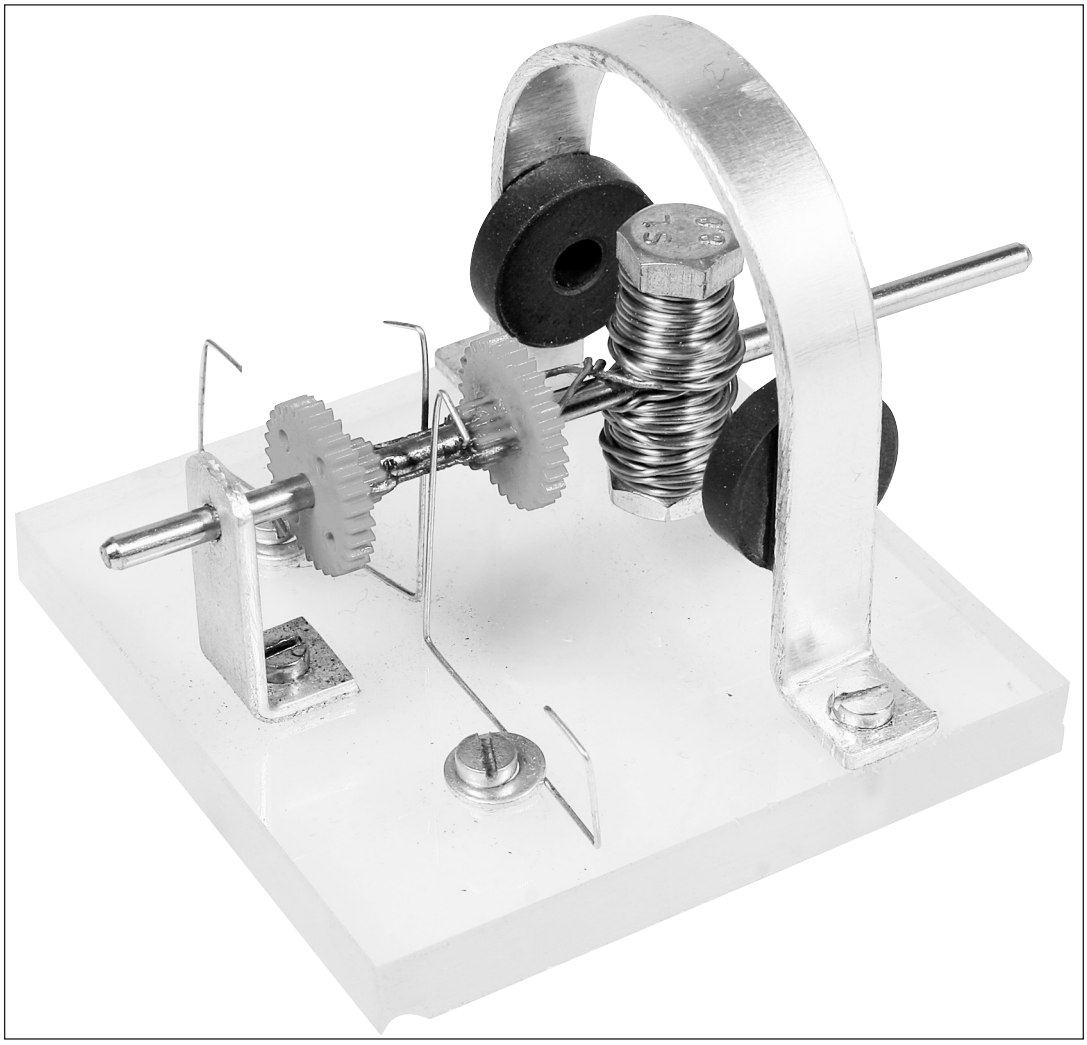
OPITEC

Attention, copper wire changed, correct wire is temporarily enclosed in the dispatch box! (247.191)

107.388

Premium-Line

Electro motor



Please Note

The OPITEC range of projects is not intended as play toys for young children.They are teaching aids for young people learning the skills of Craft, Design and Technolo- gy.These projects should only be undertak- en and tested with the guidance of a fully qualified adult. The finished projects are not suitable to give to children under 3 years old. Some parts can be swal- lowed. Dan- ger of suffocation!

