How to make a buzzer

Basic Electronics

A simple buzzer using junk box parts has often heralded the beginnings of a career in electronics. With a few simple parts, such as a piece of wood, a worn-out hacksaw blade, several bolts and some wire, a very effective buzzer can be made.

by JEFF SKEEN

Many people probably find electronics boring because very little "happens" in your average electronic circuit. There are none of those fantastic electrical explosions seen on TV (haven't they heard of fuses?) and very few robots waving their arms about and running berserk. We've yet to see an authentic ray gun project and a decent space invaders game is a little too complicated to build at home.

This simple buzzer should appeal to beginners as a first project since it moves and makes a noise, is easy and cheap to build, its operation is easily understood, and it will give you a tickle if you get across the coil. The buzzer is so easy to make in fact, that most kids should be able to construct it with little or no supervision. Once built, the buzzer can be modified to try ways to improve its performance, ie, increase its noise.

When power is applied to the circuit, current flows from the power supply, through the switch contacts formed by the hacksaw blade and the screw, through the coil, and back to the power supply. The current flowing through the coil magnetises the steel bolt and the head of this bolt then attracts the steel hacksaw blade.

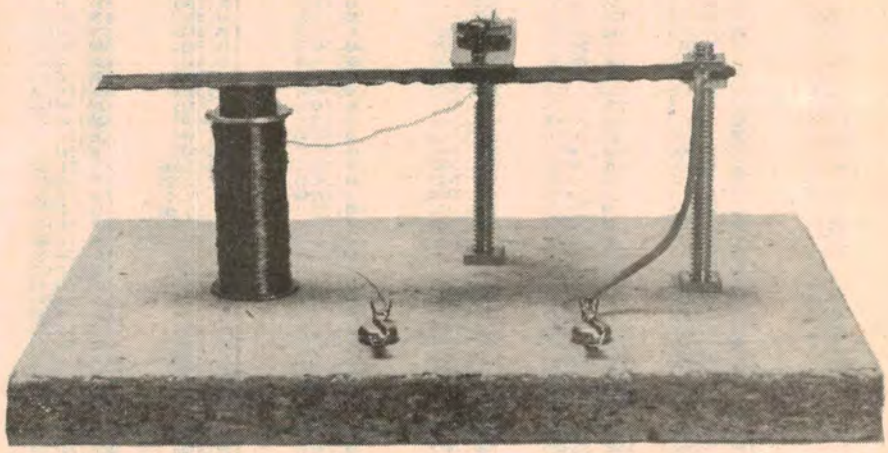
The end of the hacksaw blade bends toward the bolt but in doing so breaks the electrical path by losing contact with the screw. Current then ceases to flow, as the bolt no longer acts as a magnet, so the blade returns to its original position and hits the screw. The circuit is now completed, current flows again, and the cycle is repeated.

In truth, this simple explanation has omitted to mention any effects which the coil inductance may have. This is done because the frequency of the buzzer is too low for most of these effects to become apparent. One effect which is not frequency dependent, and which can be felt by placing your fingers across the coil terminals, is the ability of the coil to generate a high voltage.

This comes about as the coil dissipates the energy stored in its magnetic field as the switch contacts open. To understand this we need to examine one of the fundamental equations concerning inductance, $E = Ldi/dt$.

This formula states that the voltage across a coil is equal to the inductance of the coil (L) times the rate at which the current through the coil is changing (di/dt). Since we are using a switch which breaks the current flow almost instantly, di/dt is very large. Therefore the induced voltage (E) is very large, large enough in fact to cause a spark to jump the airgap between the switch contacts. It is in this spark that the stored magnetic field energy is dissipated.

In practice, because the hacksaw blade moves relatively slowly, the airgap between the blade and the screw is quite small and the induced voltage is not great – just enough to tickle your fingers.



With parts from your junkbox, a very effective buzzer can be made.

OPERATION

The buzzer will operate from DC supply voltages anywhere in the range 12 to 30V. Power is applied via the two front solder lugs and the polarity of the connections is unimportant. Do not operate the buzzer for long at the higher voltages or the coil will become very hot since it is not intended to dissipate much heat.

Initially the buzzer was constructed with the switch contact at the coil end of the hacksaw blade. This arrangement gave unsatisfactory operation because the screw lost contact with the hacksaw blade too quickly and there was not enough force between the blade and the screw to break through the insulating oxide layer on the blade.

