Clocks in Meccano

Meccano is an ideal medium from which to construct prototype clocks. Noel C Ta'Bois has the details . . .

MECCANO is an ideal medium from which to construct clocks or indeed anything mechanical. Only simple tools are required, no time has to be spent in making components, and experimental changes in design are easily made at any time during building or after completion. If a workshop is available the scope is greatly increased but the making of special parts should, I think, be discouraged. There is a challenge in making do with standard parts only and a sense of achievement when a problem has been successfully overcome, to say nothing of the satisfaction in knowing that other Meccano enthusiasts, with no means for making parts, will be able to build the same model.

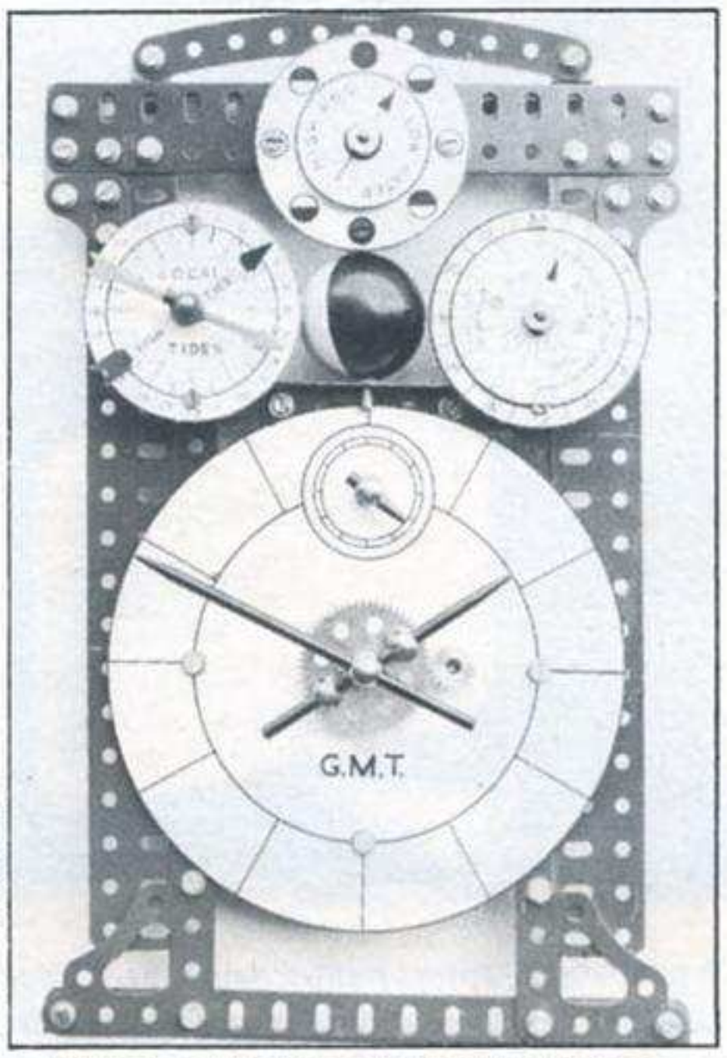
This article explains some of the aspects of Meccano clockmaking, using standard parts only, except possibly for hands and dials. One's creation may be a copy of an actual clock, made as faithfully as possible or modified to suit the parts available which may well tax the skill and ingenuity of the builder. Alternatively it may be freelance, either as a clock in its own right or as the experimental prototype for the real thing, as was the case with my two mystery clocks. In these, the Meccano versions used inexpensive quartz clock movements to actuate counterweights causing rotation of the delicately balanced hands. These demonstrated that the principles were sound and that I would be justified in purchasing the expensive analogue watch modules needed to make my 'Concorde' mystery clock.

Motive power can come from weights, clockwork motors, electric motors or batteries. A synchronous electric motor is reliable in operation, causes no electrical interference and is simple to make because there are no electrical connections to the rotor. The speed is determined solely by the number of poles on the rotor and by the frequency of the alternating current supply. As this frequency is accurately controlled at the power station a clock driven by a synchronous motor must keep perfect time provided that the gear train has been correctly calculated.

