A Meccano Master Clock

Fitted with Striking and Chiming Movements

THIS Meccano Electric Clock, fitted with chiming mechanism and slave clock impulse transmitter, is the result of many requests from Meccano model-builders for details of striking movements and master clocks. As far as possible the various movements of the model have been operated electrically, the necessary current being derived from a T20A Transformer concealed in the base. Meccano parts have been used throughout in the construction, with the exception of the gong tubes and "snails." The purpose of the snails will be made clear later. The complete model stands slightly under 5 ft. in height and, as will be seen from Fig. 1, presents a very modern appearance.

Although at first glance the model would appear beyond the scope of the average boy, it is comparatively easy to construct if the various sections are built and erected in the manner described in this article. The time-keeping qualities of the model are excellent, and the Westminster chime with which it is fitted adds considerably to its interest.

As a master clock it is very reliable, and transmits time signals at half minute intervals. It is suitable for use with almost any slave clock, and also with the model "Pul-syn-etic" Electric Clock described in the "*M.M.*" for April last. Any number of slave clocks can be operated from this master clock.

Building the Mechanism

The framework and three separate gear trains are shown in Fig. 2, one corner Angle Girder of the frame having been removed to show the construction more clearly. Two 9½″ Angle Girders form the base, and these carry at each corner a vertical 12½″ Angle Girder, two further 12½″ Angle Girders 1 being fitted at the top as shown. The two E120 Electric Motors 3 and 4 must be fitted at this point, as these hold the back and front of the mechanism frame together. The front is built in with six 5½″×3½″ Flat Plates as shown in Fig. 3, the two upper corners being left open. The back of the frame is fitted with a long vertical plate built up from three 5½″×3½″ Flat Plates. These support the inner ends of five 3½″ Strips, two of which are arranged on one side of the Plates and three on the other. The outer ends of the Strips are bolted to the two rear 12½″ Angle Girders.

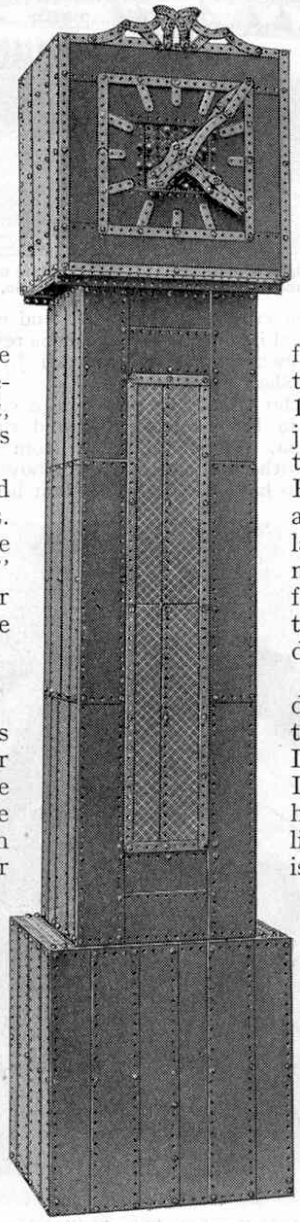

Fig. 1. A clock case of modern design for carrying the mechanism described in this article.

The fitting of the gears is commenced by incorporating the reduction train between the pendulum and hands. A Ratchet Wheel 2, spaced away from the Plate by a Collar, is mounted on a 3½″ Rod that carries a ½″ Pinion. This Pinion engages with a 57-teeth Gear mounted on the same Rod as a ¾″ Pinion 5 that rotates a 50-teeth Gear 6. This Gear in turn is connected, via a further ¾″ Pinion and 50-teeth Gear, to the 2½″ Gear Wheel 7 mounted freely on the 6½″ Rod 8, Fig. 2. A Collar on this Rod prevents the boss of the Gear from bearing against the Plates forming the front of the mechanism case. The rear face of the Gear is kept in close contact with a 1″ Dunlop Tyre by means of a 1½″ Pulley 9, the Tyre being mounted on a 1″ loose Pulley. The 1½″ Pulley is pressed against the Tyre and locked on the shaft by its set screw. The clutch so formed enables the hands of the clock to be turned without disturbing the mechanism.

