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Elastic Flexible Cable in Plane Motion Under Tension[1]

F. O. RINGLEB.[2] This paper is of particular interest in general and to the writer in particular because of his own work in this field and because of his affiliation with the Naval Air Material Center in Philadelphia, where all of the Navy's aircraft arresting gears are developed. The unusually severe use of a cable in an aircraft arresting-gear system (the cable manufacturers call it misuse) has presented for many years a large number of cable-dynamics problems of practical as well as of scientific interest.

The author is to be congratulated for a most valuable contribution to the field of cable dynamics. Compared with what has been published by other authors, his is the most general treatment of the subject. His assumptions concerning the properties of the cable are not restricting. The cable mass per foot can vary along the cable, and the local stress can be any arbitrary function of the strain, a function which, moreover, can vary along the cable. For this most general case the equations of motion of the cable are totally hyperbolic and can be solved using the method of characteristics as the author shows in general and discusses in special cases of particular interest.

It is appropriate, however, to add a few remarks concerning the position of this paper within the historical framework of development of cable dynamics during the past decade. Unfortunately, its history has been somewhat obscured by security regulations, and even more by the recent custom of the industry to distribute valuable scientific papers in private editions only, which are, therefore, usually not listed as references in other publications or reference works. The author was apparently unaware of an investigation by Frank E. Marble, entitled "The Motion of a Finite Cable," privately distributed in 1954 by North American Instruments, Inc., Altadena, Calif. This paper contains the characteristics theory of the moving cable in considerable detail and covers most of the author's results. The writer wishes to emphasize, however, that this statement in no way diminishes the author's independent performance. More important than any priority question is the existence of a well-written and easily accessible publication of the characteristics theory of a moving cable. We are indebted, therefore, to the author for having provided such a publication.

[1] By Wen-Hsiung Li, published in the December, 1959, issue of the JOURNAL OF APPLIED MECHANICS, vol. 26, TRANS. ASME, vol. 81, series E, pp. 587–593.

[2] Woodbury Heights, N. J.

The Melting of Finite Slabs[1]

E. M. SPARROW.[2] The authors are to be commended for their continuing efforts in generalizing the heat-balance integral to increase its utility. In the present paper, as well as in its predecessor, attention is focused on a plane geometry. It would be desirable to know something about the utility of the heat-balance integral in another geometry. For example, one might apply the method to the transient heat flow in an infinitely extended solid through which there passes an infinitely long cylindrical hole. Suppose that the initial temperature throughout the material is T_1, and then at $t = 0$, the temperature at the surface of the hole is raised to a level T_s. The "exact" solution is given by Jakob[3] in Table 13-4.

In applying the heat-balance integral to this problem, the writer found that after a brief initial period of time the predictions of the surface heat flux were of low accuracy. It is suspected that this inaccuracy was connected with the choice of a polynomial approximation for the temperature profile.

If the authors are planning further generalizations of the heat-balance integral, the writer would encourage them to consider the cylindrical geometry.

Authors' Closure

The authors would like to thank Professor Sparrow for his comments and for his interest in the method of the heat balance integral. With regard to his suspicions concerning the use of a polynomial profile when there is cylindrical symmetry, at the present time we can neither confirm nor invalidate this. Nevertheless, we can point out a paper by van der Velden and Schaffers[4] in which a freezing problem with cylindrical symmetry is solved using what is essentially an integral method. Logarithmic profiles were assumed by analogy with the cylindrically symmetrical problem without freezing, and the results, according to the authors, differ by only a few per cent from more exact results. This example does not rule out the possibility that a polynomial profile would work just as well, and it would be interesting to know more of the details of the problem Professor Sparrow worked out and for which he obtained low accuracy.

[1] By T. R. Goodman and J. J. Shea, published in the March, 1960, issue of the JOURNAL OF APPLIED MECHANICS, vol. 27, TRANS. ASME, vol. 82, series E, pp. 16–24.

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[3] Max Jakob, "Heat Transfer," vol. 1, John Wiley & Sons, Inc., New York, N. Y., 1949, p. 267.

[4] H. A. van der Velden and W. J. Schaffers, "Das Berechnen der notwendigen Kalteleistung beim Abteufen von Gefrierschachten," *Glückauf*, vol. 20, 95th year, 1959, pp. 1237–1244.

A Theory of Lubrication With Turbulent Flow and Its Application to Slider Bearings[1]

EDWARD SAIBEL.[2] In the paper by Y. T. Chou and the writer, referred to by the author as reference [5], only fully developed turbulence is treated; consequently, there is no direct connection between the pressure distribution and viscosity. This being the case we draw no such conclusion as is attributed to us in the last paragraph of the present paper, nor do we think such a conclusion can be drawn from our work.

Author's Closure

To clarify the misunderstanding, the following statement from the last paragraph of the paper [5] by Dr. Chou and Prof. Saibel is quoted: "It is clear that the turbulence increases the pressure distribution and the load-carrying capacity of slider-bearing lubrication. However, the power loss also increases." On the other hand, the author's analysis shows that the pressure distribution and load-carrying capacity of a slider bearing with turbulent flow can be either larger or smaller than the corresponding laminar lubrication depending on the choice of the lubricant. Hence the author concludes, "This differs from the conclusion of Chou and Saibel [5]."

[1] By L. N. Tao, published in the March, 1960, issue of the JOURNAL OF APPLIED MECHANICS, vol. 27, TRANS. ASME, vol. 82, series E, pp. 1–4.

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