Electricity Applied to Meccano

VIII—Electric Bell; Relay; Lamp Standard; Ammeter

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil-winding machine, a Meccano electric telegraph system, electro-magnets, a galvanometer, motors, an electric locomotive, and other simple apparatus. Below we deal with a Meccano bell and other instruments that can be put to practical use. All these models are constructed from a few ordinary Meccano parts used in conjunction with the special electric accessories.

OF all electrical instruments the electric bell must be one of the most familiar to Meccano boys. The majority of houses to-day are fitted with a complete system of electric bells, which for reliability, simplicity of working, and convenience, far surpass the antiquated wire-actuated bells. Their simplicity and cheapness of operation is remarkable, especially when one takes into consideration the many valuable services that they perform.

We feel sure that all "*M.M.*" readers will desire to make the practical Meccano electric bell that is illustrated in Fig. 1. When completed it may be installed in the house and used for many different purposes. It is a very useful model.

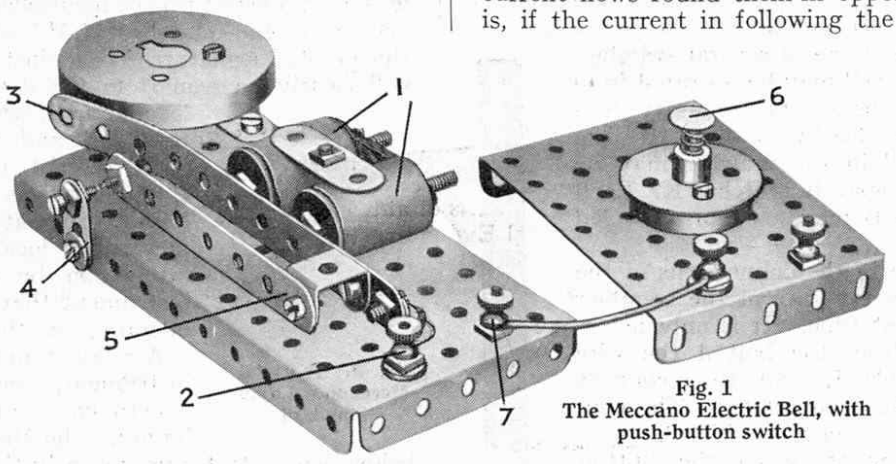


Fig. 1
The Meccano Electric Bell, with push-button switch

Meccano Electric Bell

The construction of the model should be commenced by winding to capacity the two Bobbins of the magnet with 26 S.W.G. insulated wire. Each of the completed Bobbins 1 is mounted on a Pole Piece that is bolted to two $1\frac{1}{2}$" Strips, which are placed one upon the other to form a yoke or connecting piece. This magnet is identical to that described in the article in this series which appeared in the March "*M.M.*" The coils are covered with brown paper, which enhances their appearance and protects the insulation of the wire, and are clamped in position on the $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate by means of a 1" Threaded Rod secured to the Plate by two nuts. The upper end of this Threaded Rod passes through a $1\frac{1}{2}$" Strip and a third nut placed on the Rod clamps the Strip firmly down upon the coils.

A wire from one of the coils is attached to a 6 B.A. Bolt that is insulated from the base Plate by an Insulating Bush and Washer and carries the terminal 2. The second wire from the same coil is secured to one wire of the other coil, and the remaining wire of the latter is attached to the 6 B.A. Bolt 4. This bolt is insulated from the base Plate in the usual manner and carries a Flat Bracket, in the upper hole of which is secured a Meccano Silver-tipped Contact Screw. A second Contact Screw is bolted to a $3\frac{1}{2}$" Strip 5 that, in turn, is attached by means of a Double Bracket to a $5\frac{1}{2}$" Strip 3.

The coils 1 should be connected together so that the current flows round them in opposite directions. That is, if the current in following the turns of wire passes round one coil in a clockwise direction, the ends of the wires should be so connected that the current passes round the second coil in an anti-clockwise direction. This method of connecting the coils gives a north polarity to one end of one coil and a south polarity to the corresponding end of the second coil, and adds to the efficiency of the model.

The $5\frac{1}{2}$" Strip 3 serves as a combined armature and hammer, and is attached rigidly at one end to the Flanged Plate by a $\frac{1}{2}" \times \frac{1}{2}"$ Angle Bracket in such a manner that it is in close proximity to the pole faces of the magnet 1.

The gong consists of a Wheel Flange secured to a $\frac{1}{2}$" Reversed Angle Bracket, which, in turn, is bolted to the $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate. The Wheel Flange is quite effective, but if it can be substituted by an actual bell much better results will be obtained, of course.

The push button switch needs no comment, since it was described fully in the third article of this series (see "*M.M.*" for January, 1928). The terminal 7, which is in direct metallic contact with the base Plate of the bell, is connected to one terminal of the switch, and the second terminal of the switch is connected to the accumulator or battery. The second wire from the accumulator is attached to the terminal 2 of the bell.

