

GRANDDAUGHTER CLOCK

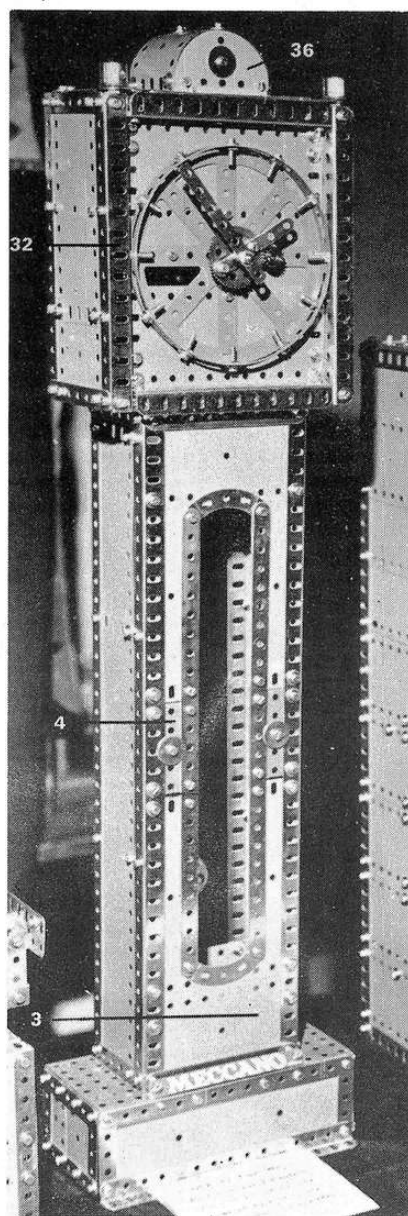
An advanced working timepiece designed and built by MMQ reader ROGER WALLIS

EVERYBODY HAS heard of a Grandfather Clock — in fact, we featured a superb example of one in the MMQ a couple of years ago — but what exactly is a *Granddaughter* Clock? Answer: a mini-sized Grandfather!

Take, for instance, this appealing model, designed and built by Roger Wallis of Solihull, West Midlands. At a glance, it *looks* like a Grandfather Clock, but if you were to put it alongside Bert Love's Clock, featured in the October 1973 magazine, you would instantly see the difference: Bert's model stands over 7ft high; this is a charming 2½ feet high! Small in comparison, it might be, though, but it is still an advanced and fully-operating timepiece, capable of running up to 24 hours on one winding. It is built from a No.9 Set, combined with a No.2 Clock Kit, plus four additional Fishplates, and it is driven by a Meccano No. 1 Clockwork Motor.

BASE AND TRUNK

Beginning construction with the base section of the clock case, this is a 7½" x 3½" x 2½" box assembly built up from three 3½" x 2½" Flanged Plates 1, forming the top, and with the front, back and sides provided by Flexible Plates edged by Strips and Girders. The front, built up from two overlapping 4½" x 2½" Flexible Plates (edged along the top by a 7½" Strip, along the bottom by a 7½" Angle Girder and along the sides by two 2½" Strips) is bolted direct to the flanges of Plates 1, as also is the back which is built up from a 5½" x 2½" and a 2½" x 2½" Flexible Plate, edged at top and bottom by 7½" Strips and at the sides by 2½" Strips. Each side, supplied by a 2½" x 2½" and a 2½" x 1½" Flexible Plate,



edged at the top by two overlapping 2½" Strips, at the bottom by a 3½" Strip and at the sides by 2½" Strips, is attached to Flanged Plates 1 by the black Angle Brackets in the Clock Kit.

Turning to the case trunk, front corner uprights for this are provided by two 18½" Angle Girders 2, with the rear uprights being 18½" compound angle girders, each built up from two overlapping 12½" Angle Girders. Each front upright is connected to the rear upright by two 3" Strips, one bolted between the lower ends of the Angle Girders and the other one hole from the upper ends. The sides are then each filled in by a 12½" x 2½" Strip Plate, extended by a 5½" x 2½" Flexible Plate, the resulting compound plate being bolted direct to the rear upright Angle Girder, but attached to the front Angle Girder by three Fishplates spaced at intervals along the plate.