The Collar 10 can now be fitted, being secured on its Rod by two 7/32″ Grub Screws. This Collar will be incorporated later in the slave clock transmitting mechanism.

The gear train through which the Motor 4 drives the chiming drum is built up in the following manner. An E120 Motor Pinion on the armature shaft meshes with a 57-teeth Gear 11, the Rod on which this is mounted being journalled in the Motor side plates. Between these two side plates the Rod carries a ½″ Pinion that drives a 57-teeth Gear, mounted on a 3″ Rod 12, together with a ½″ Pinion. This last part rotates the 6½″ Rod 13 through the medium of two 2½″ Gears 31 and 32 and a further ½″ Pinion. All the Rods supporting these Gears are prevented from sliding longitudinally in their bearings by means of Collars.

The striking gear train is now built up. The drive from this is taken from the armature of the Electric Motor 3, by a special Pinion and Driving Band, to a 2″ Pulley Wheel 14, Fig. 4. If a Meccano Driving Band is found to be too heavy for this drive it may be replaced by a light rubber band of suitable size. The 2″ Pulley is carried on a 3½″ Rod 15 on which is gripped a ½″ Pinion engaging with a 2½″ Gear 16. The 3½″ Rod supporting this Gear carries at one end a Collar 17 secured in place by means of a 7/32″ Grub Screw. This Collar and Grub Screw form a cam for operating the electric striking movement as will be described later.

The Rod 8, already mentioned, carries a Bush Wheel 22, and this part carries four equally spaced nuts and bolts as shown in Fig. 4. The Bush Wheel is clamped on its Rod so that there is just sufficient clearance for the bolt holding the Bracket 23. The four nuts are arranged in an exactly similar manner to each other, and they lift, four times every hour, a ½″×½″ Angle Bracket bolted to the end of the lever 24, represented by a 5½″ Strip. A Crank, bolted to the top of the lever 24, is secured on a 3½″ Rod together with a second Crank 25. The Rod carrying these two Cranks is held in place by a Collar 26 and it must swing very freely in its bearings.

A ¾″ Bolt 27, carrying a Washer under its head, is

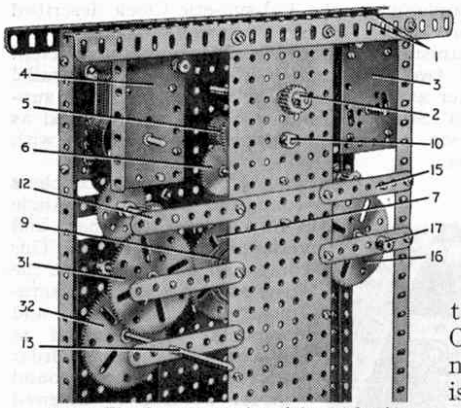

Fig. 2. The three gear trains of the mechanism.

locked in the end slotted hole of the Crank 25 by means of a nut, and this Bolt is normally resting so that it almost touches the head of a second $\frac{3}{4}''$ Bolt 28, locked in one of the tapped holes of a Crank boss by a nut. A $2\frac{1}{2}''$ Strip 29 is bolted to this third Crank and the free end of the Strip carries a Pawl without boss. The angles and positions of the Strip 29 and Pawl must be carefully copied from Fig. 4. It is best to leave all the electrical connections until the mechanical units are in proper working order.

The gathering pallet 33 is attached to one end of the Rod carrying the $2\frac{1}{2}''$ Gear 31, and it is composed of a Coupling in the centre plain hole of which is fitted a Centre Fork. This gathering pallet raises the chiming rack tooth by tooth.

