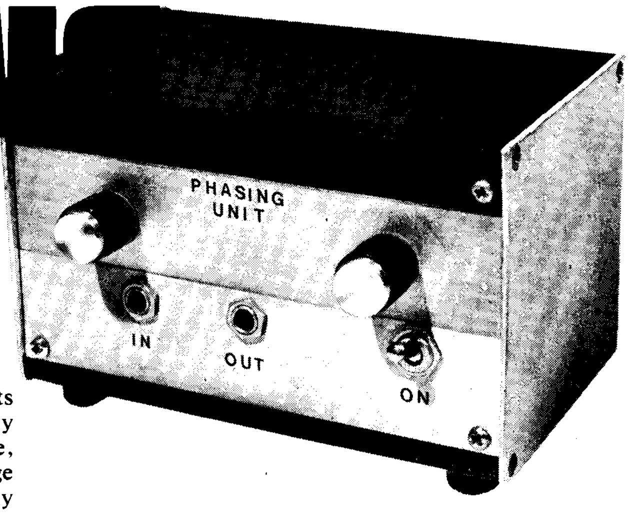
PHASING UNIT



By D. BENFIELD

THERE is a continual demand for sound effects units which can be put together easily and cheaply by the home constructor. Indeed, it is this last feature, namely cost, which gives such devices an advantage over equivalent commercial units which are usually prohibitively expensive. To this end, the Phase Box about to be described has been made as simple as possible, consistent with an acceptable performance.

PRINCIPLE OF OPERATION

The essence of musical phase effect is to play a piece of music through two channels, with a slight time delay on one input.

To produce the required effect, the input signal is passed through a variable time delay network; the output from this is then mixed with the original signal which formed the input as shown in the block diagram of Fig. 1.

At a certain frequency, depending on the delay introduced, complete cancellation occurs during the mixing process and, by varying this frequency, the well known phasing effect is produced.

THE DELAY NETWORK

The basic circuit used to produce the required phase shift is shown in Fig. 2.

If equal amplitude sinewave inputs, of frequency f, are applied to "A" and "B", but with the input to "B" inverted with respect to "A", then the output will also be of the same amplitude, but will have a phase lag of $2\tan^{-1}(2\pi fRC)$ degrees.

Note that when $2\pi fRC = 1$, then the phase lag is 90 degrees. Thus, assuming we have suitable anti-phase driving signals at our disposal, we can cascade two such networks and, at a frequency given by $f = 1/2\pi RC$ we would get a total phase lag of 180 degrees.

Such antiphase signals are easily obtained by using a single transistor stage with equal emitter and collector resistors. Omitting biasing arrangements, we have the circuit of Fig. 3 for a single stage of our two-stage phase delay network.

The required phasing effect is obtained by varying the frequency at which cancellation occurs in the mixer stage. This is most easily altered by making R a variable component, which means a dual-gang potentiometer since two stages are being used.

COMPONENTS . . .

Resistors
R1 100kΩ
R2 47kΩ
R3 1·5kΩ
R4 1·5kΩ
R5 220Ω
R6 1kΩ
R7 1kΩ
R8 220Ω
R9 470Ω
R10 15kΩ
R11 100kΩ
R12 2·7kΩ
All resistors are ⅛W 10% carbon

Potentiometers
VR1 5kΩ log pot
VR2a, b 10kΩ + 10kΩ logarithmic dual-gang
VR3 10kΩ linear carbon preset

Capacitors
C1 6·4μF, 25V elect.
C2 6·4μF, 25V elect.
C3 6·4μF, 25V elect.
C4 6·4μF, 25V elect.
C5 0·1μF, mylar
C6 0·1μF, mylar

Transistors
TR1–TR4 BC168 (4 off)

Switch
S1 Double pole on/off toggle

Miscellaneous
JK1, JK2 Standard jack sockets (2 off)
B1 PP3 9V, battery connectors, 0·1in Veroboard Instrument case 6¼in × 4in × 4in

