

## LEVITATION SPLAT-QUENCHING DEVICE

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### Introduction

For quenching high melting temperature metals and metallic alloys, levitation melting seems to be the most suitable technique because of several reasons: induced inside heating, no crucible, no contamination<sup>(1)</sup>. In conjunction with levitation melting, the two-piston device<sup>(2,3)</sup> was used. Our version had cemented carbide pistons operating with highly effective magnetic circuits, photo-cell and time delay in the triggering circuit, and a very simple 540 V d.c. power supply.

The quenched specimens were large enough to be used for X-ray diffraction experiments as well as for the investigations of mechanical and other physical properties.

### Apparatus and operation

The levitation furnace was the bucking plate type of coil<sup>(4)</sup> with seven cone-shaped turns of copper tube,  $\varnothing$  5 mm (fig. 1,1). The innermost diameter was 11 mm and the outermost 44 mm. The coil was water cooled and connected with an r.f. generator ("Radyne" C. 171, frequency 450 kHz) as the power supply.

Below the furnace there was a photo-cell (fig.1,2) and the two-piston device (fig.1,3-6). The pistons could slide towards each other through the fixed housings (fig.1,6) and had a mild steel plate pinned on their back. When the pistons were in contact, each plate closed the magnetic circuit with its housing. The housings were equipped with solenoid coils (fig.1,3) forming strong electromagnets. When the levitating specimen was melted and the desired temperature achieved the generator was switched off. When falling down the

molten drop passed the photo-cell which activated the power supply. Current of about 5 A passed through the coils and the plates were attracted to the housings. The attraction increased as the air gaps narrowed achieving an acceleration of more than 60 g before the impact of the pistons. In the impact position the plate-housing gap was reduced to 0.2 mm. The pistons take 7.8 ms to travel 22 mm.

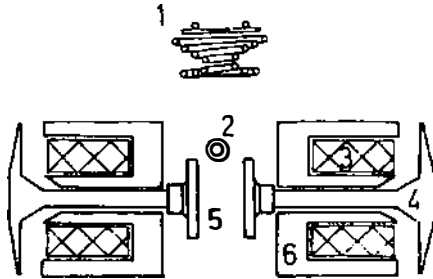


Fig 1. LEVITATION SPLAT-QUENCHING DEVICE

1. Levitation furnace
2. Photo-cell
3. Electromagnetic coil
4. Piston's mild steel plate
5. Cemented carbide pistons
6. Mild steel housing

Performance of the device and estimate of the quenching rate

We achieved that:

- the impact always takes place in the central position,
- the pistons are very firmly held together during quenching,
- the molten drop is smashed between the pistons into a thin flake.

The cooling rate can be calculated using the following formula (5):

$$\frac{dT}{dt} = \frac{8}{9}(T_s - T_o) \frac{\bar{\alpha}_p}{l^2}$$

$T_s$  and  $T_o$  being solidification and room temperature,  $\bar{\alpha}_p$  average piston thermal diffusivity, and  $l$  the thickness of the specimen. We obtained specimens of Cu, Co, Co-WC<sup>(6)</sup> and all had a thickness of about 50-100  $\mu$ m and 20-30 mm in dia.

Using room temperature thermal diffusivity<sup>(7)</sup>

$\alpha_p$  (20°C) = .25  $\frac{cm^2}{s}$  we estimated the quenching rate to be about  $10^6$  K/s.

Quenching in vacuum and in protective atmosphere is possible.

#### References

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