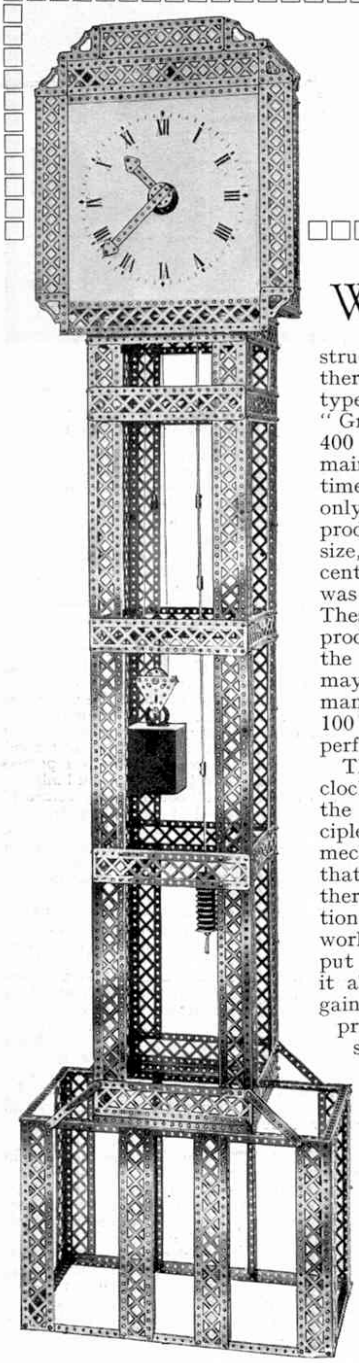

Fig. 1. General view of the Meccano Grandfather Clock.

A Splendid Meccano Super Model

Grandfather Clock

WHEEL clocks of almost every conceivable shape and size have been constructed, but it is doubtful whether there has ever been a more popular type than the weight-driven "Grandfather" pattern. For over 400 years the Grandfather clock maintained its place as the standard time-piece for the home, and it was only with the introduction of mass-produced clocks of relatively small size, during the middle of the last century, that the "Grandfather" was ousted from its proud position. These ingenious clocks were the products of skilled craftsmen, and the excellence of their construction may be gauged by the fact that many that were built more than 100 years ago are still keeping perfect time.

The "Grandfather" type of clock undoubtedly provides one of the clearest examples of the principle of operation of a clock mechanism. The Meccano model that is described in this article therefore fulfils two distinct functions, for besides being a perfect working mechanism that may be put to practical use in the home, it also enables the constructor to gain a thorough knowledge of the principles underlying clock construction.

The Meccano model stands 6 ft. high and runs for 18 hours without rewinding. With the exception of a lead weight and a cardboard dial, which may easily be made at home, the model is composed entirely of standard Meccano parts. When carefully adjusted the model will keep perfect time over long periods, the effective length of the pendulum being capable of adjustment or "compensation" for varying conditions.

The model consists of two main units, the Mechanism and the Clockcase. It is best to construct the clock mechanism first, so that this may be adjusted to operate correctly after which the case may be built up, and the top of the clockcase, and dial, etc., secured in place around the mechanism.

The frame or "skeleton" in which the various Gears and Rods forming the mechanism are accommodated, is shown in Fig. 2. The frame is composed of four 12½" Angle Girders 1 bolted at their lower ends to 9½" Girders 4 and at the top to 5½" Girders 3. Other 5½" Girders 2 and a number of 5½" Strips are secured between the vertical members. Two 5½" Angle Girders are also secured between the Girders 3 to provide supports for the 7½" Strips 7 and 9, the lower ends of these Strips being bolted to 5½" × ½" Double Angle Strips 5 and 8, secured between two pairs of horizontal 5½" Strips. A 9½" Strip 10 is secured to the back of the frame as shown, and a 5½" × 3½" Flat Plate is bolted to the two 12½" Girders forming the front of the frame. A Flat Trunnion 6 is attached to the Double Angle Strips 5, and Double Bent Strips 11 and 12 are secured to the frame in the positions shown to provide bearings for the clutch gear operating shaft and winding-crank spindle respectively.