Therefore the switch was moved to its present location where leverage forces increase the contact pressure between the screw and the blade. Also, the length of time before the blade and the screw lose contact is increased because the blade bends from the end nearest the coil first and so must travel further before breaking contact with the screw. This allows a stronger magnetic field to build up and makes operation at lower voltages feasible.

The buzzer can be "tuned" by adjusting the self tapping screw forming the switch contact. In general, turning the screw clockwise will increase the buzzer frequency while turning the screw anticlockwise will decrease the frequency.

If the bolt around which the coil is

wound is made from a magnetically hard material, it is likely that the bolt will remain magnetised (and continue to attract the hacksaw blade) even when no current flows. To stop the hacksaw blade sticking to the head of the bolt stick a piece of electrical tape to the head of the bolt. This effectively places an airgap between the hacksaw blade and the bolt reducing the residual magnetic field to the point where it is not strong enough to hold the bolt and hacksaw blade together.

CONSTRUCTION

The buzzer is constructed on a piece of scrap particle board about 12mm thick. Two mushroom head roof bolts are used to form the support pillars for the hacksaw blade and the switch contact. The bobbin around which the coil is wound is an old steel bolt, with two end-cheeks cut from scrap aluminium.

Aluminium, or some other non-magnetic material is preferred for the end-cheeks since this concentrates the magnetic field in the head of the roof bolt, increasing its pull on the hacksaw blade and making a better buzzer.

Three holes, forming the vertices of a triangle, are drilled in the particle board base for mounting the buzzer parts. Two of the holes are drilled to suit the roof bolts, the third hole is drilled so that the bolt used for the coil bobbin can be screwed directly into the wood. Distances between the vertices for our buzzer were 9.5, 5.5 and 5cm (see photo).

To make the bobbin, first mark and cut out the two end cheeks. The outside diameter of the cheek should be about 20mm, the hole through the centre of each cheek is drilled to suit the diameter of the bolt being used. Place the end cheeks on the bolt and grip the bolt in the chuck of a hand drill so that there is a gap of 35mm between the two cheeks. Clamp the drill in a vice so that the handle and chuck are free to rotate and you are ready to commence winding the coil.

The wire used for the coil is .125mm diameter enamelled copper winding wire. This is sold by most electronics parts retailers in 25g spools which contain approximately 220m of wire. The content of one spool is required for the buzzer coil.

PARTS LIST

2 mushroom head roof bolts, 60 x 5mm and nuts
6 solder lugs
1 old hacksaw blade (or piece thereof)
1 mild steel bolt, about 50 x 6mm
1 25g spool of .125mm enamelled winding wire
3 10mm self-tapping screws
1 piece of aluminium sheet, 100 x 20 x 1mm
1 piece of scrap wood (particle board), 190 x 70 x 12mm
1 6cm length of hook-up wire

Wind the entire spool of wire evenly onto the bolt between the end cheeks. The wire is quite thin so exercise care while doing this. When finished, screw the bolt assembly into the hole prepared for it in the wooden base. Screw the roof bolts into position in the wooden base and lock them with nuts screwed down against the wood.

To obtain a piece of hacksaw blade the correct length, (13cm in our case) place the blade in a vice and flex the unwanted section until it breaks off. Use carbon steel hacksaw blades since high speed steel blades do not break cleanly but tend to shatter into a number of pieces when broken.

The hacksaw blade can now be fixed onto the roofing bolt support with the aid of two nuts. The height of the blade should be adjusted so that it clears the head of the bolt by 2mm. If the hole in the hacksaw blade is too small for the roofing bolt, use a reamer or a round file to open the hole slightly. Do not use a drill, for in general, drills are too soft to make holes in hacksaw blades.

The switch contact is constructed by cutting out a small rectangle of aluminium sheet, 30 x 15mm. One end is drilled to fit the roofing bolt, the other end is drilled to suit a 10mm self-tapping screw. The self-tapping screw is located so that it will touch the hacksaw blade when the rectangle of aluminium is mounted on the roofing bolt. (see photo)

Electrical terminations are made via solder lugs. Four of these are fixed with a pair of self tapping screws to the particle board base, two allowing power to be connected to the buzzer and two providing electrical terminations for the buzzer components. Two more solder lugs are used to provide electrical terminations for the switch contacts. These lugs are placed under the top-most nut on each roofing bolt.

The coil is wired to the front left hand side lug and the lug clamped to the small rectangle of aluminium. Before soldering the coil wires, scrape the insulation from the wire ends with knife or razor blade. The front right hand side lug is wired to the lug clamped to the hacksaw blade using a short (6cm) length of hook-up wire. This completes construction.