The formula to determine the motor speed is simple: speed in

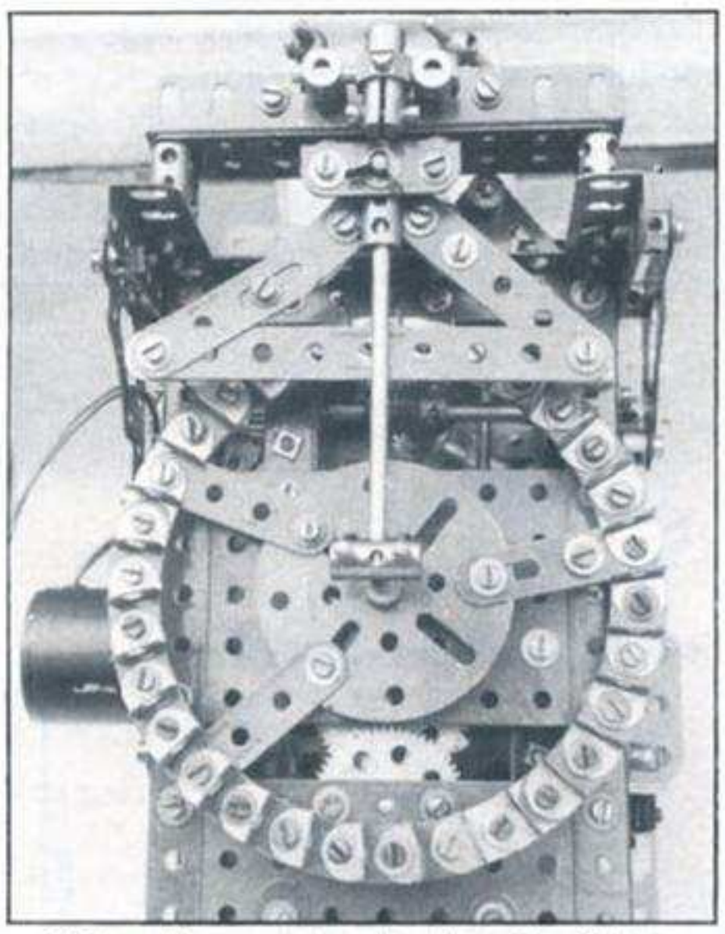
$$RPM = \frac{120 \times F}{N}$$

where F is the frequency of the alternating current in Hertz (cycles per second) and N is the number of poles on the rotor. The factor 120 is derived from 60 × 2; 60 because there are 60 seconds in a minute and 2 because two magnetic pulses are produced by each cycle of alternating current.



Picture courtesy B N Love.

Dials for Tidal Clock, by P D Briggs, which also shows the moon's phases.



Picture courtesy B N Love.

30 tooth escape wheel and built up pallets for a Tidal Clock by P D Briggs, having a seconds pendulum. In spite of its size this escapement functions very well. Note the use of elongated holes for critical positional adjustments.

The two disadvantages of this type of motor are that it is not self-starting and that, because it will run in either direction, care must be taken not to make the clock go backwards. To start the motor, the rotor must be spun in the correct direction at its operating speed. If spun too fast, it will not cut in as it slows down, although it can be made to do so if the power supply is switched on only at, or fractionally before, the instant when the stroboscopic effect of the rotor, viewed under an AC light source, shows that it is running at synchronous speed.

At a recent Meccano Club meeting I explained the principles of the synchronous motor to one of the younger members, Martin Clark, aged 16. He successfully designed and built a small motor and then decided to design and build a clock for it to drive, this being only his second venture into horology. His first was not a success; it was one of the Meccano Clock Kits which are notoriously tricky to get to work satisfactorily especially by someone with little or no experience in this field. These Clock Kits are unfortunately no longer in production but they did provide Martin with the dials for his freelance clock which so excellently illustrates the versatility of Meccano for clockmaking that I am describing it in some detail. It could well be the prototype for a tower clock, for it has dials back and front.

The low voltage motor is housed in the base and as it has a speed of 750 RPM, the gear train between the armature and the seconds-hand axle must have a total reduction ratio of 750:1. Spur gearing is used.

