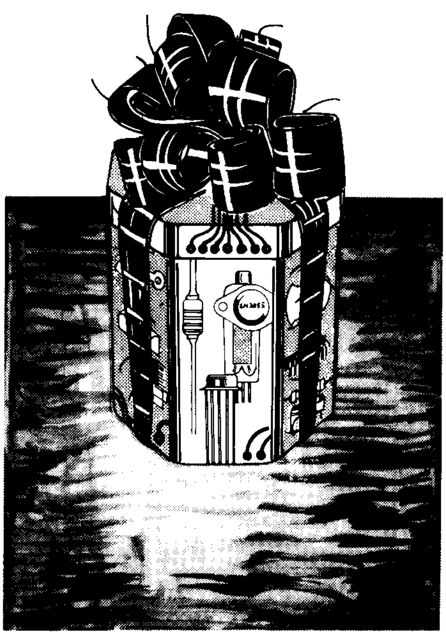
djolly djingle djenerator

This device will appeal to those who are not satisfied with the fare normally offered by regular broadcast transmitters. It offers the limit in meaningless programming that nonetheless will remain uniquely recognisable (!). It produces an endless succession of little squeaky melodies designed to drive anyone with normal mental processes straight up the wall. One might consider the circuit as a descendent of the 'donkey synthesizer' from the sixties. We can report that it has been quite successfully used to blackmail a thick-skinned neighbour into setting his fi less hi. . . .



The circuit produces a tone of frequency f, where f is given by:

$$f = \frac{f_1}{n},$$

f1 being a fixed master frequency and n a small whole number (max. about 12), that varies at random. The basic idea is that tones whose frequencies are related by small whole-number ratios are musically more or less related; so that a succession of such tones may claim to be a melody. After all, it is well known that three tones in the frequency-ratio 4 : 5 : 6 form a major chord.
Now, after fair warning, comes the 'how it is done'.

The principle

Let us start with the block diagram of figure 1.
The astable multivibrator AMV 1 delivers a square wave of amplitude u_1 and constant (but adjustable) frequency f_1. This drives a 'diode-transistor-pump' that produces a staircase waveform with a fairly small number of 'steps'. Each step of the staircase wave of course lasts for one period of the signal from AMV 1. The multivibrator has a 'sync' feedback from the staircase generator, to ensure that each staircase produced lasts a whole number of AMV 1 periods.
The staircase wave therefore has a frequency

$$f_S = \frac{f_1}{n}$$

n being the number of steps.
The trick is now to make the number of steps depend on a control voltage, u_C, that is derived from the staircase wave itself. This is achieved by having a sample-and-hold subcircuit select, from time to time, a random step and remember its voltage level. The voltage level is buffered, delayed by an RC time constant and then fed back to the diode-transistor-pump as the control voltage u_C.
The command to take a sample is given by a second astable generator, consisting of a slow free-running multivibrator AMV 2 followed by a monoflop as pulse-shaper.

For those to whom nothing is too terrible — the output from the slow multivibrator AMV 2 can be used to frequency modulate AMV 1. This produces a ghastly vibrato effect . . .
The staircase wave can be taken directly as output signal. A rather less squeaky and more flute-like, even neo-musical, result can however be obtained by first passing the output through a sine-shaper. Figure 2 gives a resumé of the above description in the form of a set of voltage waveforms.

The complete circuit

Figure 3 gives the complete circuit diagram.
The two astable multivibrators are built up using standard NAND gates. N1 and N2, together with their associated components, form AMV 1 — that is responsible for generating the master frequency f_1. N3, N4, R3, P3 and C4 make up the slow multivibrator AMV 2. Potentiometer P1 sets the degree of frequency modulation of f_1 (i.e. the vibrato).
The diode-transistor-pump is built up around D1 and T2. Each rectangular pulse from the output of N2 causes a small charge to be delivered to C3, so that a 'down-going' staircase waveform will appear at T2 collector. This will continue until the drive through the NANDs N5 and N6 saturates T3. When that happens, C3 will discharge to the zener-voltage of D2 (2.7 V), starting a new staircase wave.
The negative pulse that saturates T3 also momentarily cuts off N2, synchronising AMV 1 to the diode-transistor-pump.
The number of steps is determined by the control voltage u_C. The higher this voltage, the higher will be the gain of T1 — and therefore the greater will be the voltage jump between the steps. The greater this jump, the earlier the total 'height' of the staircase will be covered — the following staircase wave will therefore start after a smaller number of steps. Figure 4 shows what actually goes on.
The control voltage u_C comes from the sample-and-hold circuit built up around the FETs T4, T5 and T6. T4 is a source-