To complete the frame unit, supports for holding an 8" Axle Rod must be secured in place. The front support consists of a Crank 13 bolted to a Flat Trunnion which, in turn, is secured to a 1½" Angle Girder bolted to the top of the frame. The rear support incorporates also a Crank, which is secured to a 2" Strip and a Trunnion bolted to the top of the frame. The pallet pivot Rod 56 (see Figs. 4 and 6) is journalled in the centre holes of the Trunnions and also in the slotted holes in the Cranks 13.

In fitting the various gears in position, it will materially assist the constructor in understanding the operations of the model if he assembles the gears in the order in which they transmit the motion from the prime mover.

The primary gears are the 3½" Gear Wheels 43 (see Figs. 6 and 7), one of which meshes with a ½" Pinion 14 on the 3" Axle Rod 24 (see Fig. 3). This Axle should therefore be pushed into place, and the ¾" Pinion 26 and the 50-teeth Gear 15 secured in the positions shown in Figs. 3 and 6; the Rod 24 is held in place at its outer end by means of a Collar.

From the ¾" Pinion 26, the drive is taken to the 50-teeth Gear Wheel 25. This last-mentioned Gear is mounted on a 3" Axle Rod that is slideable in the holes in the Double Angle Strips 5 and 8 in which it is journalled. It carries in addition to the 50-teeth Gear a ½" Pinion 65, a Crank 60, and a Compression Spring 27. Three Washers are placed on the Rod between the Pinion 65 and the Double Angle Strips 5 (Fig. 2).

The aim of providing a sliding action for this Rod is to enable the gear train from the clock hands to the winding drum to be "broken" when it is required to adjust the hands of the clock, the action of "declutching" being achieved by the aid of the mechanism now to be described.

The boss of the Crank 60 is slipped on to a 3" Axle Rod 79 (Fig. 6), journalled in the Double Angle Strips 5 and 8; and the boss is then locked to the shaft by means of its set-screw. A Double Bracket 80 (Fig. 3) is slipped on to the Rod 79 and held in place by means of Collars secured on each side. The Bracket is pivotally connected, by means of the lock-nut device, S.M. 262, to a Bell Crank 81, the boss of which is secured to a 2" Rod journalled in the Double Bent Strip 11 that is secured to the frame of the mechanism (Fig. 2).

To the free arm of the Bell Crank 81, a length of cord is attached, and by pulling on this the Crank 60 will draw the 50-teeth Gear Wheel 25 (Fig. 3) out of engagement with the ¾" Pinion 26, thus "breaking" the main gear train, and enabling

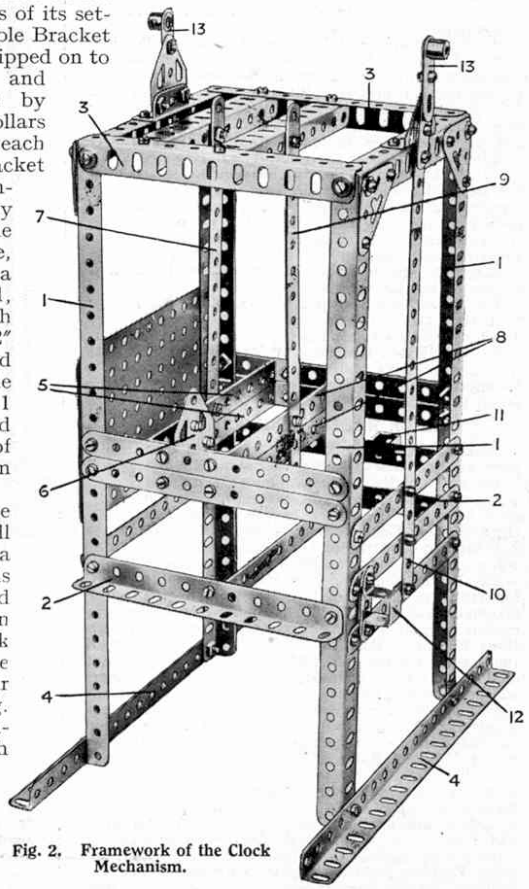

Fig. 2. Framework of the Clock Mechanism.

either of the clock hands to be turned freely.

The next step in the construction of the main gear train is to place the Rod 36 (Fig. 3) in position and mount on it the 57-teeth Gear Wheel 28 and the ¾″ Pinion 30, these Gears being secured one on each side of the Double Angle Strips 5.

