Moving-coil alarm sensor

Design: Bernd Geveshausen (Germany)

Moving coil meters belong to an era before the digital voltmeter (DVM) was invented. In those days all measurements were represented by a needle swinging back and forth in front of a graduated scale. Its name is descriptive; the meter consists of a coil (attached to the needle) pivoting in a magnetic field. The current to be measured passes through the coil and causes it (and the needle) to twist in the field.

A little while ago the Elektor offices received this circuit idea from one of our readers. Mr Bernd Geveshausen came up with an amazingly simple and unconventional alarm idea to protect his motorcycle from theft. He offered the circuit for publication and sent this photo of his finished prototype:

The circuit suggestion certainly generated some interest in the Elektor lab where we were able to dig out a few moving coil meters to test the principle. Mr Geveshausen had the idea that a moving coil meter could also be used in reverse. Many electrical transducers have properties that are reversible. In this case if the coil is physically made to turn in the magnetic field it should be possible to measure the small current induced in the coil by this movement.
Mr Geveshausen explained his idea: "Mount the meter upside down so that the pointer is hanging down and add some weight to the tip of the pointer. The measured voltage output is now proportional to the acceleration through the pendulum axis experienced by the meter." In other words you shake the meter and it generates a voltage... sounds like an accelerometer!
Tests carried out in the Elektor labs showed that the sensor is sensitive to any movement of the vehicle. To convert the signals from the meters to an alarm signal requires very little in the way of electronics. A photo of the prototype sent in by Mr Geveshausen is reproduced here.

The result of converting it into the Elektor circuit diagram format is also printed.

The additional weight pushed onto the end of the pointer is just a short length of insulation stripped from a wire. Two meters mounted at 90° to each other are used to measure movement of the bike through two axes. The meters are wired in series; all we need now is an amplifier to boost the signal produced by them. A standard 741 type of opamp together with a few components is all that is necessary.
The 4.7 kΩ trimmer adjusts the alarm sensitivity. When the voltage at the output of the 741 gets high enough transistor T1 (e.g. BC547B) conducts, pulling the output OC low and lighting the LED which indicates that the vibration has been detected. The diode (e.g. 1N4148) at the base of T1 protects the transistor from negative transients. A diode in series with the supply protects the circuit if the supply leads are accidentally swapped during installation. A 12 V piezo buzzer can be fitted between the open-collector OC output and the positive supply. The circuit can supply 100 mA to the load.
In the same way that Mr Geveshausen made his original circuit, the complete design is small enough to be built onto a small section of perforated prototyping board. The type of moving-coil meter that can be used in this circuit is not at all critical, just make sure that any resistor wired in series with the meter is removed before the meter is used in the circuit. Old VU meters like the ones shown in the photo will be fine.
The circuit draws around 2 mA and once installed in the bike it can be in continuous operation for about a month before the battery needs to be recharged. The type 741 IC can be replaced by a TL061 to reduce the operating current; this will allow the circuit to run continuously for around six months before the battery needs charging.