The chiming rack with its attendant mechanism is shown in Fig. 6, this photograph having been taken from the rear of the rack. A $3\frac{1}{2}''$ Strip 35 is mounted $1\frac{1}{2}$ in. from one end on a Rod 36 that is mounted freely in the mechanism framework. The Strip is now attached at the end of its shorter arm to a Crank 34 by means of a locknutted bolt (see Standard Mechanism No. 1A). Two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are fitted as shown in the illustration, the inner one of which forms a support for an insulated Silver Tipped Contact Screw 37. The remaining Angle Bracket carries a second Silver Tipped Contact Screw 38 that is in metallic contact with the Strip 35. The Crank 34 is now locked on the Rod 36 by its grub screw so that the Strip 35 is allowed to move slightly owing to the play in its holes. This movement need only be sufficient to allow the Contact Screws 38 and 39 to be parted for a distance of about 1/32 in.

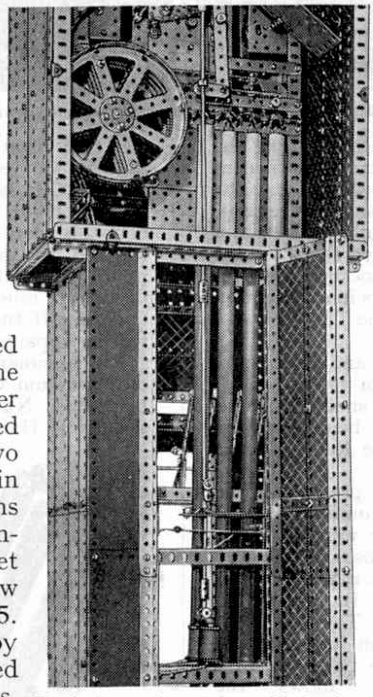
Fig. 3. A rear view of the model showing the gong tubes.

A 3″ Strip 40 is now passed on to the Rod 36, together with a second Crank 41, locked in place by two grub screws. This Crank and the Strip 40 are braced together by a 2″ Strip, a Washer being placed between this and the Strip 40. An insulated $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket is now attached to the unit, and this carries a Silver Tipped Contact Screw 39 that is held in contact with the Contact Screw 38 by a short length of Spring Cord. The relative positions of the Strips 35 and 40 should be so adjusted that they may be pulled apart slightly without disturbing the Crank 34.

The outer end of the Strip 40 carries a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket to which a $2\frac{1}{2}''$ Strip is bolted at its centre hole. This Strip, which is fitted with five $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets, must be so curved that it forms an exact segment of a circle with the Rod 36 as its centre. Care must be taken also to see that the five Angle Brackets are equidistant between their tips.

The rack unit is now ready for fitting to the model, and this is done by passing the Rod 35 through one of the holes in the lower centre $5\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plate of the front of the frame. It passes also through an appropriate hole in one of the Plates at the rear of the frame. The exact position of the Rod is shown in Fig. 4. The $1'' \times \frac{1}{2}''$ Angle Bracket 23 is next secured in place by means of a $\frac{3}{8}''$ Bolt. A Washer is placed between the head of this Bolt and the Bracket, and three Washers between the clock frame and the Bracket. An insulated Silver Tipped Contact Screw is supported by the Bracket and this makes contact with the Contact Screw 37, Fig. 6, when the rack is in its top position. Final adjustment of this will be made later.

The chiming snail 42 must now be cut from a thin sheet of brass or tin-plate, brass being preferable because of its non-rusting qualities. In the centre of a sheet of metal $2\frac{1}{2}''$ in diameter and of about .020″ gauge, an 11/32″ hole is drilled. This must be done very accurately in order to ensure the chiming mechanism working correctly.