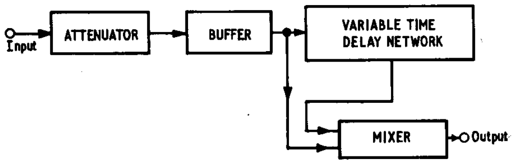


Fig. 1. Block diagram showing principle of operation

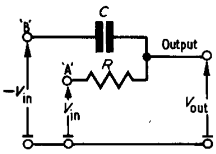


Fig. 2. The basic phase shift network employed

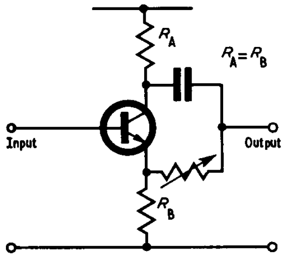


Fig. 3. Circuit for producing antiphase signals

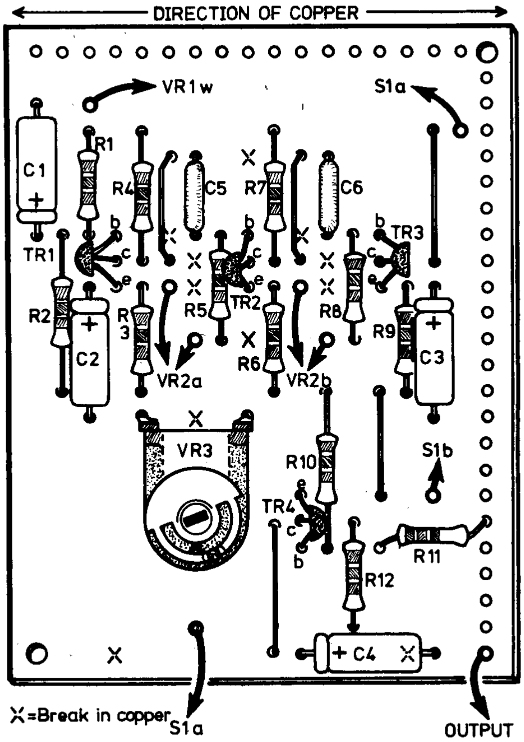


Fig. 5. Component layout and wiring on 0·1 in. matrix Veroboard

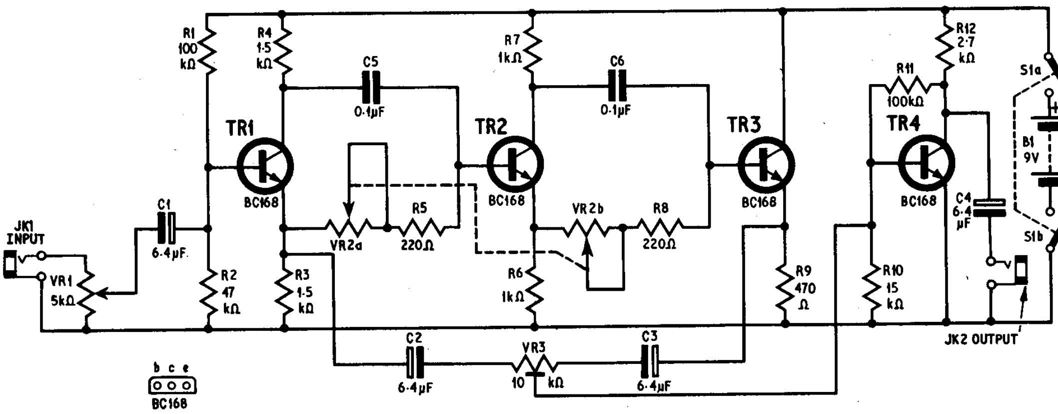


Fig. 4. Circuit diagram of Phasing Unit

FULL CIRCUIT

The phase delay is introduced by the circuitry around TR1 and TR2 as in Fig. 4. TR3 acts as an emitter follower so that a reasonably high impedance is presented to TR2 collector circuit, in order to isolate this stage from the low input resistance of the mixer.