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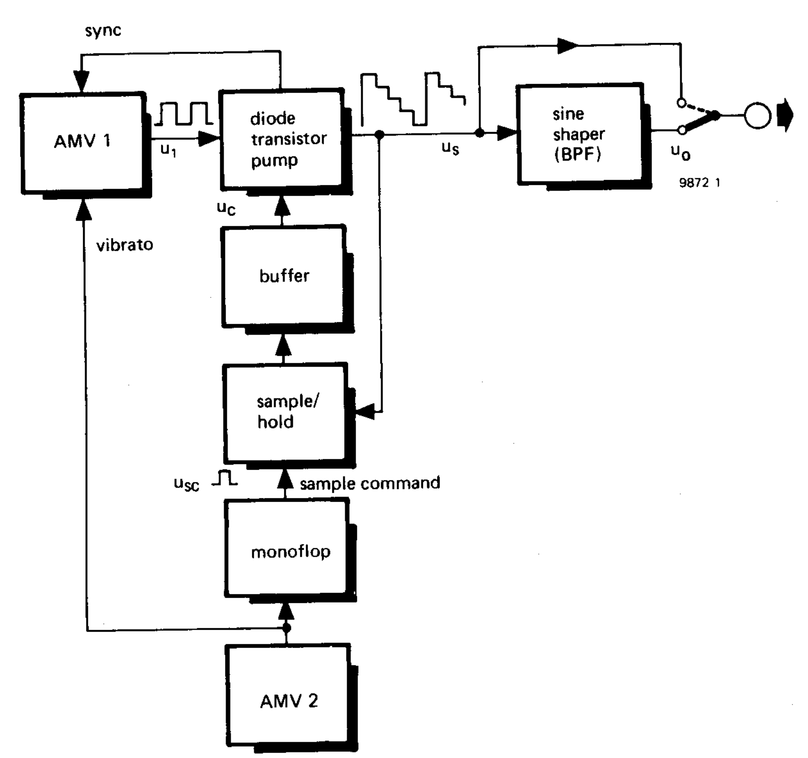

Figure 1. Block diagram of 'DJDJDJ'. At regular intervals, the sample-and-hold circuit stores the instantaneous value of the staircase voltage u_s. The held voltage is then passed through a buffer, to control the number of steps in the staircase wave produced by the diode-transistor-pump.

Figure 2. The relationships in time between the various voltages. After each sampling the control voltage u_c is held to the sampled instantaneous value of u_s. The new value of u_c (in this illustration) reduces the number of steps from six to four, corresponding to a 1½ fold increase in output frequency.

Figure 3. The complete circuit diagram of 'DJDJDJ'.

Figure 4. Illustrating how the greater voltage-jump between successive steps leads to fewer steps per completed staircase.

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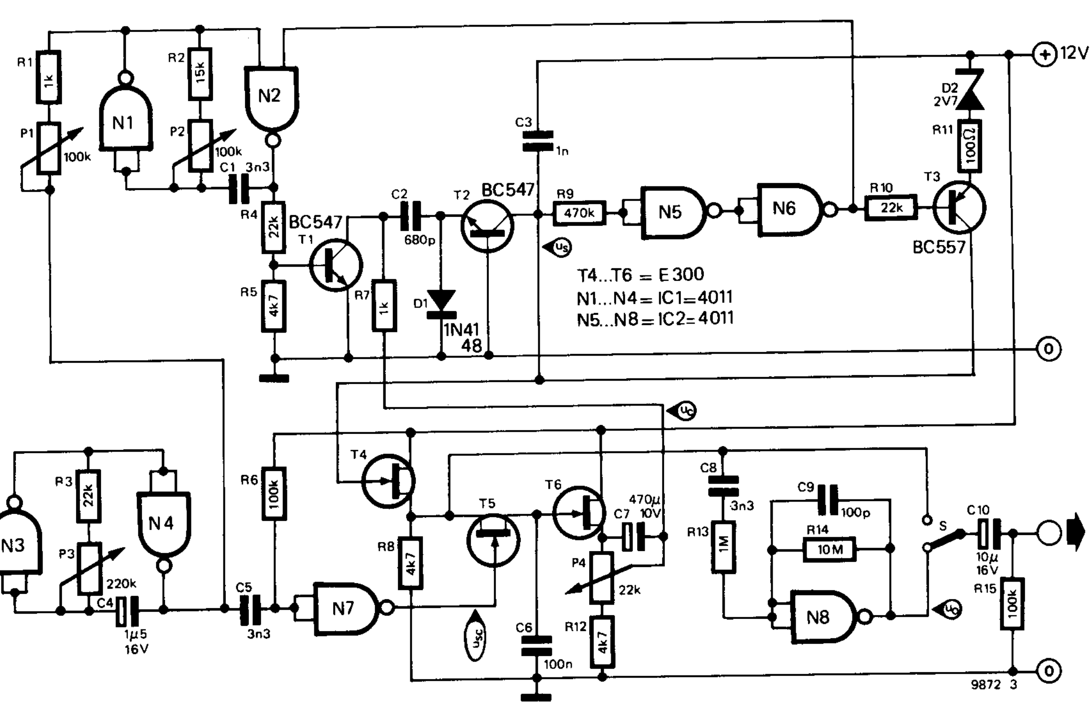

