TANGENT GALVANOMETER – mini, square

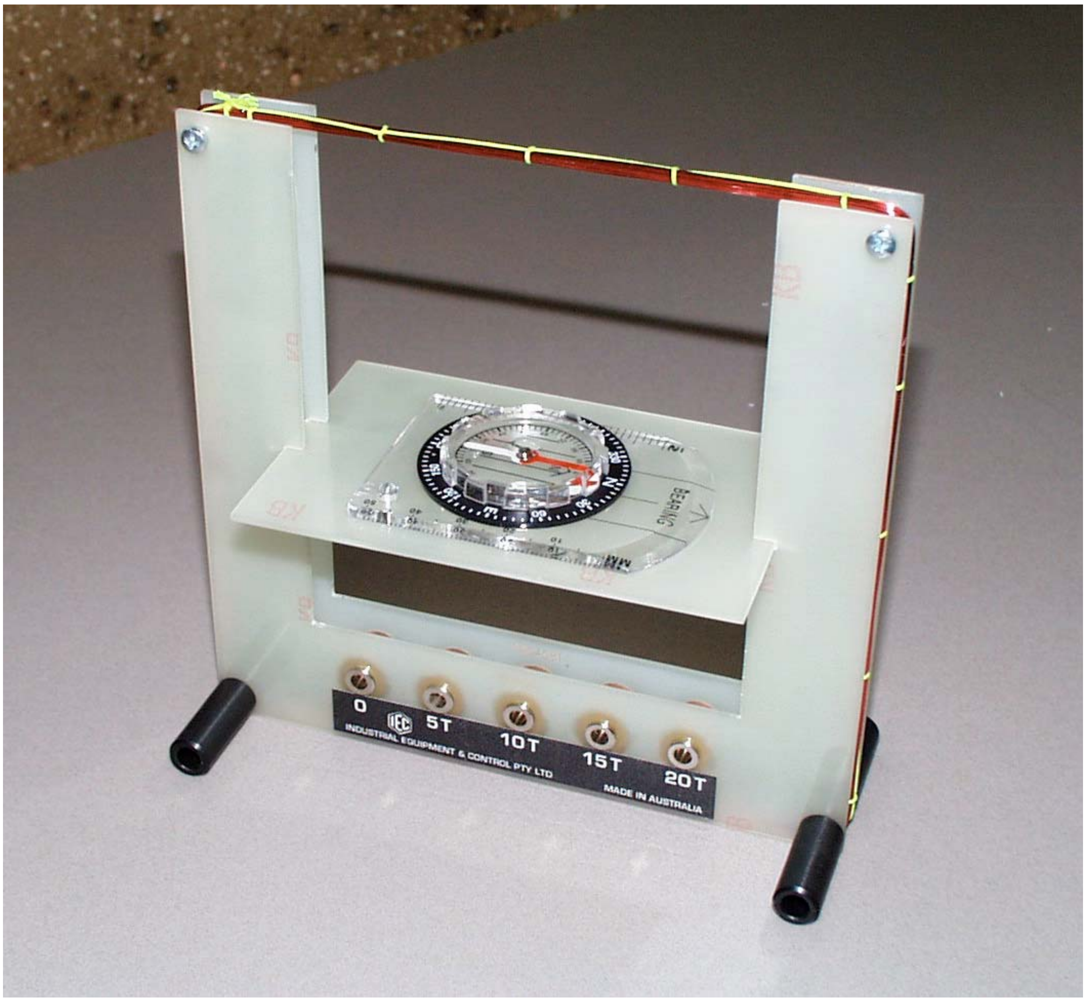
EM3981-001 mini/square format

DESCRIPTION: This robust IEC design is manufactured from non-magnetic materials. It is fully assembled and permits experiments relating to electric currents in a coil producing magnetic fields. Using the earth's magnetic field as one of the fields, this instrument proves that magnetic fields add as vectors and strength of a field in a coil is proportional to both the current flowing through the coil and the number of turns in the coil. This is often called "Ampere Turns".