The Rod 36 carries at its outer end the minute hand, but as we are dealing only with the internal gears at this stage, the minute hand unit should not yet be fitted.

A 2″ Rod is journalled in one of the Double Angle Strips 5 and the Flat Plate forming the front of the frame, and carries a 50-teeth Gear Wheel 29 that meshes with the ¾″ Pinion on the minute hand shaft 36, and a 1″ Gear 62. Two Washers should be placed between the Gear 62 and the Flat Plate in order to allow the Gear to rotate freely.

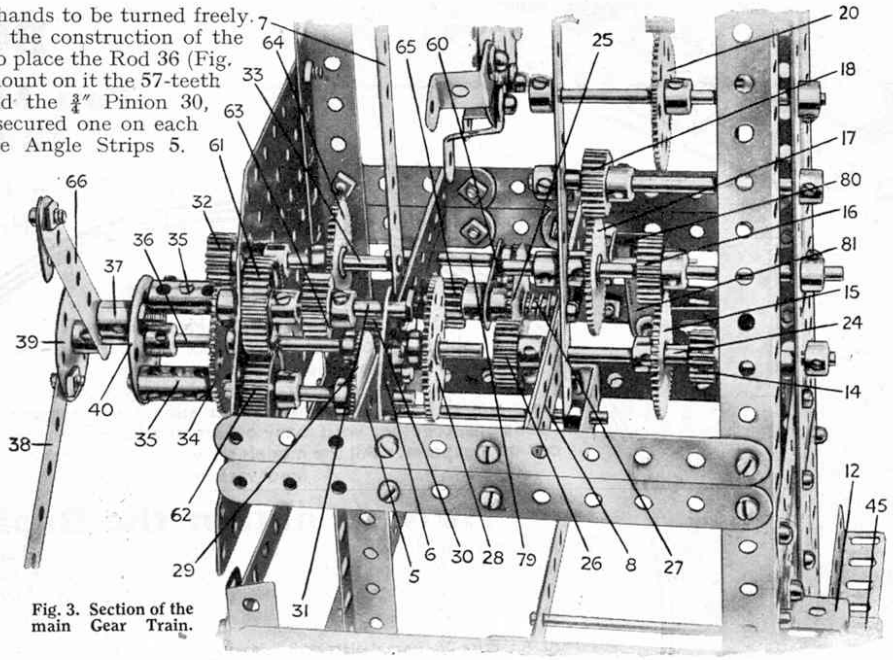

Fig. 3. Section of the main Gear Train.

The Gear 62 engages with a further 1″ Gear 61 mounted on a 2″ Rod 31, which carries also a ¾″ Pinion 63.

To complete the drive to the hour hand, a Rod 33 is journalled in the Strip 7 (Fig. 2) and the 5½″ × 3½″ Plate, and carries a 50-teeth Gear Wheel 64 (Fig. 3), which meshes with the Pinion 63. The Rod 33 carries also a ½″ Pinion 32 mounted on the Rod against the outside face of the Flat Plate.

The hour arm unit may now be built up and secured in position on the Rod 36. The unit consists of a 57-teeth Gear Wheel 34, to the face of which are secured two Couplings 35 by means of bolts. A Bush Wheel 40, with its boss turned inward, rests on the Couplings and is held to them by further bolts, the shanks of the bolts being nipped by the set-screws in the Couplings. A 3½″ Strip 66, fitted with a 1″ Triangular Plate forms the hour hand, and is held to the Bush Wheel 40 by means of a ¾″ Bolt passed through the Strip and a Threaded Boss 37. The hour hand unit is quite free to rotate on the Rod 36, but is spaced away from the face of the Flat Plate by the Wheel boss and Washers. The minute hand unit consists of a 5½″ Strip 38 fitted with a 1″ Triangular Plate, the Strip being bolted to a Bush Wheel 39, which is secured rigidly to the Rod 36.

After the main gear train has been placed in position, it is interesting to follow the manner in which the drive has been reduced before being taken to the minute hand shaft; and the method employed to provide an auxiliary reduction ratio of 12 : 1 for the hour hand shaft.

