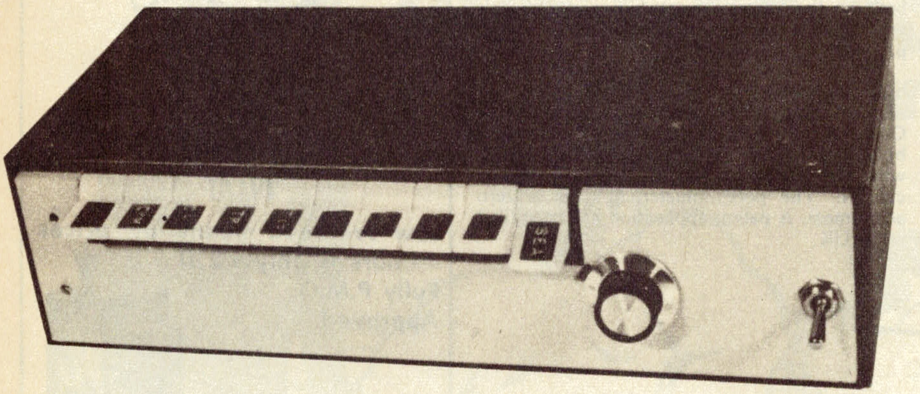
Sound Effects Synthesiser for



This is the second article in a series giving the essential information for the construction of ten separate percussion and sound effects generators for electronic organs. Part one dealt with the general layout of the complete unit and the first three generators. Five more are described below.

With the exception of the Bell Chime circuit, all the remaining circuits can be constructed and operated individually, as each has a fairly large signal output.

If all the generators are to be used together, as in the original unit, they must be finally connected together via a mixing output pre-amplifier which will be dealt with later.

The next circuits to be described are the Triangle No 4, Wood Block No 5, Taxi Horn No 6, Train Whistle No 7 and Bell Chime No 8. Each is assembled on a board as those in part 1. As will be seen from the board layout diagrams given in this article, some boards are full with components. For this reason the components used should be as small as possible.

TRIANGLE—No 4: The sound of a triangle is clear and high pitched and the waveform almost sinusoidal. The circuit as in figure 11 therefore, employs a phase shift oscillator adjusted for a frequency of approximately 4500Hz.

The output from the oscillator Tr1 is first attenuated via R21 and then taken to the control amplifier Tr3. This amplifier is triggered by Tr2 which generates a control voltage waveform as shown in the Triangle Circuit waveform B figure 21.

When the key No 4 is closed, a pulse (Triangle Circuit waveform A) is generated which causes Tr2 to conduct. This brings the emitter of Tr2 almost up to the supply voltage and C9 becomes charged. Tr3 takes its HT from C9 which then slowly discharges and produces the required decay effect.

The sine-wave output from Tr1, although considerably attenuated, does slightly overdrive Tr3 and this helps to provide the characteristic metallic sound of a triangle. Note that the key click filter C7/R9 must be included. The resistor R14 in series with C9 reduces the otherwise very hard attack and C9 itself determines the decay time. If C9 is made larger the decay time will be larger and vice versa.

The pitch should be adjusted as close as possible to 4500Hz and this can be done by either reducing the value of R1 slightly or by connecting another resistor in parallel as R1A. The circuit board layout is shown in figure 12.

WOOD BLOCK—No 5: This is a little less complicated than the other circuits and employs only two transistors. The circuit is shown in figure 13. In this Tr1 is a phase shift oscillator biased to cut off and is turned on only when Tr2 conducts, ie, when the key (No 5) is closed.

The pitch and decay time are both very important if a realistic sound is to be produced. For instance, if the decay time is too long the sound will be too much like a bell and if too short will sound like a click. Some adjustment of R9 may be necessary to achieve the right period of decay.

Pitch can be altered by slight variation of R1 which is nominally 8.2K. Adjustment of both decay time and pitch rather depends on aural estimation of the sound.

The strike and decay control voltage and output waveforms are shown in figure 21. (Woodblock Circuit waveforms A and B respectively.) The circuit board layout is shown in figure 14.

TAXI HORN—No 6: This is another of the more complex circuits and employs four transistors as shown in figure 15. First however, note that the signal from the multi-vibrator Tr1-Tr2 is also used for the bell chime circuit No 8. If the taxi horn circuit is to be used by itself the lead out to R16 on the bell chime circuit will not be necessary.