The operating conditions for TR1 are set up by R1 and R2, while direct coupling through VR2a and R5 to TR2 base enables further bias chains and coupling capacitors to be eliminated; similar remarks apply to TR3 stage. This does mean, however, that there is a risk of unpleasant "plops" being produced should a slider of VR2 become momentarily disconnected. To overcome this, the unused ends of VR2a, b tracks should be connected to their respective sliders, and so maintaining a bias path for TR2 or TR3.

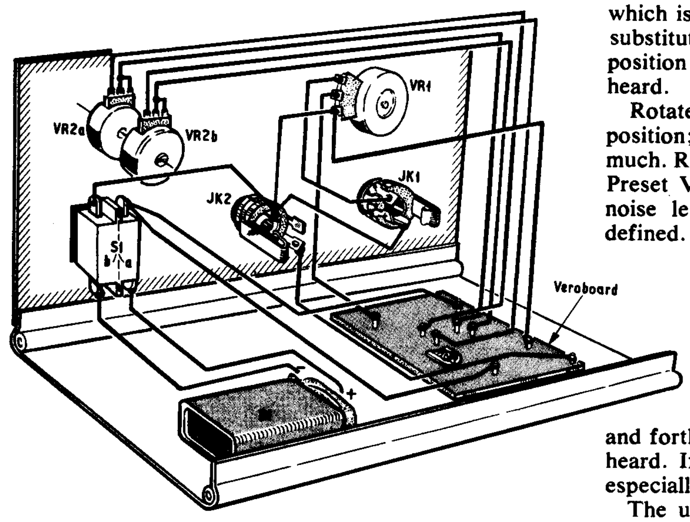


Fig. 6. Complete interwiring detail

Potentiometer VR1 provides a means of controlling the output level from the unit, by attenuating the input signal. This method is to be preferred here since it enables high level sources to be used without overloading the unit, which could occur if the level control were placed at the output.

The mixer circuit uses a single transistor, TR4. Bias conditions are maintained by the potentiometer formed by R10 and R11. By this means the collector potential is set at approximately five volts, regardless of supply voltage variations.

The inputs—direct signal and phase delayed signal—are applied to the two capacitors C2 and C3. Compensation for any difference in signal level can be provided by making either or both input resistors variable.

CONSTRUCTION

The original was assembled on a small piece of 0·1in matrix copper clad Veroboard, as this permits a neat and compact layout—see Fig. 5.

The board can now be mounted in a convenient case using 6 B.A. nuts and bolts, making sure the solder pins are well clear of the chassis by using nuts or washers as spacers.

The final wiring to input, output, VR1, VR2 and on-off switch can now be carried out; Fig. 6 shows the chassis mounted component connections.

The unit is conveniently powered by a small 9 volt battery, but it will work from any supply between 6 and 20 volts. Current drain is approximately five milliamps from a 9 volt supply.

SETTING UP

Initially set VR3 to mid-position and both panel controls to their extreme counter clockwise positions. Switch on and check that current drain is about 5mA, using a suitable meter in series with the supply.

The input should now be connected to a source of "white noise". Failing this however, an f.m. receiver which is not tuned to any station makes a very good substitute. Set the level control to a convenient position whereupon the characteristic hiss should be heard.

Rotate the "phase" control VR2 to its extreme position; some sort of phasing may be heard but not much. Rotate this control back about ¼ of a revolution. Preset VR3 should now be adjusted for a minimum noise level, the correct position being fairly well defined. Upon rotating the phase control VR2 back and forth, the familiar phasing effect should now be heard. If this is not the case, check all connections, especially the links on the circuit board.

The unit may now be tried out with music input from, say, a tape recorder. The final degree of phasing heard depends largely on the content of the music used; Pop records provide a suitable starting point with their varied frequency content, and on some of these the effect can be quite startling. ★