COMPLEX QUANTITIES

Dear Sir—I have read with amusement and sympathy G. E. Williams’s letter (Sept. 1970 E & P, p. 346), and one can agree with him that the IEC should come out with a pronouncement on complex quantities. Not only do we need the rationalised MKS system of units that we have already, but also we need an agreed rational method of teaching the physical and mathematical concepts in electrical engineering. It is not the fault of Mr. Williams’s letter has made me rethink my own attitude to some of these concepts, particularly vectors and complex quantities.

In the earlier correspondence (Dec. 1970 E & P, p. 132), I criticised the naming of complex quantities as ‘vectors’ and tried to show that if one starts by thinking of heat as being analogous to the genuine 3-dimensional vectors of field theory in electrical and mechanical engineering. However, although I still think the criticism was justified, I now feel that the engineer’s attitude of regarding a.c. quantities like current and potential as 2-dimensional vectors, even if this is partly compatible with the increased power and load cause it to run faster.

Synchronous-motor vector diagram corresponds to $E_1$ in my earlier letter). The power wasted as total mechanical output power required to drive the alternator.

Another synchronous-motor experiment

Dear Sir—In an earlier letter (Oct. 1970 E & P, p. 382), I described a simple synchronous motor which had the oddity of taking less current as the power demanded from it was increased. A consequence of this characteristic has been noticed: the single-phase unit, acting as a synchronous motor, was fed from the reactor driven by a d.c. motor, instead of being fed from a signal generator. When it is fed from a signal generator, the speed is determined by the frequency of the signal generator. When a motor-driven alternator is used, it happens that, as the power demanded from the synchronous motor is increased and the current taken by the synchronous motor system. Let $\mathbf{g}$ denote the resistance of the coils of this system. The power dissipated as heat is given by $P = \sum_{i=1}^{n} \mathbf{E}_i \cdot \mathbf{g}_i$, where $\mathbf{E}_i$ and $\mathbf{g}_i$ are the voltage (p.d.) and resistance vectors of the $i$th coil.

For ease of reference, some of the treatment of space-time relativity, whereas the synchronous motor is increased, increased power is required to drive the alternator, and so there is a temptation to write loosely

$$\mathbf{g} \bullet \mathbf{b} = \mathbf{g} \bullet \mathbf{b} + \mathbf{r}_i \mathbf{j}_x$$

but the mathematician would say that the matrices and the complex numbers are isomorphic, and correctly write

$$\mathbf{g} \bullet \mathbf{b} \sim \mathbf{g} \bullet \mathbf{b} \sim \mathbf{r}_i \mathbf{j}_x$$

where $\sim$ stands for ‘is equivalent to’.

So far, our vectors have had a static look about them, but angular rotation is shown by the vectors $[E \cos (\omega t + \phi), E \sin (\omega t + \phi)]$ and $[\cos \omega t, \sin \omega t]$ of amplitudes $E$ and $\omega t$, respectively, and leading phase angle $\phi$. A periodic waveform would be represented by $[\cos (\omega t + \phi), E \cos (\omega t + \phi)]$. All complex scalars can be found in vector algebra, and they could add further to the confusion unless our ideas and applications are founded on a sound basis. —Yours faithfully,

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27 October 1970

BULL’S EYE

Dear Sir—In the feature ‘Lasers used to aim mirrors’ (Nov. 1970 E & P, p. 341), which describes the use of a laser to adjust the position of a wing mirror on a car, it is not immediately obvious to me why it is necessary to use a laser in this application. Would it not be just as satisfactory (and perhaps safer in view of the eye damage that laser beams can cause) to use an ordinary lamp of reasonable brightness in a ‘bull’s-eye’ arrangement? The beam could perhaps be made up of concentric rings of coloured lights in a ‘bull’s-eye’ arrangement to help in aiming the beam.—Yours faithfully,

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24th November 1970

Electronics & Power January 1971