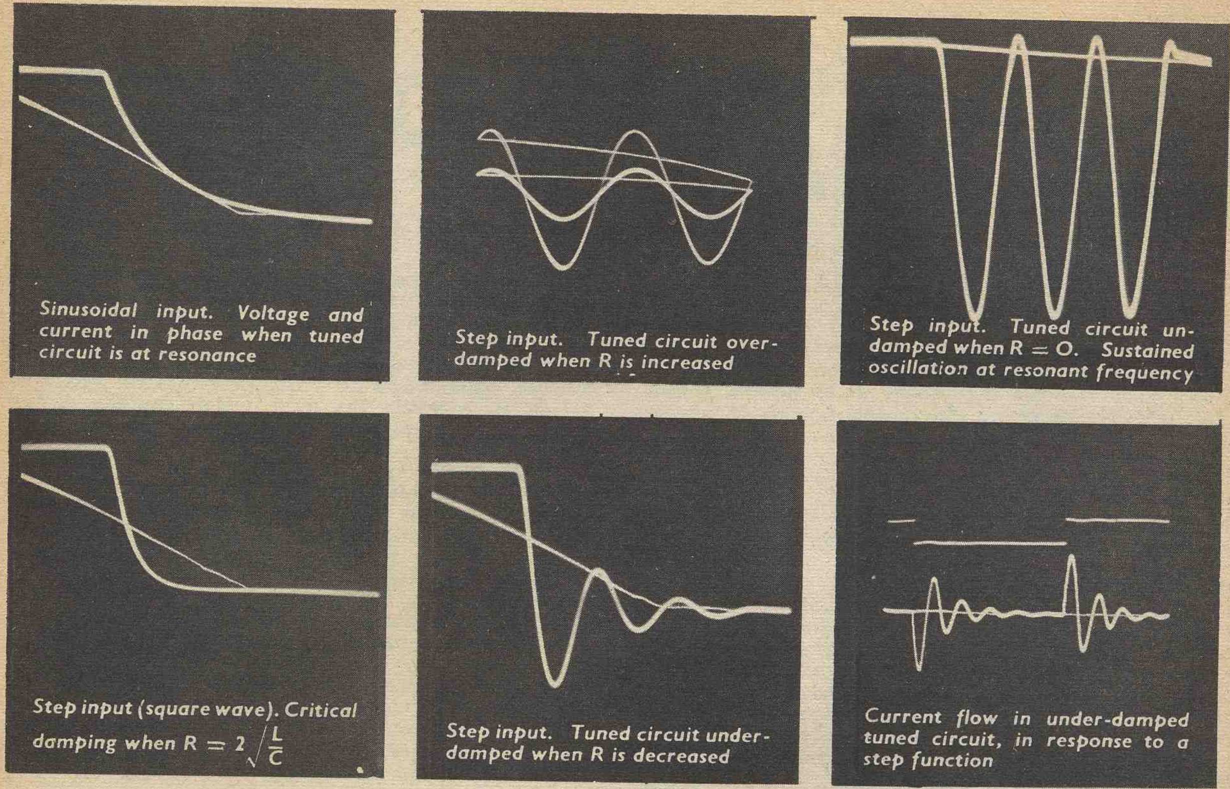

Fig. 5.7. Response of a simulated tuned circuit

Apply a 2V r.m.s. 50Hz signal to OA1/Input 2, and monitor by means of a reliable 10V a.c. meter of not less than 1 kilohm/volt sensitivity. The input function should preferably come from a low impedance source to avoid serious loading errors when the voltmeter is removed. Next, connect the a.c. voltmeter to the output of OA1 and adjust CP1 so that OA1 input and output voltages are exactly equal. CP1 could alternatively be set by the reference voltage and d.c. voltmeter method mentioned earlier, for a coefficient of 0·1. If the CP2 setting is altered it will be discovered that the simulated circuit goes off resonance, and can be tuned by CP2 between approximately 5Hz and 50Hz.

UNIT "A" will now be ready for analysis of the Fig. 5.6a tuned circuit, and will also cover a useful range of other values for L, C, and R in real time.

When handling sinusoidal or step functions, an amplifier will still have a maximum output voltage swing of $\pm$10V, but this will be the peak voltage value. To check for overloading with an a.c. meter, ensure that amplifier output voltages do not exceed 7·07V r.m.s. for a sine wave function, and 5V mean for an equal mark-space square wave.

RESCALING PROBLEM EXAMPLE 3.

To rescale the problem for larger or smaller values of L and C, beyond the coverage of CP2, and by abandoning real time operation, note that a tenfold increase in tuned circuit frequency corresponds to a hundredfold increase in $1/LC$. For most applications, where the series resistance R will lie between zero and just beyond critical damping ($R > 2\sqrt{[L/C]}$), the scaling of R/L can stay as it is for all reasonable values of L and C, but should anyway only be changed by adjustment of the gain factor at OA1/Input 1. Similarly, the $f(t)/L$ gain of 100 at OA1/Input 2 can remain fixed.

It is not necessary to use inconveniently large or small input functions when rescaling for new voltages and currents. 2V r.m.s. could equally well represent an input function of, say, 0·2V r.m.s., and from Ohm's Law the current I will automatically become 2mA, instead of the former 20mA, even though it is still represented by 2 computer volts.

If it is desired to extend the computer operating time, by adjustment of integrator and inverting amplifier closed-loop gains, refer to Table 5.2, while remembering that integrator closed-loop gains are calculated on the basis of $1/R_{in}C_f$ where R is in ohms and C is in farads.

For reasons of reduced accuracy, it is not advisable to use computer operating frequencies above 1kHz or below 0·05Hz in connection with Problem Example 3. It should be mentioned that although frequencies in the region of 0·05Hz are too low for display on an a.c. coupled oscilloscope, the behaviour of a system can be demonstrated in slow motion by the oscillating movement of a d.c. voltmeter pointer (centre-zero).

Some typical oscillograms are given in Fig. 5.7 to show the response of a simulated tuned circuit. If the computer oscilloscope is provided with a good graticule, and has a linear response, amplitude and time measurements which are accurate to within approximately 5 per cent may be obtained straight from the trace.

The behaviour of a real tuned circuit can be evaluated by comparison with a simulated circuit. A tracing is made of the real circuit oscilloscope display, and is then superimposed on the readout given by the simulated circuit. The computer is adjusted so that time scales are related by a known factor, and tracing and readout display are identical, then quantitative measurements are taken from the computer voltages and dial settings.

Next month: The construction and operation of UNIT "B"