The drive is first taken from one of the Gear Wheels 43 (Fig. 7) to the Pinion 14 (Fig. 3), thus providing a step-up of 7 : 1. It then passes to the Gear 25 via the Pinion 26, the resulting 2 : 1 ratio providing a total reduction of 14 : 1. From the shaft carrying the Gear 25, the drive passes to the minute hand shaft, a reduction of 3 : 1 being employed here in the form of the ½″ Pinion 65 and the Gear Wheel 28. The total reduction is thus 42 : 1, and the minute hand will consequently rotate at 1/42 of the speed of the winding drum.

The hour hand drive is composed of a 2 : 1 ratio between Pinion 30 and the Gear 29; a 1 : 1 ratio from Gear 62 to Gear 61, and a 2 : 1 ratio from the Pinion 63 to the Gear 64 on the shaft of which is mounted the Pinion 32 meshing with the 57-teeth Gear 34; the latter Gears giving a final drive of 3 : 1. The product of this compound gear train is exactly 12 : 1, so that the hour hand rotates at 1/12 of the speed of the minute hand, and at 1/504 the speed of the winding drum.

After the main gear train has been assembled, the gearing connecting the escapement with it may be secured in place.

The drive from the shaft 24 (Fig. 3) is taken to a ¾″ Pinion 16 mounted on a 3″ Axle, by means of the 50-teeth Gear 15 (Fig. 3). The Rod of Pinion 16 also carries a 50-teeth Gear Wheel 17, which meshes with a ¾″ Pinion 18 on a further 3″ Axle, that is journalled as shown. A 57-teeth Gear Wheel 22 is also mounted on this Axle (see Fig. 6), and this gears with a ½″ Pinion 19. The drive is finally transmitted to the pallet wheel shaft 23 (Fig. 6), by means of a further 57-teeth Wheel 20 (Fig. 3), meshing with a ½″ Pinion secured to the shaft 23.

The pallet and pallet wheel are illustrated in Figs. 4 and 6, the latter view showing the details of the construction of these parts very clearly.

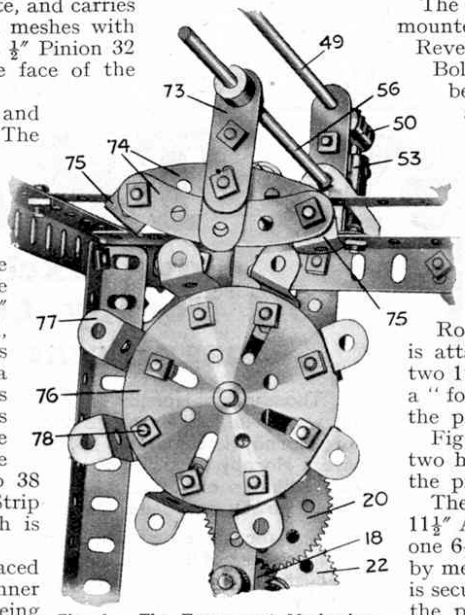

Fig. 4. The Escapement Mechanism.

The pallet wheel consists of a Face Plate 76 (Fig. 4) mounted on the Axle 23 (Fig. 6). The Plate carries eight Reversed Angle Brackets 77 secured to the Plate by Bolts placed in their slotted holes. Washers should be placed under the heads of these Bolts to ensure a firm grip.

The pallet itself is built up from two Cranks 73 secured back to back. A 1½″ Strip is secured to these, and also two Curved Strips 74. Angle Brackets 75 are also attached to the ends of the Strips 74. The complete pallet is mounted on a 6½″ Axle Rod 56 (Fig. 6), journalled in the supports 13; and is held in place at the front end by a Collar and at the rear by means of a Coupling. This Coupling carries a 6½″ Axle Rod 55, to the lower end of which a further Coupling 58 is attached, as shown. This Coupling in turn carries two 1″ Rods 59 placed in its lateral bores, thus forming a "fork" that enables connection to be made between the pallet and pendulum.

Fig. 5, shows the lower portion of the pendulum in two halves, and the weight, while the upper part, and the pivot and pivot support, may be seen in Fig. 6.

The complete pendulum rod is built up from three 11½″ Axle Rods (Fig. 5), one each for 78a, 78c, 78d and one 6½″ Rod 78b. These Rods are connected together by means of Couplings, and a Strip Coupling 54 (Fig. 6) is secured to the end of the Rod 78a. The lower end of the pendulum carries a weight composed of ten 1⅛″ Flanged Wheels, the position of the latter being adjusted when setting the clock in operation, to provide the correct movement of the crutch.