The drive from the second hand arbor is taken through a 1:1 sprocket chain loop to a train of spur gears with a total reduction ratio of 60:1, to turn the minute hands. One could use worm gearing if one were short of parts, meshing the worm with a 60 tooth gear. The hour hands are driven through 12:1 motionwork neatly provided by 3:1 and 4:1 ratios. The 4:1 gears are among the later additions to the system; early Meccano clocks had to use one stage of 3:1 and two stages of 2:1 followed by two further gears having a ratio of 1:1 in order to make both hands turn in the same direction, resulting in a clumsy arrangement. Though not visible in the photographs a friction drive is provided so that the hands may be set. Reverse gearing has to be provided to the hands on the opposite side. For the second hands there is a square of bevel gears (though three would suffice) and for the minute hands a train of spur gears, the last being the cannon pinion for the other dial.

Being electric, Martin's clock does not require an escapement but these are readily built, the escape wheel being formed by bolting small brackets to a faceplate or a circle of curved strips. Although they look rather crude these

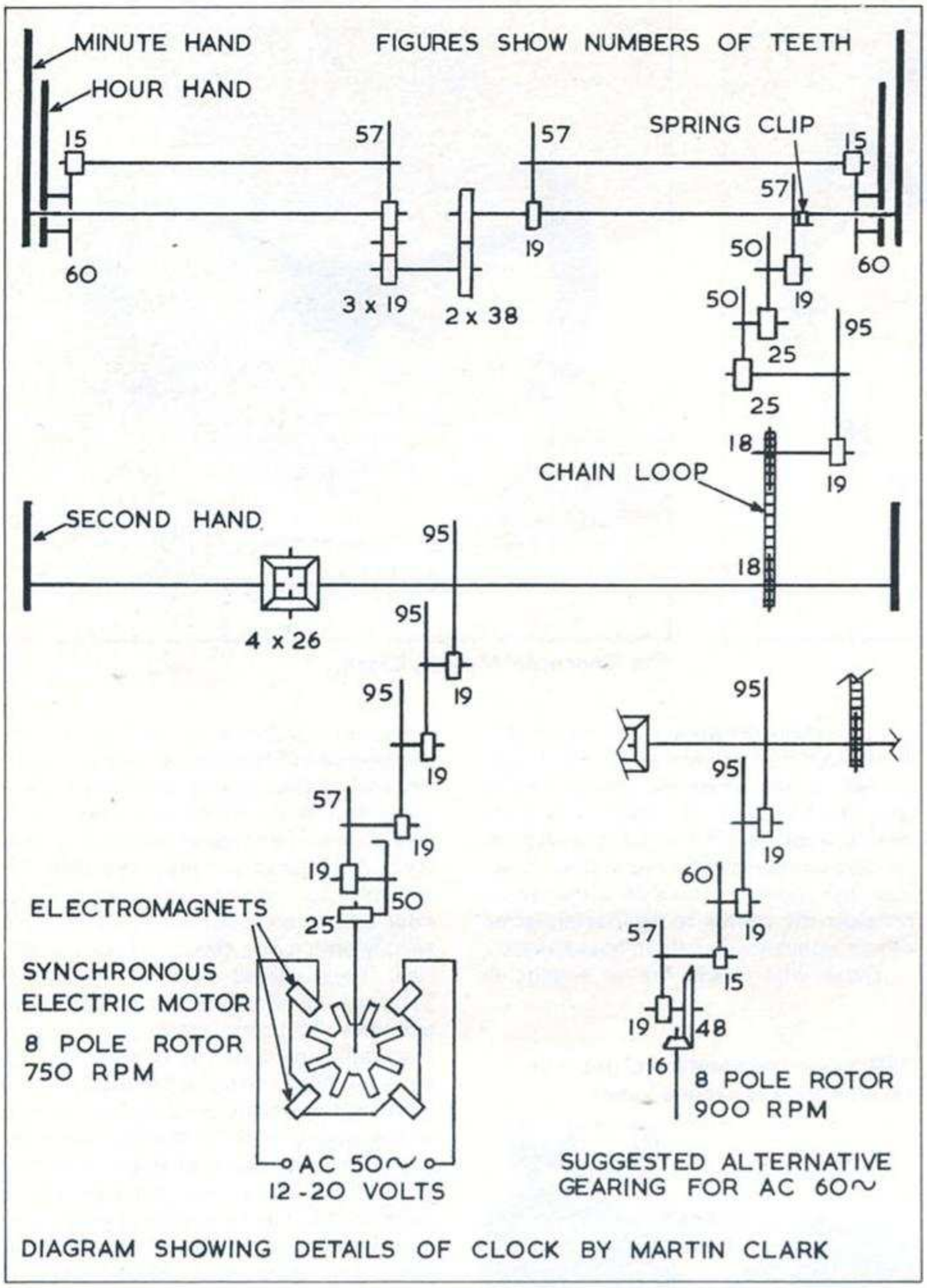
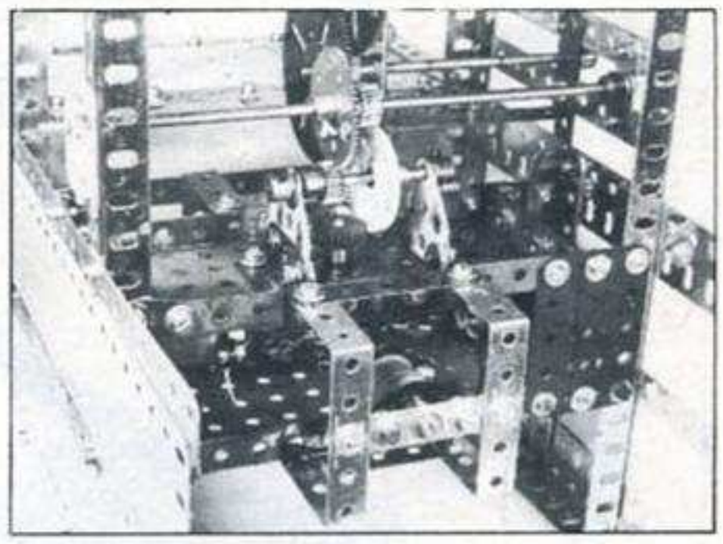


