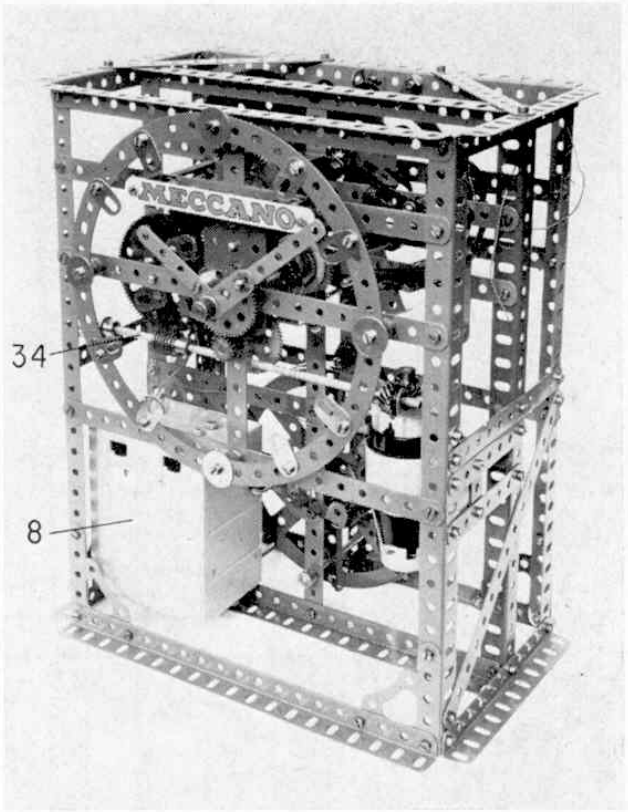
A Self-Winding Balance Wheel Clock

entirely in Meccano

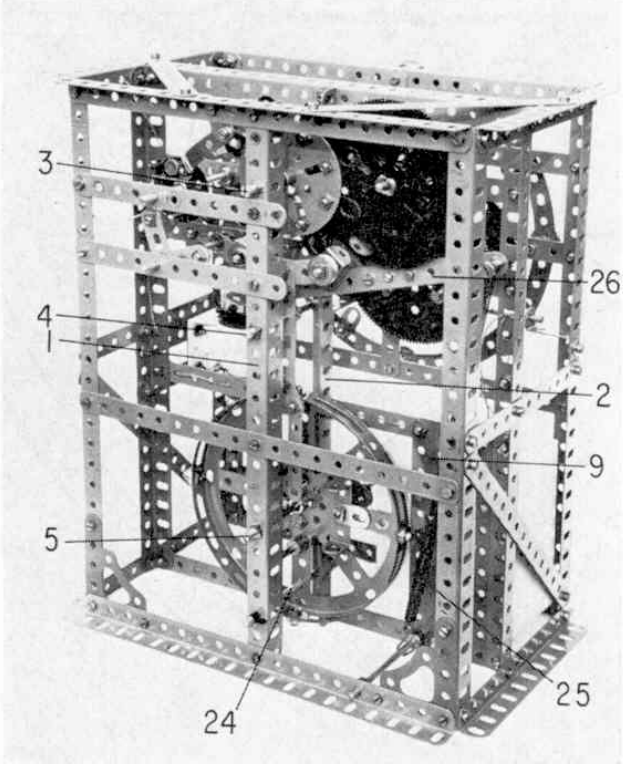
By Ron Fail, introduced by 'Spanner'

EXAMPLES of clock building in Meccano over the past five years have shown staggering advancement under the clever hands of such veteran time-piece constructors as Pat Briggs, Leslie Dougal and Ron Fail. Once again I am very pleased to be able to present a fine example of Ron's work in which he pulls off another " First " in Meccano Magazine by creating, probably for the first time, a clock with the hairspring movement of a pocket watch entirely in standard Meccano parts! As Ron says, his clock will work in any position being entirely independent of gravity so it will even work out in space. With the aid of Bert Love's photographs the clock is not difficult to build and is, of course, a complete timepiece.