The signal from Tr1-Tr2 is a typical multivibrator waveform, which is modified and attenuated by the network R6, R7, C5 and R12. The pitch should be adjusted to between 200 and 250Hz by slight variation of R2 and the attack/decay characteristic by R15 and R16. Depression and instant release of the key No 6 should produce a short but typical "honk" sound characteristic of old bulb type car horns. If the key is depressed and held down the decay will be very slightly longer but the sound will die away completely.

The circuit is triggered by Tr3 and the function of this transistor and its triggering voltages are the same as those (except for the decay time) for the triangle and cymbal circuits. The triggering voltage waveforms are shown in figure 21 (Taxi Horn Circuit waveforms A, B and C). The circuit board layout is shown in figure 16.

TRAIN WHISTLE—No 7. Two transistors and a noise diode type Z1J are required for this circuit as shown in figure 17. It will produce a typical steam train whistle complete with noise content and pitch variation. The transistor Tr1 is a phase shift oscillator, the output of which is attenuated via R9. The pitch should be approximately 1000Hz and adjustment to attain this can be made by slight variation of R1.

The noise generator ND1 is the same as used for the cymbal and snare drum circuits and its output is slightly attenuated by R11. The transistor Tr2 takes the signal from Tr1 and ND1 simultaneously but is normally biased to cut off by R14/R16. When Key No 7 is depressed Tr2 conducts and passes the combined sinewave and noise signals.

However the signal output from Tr2 is also directed via C10 to the diode rectifier circuit

ABOUT THESE ARTICLES:

This article by F. C. Judd on a Sound Effects Synthesiser is reproduced by special arrangement with "Practical Wireless". An editorial note indicates that all the circuits have been thoroughly checked out and that the prototype was demonstrated at last year's International Audio and Music Fair at Olympia.

The circuits have not been duplicated in our own laboratory and we are not in a position to answer technical questions about their operation. However, the circuits should provide an excellent starting point for readers who wish to experiment with sound effects circuits for use with electronic organs or in music group situations.

There are references in the text and parts list to components which are available to constructors in the British Isles. Australian constructors could undoubtedly import these components but they would have to make their own arrangements about ordering, payment, freight, possible duty, etc. In most cases it will be simpler to determine by experiment suitable alternatives from local sources.

Organs

by F. C. Judd — PART TWO

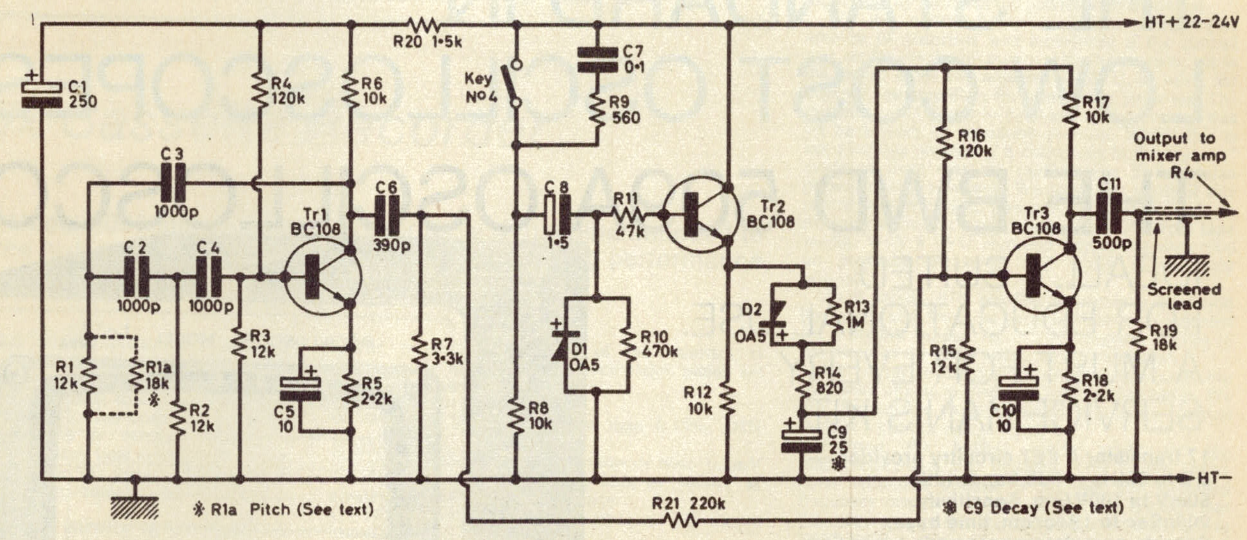


Figure 11: The circuit of the triangle sound synthesiser.

