XIII. PHYSICAL ACOUSTICS[*]

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RESEARCH OBJECTIVES

Our general objective involves the study of the emission, propagation, and absorption of sound and vibrations in matter. Specific areas of current research in fluids include generation and propagation of sound waves in ionized gases, nonlinear acoustics and shock waves, and problems dealing with acoustic and flow instabilities.

In solids the attenuation of ultrasonic waves at the order-disorder transition in alloys is being investigated.

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A. SOUND EMISSION FROM KARMAN VORTICES

The balance described previously[1] has been used to measure the drag force on a cylinder in an air stream. Of particular interest is the magnitude of the drag force when the frequency of Karman vortex shedding from the rod is coincident with a cross resonance of the duct. Some experimental data are presented in Fig. XIII-1. It can be seen that the drag force is generally proportional to V^2, where V is the mean flow velocity. When the coincidence condition described above occurs (indicated by vertical arrows in Fig. XIII-1), there is a slight increase in the drag force. The data shown are for rods 3/8 in. and 3/16 in. in diameter. It was not possible to reach flow velocities large enough to obtain the resonance condition with a rod of 0.5-in. diameter.
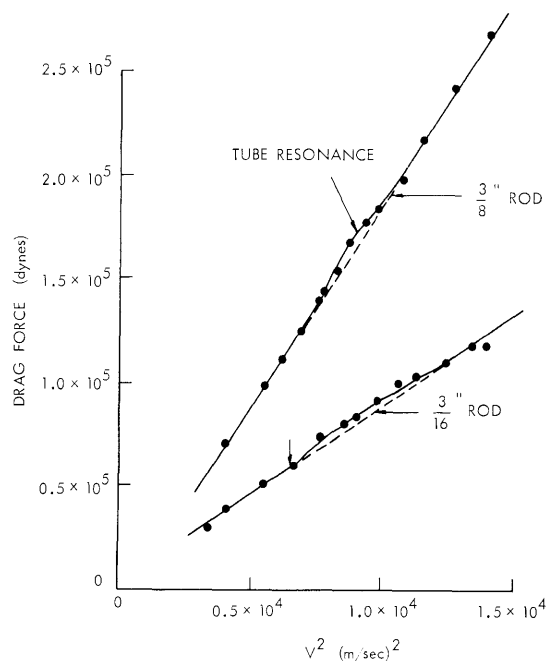
Also, we found that the frequency of the radiated sound (f_s) tended to "lock in" with the cross-resonance frequency (f_t) of the tube. As the velocity past the rod of 3/8-in. diameter was decreased, f_s tended to change abruptly at 650 cps and dropped to

Fig. XIII-1. Drag force as a function of flow velocity for rods of 3/8-in. and 3/16-in. diameter.

the cross-resonance frequency, 600 cps. An attempt was made to influence the vortex-shedding frequency by an external sound field of magnitude comparable with the magnitude of the field generated by the feedback mechanism. For these experiments, the rod was placed at the exit of the test section and exposed to a sound field generated by a loud-speaker and power amplifier. No shift in the shedding frequency could be induced by the sound field, possibly because the sound pressure is not necessarily correlated over the length of the rod when the rod is excited by an external field.

In addition to the experiments described above, a diffuser section was constructed in order to try to excite the next higher cross resonance of the tube with the rod of 3/8-in. diameter. Design changes in the wind tunnel, coupled with a lower-than-expected efficiency for the diffuser section, made it impossible to reach the resonance condition with the rod of 3/8-in. diameter, and no increase in drag was observed when using the rod of 3/16-in. diameter.

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References

1. K. U. Ingard and G. C. Maling, Jr., Sound emission from Karman vortices, Quarterly Progress Report No. 71, Research Laboratory of Electronics, M. I. T., October 15, 1963, p. 81.