Filler for Feb. issue if possible.

10 pt / 12

Flux in a Circular Circuit.

(One small cut goes with this)

By Carl Hering

The flux density, H, at the center of a circular circuit of one turn is known accurately to be $2\pi i/r$; it has been, in fact, made the quantitative connecting link between current and magnetism, & the basis of the ampere. But the H in any other part of the circle is very difficult to calculate as it involves elliptical integrals, & to integrate these for getting the total flux is almost hopelessly complicated & then at best only approximate.

The density at any point outside of a single, straight, conductor (one far removed from its return) is definitely known to be $H = 2i/r$, & the total flux around any length l and radius a, up to any radial distance r, is also known definitely to be $F = 2li \log_e (r/a)$. This, however, does not include the flux inside of the wire.

By calculating the total flux in a circular circuit indirectly from Kirchhoff's well known (though only approximate) formula for self-inductance, $L = 2l(\log_e (l/a) - 1.508)$ in which a is the radius of the wire, & l the length, the author found, over extremely wide ranges of the radius r (a being constant), the interesting result that the total flux in a circle of radius, r, seems to be equal to that around a length, l, of single, straight, conductor of equal length (that is, equal to the circumference of the circle) & up to a distance r from the axis, that is, to that in the rectangle abcd.

There is a small, though constant, difference (always greater for the circle) due undoubtedly to the flux inside of the wire, which is included in the formula for the circle but not in that for the single conductor; these lines have only a fractional effect in the induction. The agreement is of the kind that strongly indicates that this equality would probably be found to be theoretically exact, for the same size of wire, if the theoretically definite value of the flux in a circle could be found; when a result is indicated or known, a proof is sometimes more easily found. Such being the case, the total flux in a circle could be expressed by a simple, theoretically exact, definite formula, independent of the self-inductance, & the latter checked by it, so far as quantity of flux is concerned.

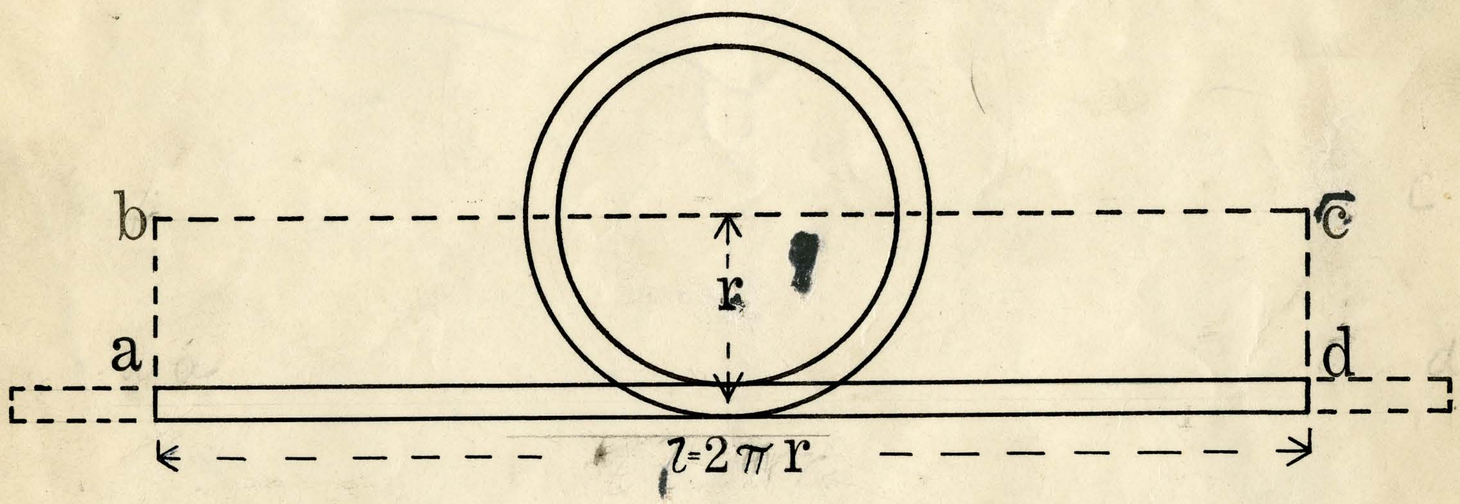
Had our forefathers adopted the single conductor instead of the circle, as their fundamental in formulating our units, the factor π would have dropped from some of the present fundamental relations.

(Tr. phrases & insert as indicated)

Note for Mr. Metcalfe

If difficult to set up $\log_e$ the e may be omitted as it is well known. Another substitute would be "nat. log" instead of "$\log_e$"

2"



lower case R

$l = 2\pi r$

Cut for Hering's note on Flux in a Circular Circuit.

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