R22, D1 and C13. The negative voltage derived from this via R21 is applied to the base of Tr1 and produces a slight change in the pitch of the whistle frequency a fraction of a second after its initial sound.

It is however, important that the white noise content of the whistle is not too great. The effect, which is that of hissing steam, should be only just apparent and should appear on the output waveform as shown in figure 21. (Train Whistle waveform B.) The output waveform should also appear slightly clipped at the top. Adjustment to the level of the white noise content can be made by altering the value of R11 slightly, ie, increase R11 for a decrease in noise content and vice versa. The circuit board layout is given in figure 18.

BELL CHIME—No 8: A deep bell chime, similar to that produced by a large clock for

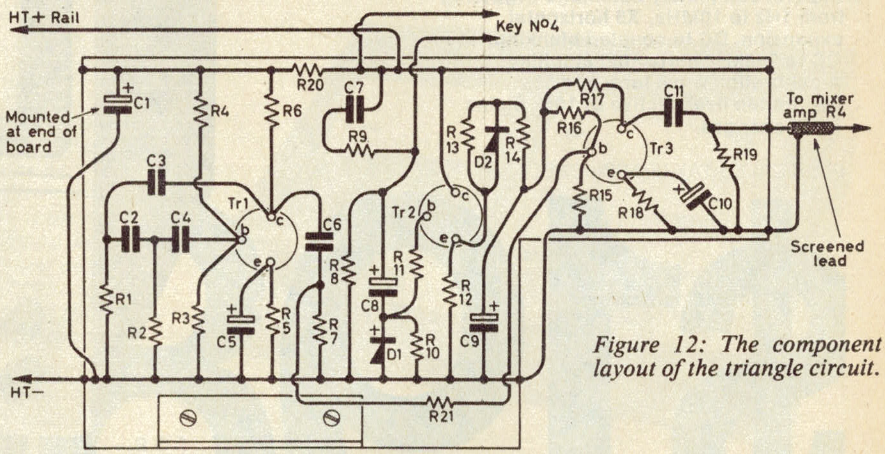
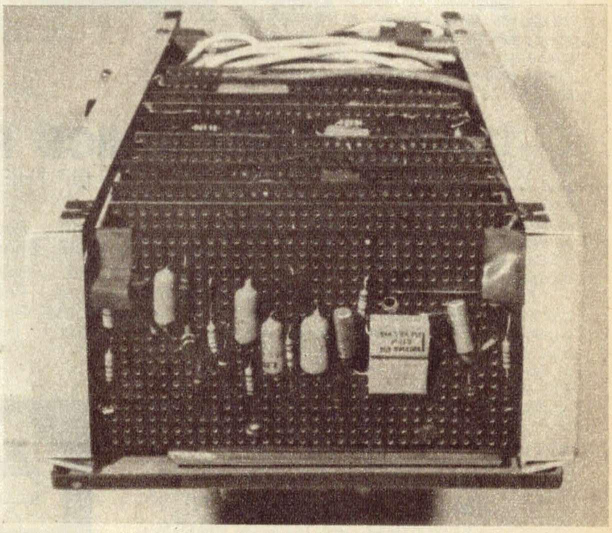


Figure 12: The component layout of the triangle circuit.

An internal view of the completed project. The board shown is for the castanets circuit.



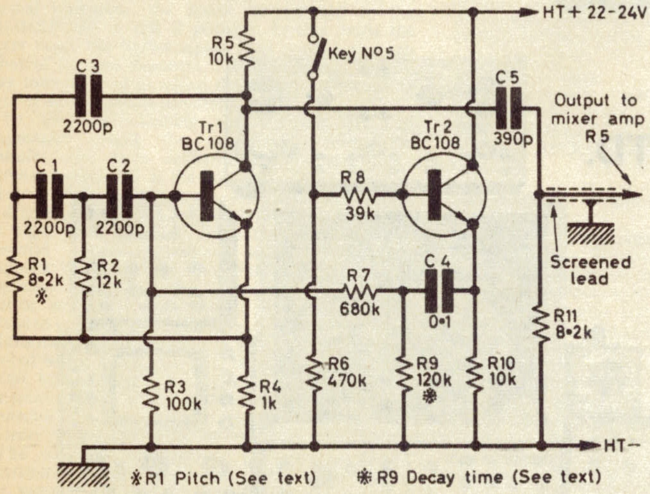


Figure 13: The wood block sound circuit.

instance, is a complex sound made up of an undulating fundamental and many overtones.