Warning!

This product contains small parts that can be swallowed. There is a danger of choking!
This product contains a magnet.
Swallowed magnets can block the intestines and cause severe internal injury.
If a magnet is swallowed by accident contact a doctor as soon as possible.

Safety notes for working with magnets

Permanent magnets and magnetic article are technical products that require safety knowledge. All persons experimenting or working with magnets should read these note and keep them in mind!

Articles that can be influenced by magnets

- Computers or electronic data
- Electronic machines
- Heart pacemakers
- Injuries caused by crushing or pinching
- Danger caused by magnetic splitters
- Danger of fire and explosion
- Health dangers caused by contact with drinking water, food or ski

Working with magnets

- People with heart pacemakers should avoid contact with all types of magnetic fields
- Computers and other data storage units should be kept away from magnetic fields
- Magnets must be carefully handled in the presence of other magnets and objects made from iron There is a danger of injury caused by pinching or squashing-wear safety protection
- Magnets must not be used in an atmosphere where there is a danger of explosion
- Items made from iron should not be left near magnets
- Strong magnets can splitter when under attraction , to avoid injury when working with magnets wear safety glasses
- When working with magnetic properties in mechanical projects there is a danger of fire
- Glowing or burning magnets should not be extinguished with water, Co2 or halogen – use sand or powder extinguisher
- The presence of hydrogen can cause magnets to deteriorate and lead to them breaking up- avoid all contact between magnets and hydrogen
- Some magnets have a nickel coating which can cause skin allergy- handle – if this happens avoid all contact

Be careful with magnetism

- Be careful of magnetic fields, magnets can spring apart and cause accidents
- Fix magnets in a holder and never hold them freely in your hands
- Magnets can shatter
- Keep your working area free from magnetic pieces
- Read any special makers instructions that come with the magnets

Transport

- When transporting magnets by air there are special regulations that must be followed
- This also applies to appliances with built in magnets- contact airline
- There are also regulations for sending magnetic goods by post – see Post Office

1. Product information:

Art: Functioning model using metal & plastic

Use: In Design Technology , Key stage 4

2. Materials:

2.1 Material: Aluminium (Light, non ferrous metal)

Working: cutting ,filing, drilling

Joining: machine screws.

Finish: polish ,varnish.

2.2 Material: Acrylic plastic
PMMA (Polymethylmethacrylate) transparent

Working: drilling , threading , cutting;

Joining: machine screws.

Finish: no special finish needed.

3. Tools:

Cutting: Use metal shears or side cutters for the holed metal, spring and copp**er wire**

Note ! cut metal edges can be sharp!
Remove any burr with a file

Filing: choose the correct grade of file for the work
Use needle files for small notches.

Note! Files only cut on the forward stroke.

Sawing : Use a hacksaw for cutting metal parts

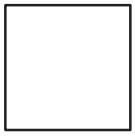
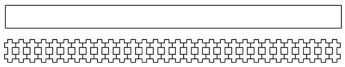
Note ! hold the work in a vice.

Drilling: Use a pillar drill;

Note! Adhere to the safety rules when drilling. Wear safety glasses and an apron. Tie long hair back , remove rings and jewellery! Hold the work to be drilled in a machine vice. Ensure the drill is set at the correct speed

Gluing: We recommend using a quick setting glue.
Do not apply the glue too thickly
Read the instructions before use !!

