Harbour from an aircraft carrier when he sees a column of smoke ahead, which he supposes to come from the customary harvest burning of sugar-cane leaves, and a " ragged pattern of silvery splashes " in the water, which he at first interprets as target-practice. Hardly has it dawned upon him that this is, in fact, war, when he is set upon by a Zero fighter: " The red disk on the white wing reminding me of a big fried egg with a red yolk." In less than three pages of breathless narrative he has accounted for the Jap, has had his rear gunner killed and has himself been shot down, has parachuted to the ground and begged a lift from a passing motorist on a picnic expedition. Again and again we have to remind ourselves that this is not a schoolboy thriller, but actual fact; that at the moment when the Japanese attacked, ordinary citizens were still going about their work and play with an idea that the unwonted noise was part of some large-scale manœuvres. There follows a vivid description of Lieut. Dickinson's return, in the midst of dive-bombing and machine-gunning, to his base aerodrome, his flight through American anti-aircraft fire back to the carrier, and sinking of a submarine. The book continues in the same breathless strain, up to its climax in the famous battle of Midway Island. It is written in a terse idiom that goes well with the subject, and shows more power of description and characterisation than is usual in similar narratives by English pilots.

CORRESPONDENCE.

The National Physical Laboratory,
Teddington, Middlesex,
Engineering Department,
6th April, 1943.

To the Editor of the JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY.

Dear Sir,—Referring to Mr. R. G. Manley's paper on the electro-mechanical analogy, he and Mr. Fairthorne succeed between them in creating considerable confusion as to the system in which capacity is identified with mass. As Mr. Fairthorne states, this system is in some ways preferable to that described by Mr. Manley; but of course the identity of force with e.m.f. no longer holds.

The system to which Mr. Fairthorne refers has the following equivalents:—

Force = current.
Velocity = potential difference.
Mass = capacity.
Stiffness = reciprocal of inductance (susceptance).
Damping factor = reciprocal of resistance (conductance).

As the electrical use of conductance and susceptance suggests, this system is more convenient for circuits in parallel than for circuits in series, and the analogies in this system avoid the inversions from series to parallel circuits, which Mr. Manley's system involves. Nevertheless the conversion from electrical to mechanical circuit is not quite so straightforward as Mr. Fairthorne implies. The velocity of a mass has to be referred to some reference point and this point represents the second " terminal " of the mass represented as a capacity. As a result capacities in series have to be represented as masses joined by levers actuated at intermediate points on the levers. Conversion from mechanical to electrical circuit may seldom introduce this kind of complexity; but it is too much to claim that the mechanical and electrical circuits are identical.

To identify force with current and velocity with p.d. may at first sight appear unnatural and awkward; but, if attention be confined to the magnetic aspect of the electrical circuit, the analogy is fully consistent. In this view, displacement is analogous to flux linking a (single turn) coil; velocity, that is rate of change

of displacement is analogous to rate of change of linkage, that is e.m.f.; whilst force compares with the force on a conductor carrying an electric current in a magnetic field. In fact by the introduction of a D.C. field, mechanical velocity is directly convertible into e.m.f. and electric current into mechanical force.

This brings us to our chief reason for contributing to this correspondence, to rebut Mr. Fairthorne's dismissal of the analogy as virtually useless. Recently in the design of an electrical drive for a mechanical oscillatory system, we were in effect compelled to represent the mechanical system by its electrical analogue in the force-current system; in fact, had the quantities in the electrical analogue not been inconveniently large, we should have proceeded to build up the mechanical system as an equivalent electrical network, in order to try out certain control gear by which amplitude of mechanical vibration was to be controlled.

Finally it is worth while remarking that the electrical analogies are virtually limited to systems possessing one degree of freedom only. To represent systems having more than one degree of freedom, it is, in general, necessary to introduce transformers and, since these must be perfect, the analogies can seldom be of practical use. On the other hand, the statement by Dr. Firestone, in J. App. Phys., 9 pp., 373-387 (the reference is wrongly printed in Mr. Fairthorne's letter) that the analogy cannot be applied to transients is quite unjustified. Properly drawn the electrical analogy represents the mechanical system exactly under all conditions.

Yours faithfully,

F. Aughtie.

H. L. Cox.

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