Fixed between the two front Girders 2 are two 4½" Strips one bolted at the lower ends and the other bolted one hole from the upper ends, the securing Bolts in each case helping to hold a 4½" x 2½" Flexible Plate 3 in position. With the exception of a long "window" to later allow observation of the pendulum, the remaining space is then enclosed by a 4½" x 2½" Flat Plate, behind the lower Flexible Plate but projecting upwards two holes, and four 5½" x 2½" Flexible Plates arranged in two uprights pairs, the Plates in each pair separated centrally by a 2½" x 1½" Flanged Plate 4. The inner edges of the Plates — and thus the "window" — are edged by two 12½" Strips connected at top and bottom by a 2½" Stepped Curved Strip. A ¾" Washer is fixed to the centre of each Flanged Plate 4 to provide added decoration.

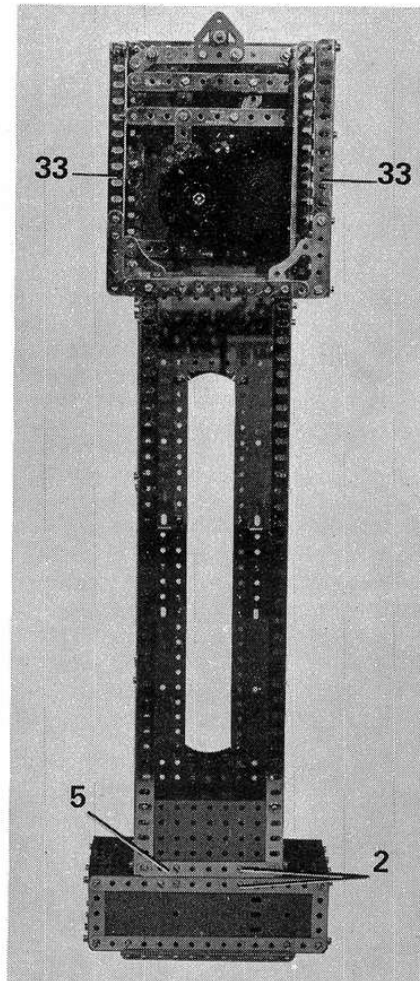
At the rear of the trunk, a $4\frac{1}{2}$ " x $2\frac{1}{2}$ " Flat Plate and a $4\frac{1}{2}$ " Strip 5 are bolted between the upright girders as shown, then the completed trunk is attached to the base by two Angle Brackets at the front and two Fishplates at the rear.

MECHANISM FRAMEWORK

Surmounting the trunk is the framework for the clock mechanism and care should be taken in building this to ensure that the whole thing is rigid and perfectly "square". The inner framework consists of two similar arrangements, each built up from two upright $7\frac{1}{2}$ " Angle Girders 6 connected together at their lower ends by a $5\frac{1}{2}$ " Strip 7, then the $7\frac{1}{2}$ " Strips in each arrangement are themselves connected together at their upper and lower ends by $2\frac{1}{2}$ " Strips 8. Note, however, that the Girders are spaced *only two inches apart*, the $2\frac{1}{2}$ " Strips projecting one hole forward in each case.

Bolted inside the rear pair of Girders 6, three holes from the top, is another $5\frac{1}{2}$ " Strip 9, this being spaced from the Girders by a Collar and two Washers on each securing $\frac{3}{4}$ " Bolt. A $4\frac{1}{2}$ " Strip 10, extended at each end by a Fishplate, angled downwards as shown, is attached by $\frac{3}{4}$ " Bolts through the second holes from the top of the Angle Girders, a Collar and three Washers on each Bolt acting as spacers in this case. Two upward-pointing Flat

Above, a general rear view of the partially-completed Granddaughter Clock. Note that one of the corner mechanism framework Girders has been removed in this view. Below left, a close-up view of the back of the clock mechanism and, below right, the completed clock face.

