DISCUSSION

V. Paschkis

The author is to be congratulated for presenting in a clear and concise fashion the answer to a problem frequently encountered in many different connections.

The author mentions specifically one application: The freezing of a rectangular bar in a sand mold, with bar and mold being apparently assumed of sufficient length so as to disregard end effects and treating the problem two dimensionally. In connection with this problem, two observations should be made:

1. The temperature of the interface is not only not constant, but depends on the physical characteristics of the "casting" filling the hollow of the cylinder.
2. In connection with the application mentioned, it is not only important to know the heat efflux, but also the temperature distribution, particularly near the corners, both within and without the hollow rectangle; put into other words, the heat efflux should be known not only as integral value over the entire surface, but as function of the location. This is important in connection with the stresses set up in the casting.

The problem solved by the author by means of a digital computer took according to his statement 17 minutes for each value of L. If solved by a simulator (direct analog computer) the comparable computing time would be in the order of magnitude of 3 to 4 minutes. The writer believes that this is a typical case where simulator calculations would be more economical and more desirable for the following reasons:

1. Without spending extra computing time the characteristic of the hollow inside the body could be included in the study, thus solving the entire problem instead of part of the problem. It is granted that the preparation for the calculation of such a case would take longer than calculation for a given surface temperature.
2. Without increasing computer time the distribution of efflux over the surface and the temperature distribution in the body could be determined.

Professor Paschkis' remarks are primarily directed at the application of this study to the casting problem. Reference [7] (AFS Transactions, 1961) which discusses this application, includes an example problem wherein the interfacial temperature is not only considered time-variant but also considered unknown. The physical characteristics of the casting are employed there in calculating the interfacial temperature and solidification time. The present paper describes the handling of a time-variant interfacial temperature.

Professor Paschkis' second comment considers a problem separate from the "solidification time" problem treated in this study. While the analysis described in this paper could be modified to treat the interior as well as exterior region, the relation of the calculated interior temperature gradients to stress distributions in the casting is a complex problem in itself. A realistic treatment of this stress problem would be a considerable contribution.

In order to compare the efficiency of analog and digital approaches to this problem one would have to:

1. Stipulate the degree of accuracy required. An analog system which would approach the degree of resolution of the digital finite-difference method might be very expensive.
2. Perhaps impose an additional assumption in the analog approach in that the analog representation of the untransformed problem would have to represent the infinite exterior region by some finite extent; or an analog solution of the transformed problem would require function generators which might add significantly to expense and/or inaccuracy.
3. Evaluate the cost of analog equipment and man-hours involved in equipment design and assembly as opposed to the cost of time spent in programming the digital solution.
4. Realize that an IBM 7090 computer would solve this problem in three minutes for each value of L at a cost of about $30.

With all factors considered, I cannot agree that the solution of this problem would be more efficient either in dollars or total time, by using an analog approach.

Author's Closure

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