The pendulum swings about a Pendulum Connection 51 (Fig. 6) which is secured tightly in the slots of the Strip Coupling 54 and 53 by means of bolts. A 1″ Rod is secured in the vertical bore of the Strip Coupling 53. This Rod is also gripped in the end lateral bore of the Coupling 50 that is mounted on the 6½″ Rod 49, the Rod being held rigidly in the bosses of the Cranks 13.

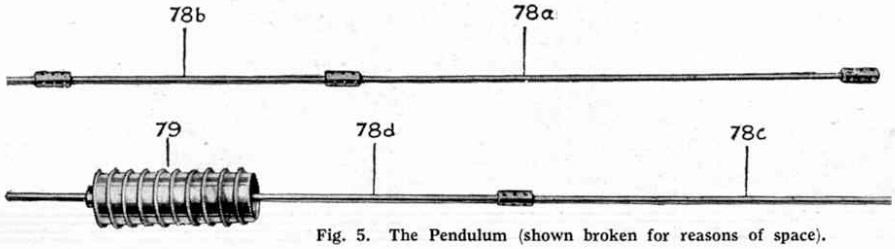

Fig. 5. The Pendulum (shown broken for reasons of space).

The ratchet winding gear and winding drum are seen incorporated in the mechanism frame in Fig. 6, while Fig. 7 shows the unit disassembled.

The drum, ratchet and gears are mounted upon a 6½″ Axle Rod 41. The drum consists of four Face Plates 68,

bolted together in pairs and securely locked to the shaft 41 by two set screws placed in each boss. Eight 3" Axle Rods 69 are then passed through the holes in the Plates and held in position by Collars. The loop in the end of the Wire Line 70 is passed over one of the Axles 69, and held in place against one of the Face Plates by means of an additional Collar.

The Ratchet Wheel 42 should next be secured rigidly to the Axle by means of two set-screws, and a 3½" Gear Wheel 43 slipped on to the Rod. As the Gear Wheel must rotate freely on the shaft 41 in one direction, its set-screw should be removed. This Wheel 43 carries two Pawls 46 secured to its face by Pivot Bolts. The Pawls are held in engagement with the teeth of the Ratchet 42 by means of short lengths of Spring Cord 67, one end of each length being secured under the head of an ordinary bolt fixed in one of the holes in the face of the Gear Wheel, and the other end passed through the hole in the Pawl and twisted back to form a strong loop. The length and tension of the springs should be adjusted so as to keep the Pawls in firm contact with the Ratchet, and thus prevent any possibility of slipping. The Gear 43, complete with Pawls and springs, is held in position against the boss of the Ratchet Wheel 42 by means of a Collar.

The complete winding drum axle is journalled in two 5½" Strips forming part of the frame (Fig. 6), and is prevented from moving lengthwise by means of two Collars 71 and 72, secured on each end. The position of the 3½" Gear Wheel carrying the Pawls of the ratchet mechanism must be adjusted so that it engages with the Pinion 14 (See Fig. 3). The second 3½" Gear 43 meshes with a ½" Pinion 44 (Fig. 6), mounted on a 4½" Rod journalled in the Double Bent Strip 12 (Fig. 2) and a 5½"×½" Double Angle Strip secured between the mechanism frame. This Rod carries also a Crank 45 (Fig. 6), fitted with a Threaded Pin, thus forming a convenient winding handle by which the Wire Line (part No. 141) may be wound round the winding barrel to raise the clock weight. The reduction gearing of 7 : 1 fitted between the winding handle and the drum shaft makes quite easy the operation of lifting the heavy Weight.

The Wire Line, after being secured to the winding drum, is passed round the groove of a 1½" Pulley mounted on a 1" Rod journalled in two Triangular Plates that form the weight pulley block. The Triangular Plates are held apart from each other by means of Double Brackets, and the weight itself is secured to the block by passing a 1" Axle through the holes in the Plate and also through a ring on the weight. Any form of weight may be used here, provided it is not less than 18 lb. and of such dimensions as not to foul the sides of the clockcase. A suitable shaped weight is shown in the general view.

