in crystal growth from vapour phase have been published. CdS single crystals have been grown from the vapour phase by Frerichs method.[1] Optimum conditions for the growth of zinc and cadmium single crystals have been investigated in detail by Keepin[2] and Price.[3] Zelenskii and Petel'guzov[4] have grown magnesium single crystals by vacuum evaporation and condensation method. A feature of this particular method is that no seed is required for the growth. At times crystals with a base of 25 mm. were grown. In the present report, an apparatus is described for growing zinc monocrystals from the vapour phase. Conditions for satisfactory growth have been established.

EXPERIMENTAL PROCEDURE

A temperature gradient furnace was constructed for the experiments. The heating element (22 SWG, nichrome wire) was tightly wound on a 35 cm. long silica tube, spacing the turns to suitably achieve a temperature gradient and a short constant temperature zone close to it. The furnace was mounted in a vertical position for the experimentation. High-purity zinc block was sealed under vacuum in a pyrex capsule of about 4 to 5 cm. length and having one end tapered. This capsule was inserted in another slightly larger diameter pyrex tube. This unit was further inserted into the furnace such that the tapered end of the capsule was in the useful or growth zone of the furnace. The line diagram of the experimental set-up and the plot showing the thermal conditions inside the furnace are reproduced in Figs. 1 and 2 respectively.

