An electronic fog horn

Electronic devices that simulate everyday sounds are always interesting. This fog horn is also instructive.

IF YOU LIVE ON the shores of a busy harbour, you have probably been woken up occasionally in the early morning by the sound of a ship's fog horn. Before the advent of radar, fog horns were the only means ships' captains had of avoiding collisions. The distance and direction of the low-pitched sound gave an indication of another craft's position. Despite radar, many boats and ships (Sydney ferries in particular!) still have fog horns in active service.

This project won't wake the household (or the neighbours!) but it certainly makes a realistic sound.

How it works

The fog horn consists of an oscillator, which generates the basic sound, and a speaker driver. The oscillator we used is known as a "multivibrator". This type of circuit is widely used – in one form or another – in electronics, it is one of the 'building blocks' used in many complex circuits. For example; you will find multivibrators in 'clocking' circuits for timing applications, in function generators and many digital circuits.

The multivibrator here consists of Q1, Q2, C1, C2 and R1 to R4. To understand how it oscillates, we must first make an assumption: let us assume Q2 turns on when the push-button, PB1, is operated. One or other of the transistors, Q1 or Q2, will turn on first as no two devices are *exactly* the same.

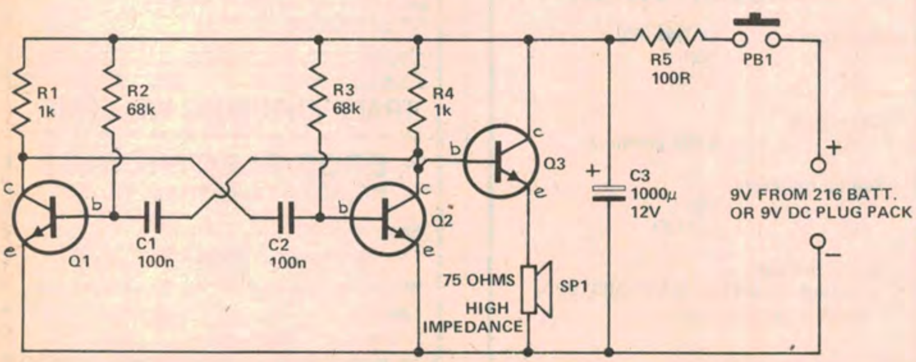
Now, when PB1 is pushed, Q2 conducts and Q1 will be 'cut off' (not conducting). The collector voltage on Q1 will be at the supply voltage (about +9 V) and the base of Q1 almost at zero volts as C1 will not be charged and the collector voltage on Q2 will be close to zero (as Q2 is on). C2 will charge via R1 and the base of Q2, keeping Q2 on while it charges. C1 will begin to charge via R2, and when the base voltage on Q1 has risen sufficiently, Q1 will commence to conduct. The collector voltage on Q1 will rapidly fall. This will cause the charge on C2 to reverse-bias the base of Q2, immediately turning it off. Thus, the collector voltage on Q2 will jump to the supply voltage and C1 will begin to charge via R4 and the base of Q1, holding it on while C1 charges.

However, C2 will begin to charge – in the opposite direction to which it was first charged – and the negative voltage on the base of Q2 (from C2) will decrease, pass through zero and rise in a positive direction. When it has risen sufficiently for the base of Q2 to conduct once more, Q2 will turn on.

And the whole business begins again. The charge on C1 will reverse bias Q1 which turns right off, C2 will charge via R1, driving Q2 further on . . . until C1 charges (via R4) sufficiently to turn Q1 on again, etc.

Thus, the collector voltages on Q1 and Q2 will alternately rise, stay up for a period, fall and stay down for a period, then rise again – a square wave.

That's your basic, or common-garden-variety, multivibrator. The frequency of oscillation is dependent on the values (and thus the time-constant) of R1, C2 and R2, C1. An output can be taken from the collector of either Q1 or Q2. The signal on one



collector will be the opposite phase to that on the other collector (while one collector is up, or 'high', the other collector is down, or 'low').

The output from the oscillator will not be able to drive the speaker directly. This is because the oscillator has a high impedance output and cannot supply enough current to drive the relatively low impedance of the speaker. To increase the available current, and lower the output impedance, we use an emitter follower, where the input is fed to the base of a transistor, Q3, and the output is taken from the emitter. The voltage output from the emitter follower is very close to the input voltage, but the current is amplified sufficiently to drive the speaker.