Main Frame

A rectangular framework as shown in Figs. 1 and 2 is built up from 5½ in., 9½ in., and 12½ in. Perforated Strips and Angle Girders. The general construction is clear from the photographs. The Escapement is mounted between the 12½ in. Angle Girders 1 and 2 by means of Electrical Pivot Bolts 3, 4 and 5 on the rear Girder 1 and a corresponding set of Pivot Bolts on the inner Girder 2. The top Pivot Bolt is covered by the Double Bent Strip 7, see Fig. 3, and forms the rear journal for Axle Rod 56. The second Pivot Bolt on the inside Girder is also in line with shaft 61 carried in a 1 in. Reversed Angle Bracket mounted immediately below the Pivot Bolt. Fig. 4, which shows the hairspring arrangement, also shows the bottom Pivot Bolt in the centre hole of the Flat Trunnion 6. Battery Box 8 is bolted to the 5½ in. × 2½ in. Flat Plate 9.



Escapement

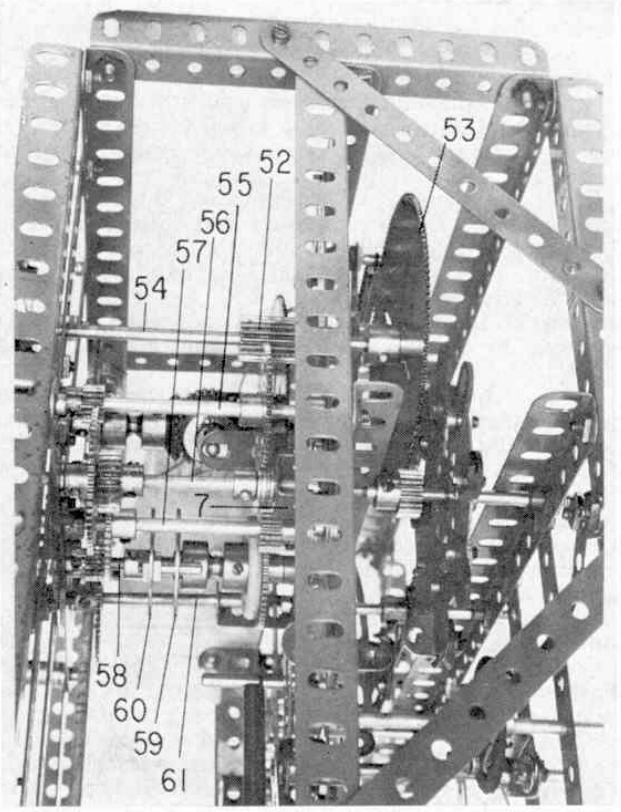
A rear view of the complete escapement, removed from the clock, is shown in Fig. 5. The escapement wheel consists of a Faceplate 10 fitted with eight Fishplates. (Electrical Insulating Fishplates can be used to give quieter running). The Faceplate is secured to a 2 in. Pivot Rod together with a ½ in. Pinion in front.

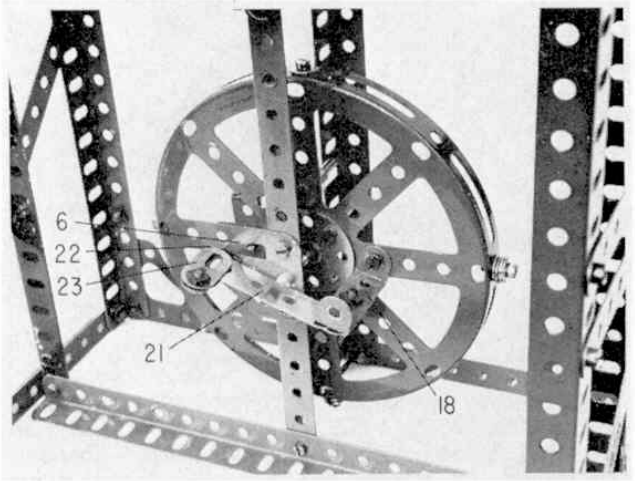
The lever is built up from a 3 in. Strip 11, with a 2½ in. Curved Strip 12 at the top and a 1 in. Triangular Plate 13 at the bottom. Two 2½ in. Narrow Strips are bolted to the Triangular Plate, leaving a slot between the Strips in which fits an Adaptor for Screwed Rod 16 on the balance wheel. The pallets consist of ½ × ½ in. Angle Brackets 14 bolted through their elongated holes to the Curved Strip. The bolts also hold ½ in. metal Pulleys 15 which serve to balance the lever, the completed lever being mounted on a 2 in. Pivot Rod by means of a Double Arm Crank.

The balance wheel is a Hub Disc also mounted on a 2 in. Pivot Rod by means of a Bush Wheel. Adaptors

Above, Fig. 1. A general frontal view of the Author's Self-Winding Balance Wheel Clock. When correctly adjusted, it will operate successfully in any position.