To achieve a close approximation of this without having to resort to the use of filters and/or a number of tone generators, a multivibrator has been used for the fundamental pitch and overtones. A strong beating or undulating effect is produced by adding another signal at almost the same frequency as the fundamental.

This extra signal is obtained from the taxi horn oscillator. The harmonics of this also add considerably to those produced by the bell chime oscillator and the result, after suitable attentuation and "voicing", is a deep undulating but strident clock chime.

The triggering circuit for the bell chime is produced by Tr3 which is switched on by key No 8. The action of the circuit is the same as that used for the cymbal and triangle circuits and the decay time about the same, ie, two to three seconds.

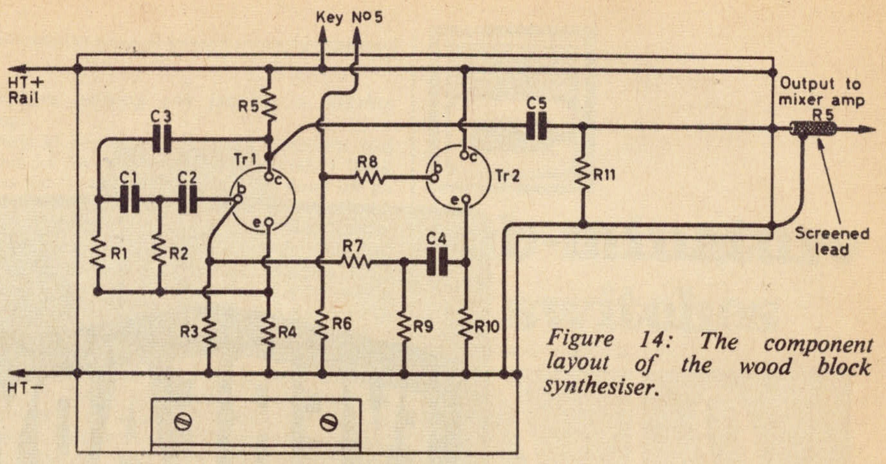


Figure 14: The component layout of the wood block synthesiser.

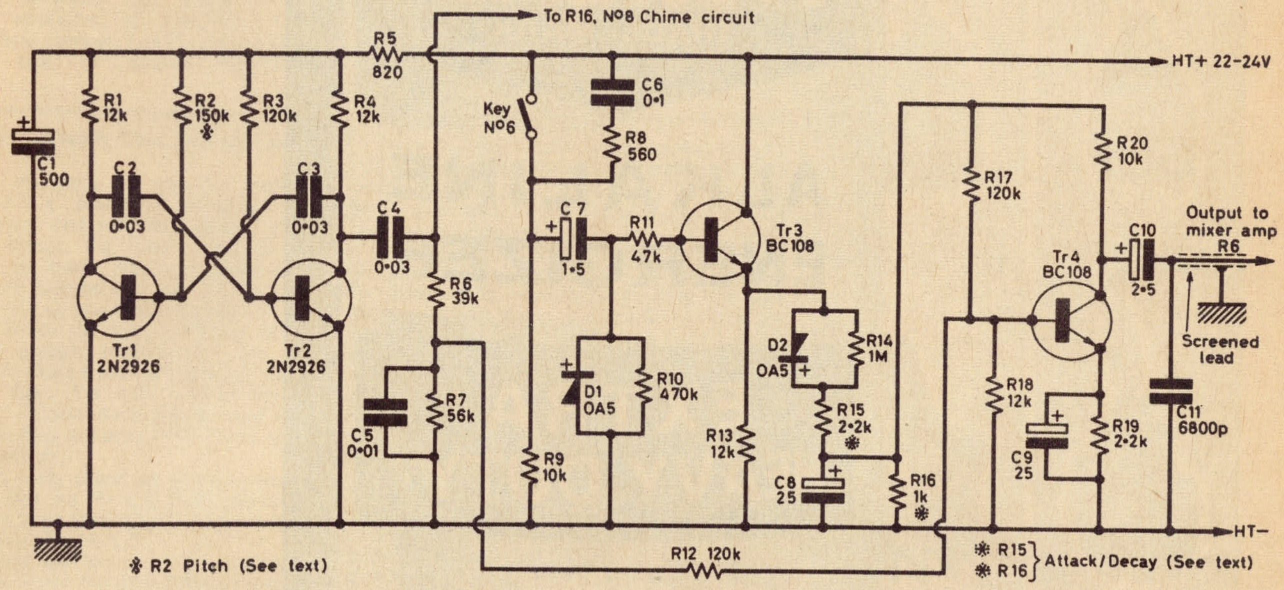


Figure 15: The taxi horn sound synthesiser circuit. The various waveforms produced are shown in figure 21 on page 37.