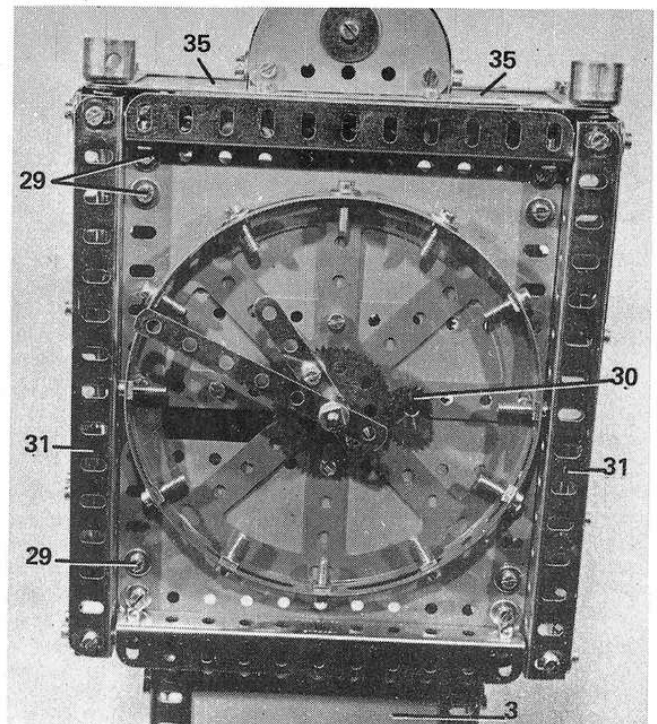
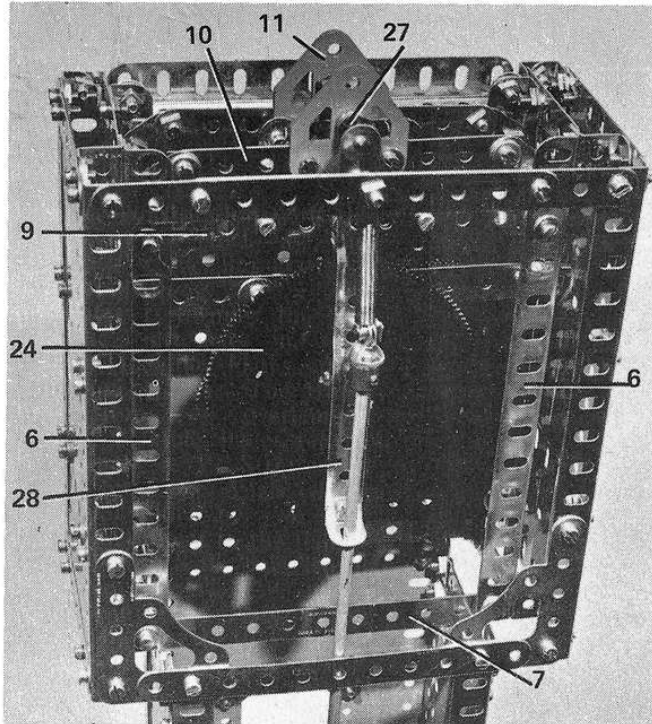


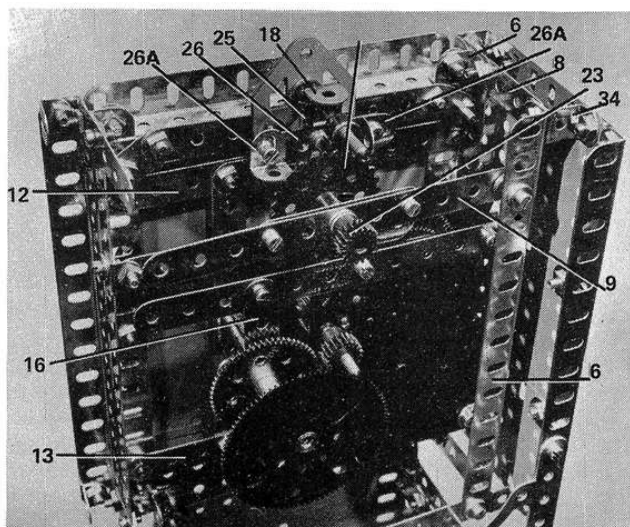
Trunnions 11 are centrally bolted, one to each side of the $4\frac{1}{2}$ " Strip, while a $2\frac{1}{2}$ " Strip is attached to the centre inside of $5\frac{1}{2}$ " Strip 9, being spaced from it by a Washer on the shank of each securing Bolt.

