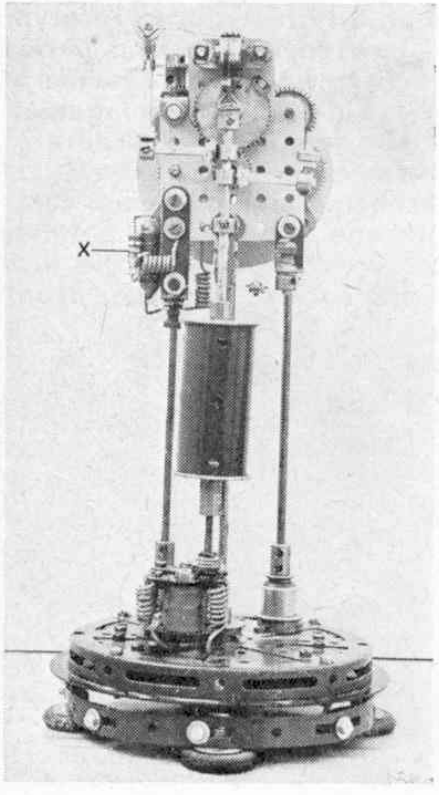
MECCANO ELECTRIC PENDULUM CLOCK

by L. R. Dougal, M.B.E., M.T.A.I.

DURING THE first half of the nineteenth century clock-makers began to turn their attention to the electric clock and many electrically-driven pendulum clocks were produced. A very simple electric clock was devised by Hipp in 1842 and, by the middle of the century, these were being produced commercially at Neuchatel to grace the mantelpieces of the Victorian era. Very few indeed of these interesting timepieces remain, but an excellent example can be seen at the South Kensington Science Museum, while a first class reproduction was displayed recently at the Chichester Model Engineering Exhibition.



A general rear view of Mr. Dougal's Pendulum Clock. Note, the interference suppressor shown at X is not essential.

An article on electric pendulum clocks appeared in the Meccano Magazine early in 1925 when the method of operation of the Hipp clock was explained in detail, but it was not until 1935 that the first Meccano Clock operating on the Hipp system was shown to be possible. Since then, Hipp-type clocks in Meccano have appeared, although not too frequently, and I have myself produced the example featured in the accompanying illustrations. Relatively few parts are required to build the model, but some care is needed in its construction and adjustment.

The base is built up on a 6 in. Circular Plate 1, towards the edge of which four Threaded Bosses are attached by Angle Brackets. Four 1 in. Pulleys with Motor Tyres are secured, one each, on four 1 in. Screwed Rods held in the Threaded Bosses by Grub Screws, these four Pulleys forming the feet of the Clock and serving to level it. A Hub Disc 2 is now completely filled in by $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates, then, to the underside of the resulting construction, three Bush Wheels are fixed, one at the centre and two at positions immediately below the two front pillars, as shown in the illustrations. Three 8 in. Rods 3 are clamped in the bosses of the Bush Wheels, each front Rod being fitted with a $\frac{3}{4}$ in. Flanged Wheel 4, a Chimney Adaptor 5, a $\frac{1}{2}$ in. Pulley without boss 6 and a Short Coupling 7. At their upper ends, these front Rods are fitted with Worms for decoration purposes.

Next, two Elektrikit Cylindrical Coils 8, fitted with Cores, are bolted to a $1\frac{1}{2}$ in. Insulating Flat Girder 9 and the whole assembly is secured to Hub Disc 2 as shown, a Collar on the shank of each securing Bolt acting as a spacer.

At this point, the Hub Disc is clamped to the Circular Plate by four $\frac{3}{4}$ in. Bolts 10, then seven Formed Slotted Strips 11 are bolted together and fitted loosely round the Pulleys to mask the feet and so give a better appearance.

In the case of the gear train, the front and back plates providing the Rod mountings are identical, each consisting of a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 12 extended by a $1\frac{1}{2} \times 1\frac{1}{2}$ in. Flat Plate 13. The lower corners of Plates 12 are joined by a unit 14 consisting of a Coupling in which an Adaptor for Screwed Rods is held. Note that the front Plate is attached by a Bolt passed through the Plate into the Coupling where it is held by the Coupling's Grub Screw. At the top, the Plates are joined by a 2 in. Screwed Rod 15 and by a Double Bent Strip 16, overlayed by a $1\frac{1}{2}$ in. Strip, both being attached to the Plates by Angle Brackets. The Plates are now fitted to the pillars, the front pillars being inserted into the Couplings of units 14, while the centre pillar is fitted with a Rod and Strip Connector 17, bolted to rear Plate 12.