The output from the bell chime oscillator Tr1-Tr2 is voiced by R6/C5 and attenuated by R12. The signal from the taxi horn oscillator is treated in much the same way by R16, C8 and R15. Both signals are fed to the base of Tr4. Further attenuation and voicing is introduced at the output from Tr4. The frequency of the signal produced by Tr1 and Tr2 should be adjusted by slight variation of R1 so that a slow audible beating effect is obtained when the sound is keyed.

Do not alter the pitch of the taxi horn circuit which should have been adjusted to between 200 and 250Hz. The pitch of the bell chime oscillator is best adjusted by substituting R1 with a variable of say 100K in series with a fixed resistor of not less than 18K, to prevent the base of Tr1 being taken straight to the positive rail. Pitch should then be adjusted until it is very close to that of the taxi horn oscillator frequency, ie, until a slow beat becomes audible.

Check the amount of resistance in circuit and replace with an appropriate value fixed resistor. It might be better to replace R1 completely with a small pre-set of say 50K in series with a fixed resistor of 18K. Again the effectiveness of the sound is best judged aurally but the output waveform, if displayed on an oscilloscope, should appear complex and with considerable fluctuation in the amplitude of the harmonics.

The triggering and output waveforms are shown in figure 21. (Bell Chime circuit waveforms A, B and C.) The circuit board layout is shown in figure 20.

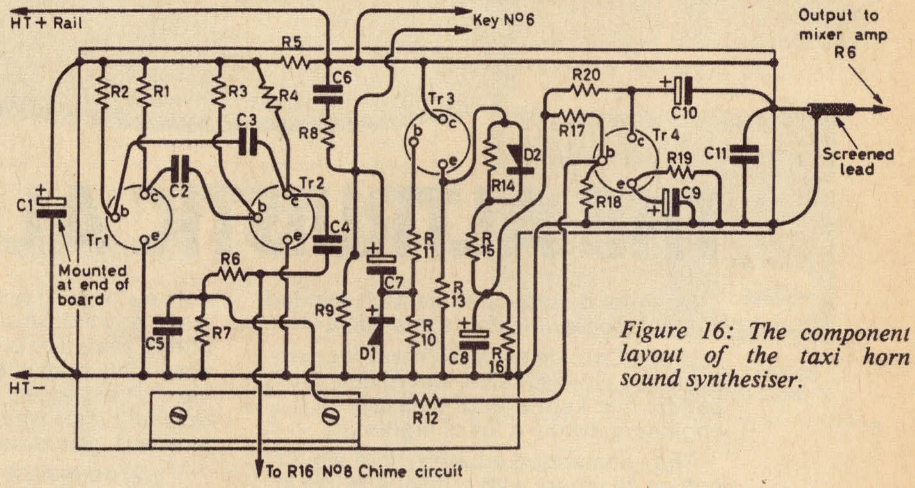


Figure 16: The component layout of the taxi horn sound synthesiser.