4. Parts list :

No.	Quantity	Description	Material	Size (in mm)
1	1	**Base**	Acrylic	8 x 70 x 70
				
2	1 2	**Holder**	Aluminium strip Holed strip metal	2 x 10 x 250 0,5 or 0,8 x 10 x 150
				
3	1	**Shaft**	Metal axle	Ø 3 x 95
4	1	**Iron core**	Machine screw &nut	M6 x 25
				
5	1	**Winding** Varnished copper wire ~~Ø 0,6 x 2400~~	Ø0,5 x 4000	
				
6	2	**Commutator**	Double gears	30/10 Zähne
				
7	1	**Contacts**	Spring steel	Ø 0,5 x 500
8	2	**Permanent Magnets**	Ring	Ø 18/5 x 5
				
9	2	**Sundries**	Machine screws	M3 x 16
10	2	**Sundries**	Nuts	M3
				
11	6	**Sundries**	Machine screws	M3 x 6
12	2	**Sundries**	Washers	M4
				
13	1	**Jig**	Beech wheel	Ø 40 x 10
				

Also needed :

A few drops of a turbo glue (not included in the pack)

311.619 4g-tube

311.620 10g bottle

6. Making the base

6.1 Making the holder and bearings

6.2 Making the core and commutator

6.3 Final assembly and testing

6.4 Principles of the electric motor

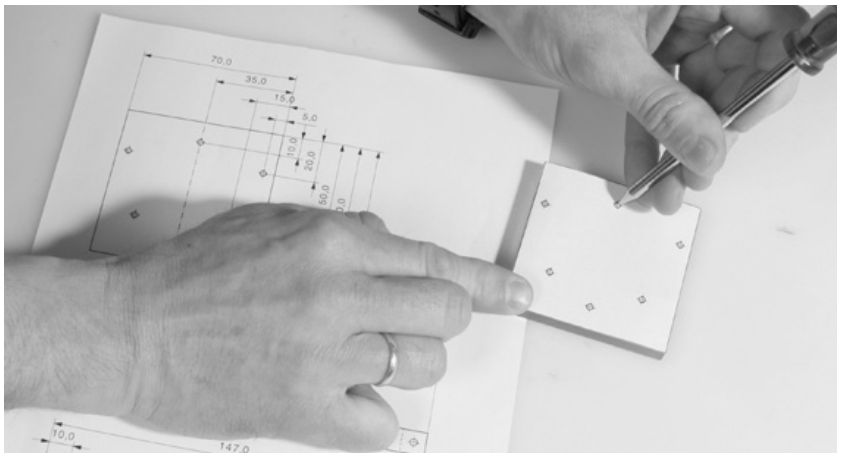
General:

In the pack are different materials for making the holder and bearings
This choice depends on the difficulty of which level of model you make.

6.1 Making the base

6.1.1 Cut or mark out the pattern (see page 9) and selloptape it to the acrylic base. Mark the middle of each hole that is to drilled with a pointed hole maker or similar

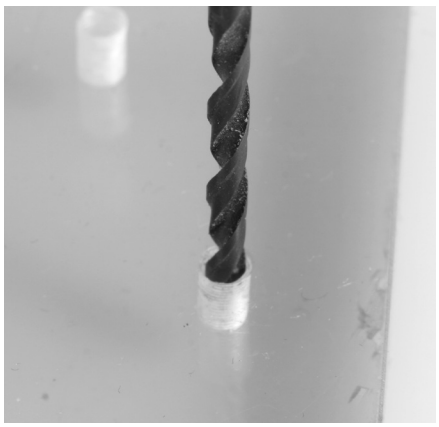
Note! Do not remove the protective foil from the acrylic !

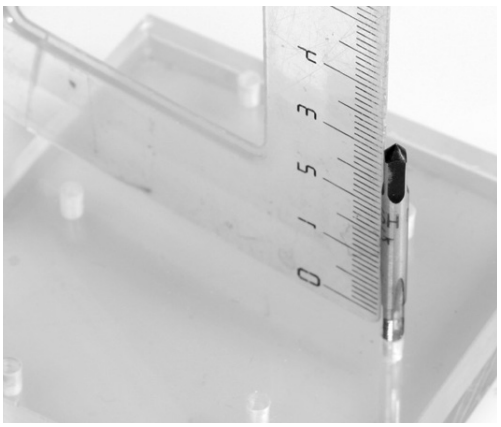


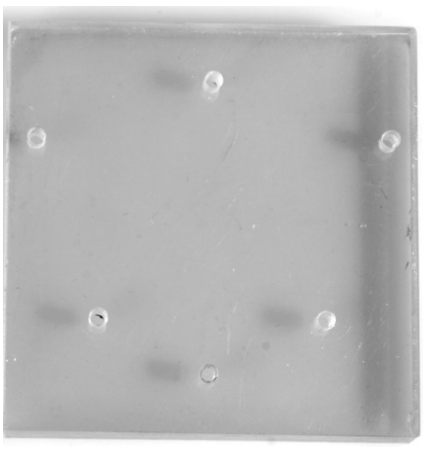
6.1.2 Drill the 2.5 diameter holes (Use a drill for plastic or metal)