The other end of the Wire Line, after passing round the 1½" Pulley, is secured to a Hook attached to the lower 5½"×1½" Double Angle Strip in the lower portion of the mechanism frame. (See Figs. 2 and 3).

It now remains to build the clock case, as shown in the General View (Fig. 1) of the completed model.

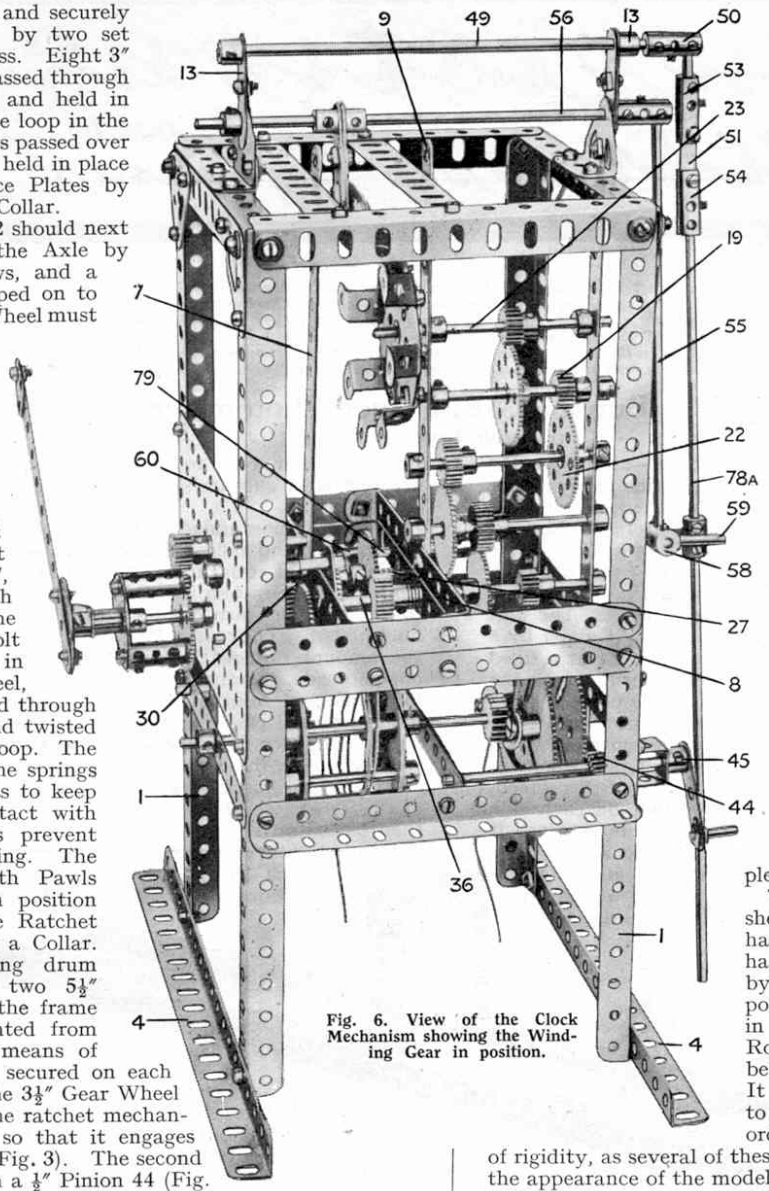

Fig. 6. View of the Clock Mechanism showing the Winding Gear in position.

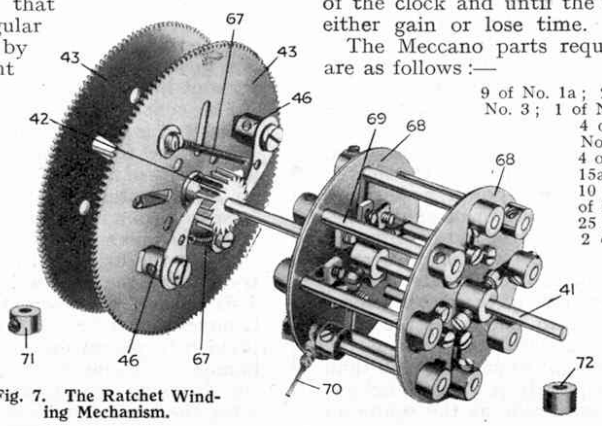

Fig. 7. The Ratchet Winding Mechanism.