PARTS LIST, PART 2

TRIANGLE CIRCUIT No 4

Transistors

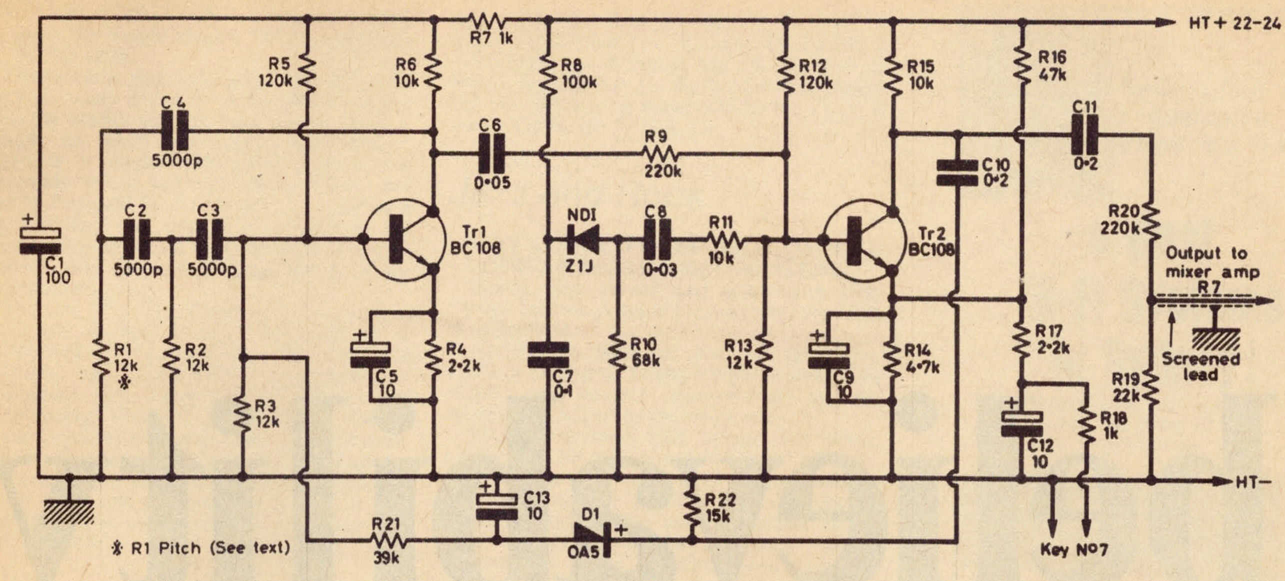
Tr1, Tr2, Tr3 BC108

Diodes

D1, D2 OA5

Resistors

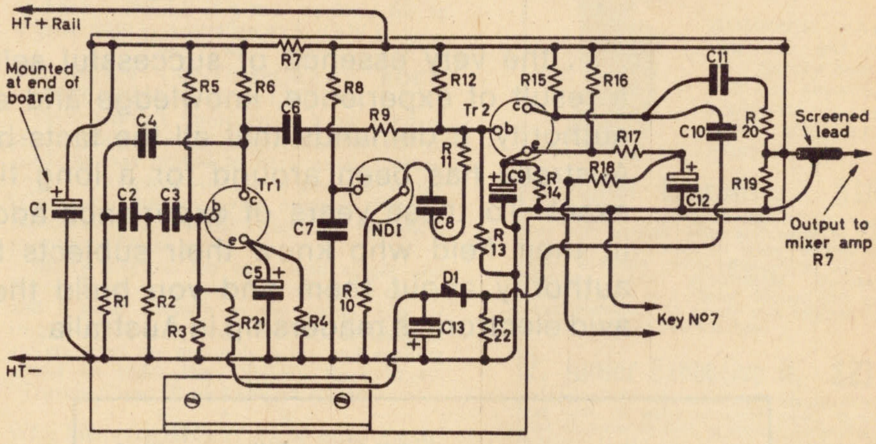
R1	12K	R11	47K
R1A	18K	R12	10K
R2	12K	R13	1M
R3	12K	R14	820
R4	120K	R15	12K
R5	2.2K	R16	120K