Next to be attached is the pendulum support 18 which consists of two Angle Brackets held by two $1\frac{1}{8}$ in. Bolts locked to the top of rear Flat Plate 13. The pendulum is supported by a pendulum spring supplied by a small piece of razor blade a little over an inch in length. This pendulum spring is carefully produced by clamping a razor blade between two $2\frac{1}{2}$ in. Strips and removing both cutting edges with a pair of pliers.

The ends of the blade are removed in a similar manner.

The gear train itself is now produced. Mounted on a 2 in. Rod 19, journalled as shown in Flat Plates 13, are a Ratchet Wheel 20, boss outwards, a Worm Gear 21 and a Collar. The Worm engages with a 57-teeth Gear 22 on a 1½ in. Rod mounted in Double Bent Strip 16 and its 1½ in. Strip. This Rod also carries a ¾ in. Contrate Wheel 23 which meshes with a ¾ in. Pinion 24 on a 2 in. Rod also carrying a 7/16 in. Pinion 25, this latter Pinion engaging with a loose 60-teeth Gear on the minute hand shaft which is a 2½ in. Rod carrying at its rear end a ¾ in. Pinion 26 and, at the front end, a 57-teeth Gear 27, loosely mounted. A Collar on the end of the minute hand shaft is separated from loose Gear 27 by a Washer. Note that the 60-teeth Gear on the minute hand shaft is held between a Collar and a 1 in. Pulley with Motor Tyre, thus providing a simple clutch.

In mesh with Pinion 26 is a 50-teeth Gear on a 2 in. Rod also carrying a 1 in. Gear. This Gear engages with a similar 1 in. Gear 28 on another 2 in. Rod that carries a ¾ in. Pinion which engages with a second 50-teeth Gear 29 on a Rod carrying a ½ in. Pinion 30. This last Pinion engages with Gear Wheel 27 to complete the 12 : 1 hour hand drive.

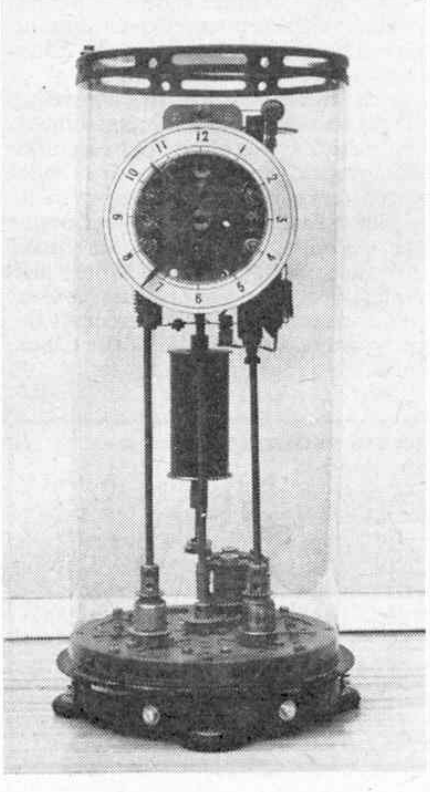
Four Reversed Angle Brackets are now bolted to front Plate 12, than a simple cardboard face is fixed to their free lugs with impact adhesive. Two hands are cut from stiff card, the hour hand being fixed to the boss of Gear Wheel 27 and the minute hand to the back of a Collar holding the Gear in place, impact adhesive again being used in both cases.

At this stage, the electrical connections should be made. Coils 8 are connected in series, one lead going to the source of supply, the other being taken up the central pillar to an Elektrikit 1 in. Wiper Arm 31, insulated from the frame and projecting towards the back of the clock. The model illustrated uses some pre-war Meccano electrical parts, but Elektrikit parts are easily substituted. A 2 in. Bent Wiper Arm 32 is now fitted to a 1 × 1 in. Angle Bracket, earthed to the frame of the clock, the other side of the source of supply also being connected to the frame.

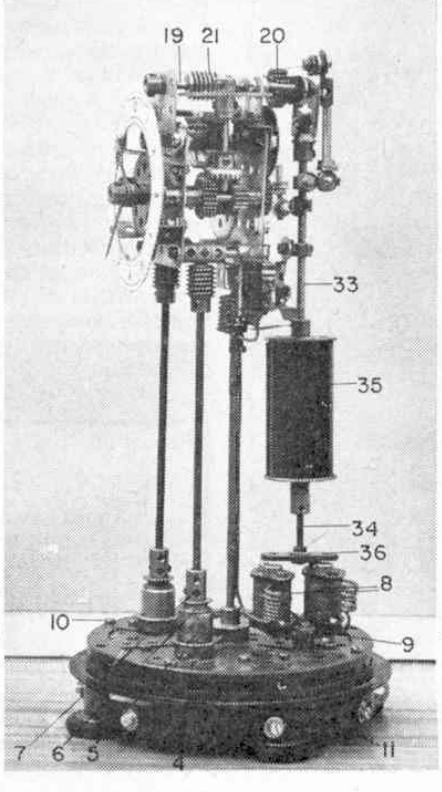
The pendulum consists of a 5 in. Rod 33, connected to a 2 in. Screwed Rod 34 by means of a Threaded Boss and Rod Socket. The pendulum bob is a 2½ in. Cylinder 35 fitted with 1⅛ in. Flanged Wheels. A sheet of lead is formed into a sleeve and slipped inside the Cylinder before fitting, care being taken to ensure that the whole bob runs freely on the pendulum. The bob can be raised and lowered by means of a Threaded Boss mounted on Screwed Rod 34. Mounted on the lower end of the pendulum is an armature built up from three 1½ in. Strips 36 fixed with lock-nuts to Screwed Rod 34. The air gap between the armature and the Cores should be as small as possible.