Similar $4\frac{1}{2}$ " and $5\frac{1}{2}$ " Strip arrangements are bolted between the front frame Angle Girders, with the difference that $\frac{3}{8}$ " Bolts are used to fix the $5\frac{1}{2}$ " Strip (numbered 12) and only three Washers are used on each Bolt for spacing purposes.

The clock is powered by a No.1 Clockwork Motor, but, before fixing the Motor in position, it is advisable to ensure that it is well, but not over-oiled, paying particular attention to the spring coils and ensuring that they do not bind as they unwind. The Motor, switched to normal running with key shaft to the front, is fixed to right-hand Angle Girders 6 by four Angle Brackets, secured through the fourth and eleventh holes from the bottom of the Angle Girders. The upper edges of the Motor side plates are overlayed by $5\frac{1}{2}$ " Strips, the protruding ends of which are connected to left-hand Girders 6 by Angle Brackets.

Next, a $5\frac{1}{2}$ " Strip 13 is fixed by $\frac{1}{8}$ " Bolts between front $7\frac{1}{2}$ " Girders 6, but is spaced from the inside of the Girders by three Washers on each securing Bolt. Bolted between this Strip and Strip 12, four holes from the left-hand side, is another, vertical,





In this close-up view of the Granddaughter Clock mechanism one of the framework corner Girders has been removed to allow the camera to see more of the internal arrangements. The pendulum and driving $3\frac{1}{2}$ " Gear Wheel have also been omitted for the same reason. Construction is not as difficult as it may seem.

$5\frac{1}{2}$ " Strip, through the fourth hole from the bottom of which two Fishplates 14 are fixed, one on each side of the Strip, using the Fishplates' slotted holes. The round holes in the Fishplates will later supply one bearing for a Rod, the other bearing for which is provided by the corresponding holes in two more Fishplates 15 fixed one each side of a vertical $3\frac{1}{2}$ " Strip 16 bolted to the upper horizontal $5\frac{1}{2}$ " Strip edging the Motor side plates and to a $1\frac{1}{2}$ " Strip fixed to the nearby Motor side plate.

CLOCK MECHANISM

At this stage the clock mechanism can be tackled, but, before building begins, it is essential that all of the Axle Rods are brought to a high polish by means of a proprietary metal polish. (In the prototype, "Duraglit" was used). Also, to ensure absolute minimum friction, where Washers are specified for spacing, the domed side of the Washer should rest against the bearing, and where more than one Washer is used, they should be placed back to back so that the domed sections bear against the gear and bearing.

The mechanism itself is not excessively complicated. The motor output shaft is removed and replaced by a 2" Axle Rod on which a $\frac{1}{2}$ " Pinion 16 is fixed. This Pinion meshes with a $2\frac{1}{2}$ " Gear Wheel 17 on a 2" Rod journaled in Fishplates 14 and 15, the Gear being spaced from the nearby Fishplates by three Washers. Also mounted on the Rod, between the Fishplates, is a $\frac{1}{2}$ " Pinion 18 which is loose on the Rod, but which is held in the jaws of a Small Fork Piece 19 fixed on the Rod. The Fork Piece must grip the Pinion firmly as this arrangement serves as the friction drive to the

hands. In mesh with the Pinion is a 57-teeth Gear Wheel 20 fixed, boss outwards, on the minute hand shaft — a 3" Rod journaled in the holes in the Motor side plates beneath the motor output shaft. The Gear is spaced from the Motor by two Washers. Fixed on the shaft, behind the motor, is a $\frac{7}{16}$ " 15-teeth Pinion spaced from the motor by one Washer. This Pinion meshes with a 60-teeth Gear Wheel 21 mounted, boss outwards, on a $2\frac{1}{2}$ " Rod 21A held by a Collar in the vertical $5\frac{1}{2}$ " and $3\frac{1}{2}$ " Strips 16. (The 60-teeth Gear hides the $\frac{7}{16}$ " Pinion from view in the illustrations).

