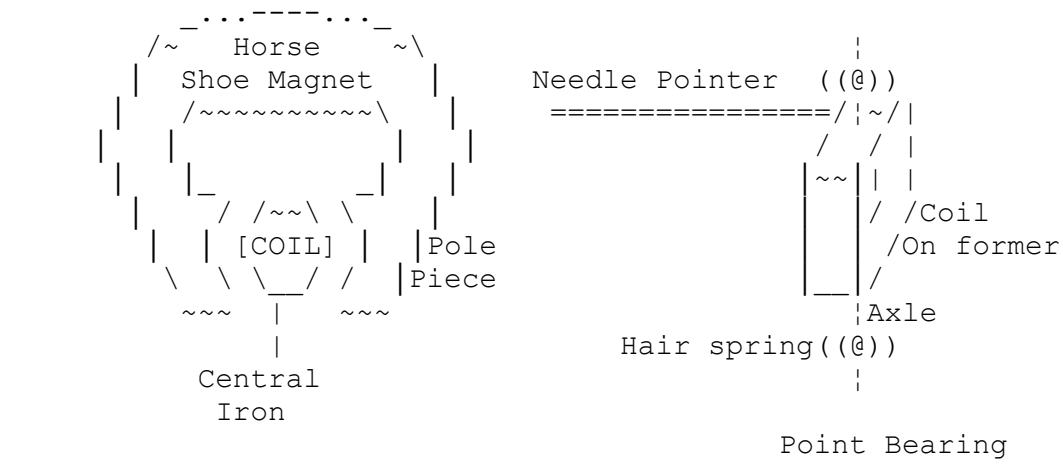
Meter Movement Types

By G8MNY (Updated Jan 14)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

METER PRINCIPLES

There are several ways to move a meter from a current or voltage. The most common type is the moving coil..

MOVING COIL MOVEMENT

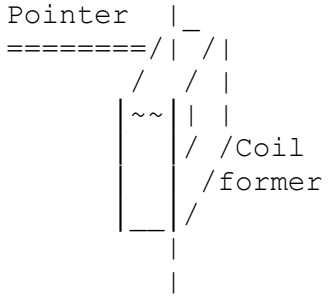


The coil is free to move in the gap between central iron & the shaped magnet poles. It is electrically connected via the 2 hair springs which also give the return to zero force. The light aluminium needle is attached to the coil & is counter balanced with tiny weights so that the meter reads zero in any position (when it left the factory unbent.) Movement calibration is often achieved with a movable iron link that can bypass some of the magnet's flux.

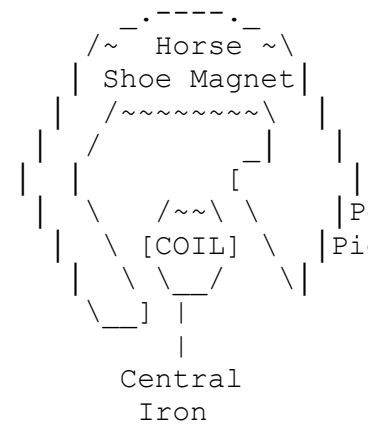
With this movement the deflection angle is proportional to the coil current, with string return torque & magnet flux fixed.

SUSPENSION

A pair of hair springs that wind up & unwind are to compensate for temperature with end conical point bearings. But sometimes a very fine twisting torsion spring in used without bearing. This means the meter has no friction, improving the accuracy. Drawback is these movements are more fragile!



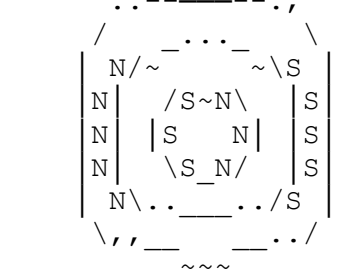
NON LINEAR



For some applications like "light meters" the pole pieces can be shaped to produce a log or true square law scales.

HIGH SENSITIVITY

Improvements to the basic design for high sensitivity use powerful circular ferrite magnets both on the outside & inside of the coil, The penalty is poor scale accuracy, but several times the sensitivity can be achieved. e.g. a large 6" meter with a 15uA 6kΩ coil.



MULTIPLICATION MOVEMENTS

If the magnet is replace with an electromagnet, then the deflection is proportional to the product of the two. e.g. a true power meter where the AC or DC current produces the magnetising flux. This flux must not be near saturation if the effect is to be faithful. It is the only AC meter using moving coil principle without rectification.

Another approach is to use a magnet but use 2 coils & no return springs. This gives high sensitivity.

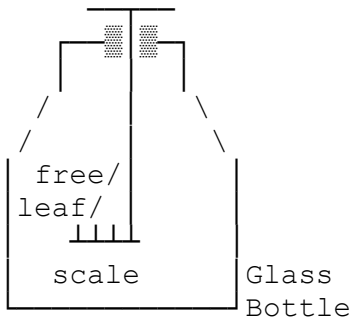
MOVING IRON

This is a different system magnetic repulsion. It uses 2 pieces of iron inside a coil. As the coil in is energised the flux on each piece of iron causes them repel each other. One piece is held fixed & the other on a hair spring balanced arm & pointer.

This effect works for DC & true RMS AC current as long as the coil current is the same (inductance) & there is negligible iron losses at the AC frequency (e.g. ok DC to 1kHz?) The sensitivity is much lower than moving coil meters

If the coil is replace by coupled in flux from a power cable then the AC/DC current can be read by a clip on meter. But 1 turn currents of about 20 Amps are needed.

ELECTROSTATIC VOLTMETERS
These work in a similar way to the moving iron, but high voltage static is used on 2 conductors & they try to repel. The normal example is the gold leaf electroscope. Versions have been made calibrated in kV. e.g. 0-50kV & of course no current flows!



THERMAL MOVEMENTS
These are typicaly used on slow instruments like petrol gauges. A bimetal strip has a heating element rapped around it. It's bending is geared up to work a pointer.

```
                    /
           Heater  /Pointer
      O>==[]======.o System
 Zero  Gain
clamp  Clamp
```

Two fixing clamps along the bimetal strip enable calibation. And if a similar bimetal controlled voltage on/off switch (regulator) is used at the same location as the display, to supply the referance power, then voltage & temperature errors are all eliminated! But the switch can be an anoying source RF noise in the dashboard!

METER STICKING (From feedback from Osvaldo LW1DSE)
Plastic meter movements can wrarp over time causing the needle pointer to foul the glass or scale. Also I have found that static can be a problem (rubbed glass), causing mis readings, the cure is a slow breath on the glass to discharge it. Sometimes sticking is due to overtight bearings. More difficult to fix is iron or rust particles in the magnet gap. These can be removed with file steel pin/wire, as the fine point concentrates the magnetism so the magnetic dust is more attracted to the wire pin then the powerful pole pieces!

See meter Tech buls on... "Lafayete 57 Range Multimeter", "Meter Damping &", Speed Up", "Edgcume Peebles Earth Loop Z", "Edgcume Peebles Megger & Low R", "PEP Meter modification", "Mains Peak/RMS/Mean Meter", & "Marconi Distortion Meter TF2337"

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73 De John, G8MNY @ GB7CIP