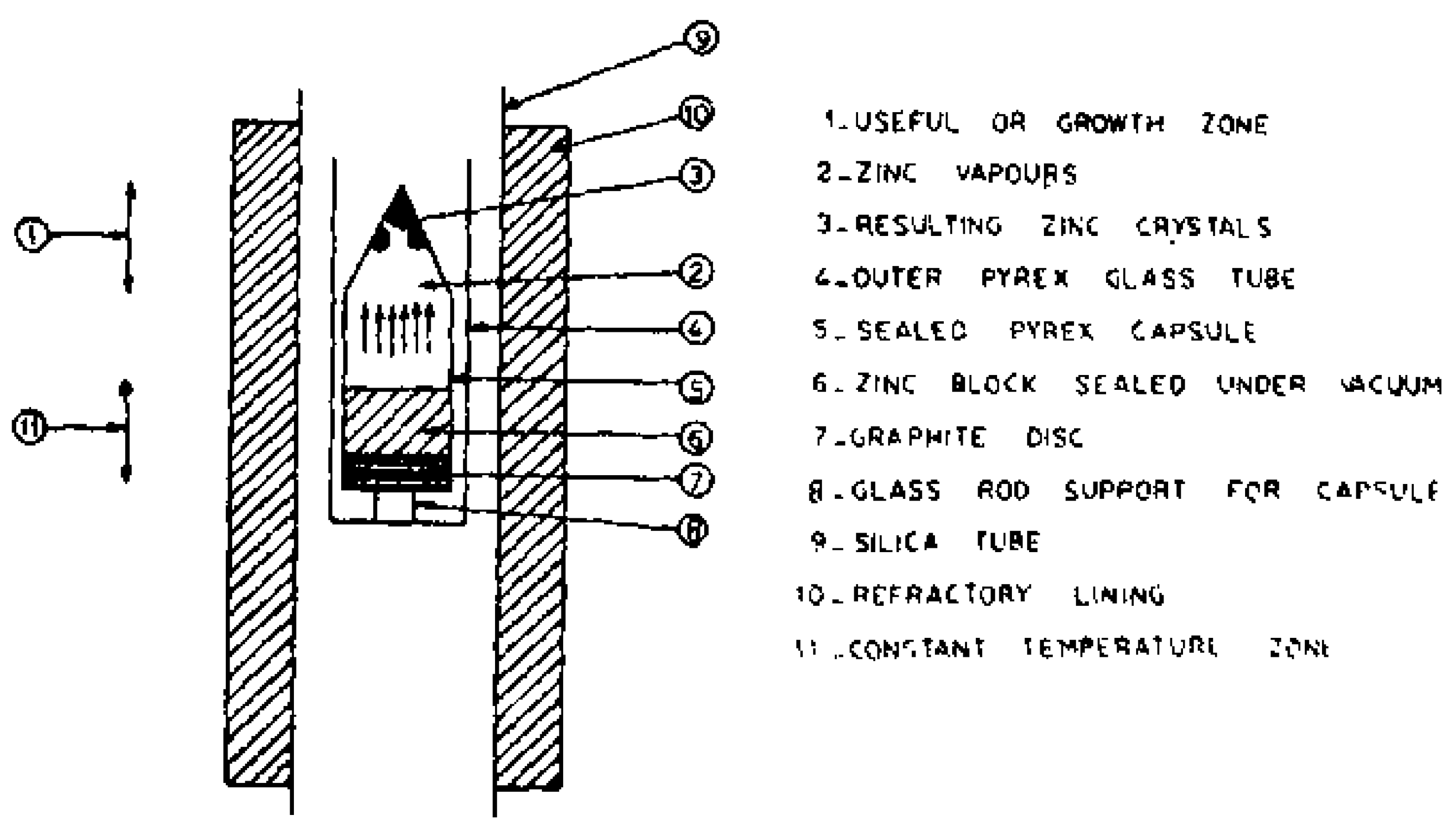

FIG. 1. Experimental set-up

The useful or the growth zone and the constant temperature zone are clearly indicated in Fig. 2. The pyrex tube containing the capsule was pulled at a rate of 0·5 cm. or 1·0 cm./hr. by a motorgear train assembly for a distance of 4 cms. The furnace was gradually put off, capsule allowed to cool inside the furnace and taken out.