6.1.3 Tap the M3 threads (Use a 3 part drill and a tap wrench or a single cut tap)

Note! Ensure that the tap is at right angles to the base.







6.2 Making the holder and bearings

At this stage you can chose your material

Version 1

Using the holed metal strip, this is easy to bend into the U shaped holder. No need to drill holes..

Version 2

A more testing way is to make the U shaped holder from the aluminium strip

This version has more stages of construction which must be accurately carried out.

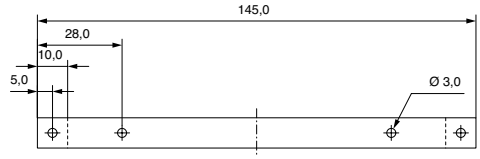
The holes must be marked out and drilled.

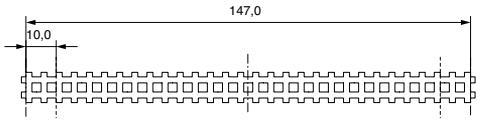
The instruction show you how to make the aluminium strip version.

6.2.1 Mark or cut out the plan for the holes on the aluminium strip (See page 9). If you cut out the plan pattern fix it with sellotape. Mark out and centre punch the holes for drilling. Mark out with a pencil the bending point (broken line) in the middle of the strip.

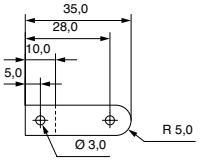
Note! Only use a pencil to mark out where to bend so that no weakness occurs in the metal that can lead to it snapping !

U shaped holder

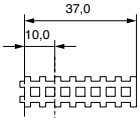




Bearings



2x



6.2.2 Cut the bearings and U shape holder to size with a junior hacksaw
File the ends and round off

Note! Use vice soft jaws

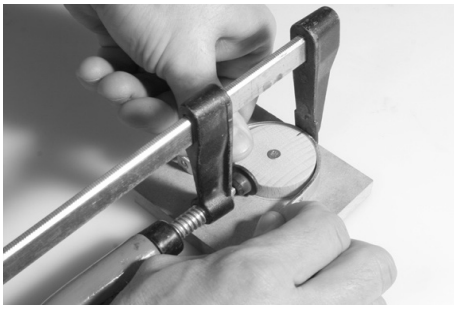
6.2.3 Drill the 3mm dia holes in the holder and bearings. To make it easier you do not need to drill the holes for fixing the magnets as these can be glued in position

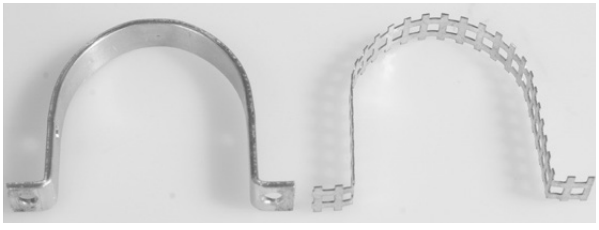
6.2.4 Bend the ends of the U shaped holder at 90 degrees

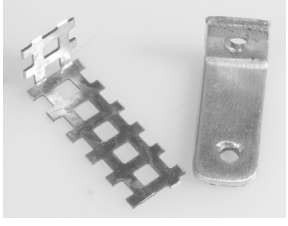
Note ! use a vice with soft jaws-ensure that the bends are accurate

6.2.5 Use wooden wheel (13) to bend the holder around. Just fasten the wheel to a piece of wood (not in pack) and use the wheel as a former, hold the strip in the middle of the wheel and bend it left and right .

Note ! Ensure that the shape is accurate !

