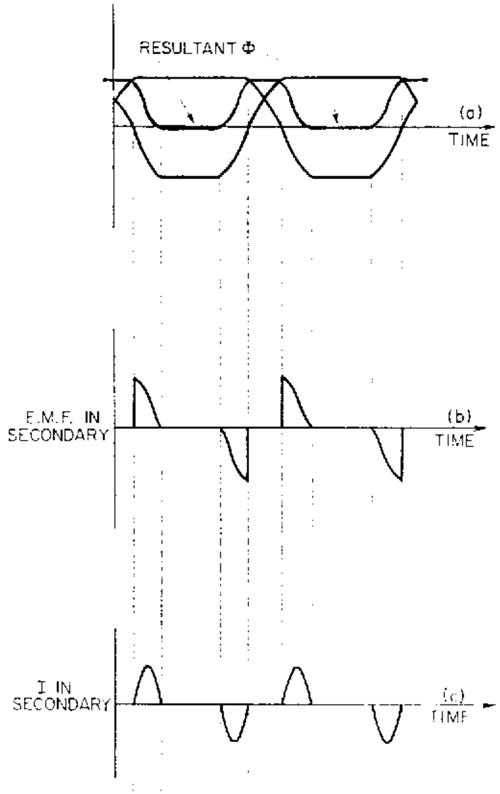

FIG. A.II.18. Resultant flux, e.m.f. and current in secondary

When no outside magnetic source is influencing the soft iron core(s) there will be no flux change in the cores—because the flux from the two primary coils cancel out—and so there can be no voltage induced in the secondary.

The primary winding is fed by an alternating current of such a value that at or near maximum instantaneous current flow the iron core(s) become saturated, that is, a further increase in current will produce no further flux.

Let the two primary coils and cores be known as " A " and " B " (see Fig. A.II.15).

Now study the graphs shown in Fig. A.II.16 (a) and (b).

The graphs in Fig. A.II.16 show the input current (I) to the primary and the resulting flux (Φ) in each core—it will be understood from the graphs that the resultant flux of A and B is zero.

Suppose now that the cores of the flux valve have d.c. magnetic flux induced in them longitudinally from an outside source, for example by the earth's magnetic field or by the field system around the magnetic needles of a magnetic compass—this will have the effect of altering the periods of flux saturation in the cores as shown in the graphs of Figs. A.II.17 (a) and (b).

Thus core A becomes saturated earlier and remains saturated longer in the first half cycle and then reaches saturation later and remains saturated shorter during the second half cycle than previously (Fig. A.II.17 (a)).

In Fig. A.II.17 (b) on the other hand core B is shown to become saturated later and remains saturated shorter in the first half cycle and then reaches saturation earlier and remains saturated longer in the second half cycle than it did previously.

Note that the saturation levels are the same as before (in Fig. A.II.16)—it is only the *times* of reaching and leaving saturation which have been changed.

Combining the flux in A with that in B it is seen that the resultant flux is no longer zero —in fact the resultant flux fluctuates with time. Figure A.II.18 (a) shows the combination of flux under such conditions. It can be seen from this figure that at the times at which the two cores are either *both* saturated or *both* unsaturated that there is no *change* of flux. However, when one core is saturated and the other unsaturated then there is a *change* of flux. This change of flux will induce an e.m.f. in the secondary winding. The e.m.f. generated is shown graphically in Fig. A.II.18 (b). If the circuit to the secondary is complete the e.m.f. will produce an alternating current, see Fig. A.II.18 (c).

Note that the frequency of the output is twice that of the input.

A flux valve can be used to find the direction of a ship's head in relation to the earth's magnetic meridian. In this case, though, the flux valve must have three arms instead of one arm to avoid ambiguity. A single arm would have the same output on four different headings—though the same output and phase on two different headings. Such a three-arm flux valve is used in the Gyrosyn Compass—see Volume I.

The simple one-arm flux valve is employed in the Sperry magnetic compass pilot Vol. II (Chapter VIII). Here the ambiguity does not arise as when the vessel is on a set course, the iron core of the flux valve is perpendicular to the magnetic field of the compass. When the vessel changes her heading a phase discriminator detects the *direction* of the off-course movement and the vessel will return automatically to her set course.