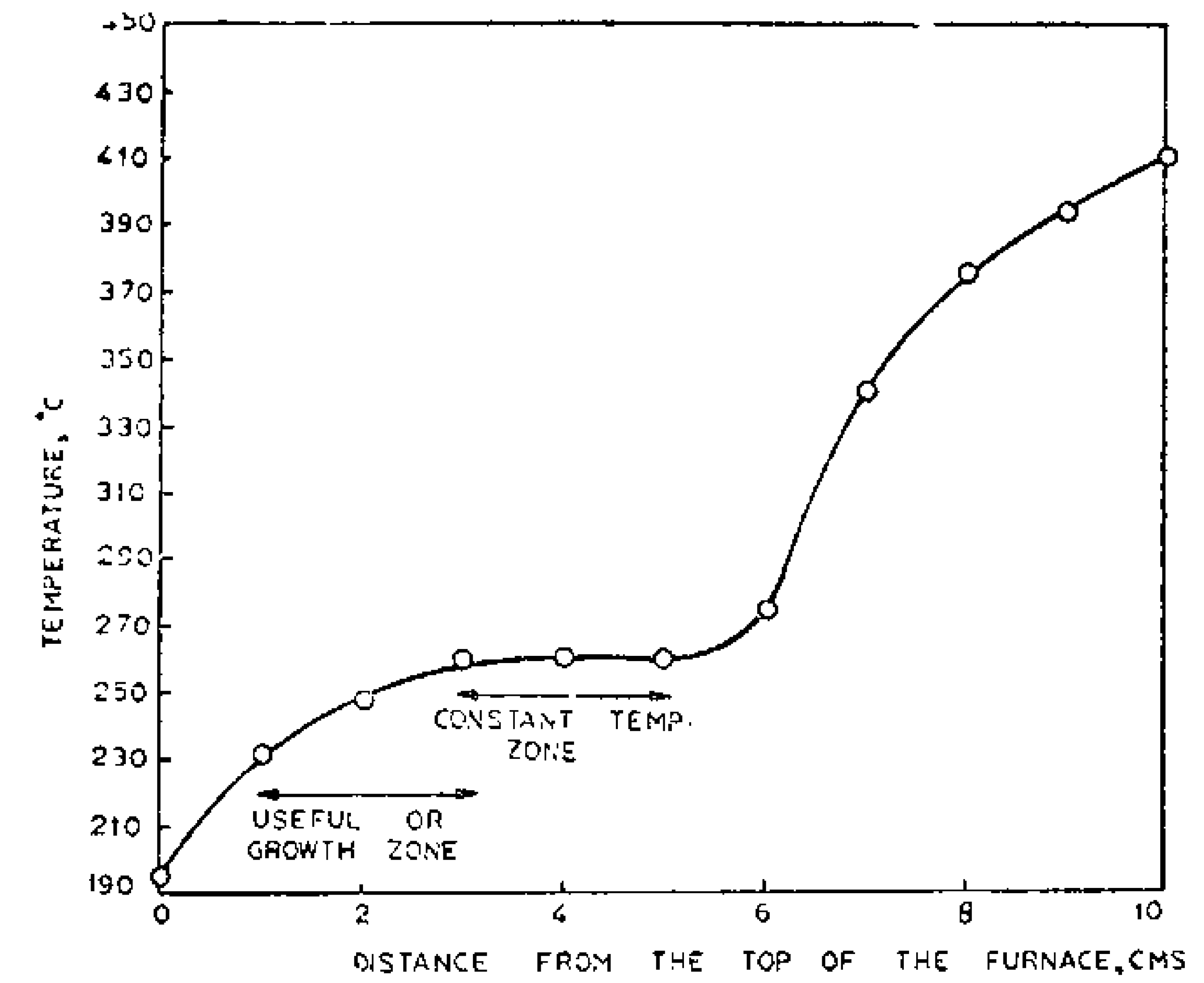

FIG. 2. Plot showing the thermal conditions inside the furnace.

crystals. Some crystallisation was observed on the walls of the capsule in the case where graphite disc was not used and the capsule was pulled at the rate of 1·0 cm./hr. Resulting crystals were too small to perform any test.

In the second variation where the graphite disc was not used and the capsule was kept static, denser crystallisation was noticed. In this case also size of the crystals was not large enough to perform any further tests. In the third variation the graphite disc was used and the capsule was pulled at the rate of 0·5 cm./hr. In this case higher temperature was necessary for melting zinc. The capsule on pulling yielded only dense crystallisation all over the walls. The size of the crystals in this case was again too small.

In the fourth and the most suitable variation the zinc block was kept on the graphite disc inside the capsule and the capsule was kept static. The tapered end of the capsule was well within the useful or growth zone and the zinc block on the graphite disc was in the constant temperature zone. Globular crystals of sizes ranging from 2 × 2 × 5 to 8 × 6 × 5 mm. were obtained in the growth zone. X-ray back reflection patterns were obtained to ascertain single crystallinity of the crystals. Presence of graphite disc inside the capsule appeared to be most suitable for maintaining the appropriate thermal conditions for single crystal growth. It is suggested that the same experimental set-up can be employed to grow single crystals of metals having low melting point and high vapour pressure. The experimental results in detail are presented in Table I.

TABLE I

Summary of the experimental results

Experiment No.	Experimental conditions	Materials inside the capsule	Time of pulling/keeping the capsule (hr.)	Results
1	Capsule pulled at 1 cm./hr. rate	Zinc block	4	Deposition
2	Capsule pulled at 0·5 cm./hr. rate	do.	7	Very small crystals
3	do.	Zinc block on graphite disc	8	Slightly bigger crystals
4	Capsule static	do.	24	Crystals of 2×2 to 2×10 mm. section obtained
5	do.	do.	28	Globular crystals of sizes from 8×6×5 to 2×2×5 mm. obtained

In another set of experiments the zinc block was cast under vacuum and kept on a thin graphite disc in a pyrex tube; the tube was then sealed under vacuum to get the capsule. This capsule was as before pulled through the furnace at a rate of 0·5 cm./hr. for a distance of 4 cms.

Appropriate conditions for satisfactory growth appeared to have been established, when the capsule containing the zinc block resting on the graphite disc was kept static at a fixed distance from the top of the furnace for about 24 hours. The temperature gradient in the growth zone close to the constant temperature zone was maintained at 15° C./cm. The length of the constant temperature zone was about 2·0 cms. and that of the useful or growth zone was about 1·5 cms.

RESULTS AND DISCUSSION

The effect of four variations in experimental conditions was studied on the growth of zinc crystals.

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