Divide the circle into quarters, and cut away a segment of metal from each quarter so that the four sections form a series of steps. Each step must be exactly $\frac{1}{8}''$ lower than the preceding section. The finished snail is shown in Fig. 4 and, as will be seen, it is secured to a Bush Wheel locked on the minute hand spindle of the clock. When the chiming rack is released its movement is limited by the Threaded Pin 43, which bears against the edge of the snail 42.

The operation of the chiming movement is as follows. As the hour approaches, one of the nuts in the Bush Wheel 22 raises the Angle Bracket secured to the lower end of the Strip 24. This motion causes the Crank 25 and short Strip 29 to lift the Pawl out of engagement with the rack. At the same time two Silver Tipped Contact Screws, carried on the Brackets 44 and 45, are drawn apart. The connections for these will be dealt with later.

In falling, the chiming rack opens the contacts 23 and 37 and closes the contacts 38 and 39. This movement is known as the "warning." As the minute hand comes on to the hour mark, the Bracket, carried on the Strip 24, is released from the nut on the Bush Wheel 22, thereby closing the contacts 44 and 45. The motor now starts, and the gathering pallet 33 commences to rotate in a clockwise direction. For every complete revolution it picks up one tooth of the chiming rack, and the Pawl holds the rack as each tooth is picked up. When the last tooth is reached and the gathering pallet is almost slipping clear, the two contacts 23 and 37 come

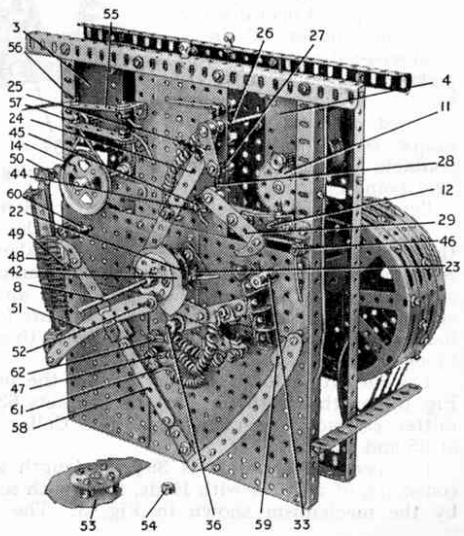

Fig. 4. The complete striking and chiming mechanism.

together, and the resulting movement of the Strip 35 causes the contacts 38 and 39 to open for a fraction of an inch. The motor now gradually stops, thus giving the gathering pallet time to slip clear of the chiming rack.

A similar motion takes place at 15-minute intervals, but the fall of the rack is controlled by the position of the snail 42. At the quarter hour the Threaded Pin 43 comes into contact with the snail at its greatest diameter, and at the half hour at the first step towards the centre. This continues past the three quarters, until at the hour the innermost section is reached.

The electrical connections for the chimes are made in the following way. A wire from the terminal 46 is taken to the contact 45 and from 44 to the terminal 47. A coiled length of wire connects this latter terminal to the contact 39. A further length of wire is used to connect the insulated terminal of the motor 4 to the contact 38 by way of the terminal 62.

The striking mechanism is now fitted. The main portion of this is the vertical rack 48 shown in Fig. 4. Two Eye Pieces 49 and 50 are attached to the frame by Threaded Pins, the Pin carrying the Eye Piece 50 being carried on a Flat Bracket. This form of construction allows for adjustment of the angle of the rack. The construction of the rack will be seen from the two illustrations. It will be seen also that at its lower end it is pivotally secured to a $5\frac{1}{2}''$ Curved Strip 51, which is free to slide in an Eye Piece carried on a $3\frac{1}{2}''$ Rod free to turn in its bearings. The unoccupied end of the Curved Strip carries a $\frac{3}{8}''$ Bolt 52, and this works in conjunction with the striking snail 53 in a similar manner to the Threaded Pin 43 and snail 42.