DIAGRAM SHOWING DETAILS OF CLOCK BY MARTIN CLARK



Synchronous motor in Martin Clark's clock.

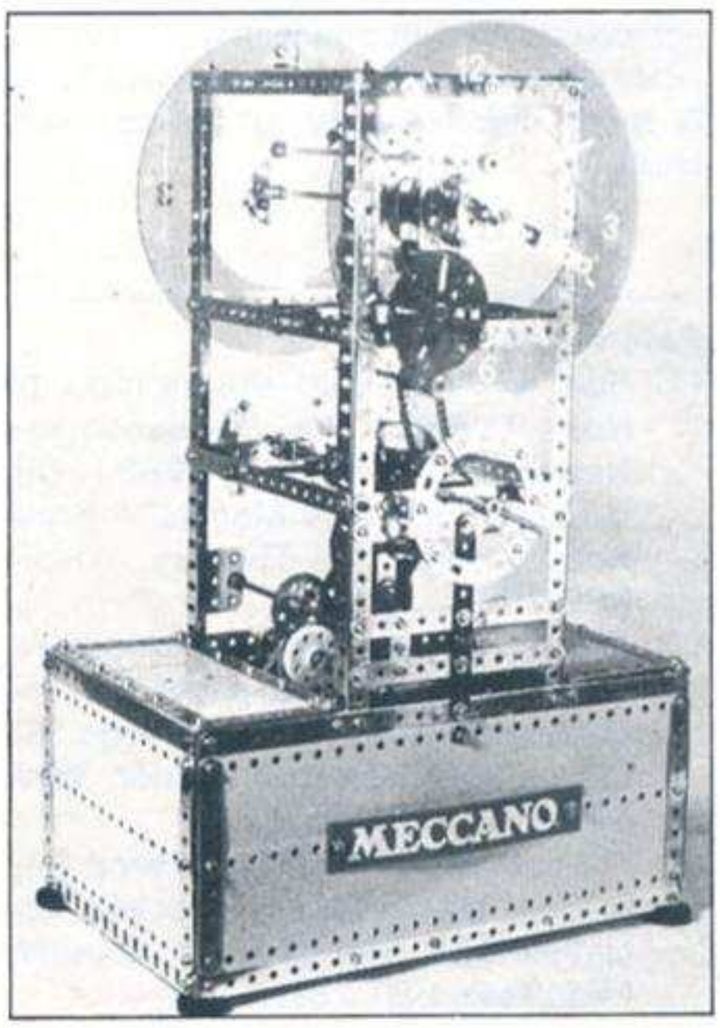
escapements do work remarkably well, and if a jig is made (from Meccano, of course!) accurately to position every bracket, it is possible to get a very even and satisfying beat. Sprocket wheels make good recoil escapements but, unlike the real thing, the sloping sides of their teeth, rather than the pallets, provide the impulses to the pendulum. Unfortunately no sprocket has 30 teeth so it is not possible to use one in a longcase clock with a seconds pendulum and a second hand on the same arbor as the escape wheel. The nearest compromise is to use a $1\frac{1}{2}$in sprocket which has 28 teeth and to lengthen the pendulum by nearly 6in. It is unlikely that anyone would notice that the pendulum is not beating seconds or that the seconds hand is not keeping in step with the seconds marks on the dial!