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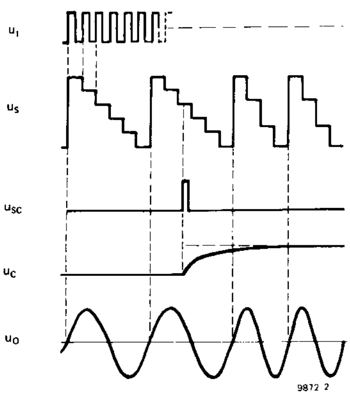

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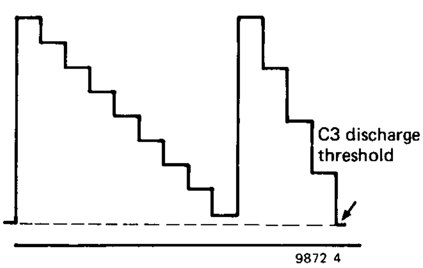

follower, to provide a low-impedance driving point. Each time T5 is driven into conduction by a short pulse, the 'memory' element C6 will charge or discharge to the instantaneous value of the staircase voltage u_S. C6 will hold this value until the next sample-command pulse to switch T5 causes it to assume another instantaneous value. The command pulses to the gate of T5 are derived from the slow multivibrator AMV 2, with monoflop N7/R6/C5 ensuring that they are sufficiently narrow. P3 provides an adjustment of the 'nervousness' of the final sound. by controlling the rate at which the individual tones succeed one other.

The voltage on C6 is buffered by another source-follower (T6) and taken to the control-voltage input of the diode-transistor-pump. The setting of potentiometer P4 determines the average jump in frequency from one tone to the next. The output signal can be taken directly from T4 source, with switch S in the upper position; or from the shaper circuit around N8 (used as analogue buffer), that operates as a simple band-pass filter. The output obtained in the lower position of S is more like a sine-wave – and certainly more pleasant to listen to.

Practical aspects

The individual constructor may decide whether the potentiometers should be presets or normal 'knobs'. All of them affect the final sound, of course: P2 sets the range of frequencies covered by the 'melody'. P3 and P4 both affect the rates at which the tones (if you must: 'notes') (appear to) succeed one another. P3 also affects the frequency of the 'vibrato' effect and P1 its depth. It is probably a good idea to use a preset for P3, adjusting the modulation frequency to 6 Hz.

A gadget like this music-generator-to-end-all-music deserves a suitable 'make-up'. One attractive possibility would be to mount the generator proper, together with a simple power amplifier and supply circuit, in an inspiring case – for example a junked transistor radio. One may wish to go back even further into the past, to make a miniature replica of the enormous radio sets from the days of conduction through vacuum. ◼

Parts list

Resistors
R1,R7 = 1 k
R2 = 15 k
R3,R4,R10 = 22 k
R5,R8,R12 = 4k7
R9 = 470 k
R11 = 100 Ω
R6, R15 = 100 k
R13 = 1 M
R14 = 10 M
P1,P2 = 100 k lin.
P3 = 220 k lin.
P4 = 22 k lin.

Capacitors
C1,C5,C8 = 3n3
C2 = 680 p
C3 = 1 n
C4 = 1µ5/16 V
C6 = 100 n
C7 = 470 µ/10 V
C9 = 100 p
C10 = 10µ/16 V

Semiconductors
D1 = 1N4148
D2 = zener 2V7
T1,T2 = BC547
T3 = BC557
T4,T5,T6 = E 300
IC1,IC2 = 4011