The striking snail has a maximum radius of 2″, and this passes down through 12 successive steps to a minimum radius of $\frac{1}{2}''$. Each step is therefore $\frac{1}{8}''$ in depth. The complete snail is secured to a 57-teeth Gear by four $\frac{3}{8}''$ Bolts, four Collars being used for spacing purposes. This snail is free to turn on the Rod 8, but is prevented from sliding forward by a Collar 54.

At the top of its movement the striking rack presses on the underside of a $4\frac{1}{2}''$ Strip 55, thus opening two contacts 56 and 57, as shown in Fig. 4. A small piece of thin fibre must be glued to the underside of the Strip 55 for insulating purposes.

The ratchet for holding the rack is built up as shown in Fig. 4, on one side with three 3″ Strips 59 must be adjusted so that rack falls for the hour chime This releases the ratchet striking rack to fall, thereby closing the contacts 56 and 57. When the Motor 4 has finished turning, the motor 3 starts up and operates the gathering pallet 60 in a clockwise direction. This picks up the rack, tooth by tooth, until it reaches its topmost position, when the motor is stopped by the contacts 55 and 56 opening. The point of the gathering pallet consists of a Silver Tipped Contact Screw.

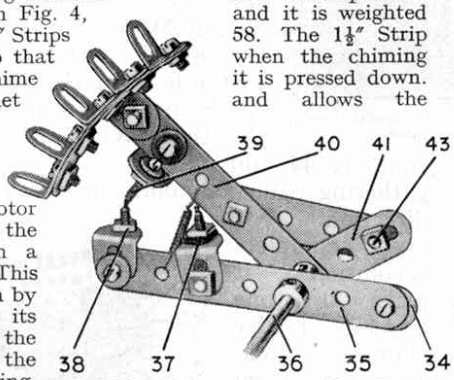

Fig. 6. The chiming rack removed from the clock.

The connections for this section of the mechanism start at the terminal 46, from which a wire is taken to the contact 23. A second wire is taken from 37 to a terminal 61, and from here a connection is taken to the contact 57, and from 56 to the insulated terminal of the motor 3. The gears for operating the hour hand are arranged in a similar manner to those of the Grandfather Clock, Instruction Leaflet No. 14A.

The mounting for the upper end of the pendulum is shown in Fig. 5, together with the striking contacts 63 and 64. The transmitter contacts, operated from the Collar 10, are also shown at 65 and 66.

The pendulum, which is $39\frac{1}{2}''$ in length and carries a "bob" consisting of a Boiler with Ends, filled with scrap lead, is energised by the mechanism shown in Fig. 3. The operation of this is identical with that employed in the Pul-syn-etic Clock described in the "*M.M.*" for April last.

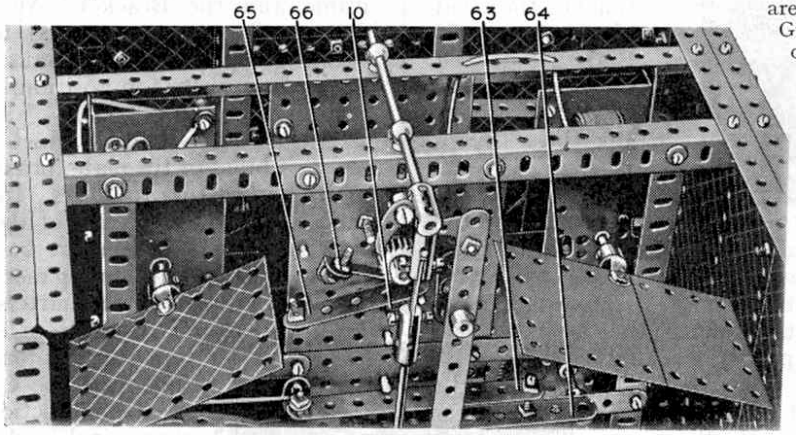

Fig. 5. In this view the governor fans are shown.