The base of the case consists of two rectangular frames composed of 12½" and 9½" Angle Girders spaced apart by means of vertical 12½" Angle Girders; 12½" Braced Girders and extra Angle Girders also being secured as shown to give added strength and to improve the appearance of this portion of the case.

The main body of the case consists of four vertical compound 46" Angle Girders, each built up from two 24½" Angle Girders overlapped three holes and bolted together. The vertical members are secured together at top and bottom by 9½" and 12½" Angle Girders, and Braced Girders are affixed as shown to provide an artistic finish. The framework is securely bolted to the base of the case, and four 4½" Strips bolted in the positions indicated ensure rigidity.

The complete mechanism may next be secured rigidly in place by passing bolts through the end holes in the Angle Girders 4 (Fig. 2), and the 12½" Girders forming the upper portion of the case. The mechanism frame is enclosed in a casing that carries the dial. This casing consists of 12½" and 9½" Girders, and four vertical members each consisting of a 12½" and a 3" Girder, the latter being overlapped two holes. The frame surrounding the dial is composed of 12½" Braced Girders and Architraves bolted together in rectangular formation as shown in the view of the completed Clock.

The dial or clock-face consists of a sheet of white smooth-surface cardboard having a centre hole to admit the hand units. It is fastened in place by boring holes in the card to correspond with those in the Braced Girders in which the securing bolts are placed. Roman numerals or Arabic figures should be drawn on the card in Indian ink. It should be noted that it is not essential to employ all the Braced Girders in order to maintain the required degree of rigidity, as several of these parts are included simply to enhance the appearance of the model.

After the final assembly of the Clock parts, the mechanism may be wound up and the Clock set in motion.

Before setting the clock to work apply a little oil to all gears and shafts and bearings of the mechanism. For best results use Meccano Oil, which is specially prepared for use with Meccano models.

It will perhaps be found necessary to make several little adjustments before smooth operation of the different parts is secured. Special attention should be paid to the pendulum and probably experiments will have to be made in order to ascertain the exact position required for the weight 79, for any slight alteration to the position of this weight will make a great difference in the timing of the clock and until the right position is found the clock will either gain or lose time.

The Meccano parts required to build the Grandfather Clock are as follows :—

9 of No. 1a ; 2 of No. 1b ; 11 of No. 2 ; 4 of No. 2a ; 2 of No. 3 ; 1 of No. 4 ; 1 of No. 5 ; 2 of No. 6a ; 8 of No. 7 ; 4 of No. 7a ; 25 of No. 8 ; 12 of No. 8a ; 6 of No. 9 ; 1 of No. 9f ; 3 of No. 11 ; 6 of No. 12 ; 4 of No. 13 ; 4 of No. 14 ; 1 of No. 15 ; 1 of No. 15a ; 5 of No. 16 ; 1 of No. 16a ; 3 of No. 16b ; 10 of No. 17 ; 3 of No. 18a ; 2 of No. 18b ; 10 of No. 20 ; 1 of No. 21 ; 2 of No. 24 ; 5 of No. 25 ; 5 of No. 26 ; 5 of No. 27 ; 4 of No. 27a ; 2 of No. 27b ; 2 of No. 31 ; 422 of No. 37 ; 42 of No. 38 ; 2 of No. 45 ; 5 of No. 48d ; 2 of No. 52a ; 1 of No. 57 ; 39 of No. 59 ; 6 of No. 62 ; 11 of No. 63 ; 2 of No. 63b ; 1 of No. 64 ; 2 of No. 76 ; 2 of No. 77 ; 2 of No. 90 ; 38 of No. 99 ; 24 of No. 99a ; 1 of No. 99b ; 8 of No. 100 ; 1 of No. 103a ; 6 of No. 108 ; 3 of No. 109 ; 1 of No. 111a ; 3 of No. 111c ; 1 of No. 113 ; 1 of No. 120b ; 2 of No. 125 ; 1 of No. 126 ; 2 of No. 126a ; 1 of No. 128 ; 6 of No. 133 ; 1 of No. 141 ; 2 of No. 147 ; 1 of No. 148 ; 1 of No. 172 ; 1.18 lb. weight.