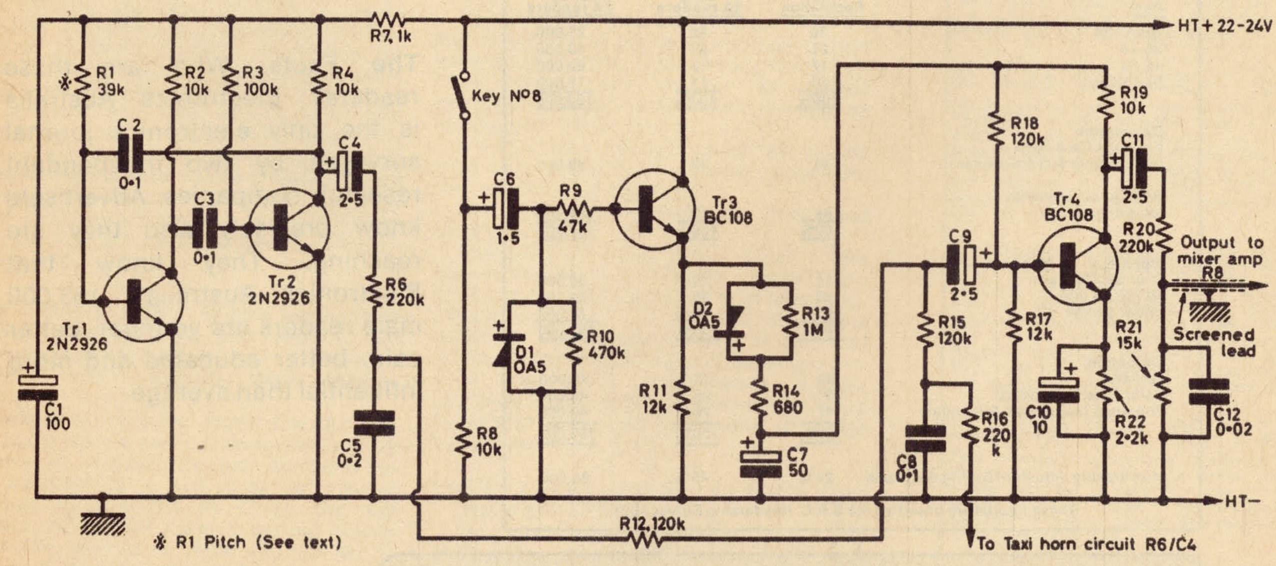


ABOVE. Figure 17: The circuit used for simulating the train whistle sound.

RIGHT. Figure 18: The component layout for the train whistle synthesiser.

BELOW. Figure 19: The circuit of the bell chime synthesiser. The waveforms of the various stages are shown in figure 21 on page 37.





R6	10K	R17	10K
R7	3.3K	R18	2.2K
R8	10K	R19	18K
R9	560	R20	1.5K
R10	470K	R21	220K

All ½W, 10% tolerance

Capacitors

C1	250uF	C7	0.1uF

WOODBLOCK CIRCUIT No 5

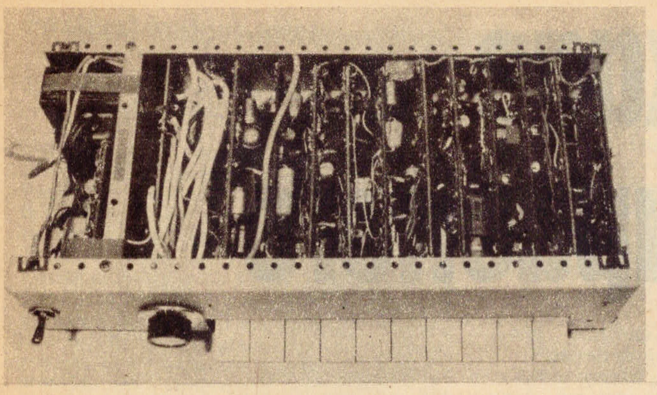
C2	1000pF	C8	1.5uF
C3	1000pF	C9	25uF
C4	1000pF	C10	10uF
C5	10uF	C11	500pF
C6	390pF		

Transistors Tr1, Tr2 BC108

Resistors

R1	8.2K	R6	470K
R2	12K	R7	680K
R3	100K	R8	39K
R4	1K	R9	120K
R5	10K	R10	10K

All ¼W, 10% tolerance



The various boards are shown at the centre and right, the power supply on the left.

Capacitors

C1	2200pF	C4	0.1uF
C2	2200pF	C5	390pF
C3	2200pF		

TAXI HORN CIRCUIT No 6

Transistors

Tr1, Tr2	2N2926
Tr3, Tr4	BC108

Diodes

D1, D2	OA5

Resistors

R1	12K	R11	47K
R2	150K	R12	120K
R3	120K	R13	12K
R4	12K	R14	1M
R5	820	R15	2.2K
R6	39K	R16	1K
R7	56K	R17	120K
R8	560	R18	12K
R9	10K	R19	2.2K
R10	470K	R20	10K

All ¼W, 10% tolerance

Capacitors

C1	500uF	C7	1.5uF
C2	0.03uF	C8	25uF
C3	0.03uF	C9	25uF
C4	0.03uF	C10	2.5uF
C5	0.01uF	C11	6800pF
C6	0.1uF		

TRAIN WHISTLE CIRCUIT No 7

Transistors

Tr1, Tr2	BC108

Diodes

NDI Noise Diode Z1J Semitron (see Part 1)
D1 OA5

Resistors

R1	12K	R12	120K
R2	12K	R13	12K
R3	12K	R14	4.7K
R4	2.2K	R15	10K
R5	120K	R16	47K
R6	10K	R17	2.2K
R7	1K	R18	1K
R8	100K	R19	22K
R9	220K	R20	220K
R10	68K	R21	39K
R11	10K	R22	15K

All ¼W, 10% tolerance

Capacitors

C1	100uF	C8	0.03uF
C2	5000pF	C9	10uF
C3	5000pF	C10	0.2uF
C4	5000pF	C11	0.2uF
C5	10uF	C12	10uF
C6	0.05uF	C13	10uF
C7	0.1uF		