At its upper end, the pendulum is now fitted with three Collars and an End Bearing 37, the latter being bolted to the earlier-mentioned pendulum spring, the other end of which is clamped between Angle Brackets 18 with Washers being used for packing purposes. Screwed into one threaded bore of each of the two upper Collars on the pendulum is a Long Threaded Pin on the end of which a Collar is mounted. In one case, this Collar is fitted with a Small Threaded Pin 38 upon which Washers are placed to balance the pendulum,

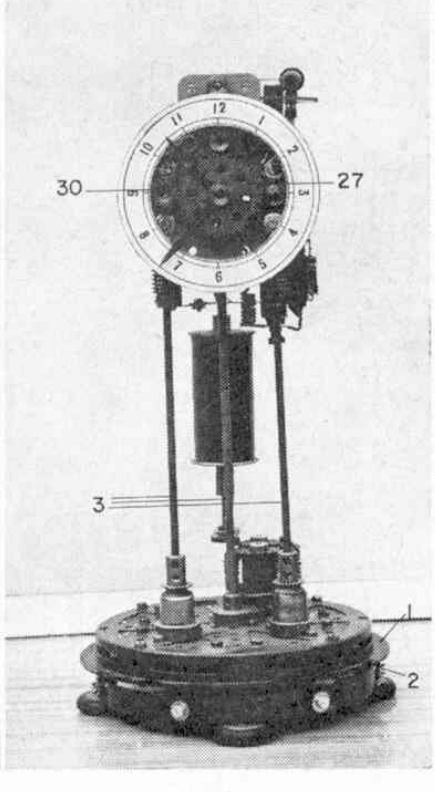
This overall view of the model clearly shows its comparatively simple construction.

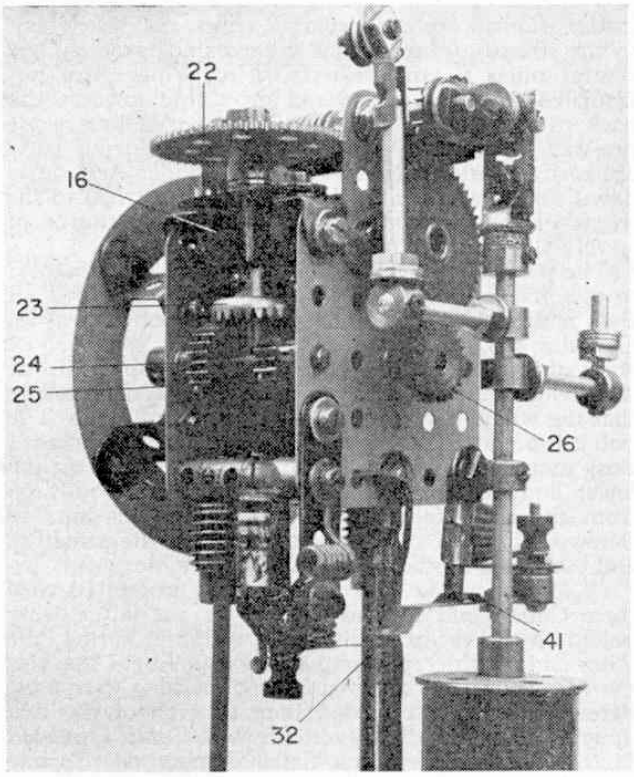


Another view of the Clock showing construction of the base and elevated mechanism supports.



