THERMAL STRESSES IN THE INSERT OF LOW-PRESSURE CASTING APPARATUS

P. I. Khristichenko, V. S. Serebro, and N. V. Naumenko

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One of the structural components of low-pressure casting apparatus is the insert, which operates in three ways: it is immersed in liquid metal when the melt flows at the same velocity along its inner and outer surface; it is fully submerged in the melt; and the metal flows only along its inner surface.

In examining the stress–strain condition, one treats the insert as a circular cylinder shell with an axially symmetrical temperature field.

The formulas derived for calculating the temperature field, the stresses, and the radial displacements were applied to the first two operating conditions of steel inserts with different dimensions and at different immersion rates.

The calculations have shown that in long inserts the temperature at the immersed end always approaches asymptotically the same constant value, while the immersion rate has a considerable effect on the temperature field in the region near the free metal surface. The distribution of radial displacements is analogous in character to the temperature distribution.

In Fig. 1 we show the curves of stress variation along the height of an insert on the inner surface. The highest stresses occur at the free surface level after the insert has been immersed. The smaller the inside cross section of the insert is, the higher are the absolute stress levels. A comparison between curves a and b on the graph shows that making the insert wall thicker will result in an unfavorable stress distribution at the free surface of the metal, since there occurs a reversal of stresses as the insert becomes immersed.

The proposed method and this performance analysis of inserts are useful for the design and operation of casting equipment.

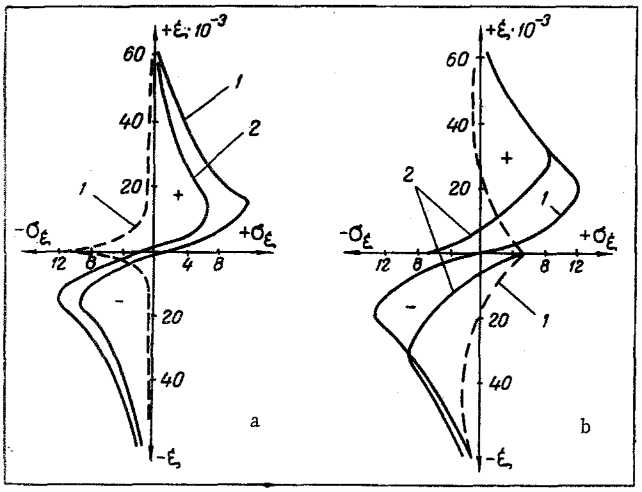

Fig. 1. Axial thermal stresses in cylindrical inserts: a) $\delta = 5 \cdot 10^{-3}$ m; b) 10^{-3} m. Solid curve refers to V = 0; dashed curve refers to V = 0.0025 m/sec; 1) R = $4 \cdot 10^{-2}$ m; 2) $6 \cdot 10^{-2}$ m.

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