Left, Fig. 2. Assembly of the main framework of the model is evident from this rear view of the Clock. Note the positions of the balance wheel escapement.





Left, Fig. 3. A top view of the model showing the main gearing arrangement.

Above, Fig. 4. A close-up view of the balance wheel showing the hairspring arrangement. Note the Washers stacked on the balance wheel for timing regulation.

for Screwed Rod 16 and 17 are bolted to the Hub Disc, the upper one engaging in the slot in the lever, and the lower one acting as a balance weight. A $1\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip 18 is bolted to the front of the Hub Disc and again is balanced by attaching a second Double Angle Strip 19 and Fishplate 20 to the back of the Hub Disc. Balancing and timing weights, each consisting of a $\frac{3}{8}$ in. Bolt and three Washers, are attached to the top, bottom and each side of the balance wheel.

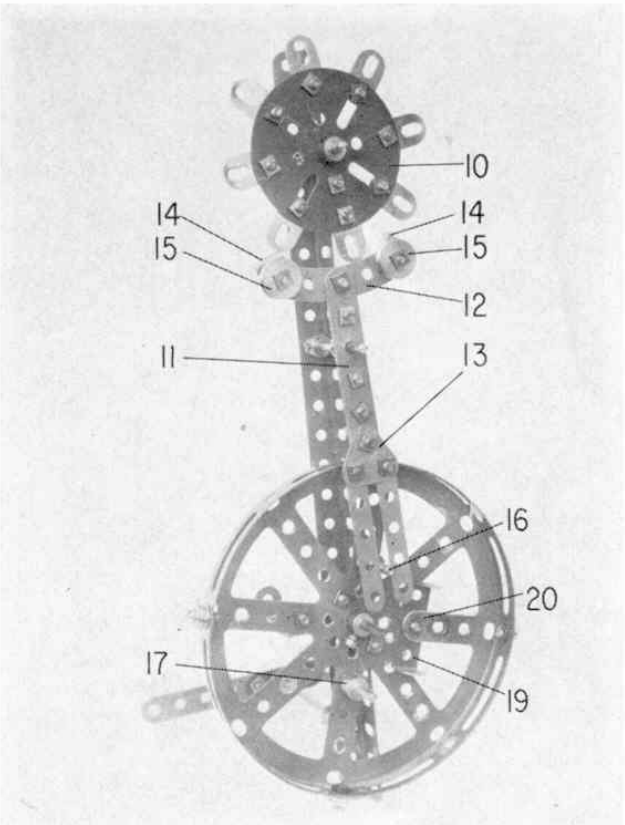
Perhaps the most important part of the Clock is the hairspring which consists simply of a 2 in. Electrical Flexible Strip 21. A $1 \times \frac{1}{2}$ in. Angle Bracket 22 is bolted to Flat Trunnion 6 and one end of the Flexible Strip is clamped to it by means of Fishplate 23. The other end of the Flexible Strip is similarly clamped to Double Angle Strip 18. The various parts should be adjusted so that the Flexible Strip is straight and symmetrical, passing through the axis of the balance wheel and just clear of the head of the Pivot Bolt. While fitting the hairspring and, later, when adjusting the balance weights, the balance wheel should be locked by passing a Rod 24 through it and through Girders 1 and 2.

Winding Gear

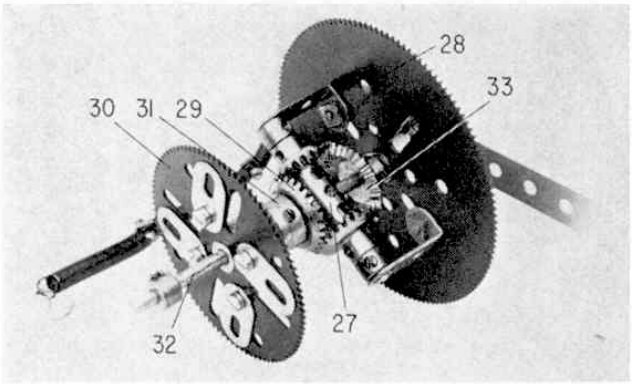
The clock is driven by three Tension Springs 25 bolted together in series and attached to lever 26 by a Pivot Bolt. This spring is automatically re-tensioned at frequent intervals.