But what about R5 and C3. Well, these help to give the oscillator its characteristic sound. The multivibrator generates the basic low pitch of the fog horn. But, if you listen carefully to a real fog horn, you will notice that the pitch and volume vary slightly as it sounds. Now, the frequency of a multivibrator depends on the supply voltage to a large extent. The lower the supply, the lower the frequency, and vice-versa. Also, the output, and thus the volume, is lower at lower supply voltages — vice-versa.

When PB1 is pushed, C3 will take a short while to charge and therefore the voltage supply to the oscillator (and speaker driver) will take a short while to rise. Thus, the sound from the speaker will have the characteristic rising pitch and volume of the first part of a fog horn's blast. When PB1 is released, C3 will take a short while to discharge and the sound level and pitch will die away.

In this way, the circuit simulates the characteristic sound of a ship's fog horn.

Construction

This circuit is simple enough to be constructed on matrix board or tag strips. However, we have used a printed circuit board. If you are not yet confident of getting all the connections right, we suggest you construct this project as we have. Printed circuit boards should be available from quite a number of suppliers. See our "Shoparound" and "Kits for Projects" pages in this issue.

No matter what method of construction you elect to use, as always, take care with the orientation of the transistors and the polarity of the battery connections. The speaker we used is rather an unusual item. Small speakers commonly have an impedance of either eight or 16 ohms. The one used here has an impedance of 75 ohms. Refer to "Shoparound" on page 83 for sources of supply of this component.

You can modify the sound of the fog horn if it is not quite to your satisfaction — normal component variations will produce differing results. You can vary the basic sound produced by the multivibrator by varying C1 and C2. Changing these by one standard value higher or lower will produce quite a gross variation in pitch. Smaller variations can be obtained by having several capacitors in parallel. Use a large value — close to that specified — and connect a smaller value capacitor in parallel, for each of C1 and C2.

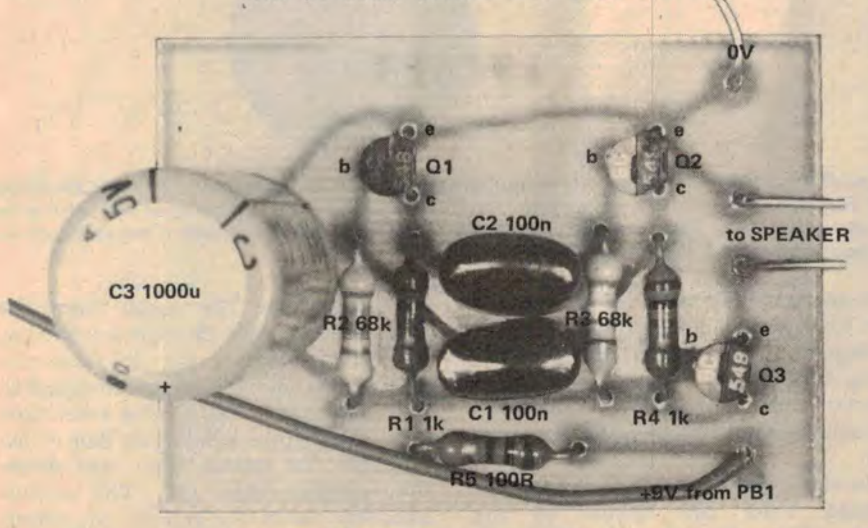
The rising and falling pitch and volume is controlled by R5 and C3. The value of R5 can only be practically varied a small amount. You get a much more satisfactory result by varying the value of C3 or varying its discharge time. You can decrease the 'die away' period by putting a low-value resistor in parallel with C3, increasing the discharge current. Start experimenting with something like 680 ohms. ●

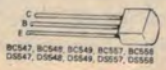
PARTS LIST - ETI 261

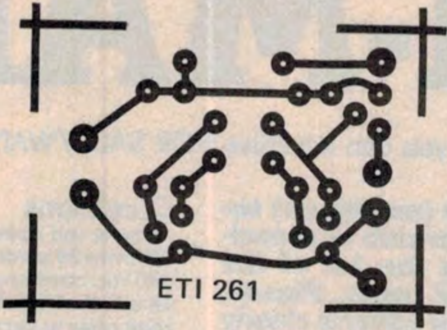
Resistors	all ½ W, 5%
R1	1k
R2, R3	68k
R4	1k
R5	100R
Capacitors	
C1, C2	100n Greencap
C3.	1000µ, 12V electro
Semiconductors	
Q1–Q3.	BC548, BC108, DS548 or similar
Miscellaneous	
SP.	high impedance speaker, greater than 40 ohms
PB1.	push-to-make momentary push button

No.216, 9 V battery or suitable battery eliminator (Ferguson PPA 9DC or similar); ETI 261 pc board.

The pc board pattern is on page 145.







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