The hammer mechanism shown in Fig. 7 is now constructed. The base consists of two $9\frac{1}{2}''$ Angle Girders arranged parallel and connected together at each end by a $3\frac{1}{2}''$ Angle Girder supporting a $2\frac{1}{2}''$ and a 3″ Strip. These two Strips are arranged as shown in the illustration, and at their upper ends are fitted with a $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Bracket.

The two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are connected by two $5\frac{1}{2}''$ Angle Girders, bolted together and overlapping five holes. This compound girder supports the four solenoids used for actuating the hammers, and solenoids are clamped in place by a $4\frac{1}{2}''$ Angle Girder attached to the compound girder by five 1″ Screwed Rods.

The hammers are now fitted, and the pivot for these consists of a $4\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip and a 5″ Rod. The Double Angle Strip is bolted to one of the base Girders of the mechanism and the Rod is journalled in the two turned-up ends of the part. Collars are used to prevent the Rod from moving sideways. The hammer levers consist of four $5\frac{1}{2}''$ Curved Strips mounted pivotally on the 5″ Rod between pairs of Collars.

Each lever has a 1″ Triangular Plate bolted to it as shown, and this plate supports a Collar by means of a set screw. The screwed portion of an Elektron Magnet Core is passed into the plain hole of the Collar, and is held in position by the set screw. Great care must be taken when lining up each hammer and Magnet Core, for if they tend to jam, the tone and volume of the note will be impaired.

The hammers are kept in the position shown in Fig. 7 by means of Pendulum Connections. These are attached to Flat Brackets by 6 B.A. Nuts and Bolts, and the Brackets are carried on the shanks of Handrail Supports and locked in place by nuts. The four Handrail Supports are carried on an 8″ Rod that is locked at each end in the boss of a Double Arm Crank. This Crank is bolted to a $1\frac{1}{2}''$ Angle Girder that in turn is bolted to its respective $3\frac{1}{2}''$ Angle Girder of the framework.

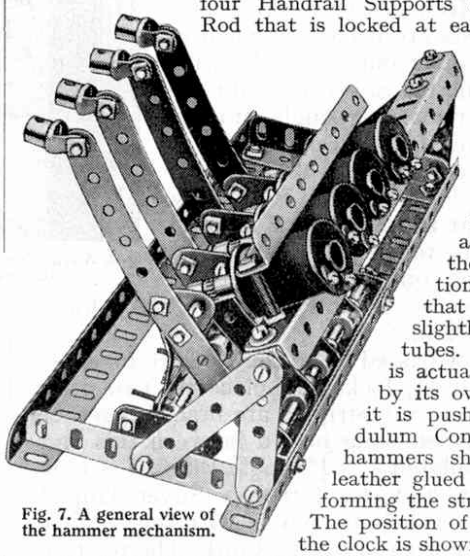
Fig. 7. A general view of the hammer mechanism.

When the hammer mechanism is complete and fitted in the clock, the Pendulum Connections must be so arranged that they hold the hammers slightly away from the gong tubes. Thus when a hammer is actuated it strikes the tube by its own weight, after which it is pushed clear by the Pendulum Connection. Each of the hammers should have a piece of leather glued over the End Bearing forming the striking head.

The position of this mechanism in the the clock is shown in Fig. 3.

In order to reduce mechanical noises to a minimum in the hammer movement thin pieces of soft india rubber may be glued in place at the necessary points. A piece glued to each Magnet Coil cheek, at the point where the 1″ Triangular Plate of the hammer hits it, will reduce unwanted noise considerably. Similar pieces can be fitted to the upper ends of the Pendulum Connections.

A good deal of noise is caused also by the "warning," especially at the hours. Carefully placed pieces of rubber will also do much to reduce this, and a short length of small diameter rubber tubing passed over the smooth portion of the Threaded Pin 43 will help considerably.

Owing to lack of space the construction of the clock case has not been described. Any model-builder who experiences difficulty in this should write to the Editor for details.