Maintaining the drive to the clock during the re-tensioning is done through the differential mechanism shown in Fig. 6. The carrier consists of Coupling 27 with two $\frac{7}{8}$ in. Bevel Gears free to rotate on 1 in. Rods fixed in the longitudinal bore of the Coupling, and located by Collars. The carrier is connected to $3\frac{1}{2}$ in. Gear 28 by $1 \times \frac{1}{2}$ in. Angle Brackets. Bevel Gear 29 is connected to $2\frac{1}{2}$ in. Gear 30 by Socket Coupling 31 and this unit, as well as the complete carrier (including Gear 28), is free to rotate on 4 in. Rod 32. Bevel Gear 33 is fixed to this Rod.

Lever 26 is built up from a $3\frac{1}{2}$ in. Strip, a $5\frac{1}{2}$ in. Strip and a Double Arm Crank overlapped so that seven holes project in one direction and five in the other. The lever is fixed to Rod 32 and the spring attached to the short end. The long end operates the switchgear.



Right, Fig. 5. The full escapement mechanism as it appears removed from the model.



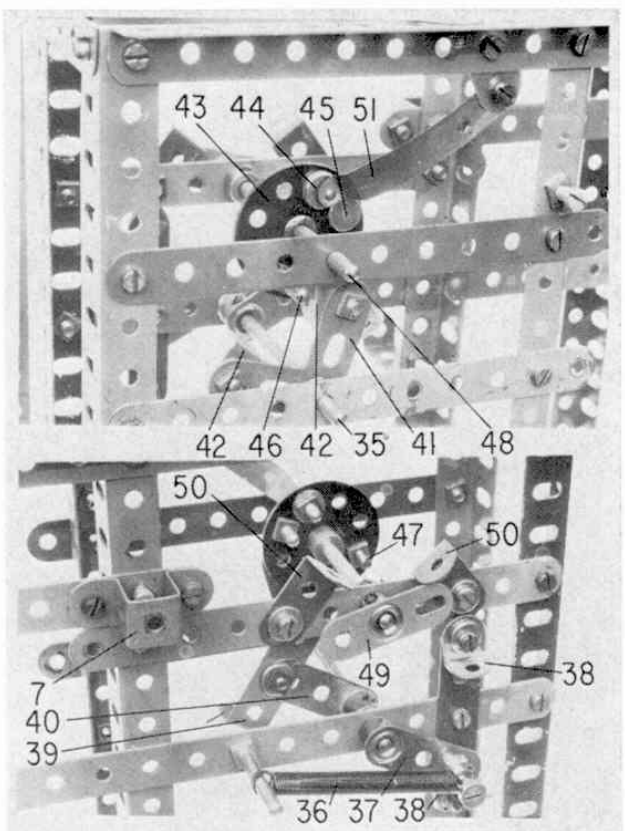
Left, Fig. 6. The differential winding gear, shown here removed from the model.

The winding mechanism is driven by a Motor with 6-speed Gearbox via a pair of ½ in. Helical Gears, an 8 in. Rod 34 and a Worm engaging with Gear 31. Rod 34 is journalled in a pair of 1 in. Reversed Angle Brackets bolted to the main frame. The Fishplates bolted to Gear 31 are intended to reduce noise due to " ringing " of the Gear.

The lower end of the main spring is hooked on to a 3½ in. Rod in the base girders of the main frame. The spring is not vertical, its inclination helping to keep the driving torque constant.

Switch Gear

The first part of this mechanism is assembled on 3½ in. Rod 35, as shown in Figs. 7 and 8. One end of Tension Spring 36 is attached to Crank 37 by a Pivot Bolt and the other end to a Long Threaded Pin on the main frame. A 2½ in. Strip is bolted to the main frame and carries a pair of ½ × ½ in. Angle Brackets 38 which limit the movement of the Crank. A 1½ × ½ in. Double Angle Strip 39 is bolted to a second Crank 40, also fixed on Rod 35. The switchgear is operated by a lever 26 pushing alternately against the ends of the Double Angle Strip. Finally, a Bell Crank 41, with a ½ × ½ in. Angle Bracket 42 on each arm, is fixed to Rod 35.



The switch consists of an Insulating Bush Wheel 43 fitted with two Contact Studs 44 and 45 and, opposite these, a Threaded Pin 46 and (for balance) a ⅜ in. Bolt 47. This unit is fixed on 3½ in. Rod 48 together with a Double Arm Crank 49. 1 × ½ in. Angle Brackets 50 limit the movement of the switch, which is operated by Angle Brackets 42 pushing Threaded Pin 46.