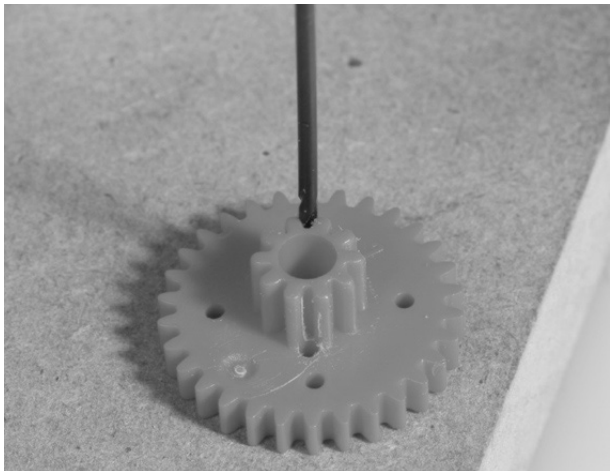


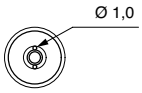


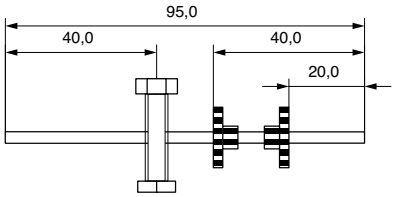


6.3Making the core, coil and commutato

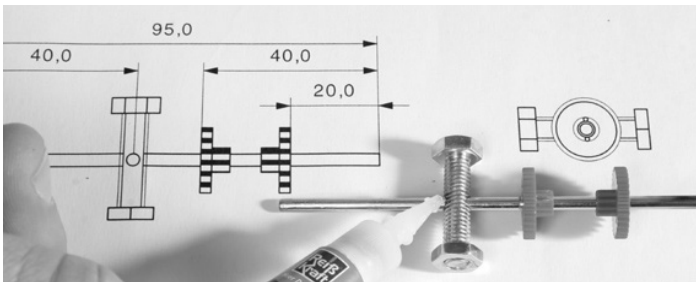
6.3.1 Drill two holes in one of the double gears (6) these holes should be between two teeth on the small gear and 1mm in diameter. Drill one side first and then the other on the opposite side.







6.3.2 Use the drawing (page 11) to mark out and drill the bolt (4) and then insert the shaft 3dia x 95mm to 40mm.Use a drop of glue to hold it in place. Screw on the nut so that it is level with the end of the bolt and glue it in place.

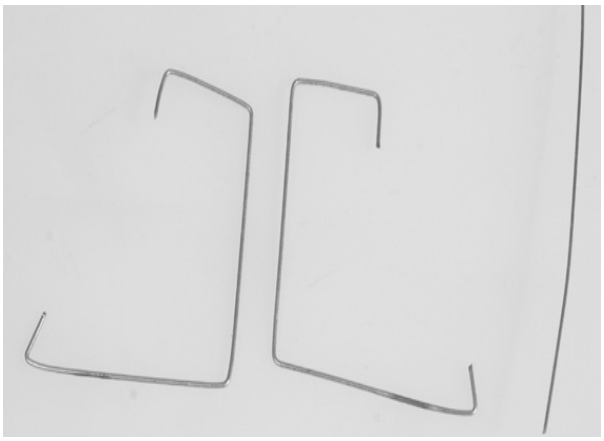


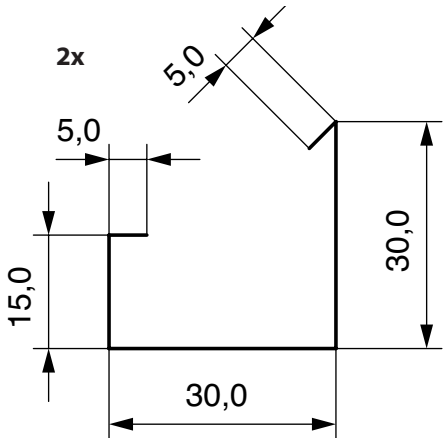
6.3.3 Glue the drilled double gear on the shaft 40mm in. Slide and glue on the second gear
With the small gear first 20mm in
Arrange the holes in the gear so that they are 90 degrees to the bolt (iron core)
(see page 11)