The escapement wheel is a $1\frac{1}{2}$ " Sprocket Wheel 22 which is mounted on a 2" Rod journaled in the centre holes of Strips 9 and 12 and in the overlying $2\frac{1}{2}$ " Strips, where it is held in place by a $\frac{1}{2}$ " Pinion 23, with Washers being used as spacers. Double Grub Screws are used in the Sprocket Wheel to ensure that it runs as concentrically as possible. If a long-running, i.e. 24 hours, clock is required, the escapement wheel must be double checked for concentricity and freedom from binding. Care taken here will pay dividends when the finished clock is set in operation. In mesh with the Pinion is a $3\frac{1}{2}$ " Gear Wheel 24 fixed on the motor output shaft using Double Set Screws. Note that there is an absolute minimum clearance between the faces of this Gear and $2\frac{1}{2}$ " Gear 17.

The mechanism should now be tested by running the Clockwork Motor, while watching for tight bearings, accurate gear meshing, and ensuring the gears run true. Any rough running is now removed by polishing the shafts once again, adjusting bearings by loosening fixing Bolts and re-tightening, etc. As a guide to the setting up of the mechanism — on a

run-down motor, the prototype clock needed only one complete turn of the winding key to enable the escapement wheel to spin.

ESCAPEMENT

We come, now, to the escapement itself. A Slide Piece 25 is slipped over the long lug of a $1\frac{1}{2}$ " x $\frac{1}{2}$ " Angle Bracket, to the slotted hole of which a 5-hole 2" Strip 26 is bolted by its centre hole. The Strip pushes firmly against the Slide Piece to make one solid unit, then to each end of the Strip an Angle Bracket 26a is bolted, as shown, one of the Brackets being mounted vertically and the other horizontally. The complete assembly is then fixed by means of the Slide Piece boss on a short Rod which is journaled in the centre vertical holes of Trunnions 11, where it is held in place by a Collar.

Mounted on the rear protruding end of the escapement Rod is a Coupling 27, to which a $5\frac{1}{2}$ " Strip 28 is bolted. This Strip is carefully bent so that it clears the boss of the $3\frac{1}{2}$ " Gear 24, noting that the distance between the Gear and Strip should be equivalent to the thickness of a Washer. An Angle Bracket is bolted to the lower end of the Strip, after which the escapement should be set up and tested. Once again, this needs some patience, but care at this stage will result in long-running.

The Angle Brackets in the escapement are adjusted so that, as one is in the dwell of the teeth of the Sprocket Wheel, the other is just clearing a tooth. When the pendulum Strip 28 is swung over, the second Angle Bracket should now be in the dwell of a tooth, and the first just clearing the next tooth. The Motor can now be wound up and the escapement tried under power. The Angle Brackets are minutely adjusted, as necessary, until only a few turns of the motor key allow the pendulum Strip to swing under the control of the motor.

CLOCK HEAD

Coming next to the head of the clock the face consists of a $5\frac{1}{2}$ " x $1\frac{1}{2}$ ", a $2\frac{1}{2}$ " x $2\frac{1}{2}$ " and two $5\frac{1}{2}$ " x $2\frac{1}{2}$ " Plastic Plates, arranged as shown, and overlaid by a Hub Disc, the complete assembly being fixed to the front $7\frac{1}{2}$ " Angle Girders 6 of the mechanism frame using the long Bolts (29) holding the $4\frac{1}{2}$ " and $5\frac{1}{2}$ " Strips of the mechanism front. These Strips should be removed and refitted with the Plastic Plates in place and, with the mechanisms set up as previously described, it is a relatively simple operation to refit the Strips in their correct positions.