Undesirable friction, especially at the top end of the movement can be considerably minimised by using pivot rods which have pointed ends and run in conical depressions in the ends of the shanks of pivot bolts. The normal horological practice of polishing pivots and bearings and the correct application of clock oil can work wonders.

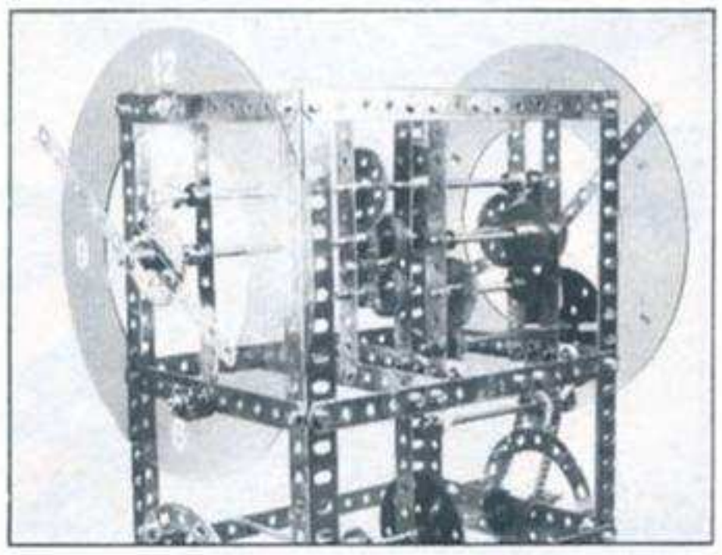
Meccano clockwork motors can be used to operate clocks but their power is limited and it is often a challenge to obtain a reasonable length of run on one winding. One solution is to use two or more motors in tandem.

Foliot clocks are occasionally to be seen at club meetings and have a certain fascination of their own. Like their distant cousins they are very poor timekeepers. Not so the Meccano Grandfather Clock which first appeared in 1928 and was subsequently improved by the fitting of a newly introduced $3\frac{1}{2}$in gear for the great wheel. This clock can be made to keep time to within a few seconds a week provided the temperature is constant. I really must get down to fitting a wooden pendulum rod to see how much this will improve the timekeeping properties of my own model.