6.3.4 Cover the thread of the bolt with sellotape or insulating tape.
Wind the varnished copper wire around the bolt , winding it doubled, making sure there are no kinks. Wind it around one half of the bolt until there is about 40mm over (approx. 75 windings).
Now wind the second half of the wire in the" same direction " until there is also about 40mm left over.
Remove the varnish with from both ends of the coil with emery cloth then threasd the ends through the small holes in the gears so that they lay cleanly (use pliers if necessary) the wire should lay parallel to the shaft (With a version with one gear the ends should protrude 5-10mm and not touch the shaft)

Note! Keep to the winding direction ! check the gears with the coil

6.3.5 Bend the two spring (7) contacts as shown.





6.4 Final assembly and testing:

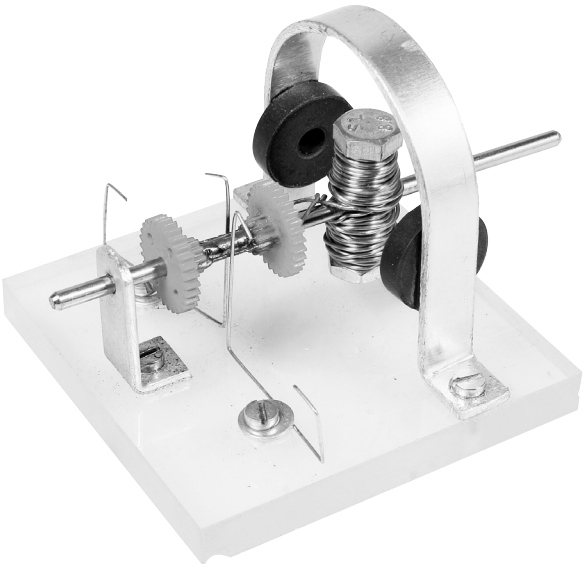
6.4.1 Machine screw (9) and bolt (nuts 10) the magnets to the U shaped holder or glue them in place.

Note ! ***Check the polarity of the magnets !!***
Fix the magnets to the holder type as shown

6.4.2 Screw the bearing strips to the base as shown using two machine screws (11)
Ensure that the hold the shaft and that it can turn easily.
Now screw (11) on the U shaped holder checking that the rotor can turn easily
Now mount the two contact springs using the screws (11) and washers and check that the have a light contact with the copper wire

6.4.3 Connect to a 4.5 volt battery and give the rotor a light twist and the motor should run !

Note : ***apply a few drops of oil the bearings and the contacts!***



Principles of the electric motor

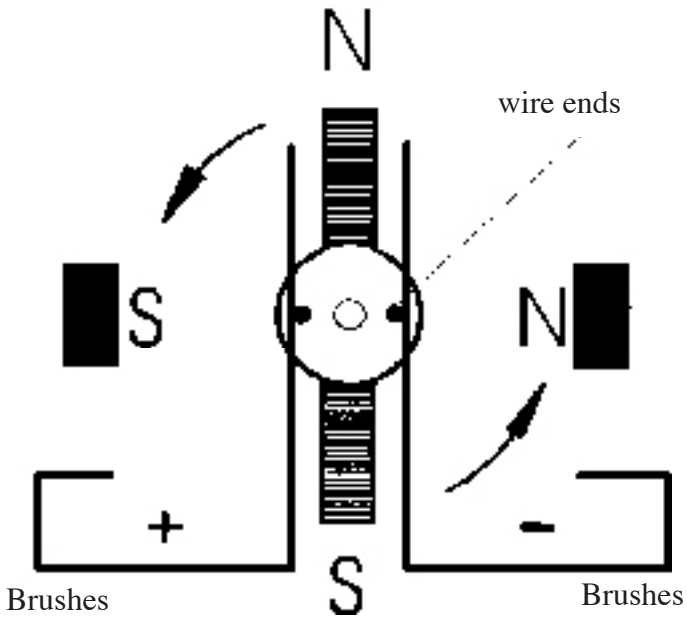
How does an electric motor function
Look at the diagram below

Note:
The same magnetic poles push against each other. Unlike attract each other.
As the two permanent magnets here are always attracting each other –they can be switched on & off with an electro magnet. The plus pole and the minus pole are then changed over. The North becomes a South pole and the South pole a North pole and so on
The iron core increases the magnetic power of the coil.