A 2 in. radius Wiper Arm 51 is fitted to the main frame by a Fishplate and is adjusted so that it slides from one Contact Stud to the other as the switch operates. The Wiper Arm must be in electrical contact with the main frame.

One of the Motor leads is connected directly to the Battery Box, the other to Contact Stud 45. The remaining Battery Box terminal is connected to the main Frame.

Main Gear Train

Collars are required to locate some of the Rods and Washers used to ensure proper meshing of the Gears and these are generally not mentioned in the following description. A ½ × ¾ in. Pinion 52 and a 3½ in. Gear 53 are fixed on Rod 54. The 3½ in. Gear meshes with a ½ in. Pinion on the escapement wheel Pivot Rod. The ½ in. Pinion 52 meshes with the differential carrier Gear 28 and also with a 57-teeth Gear on a 3½ in. Rod 55, this Rod also carrying a 7/16 in. Pinion which drives a 60-teeth Gear on a 3 in. Rod 56. Also fixed on this Rod is a ¾ in. Pinion which meshes with a 50-teeth Gear on a 3½ in. Rod 57, this latter Rod also carrying a ½ in. Pinion which drives a 57-teeth Gear, free to rotate on the minute hand 4½ in. Rod 58, located by a Collar fixed behind it.

A friction clutch, enabling the hands to be set, is arranged as follows. A Bush Wheel 59 is connected to a 1 in. Pulley with Rubber Ring by a Socket Coupling. Bush Wheel 60 is fitted with a pair of threaded Pins and fixed to Rod 58. A Compression Spring between the two Bush Wheels presses the Rubber Ring against the 57-teeth Gear. A 7/16 in. Pinion is fixed to Rod 58 in front of Bush Wheel 60 and drives a 60-teeth Gear on 3 in. Rod 61. The minute hand is a 3½ in. Narrow Strip bolted to a Crank fixed on the front of Rod 58. The hour hand is a 2½ in. Narrow Strip bolted to a 57-teeth Gear which is free to rotate on Rod 58. Washers are used to space the hands and the 57-teeth Gear carrying the hour hand is driven by a ½ in. Pinion on the front end of Rod 61. The clock dial is a 7½ in. Circular Strip, embellished with ¾ in. Washers and Fishplates, and attached to the main frame by four Threaded Bosses spaced with Washers.

Adjusting the Timekeeping

Since it is impossible to make small precise changes to the hairspring, the Clock is regulated by altering the number and position of Washers bolted to the rim of the balance wheel. This is the usual practice for precision watches and clocks. The four sets of three Washers already mentioned in the description of the

Left top, Fig. 7. A close-up view of the switch gear as seen from the back of the Clock. Bottom, Fig. 8. Another view of the switch gear as seen from the front.

escapement should provide a reasonable starting point. Removing Washers will cause the clock to run faster while the addition of Washers will slow it down. If necessary, Electrical Thin Washers will provide a fine adjustment.

It is also desirable to retain good timekeeping regardless of the position of the Clock, and this can be achieved as follows. Suppose the Clock is found to run faster when upside down than when it is right-way up. This will be corrected by transferring one or more washers from the top of the balance wheel to the bottom. Similarly if it runs faster when lying on its left side than on its right side, washers should be transferred from the left side of the balance wheel to the right.

When correctly built and adjusted, the Clock will keep very good time—in any position!