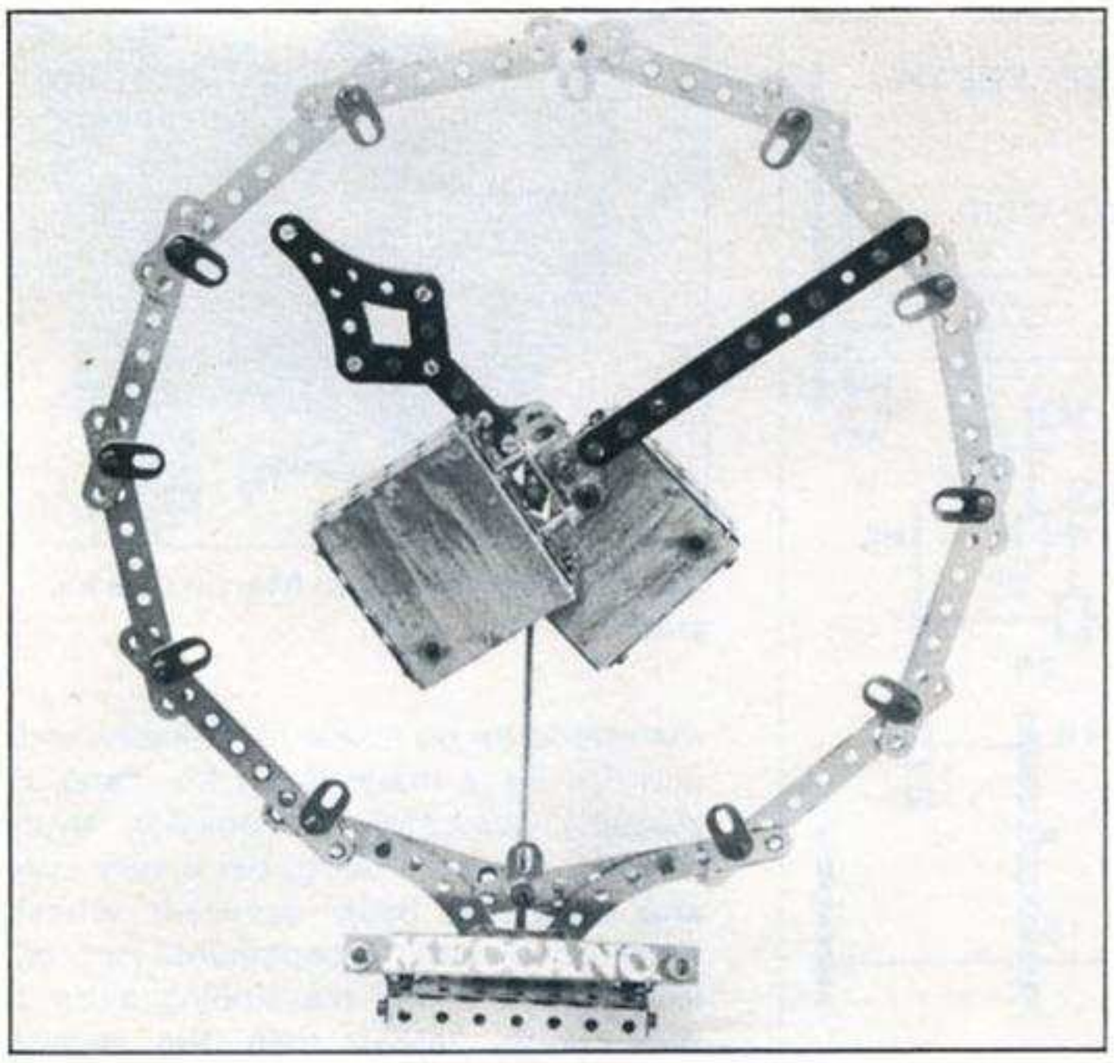
Weight-driven clocks present no problems for it is very easy to build neat containers for weighty objects such as iron nails, steel balls, sand in plastic bags, stones and so on. A wire line for clock