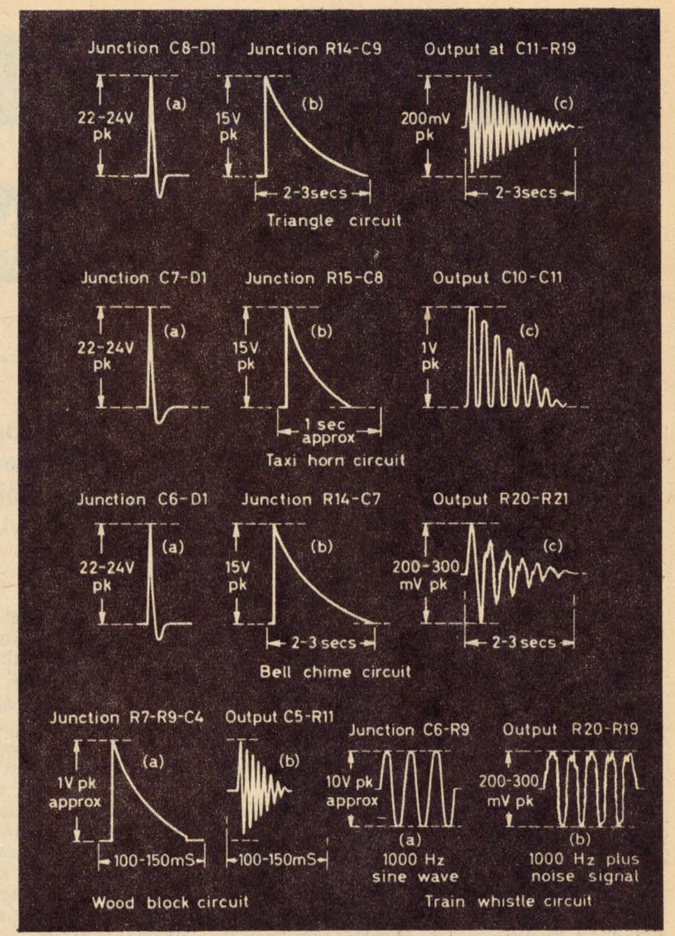


Figure 21: The waveforms produced by the circuits described in Part 2. If possible, these should be checked on an oscilloscope.

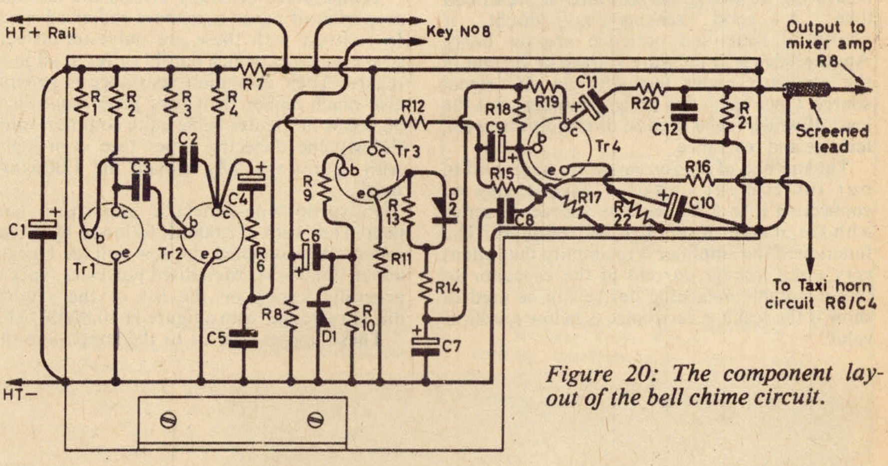


Figure 20: The component layout of the bell chime circuit.

BELL CHIME CIRCUIT No 8

Transistors

Tr1, Tr2	2N2926
Tr3, Tr4	BC108

Diodes

D1, D2	OA5

Resistors

R1	39K (see text)		
R2	10K	R13	1M
R3	100K	R14	680
R4	10K	R15	120K
R5	omitted	R16	220K
R6	220K	R17	12
R7	1K	R18	120K
R8	10K	R19	10K
R9	47K	R20	220K
R10	470K	R21	15K
R11	12K	R22	2.2K
R12	120K		

All ¼W 10% tolerance
(Note: R5 omitted following circuit modification.)

Capacitors

C1	100uF	C7	50uF
C2	0.1uF	C8	0.1uF
C3	0.1uF	C9	2.5uF
C4	2.5uF	C10	10uF
C5	0.2uF	C11	2.5uF
C6	0.5uF	C12	0.02uF

TO BE CONTINUED