PARTS REQUIRED

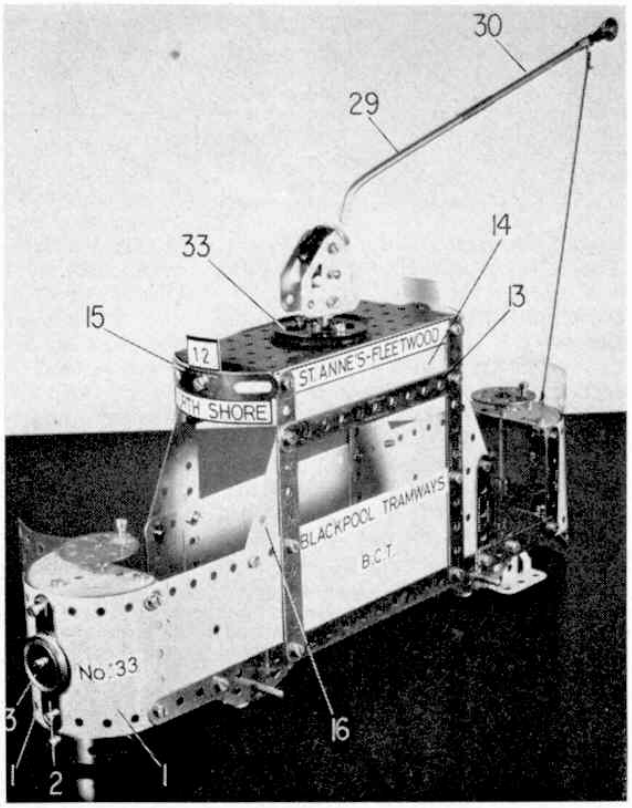
5—1a	1—22	3—48	1—126a
3—1b	2—23b	1—57d	1—128
7—2	3—24	12—59	1—145
3—3	1—25	3—62	2—147b
1—4	3—26	3—62b	1—155
1—5	1—26b	1—63	2—171
2—6a	2—26c	4—64	2—173a
8—8	1—27	1—70	2—211a
6—8a	3—27a	1—73	3—235
4—9	2—27b	1—77	1—235b
24—10	1—27c	1—90	1—514
6—12	2—27d	4—108	1—530
4—12b	4—30	1—109	1—533
1—13a	1—32	16—111c	2—544
2—15a	133—37	2—115	6—545
1—15b	60—38	1—115a	3—549
5—16	4—38d	1—118	1—Motor with 6 speed Gearbox
2—16b	4—43	1—120b	
2—18b	1—45	3—124	1—Battery Box

. . . and for owners of a No. 4 set, Bert Love describes a

SEASIDE TRAM

M.M. readers will have had a chance to admire the excellent Bondi Tram built by Colin Campbell which was published in the April Magazine. Such a tram, however, may be beyond the scope of many younger readers, but those younger readers may take heart in seeing that a perfectly satisfactory and realistic tramcar can be built from one of the smaller standard Meccano Sets. The Seaside Tram featured here is built with the No. 4 Set only, and yet it captures much of the atmosphere of its subject. Construction is quite straightforward and aims at utilising nearly all the parts in the Set, with the utmost economy in employing each Nut and Bolt to the full extent.

The only features which require careful modelling are the round ends to the driver's compartments and these should be tackled first. One end is made from a pair of $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 1 secured together by overlaying their slotted holes in the middle with a $2\frac{1}{2}$ in. Strip 2. The centre Bolt is $\frac{3}{8}$ in. and carries a $\frac{3}{4}$ in. Washer and a 1 in. loose Pulley 3, forming the headlamp. The upper Bolt is also $\frac{3}{8}$ in., but carries a lock-nut to allow the Bolt shank to protrude outside the tram body so that the loop of the trolley arm cord can be secured to it. The upper Bolt traps a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Transparent Plastic Plate in place to serve as the windscreen and also carries an Angle Bracket inside, to which a $2\frac{1}{2}$ in. Semi-circular Plate 4 is later attached.



Meccano Set No. 4 contains all the parts needed to build this delightful model of a Seaside Tram, designed and built by B. N. Love.

At this stage the curved form of the tram ends may be carefully shaped by bending the flat Flexible Plates gently but firmly, using a springing action of the hands rather than any attempt to make a sharp bend in one go. Such latter action will produce creases, or ugly bends instead of a smooth curve. The second tram end is fashioned in a similar manner, but the owner of the No. 4 Set will be obliged to use Part Nos. 199 and 200. Both of these are $2\frac{1}{2}$ in. square Flexible Plates, but the 199 has a sharp-radius bend, which must be eased out, while the No. 200 has a gentle bend which is not far off that required in the final form. When the two ends have been satisfactorily shaped, the side portions of the tram body may be assembled to them. The rounded ends of the tram will assume their final shape when tightly bolted up to the side frames.

Side Frames

Both side frames of the model are similarly built up from a $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plate 5, bolted to the left-hand side Plate 1 in one of the curved end assemblies, the two Plates being overlapped two holes. The upper securing Bolt also holds an Angle Bracket in place, this Bracket later being attached to Semi-circular Plate 4, while the lower securing Bolt holds a $12\frac{1}{2}$ in. Strip 6 outside the Plates and another