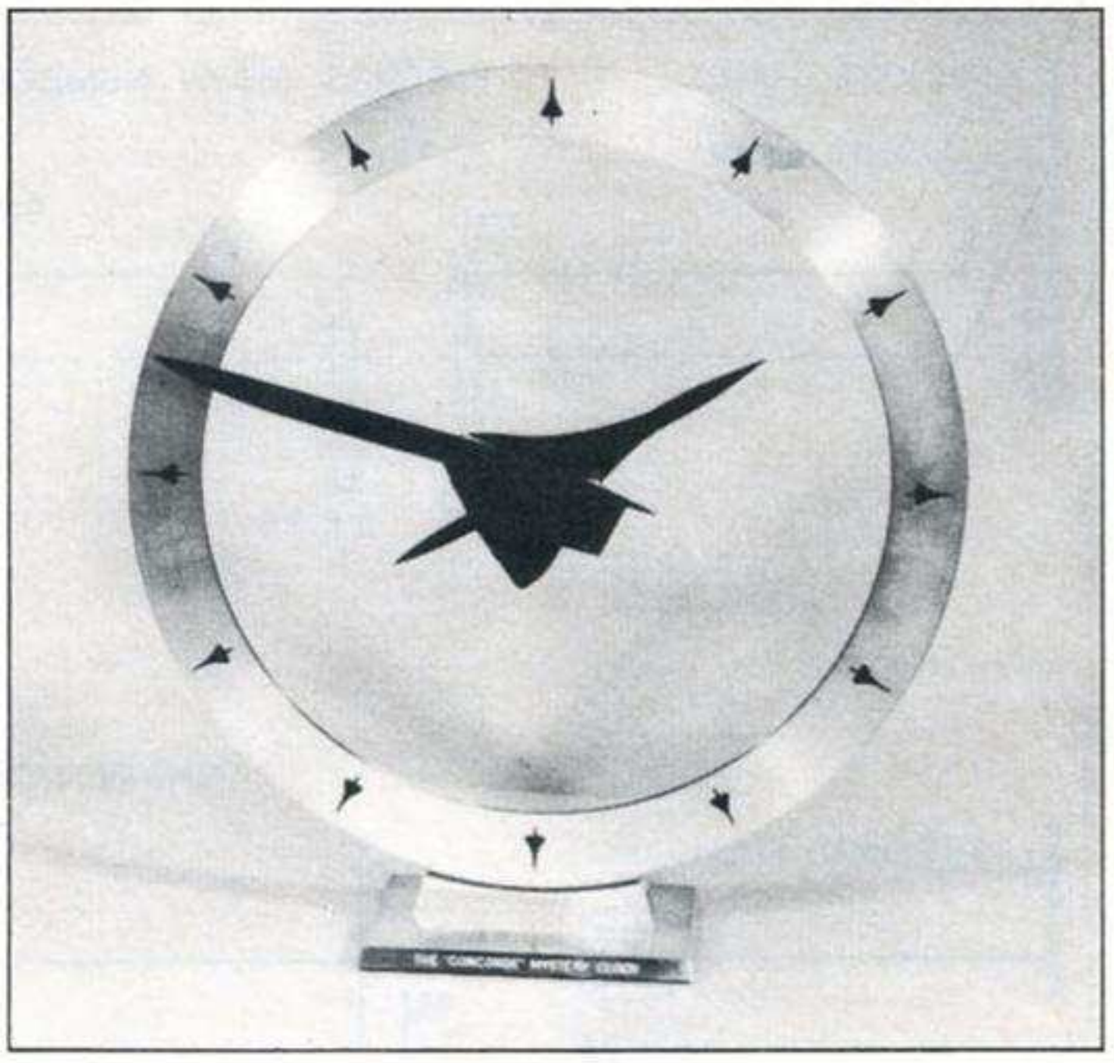
Tower clock by Martin Clark, front view.



Main dials and gearing for Tower clock by Martin Clark.



The prototype Meccano Mystery Clock.



The 'Concorde' Mystery Clock.

weights was introduced into the parts list in the 1930s but it is apt to fray, so it is a good plan to fit gut or a properly hardened and tempered wire line.

Striking and chiming clocks have been built successfully but bells and gongs have to be non-Meccano if they are to be melodious. Count wheels, snails and racks can be built from standard parts but they are not very elegant and one is often tempted to resort to thin sheet metal and shears.