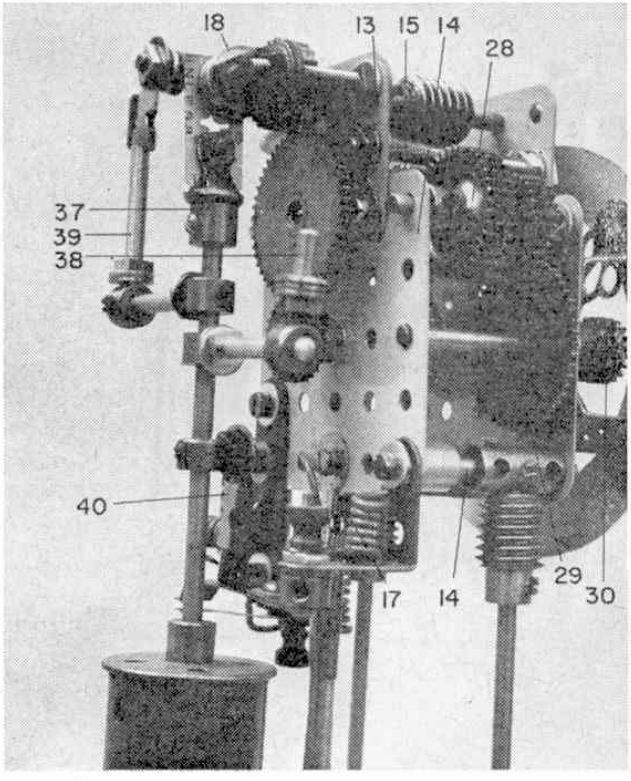
A small but accurate electrically-driven Pendulum Clock, working on the Hipp system, designed and built by L. R. Dougal M.B.E., M.T.A.I.





A close-up view of the drive gearing and pendulum connection.

Another close-up view of the Clock showing the initial drive gearing and the electrical contacts controlling the solenoids.



while, in the other case, the Collar is fitted with a second Long Threaded Pin 39, to which a Rod and Strip Connector is attached. A thin " L "-shaped piece of wire is attached by a lock-nut to this Rod and Strip Connector to rest on the upper teeth of Ratchet Wheel 20. Thus, when the pendulum is vibrating, the Ratchet Wheel is advanced tooth by tooth.

Another Rod and Strip Connector 40 is loosely fitted to the lower of the three Collars at the top of the pendulum and, in it, is fixed a small length of Axle Rod brought to a sharp edge with a file. A small piece of Flexible Plate $\frac{3}{4}$ in. long by $\frac{1}{4}$ in. wide is formed into a " bridge " 41 and bolted to 2 in. Bent Wiper Arm 32, then the Collar carrying the Rod and Strip Connector with its sharpened Rod is lowered until the Rod rests on one side or the other of the bridge. (A Centre Fork could be substituted for the sharpened Rod, if available.)

The whole clock is now levelled fore and aft and side to side using a spirit level. With the pendulum at rest, the armature should be in the position shown in the illustrations. When the pendulum is swung, the sharpened Rod should travel backwards and forwards over bridge 41 and, as the amplitude of the swing decreases, the time will arrive when the Rod fails to clear the bridge, but rests on top. On its return beat, the pendulum will cause the Rod to press downwards on the bridge, closing the contacts, energising the solenoids and attracting the armature. As the pendulum passes dead centre, the contacts should open and this action must take place before the armature reaches the edge of the solenoid Cores.

Being mounted on the Insulating Flat Girders, the solenoids are capable of slight adjustment as they are fixed to Hub Disc 2 by the centre elongated hole. The sharpened Rod can also be adjusted by rotating the Collar slightly one way or the other and the Clock is re-levelled by adjusting the feet until satisfactory operation is achieved.

The Clock will operate from an A.C. or D.C. source of between 6 and 9 volts, although A.C. voltages of up to 13 volts are quite permissible. Once adjusted, the Clock is most reliable, will keep excellent time and call for no attention. The Clock shown in the illustrations has now been operating for more than 18 months. A spark quench circuit (suppressor), consisting of a condenser and resistor have been incorporated, but this is a refinement which is not altogether essential.

In one of the photographs you will see the model enclosed in a transparent case. This was simply made from double glazing clear plastic which can be bought at most ironmongers. A tube is formed and joined with Sellotape, then bolted to a Circular Girder, also fitted with a disc of clear plastic. The case, of course, serves to keep out the dust and moisture present in the atmosphere, thus greatly increasing the life of the Clock.

PARTS REQUIRED

1—6	1—26c	2—72	2—164
4—6a	2—27	2—74	1—166
7—12	2—27a	2—81	2—173a
1—12a	1—27d	4—82	1—179
3—13a	1—29	4—111	8—188
1—15	2—31	4—111a	3—212
1—16a	3—32	2—111d	7—215
6—17	82—37a	1—115	1—216
1—18a	60—37b	3—115a	1—502
2—20	60—38	1—118	2—542
3—20b	1—45	4—125	1—508
5—22	12—59	5—142c	2—522
2—23	2—63	1—143	2—528
3—25	2—63a	1—146	1—531
1—26	6—64	1—148	1—533