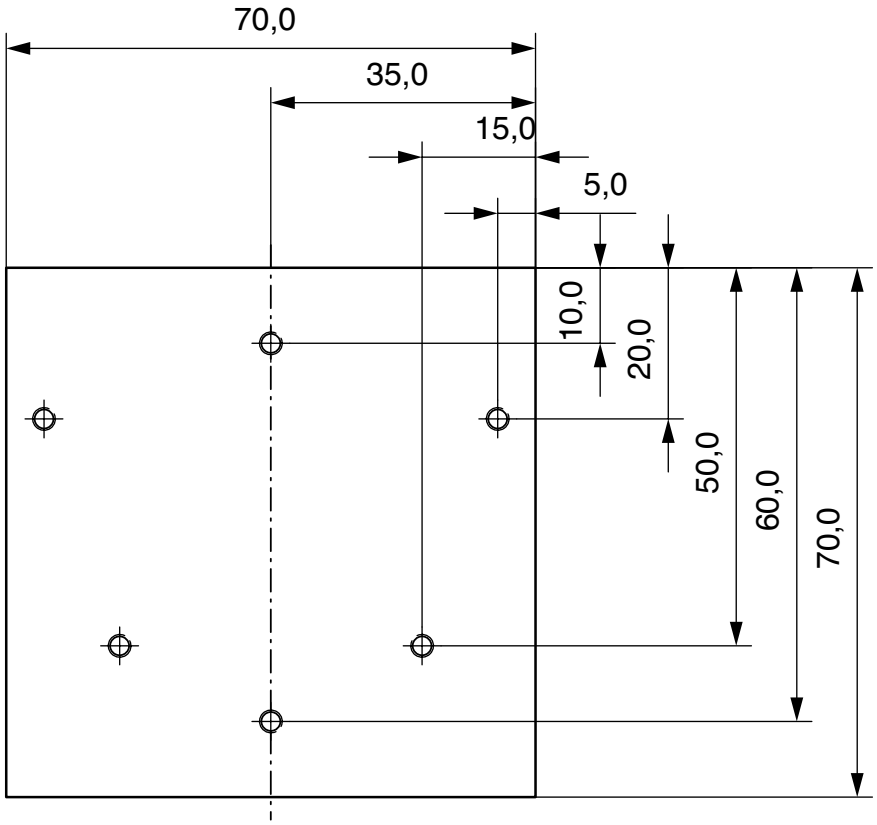
When a current flows through the coil the core becomes magnetic. Its pole is pulled by the permanent magnet . As the collector turns each end of the coil touches a different contact. Because the coil receives current in different directions so the poles of the coil change. The iron core is pushed and pulled by the permanent magnets causing it to turn

Schematic diagram of the collector

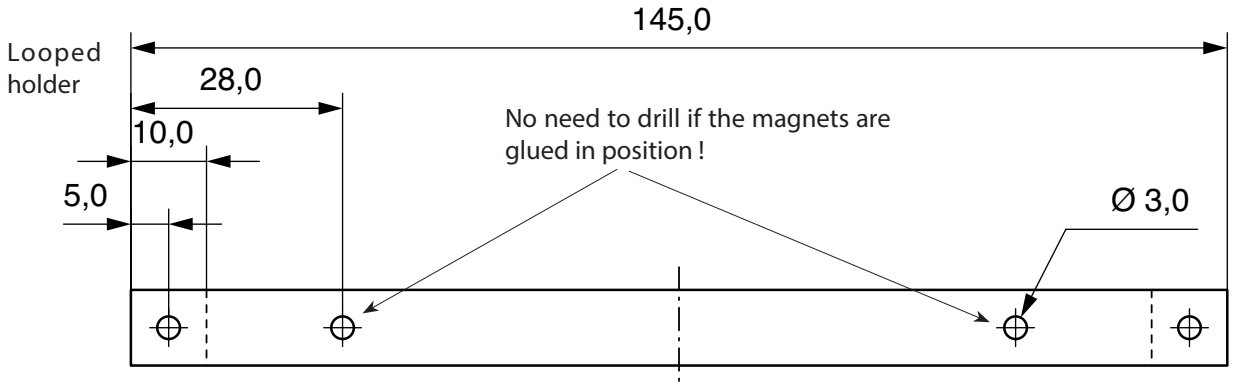
A schematic diagram of how the motor coil turns and the wire ends in the 1mm holes