CONTENTS:

- 1 pce mini Tangent Galvanometer …. square format. Complete with 20 turn coil tapped at 5, 10, 15 turns. Use about 2V.DC. for max.current of 1 amp.
- 1 pce magnetic compass fixed to platform.

EM3981-001 Tangent Galvanometer



Physical size: 150x150x70mm LxWxTh Weight: 0.17 kg.

CAUTION: Do not overheat the coil. The resistance of the coil is very small, therefore only a very low voltage is required to cause say 1 amp to flow through the coil. At 1 amp the coil will heat gently and at higher currents it will heat more quickly, therefore, if higher currents are used, be sure the current is turned off after a short time to prevent overheating and damage to the coil.

EXPERIMENTS: Two experiments can be performed:

1) To prove that magnetic fields add as vectors
2) To prove that field strength varies proportionately as the number of turns in a coil and the current passing through the coil (Ampere Turns).

EQUIPMENT REQUIRED:

The best power supply for the best results in these experiments is a "Constant Current" power supply where the current can be set to any current and the setting does not alter when the coil changes its resistance due to warming.

However, if a Constant Current power source is not available, a normal adjustable DC power supply can be used together with a sliding rheostat in series with a 0-5A DC ammeter to adjust and monitor the current through the coil. It will be necessary to adjust the rheostat as the coil warms to bring the current exactly back to the desired value before making any measurements.

1) Magnetic fields add as vectors:

Position the Tangent Galvanometer so that the coil itself is in line with the compass needle pointing exactly magnetic North/South. Run a pencil along the edge close to the work bench surface to mark a line indicating this N/S direction, then draw a second line crossing this N/S line at 90 degrees.

Align the coil itself along this second line but the compass needle will be pointing along the N/S line which is also along the axis of the coil. Any magnetic field along this axis will either add to or subtract from the earth's magnetic field. Use the "right hand rule" to determine which direction the current should flow in the coil to CANCEL the earth's magnetic field. Before doing it, decide which direction North should be and which end of the magnetic needle is North and South. Discuss how to detect if the fields will be adding or subtracting.

Connect about 2V.DC to the 5 or 10 turns tapping and gradually adjust the current until the magnetic needle can be made to point in any direction (use a very small/weak magnet to deflect the needle off the N/S line). When the compass needle does not try to point N/S, your magnetic field from the coil has completely cancelled the earth's magnetic field. Take note of the number of turns and the exact current used.

NOW, retaining the same current flow through the same number of turns, rotate the whole unit around until the coil aligns with the N/S line. This means that the two exactly equal fields are now at 90 degrees to one another. Take note of the deflection angle on the compass.

NOW reduce the current through the coil to exactly half. Note the deflection of the compass needle. Return the current to the original value.

NOW use double the number of turns and adjust the current to be the same as the original value. Note the deflection of the compass needle.

The next step is to discover if the angles you have measured indicate that the addition of magnetic fields add as vectors …. So, draw some vector diagrams:

Draw a rectangle representing value 1 and value 0.5 on adjacent sides. Draw the diagonal and measure the angle from the side representing value 1 (earth's magnetic field).

Repeat drawing rectangles using values 1 and 1, then values 1 and 2. Always measure the angle from the side that represents the earth's magnetic field.

Compare the angles on the vector diagrams with the angles measured in the experiment. Does your result make you decide if the field strengths add together as vectors ?

2) Magnetic field strength is proportional to both the current flowing through a coil and the number of turns of the coil:

Set up the experiment as above so the earth's magnetic field adds to your coil's field at 90 degrees. Adjust the currents using a constant number of turns, then adjust the number of turns while using the same current each time. Work out the Ampere Turns each time and note the compass deflection each time.

From your results, decide if the theory is correct.

Why is it called a "Tangent Galvanometer":

1) Because the **Tangent** of the angle deflected by the compass needle away from the N/S line is the ratio between the strengths of the 2 magnetic fields.

2) It is called a **Galvanometer**, because in certain circumstances it can be used to accurately measure currents from known field strengths.

Designed and manufactured in Australia