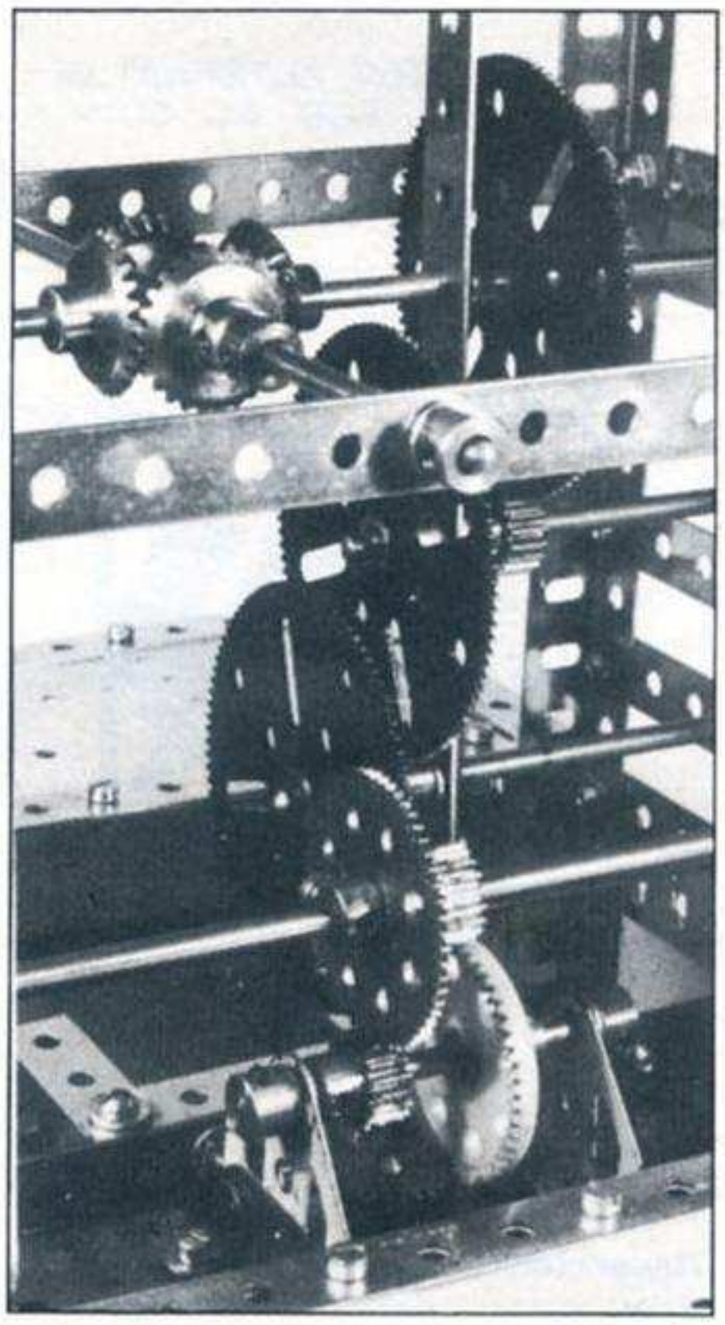
Battery clocks, such as the Hipp, present no untoward problems and neither do automatic electric winding mechanisms which enable weight-driven clocks to be left unattended for weeks on end.

Astronomical clocks are a very practical and popular proposition for the advanced constructor. With the many gears and sprockets available, and with the help of a pocket calculator, it is possible to obtain difficult ratios. If one includes gears from the Marklin and Stokys systems which, with certain reservations, are compatible with Meccano, the task becomes even easier. I have written an exhaustive article on this subject for the North Midlands Meccano Guild.[1] By using differential gear mechanisms Alan Partridge has shown that virtually *any* ratio can be obtained.[2] A very useful component for calendar work is the thrust bearing sprocket which has 73 teeth. By combining this with a 5:1 ratio one conveniently arrives at the number of days in a year.

Hands, dials and cases always pose a bit of a problem. They can all be made from standard parts and it is surprising what a little ingenuity can do when parts are used unconventionally. Alternatively, hands and dials may be purchased from dealers or salvaged from the junk box. Dials carefully drawn in black ink on stiff white card can be very satisfying. Cases provide ample scope for the artistically gifted person to use standard parts in the most unexpected and pleasing ways both for construction and for decoration. However, like modern art, while some would consider the results to be masterpieces, others would not give them houseroom.

Those who would like to engage in Meccano clockmaking but have little experience in Meccano techniques might do well to join one of the many active clubs in this country[3] or abroad. They will not have far to look for a helping hand when it is needed and they may well have opportunities for purchasing spare parts, new and second-hand, which are still readily obtainable, though prices steadily rise. They should bear in mind that horology is a very small aspect of a club's activities. Meccano clock building is a fascinating pastime, particularly for the keen horologist without the ability or the facilities for making parts, to say nothing of the saving of time. Martin Clark built his clock in a matter of days; how long would it have taken even an experienced horologist to build a similar clock if every part had to be designed and made, if every gear had to be calculated and cut? There can be no doubt that the scope is unlimited and that one learns a lot about what makes clocks tick or, perhaps what is more important, what makes them stop!

720:1 gear train and bevel gears to reverse drive to second hands.



References

(1) *How to obtain that elusive ratio*, by Noel Ta'Bois. The Meccanoman's Newsmag, February 1983. Obtainable from M W Models, 4 Greys Road, Henley-on-Thames, Oxon, RG9 1RY.

(2) *'Gear Trains for Astronomical Clocks'*, unpublished paper by, and obtainable from, A B Partridge, 63 Clifton Road, Sutton Coldfield, West Midlands, B73 6EN, £1.

(3) For details of British Clubs send SAE to The UK Guild of Meccano Societies, 129 Allenby Road, Southall, Middlesex, UB1 2EZ.