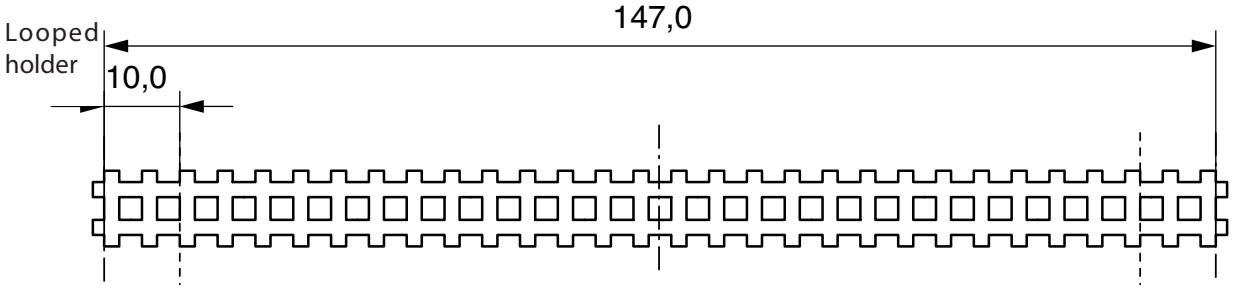


Patterns
Scale 1:1

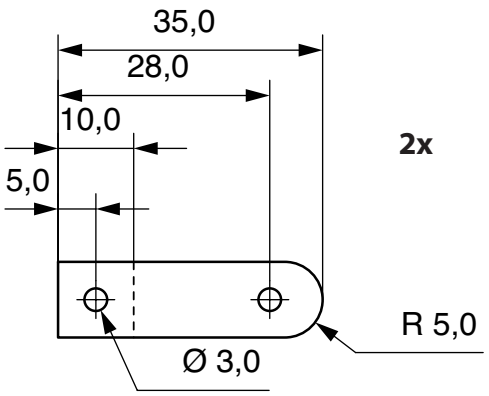


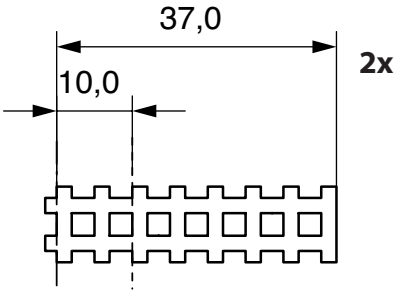
Base

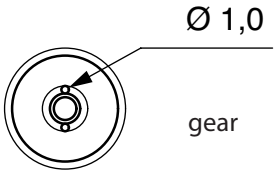


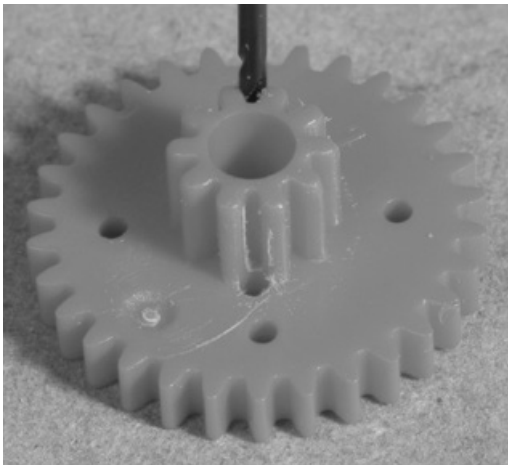


Bearings









commutator