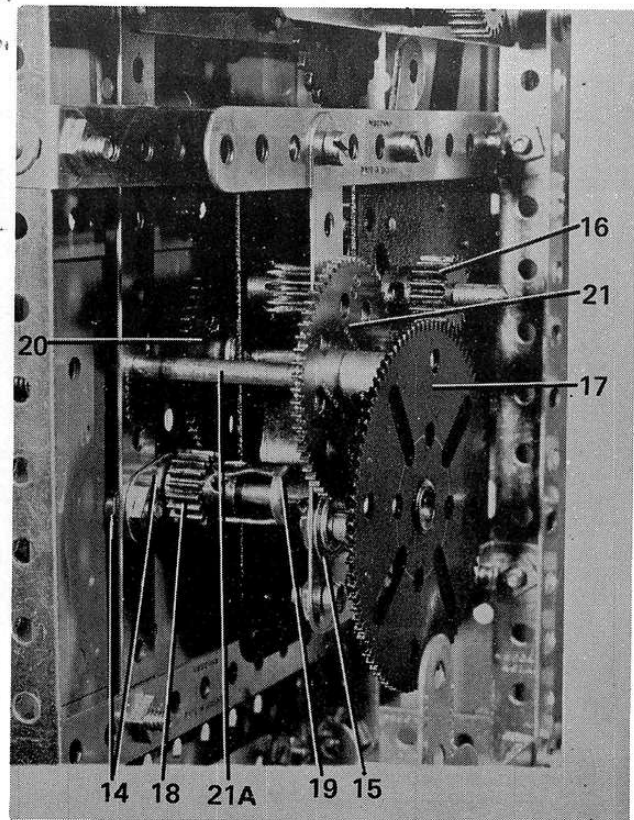
With the clock face fitted, Rod 21A should project through a hole in the face. Fixed on the end of this Rod is a $\frac{1}{2}$ " Pinion 30 which drives a 57-teeth Gear Wheel, loose on the minute hand shaft which also projects through the clock face. Bolted to the face of this Gear is a $2\frac{1}{2}$ " Narrow Strip, spaced from the Gear by two Washers, which serves as the hour hand. The minute hand is a $3\frac{1}{2}$ " Narrow Strip, mounted on a Rod Socket fixed on the end of the minute hand shaft. The clock digits are $\frac{1}{2}$ " Bolts held in the rim of the Hub Disc by Nuts. Their correct positions are found by placing the two hands at the twelve o'clock position and fixing the first Bolt. One revolution of the minute hand will show the hour hand pointing to the position where the next digit is to be placed, and so on round the full twelve-hour circle.

The sides of the face are completed by $7\frac{1}{2}$ " Angle Girders 31 which are bolted to the $2\frac{1}{2}$ " Strips projecting from the clock mechanism. The upper and lower sections of the face are framed by two $5\frac{1}{2}$ " Angle Girders fixed by Angle Brackets to the uprights of the mechanism.

Each side of the clock head is similar in construction, consisting of a $7\frac{1}{2}$ " x $2\frac{1}{2}$ " compound flexible plate (built up from one $5\frac{1}{2}$ " x $2\frac{1}{2}$ " and one $2\frac{1}{2}$ " x $2\frac{1}{2}$ " Flexible Plate), edged at top and bottom by $3\frac{1}{2}$ " Strips attached to the ends of nearby Angle Girders 31 by Angle Brackets. The Bolts fixing the $3\frac{1}{2}$ " Strips to the Angle Brackets also secure a vertical $7\frac{1}{2}$ " Strip 32 between the two $3\frac{1}{2}$ " Strips. The rear ends of the $3\frac{1}{2}$ " Strips are connected by a vertical $7\frac{1}{2}$ " Angle Girder 33, the compound plate being attached to this and the $7\frac{1}{2}$ " Strip by strategically-placed Fishplates. Two $\frac{1}{2}$ " Reversed Angle Brackets 34, bolted one through the second hole from the rear of each $3\frac{1}{2}$ " Strip, help to fix the head sides to the mechanism frame. At the rear of the clock, Angle Girders 33 at each side are connected, at the top, by two overlapping $5\frac{1}{2}$ " Strips and, at the bottom, by one $5\frac{1}{2}$ " Strip braced by Corner Gussets.

The top of the clock head is built up from two $6\frac{1}{2}$ " compound strips (provided by two overlapping $5\frac{1}{2}$ " Strips), connected together at each end by a $3\frac{1}{2}$ " Strip. A $2\frac{1}{2}$ " x $2\frac{1}{2}$ " Flexible Plate 35 is bolted to each $3\frac{1}{2}$ " Strip, a $2\frac{1}{2}$ " x $\frac{1}{2}$ " Double Angle Strip being bolted to the top of the inner edge of this Flexible Plate. Bolted on to the lugs of the Double Angle Strips are two Semi-circular Plates 36, then the top is completed by two $2\frac{1}{2}$ " x $2\frac{1}{2}$ " Curved Plates

Another close-up view of the clock mechanism as seen more from the side, with the $3\frac{1}{2}$ " Gear and nearside corner Angle Girder still removed to allow a clearer view. Note Pinion 18 held in the arms of Small Fork Piece 19, this arrangement serving as a friction clutch to permit the hands of the clock to be turned without damaging the mechanism. Note also that Fishplates 14 and 15 must be set absolutely accurately to ensure that the dependent gears mesh correctly.



attached to the Double Angle Strips by Angle Brackets and arranged to follow the contours of the Semi-circular Plates. Decoration is provided by a $\frac{3}{4}$ " Washer bolted to the centre of the front Semi-circular Plate, and by two Chimney Adaptors, one at each front corner, as shown.

It now only remains to complete the pendulum, which consists of a 9" Pendulum Rod from the Clock Kit, a $3\frac{1}{2}$ " Axle Rod and an Adaptor for Screwed Rod, all joined together by Rod Connectors. The pendulum is extended downwards by a 6" Screwed Rod held in the Adaptor and mounted on the Screwed Rod is the bob weight. This is built up from six Wheel Discs fixed by $\frac{3}{4}$ " Bolts to a Bush Wheel, the Threaded Rod being screwed through the tapped bores in the boss of this Bush Wheel.

The completed pendulum is inserted through the Angle Bracket attached to the previously-mentioned $5\frac{1}{2}$ " pendulum Strip 28, and an End Bearing 37 is fixed on the upper end of the pendulum rod. Finally, a Tension Spring is attached to the End Bearing, the other end of the Spring being fixed by a $\frac{1}{2}$ " Bolt to the centre of the compound $6\frac{1}{2}$ " strip at the rear of the clock head.

The completed clock can now be tested by winding the Motor and setting the pendulum swinging, after

ensuring that the clock is standing firm and upright by adjusting the $5\frac{1}{2}$ " Angle Girder at the rear of the base. If the setting-up procedure described previously has been carefully followed, the tick of the escapement should be found to be regular and even. Any discrepancy should be removed by slightly adjusting the relationship between the pendulum and the escapement. A careful study of the escapement Angle Brackets in motion, particularly as the Motor runs down, should detect any minor adjustments that may be needed.

PARTS REQUIRED

2-1	1-16b	2-51	1-166
5-1b	4-17	3-53	1-173a
17-2	1-24	2-53a	1-179
5-2a	6-24a	8-59	2-188
9-3	4-26	1-63	4-189
4-4	1-26c	1-79a	7-190
18-5	2-27a	2-90a	4-191
1-6	1-27b	1-95a	5-192
1-6a	1-27c	2-108	1-194a
2-7a	1-27d	8-111	1-194d
4-8	243-37b	14-111a	2-194e
9-8b	275-37a/c	6-111c	2-197
3-9	134-38	1-116a	2-200
26-10	4-38d	1-118	2-213
30-12	1-43	4-125	2-214
1-12b	2-48a	4-126a	1-235
1-16	1-50	2-164	1-235b
1-16a			1-252

1 No.1 Clockwork Motor.