When the button 6 of the switch is depressed the circuit is completed and the current flows through the switch and through the frame of the bell to the Silver-tipped Contact Screw mounted on the Flat Bracket 4. From there it passes through the coils and back to the accumulator via the terminal 2. The current flowing through the coils 1 causes

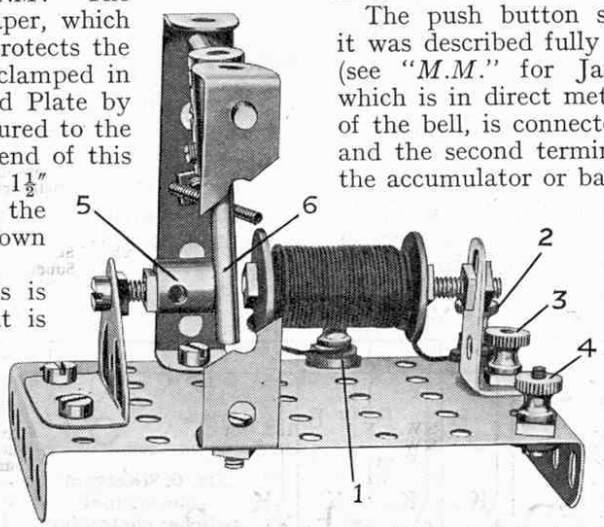


Fig. 2. The Meccano Relay. (Part of the Strip in the foreground has been cut away to disclose the inner details)

the Pole Pieces to attract the armature 3, and the end of the latter strikes the bell. As soon as the armature is attracted in this way, however, the Contact Screws are drawn apart and the circuit is broken. Consequently the coils are de-energised and the armature 3 flies back to its former position. But in doing so it brings the Contact Screws together once more and closes the gap in the circuit, and the cycle of operations is then repeated. The movements of the armature are very rapid, and produce a continuous ringing of the bell for so long as the push 6 is depressed. This type of bell is known as a "trembler," since the armature trembles, or vibrates.

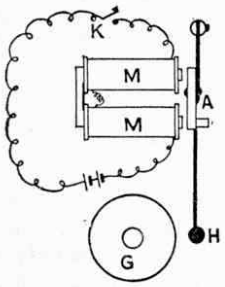


Fig. 3. Diagram of connections for single-beat bell

Control by Several Switches

It is quite a simple matter to arrange the connections so that the bell may be rung by closing any one of several switches. In this way the same bell may be operated from various parts of a house. The necessary connections are shown clearly in Fig. 5. The electric bell indicated in the drawing may be controlled from four separate switches K. Each pair of branch wires B may, of course, be led into different rooms.

A simple alteration in the connections of the Meccano bell will convert it from the trembler type to the single-beat type. It is only necessary to disconnect from the bolt 4 the wire attached to the coils 1, and to reconnect the wire direct to the accumulator. The connections will then be as shown in Fig. 3.

With this arrangement, when the button (K in Fig. 3) is pressed the current passes directly to the magnet M, which attracts the armature A. The end H of the latter produces a single beat on the bell G, for the magnet will hold the armature against the ends of the Pole Pieces as long as the button K is pressed. To sound the bell a second time the button must first be released and then pressed down again.

It will be obvious that the number of strokes or beats given by the bell is absolutely under the control of the operator. For this reason the single-stroke bell is of considerable value for signalling purposes. It is used exclusively on British railways in communicating from one signal box to another.

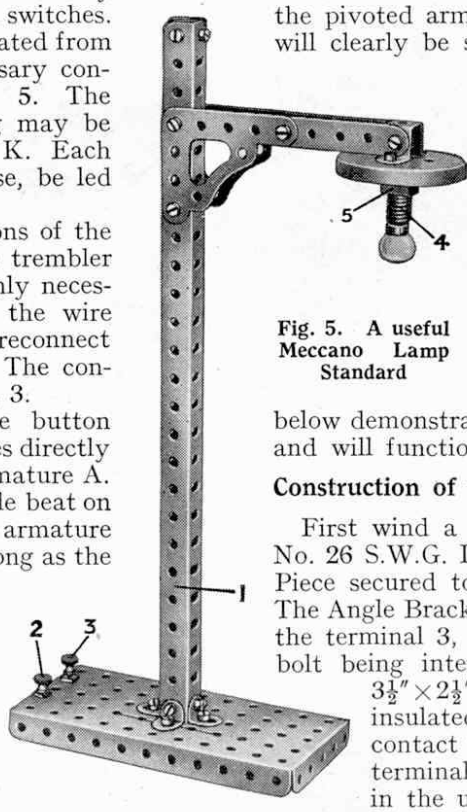


Fig. 5. A useful Meccano Lamp Standard

Functions of a Relay

If a current flows through a long length of wire in order to work an instrument—such as a telegraph sounder—situated at a distance from the operating point, it becomes comparatively weak because of the resistance in the wire through which it passes. Hence, if an ordinary circuit is used, the battery power will have to be increased in accordance with the distance through which the current is required to flow. There is a better method of getting over this difficulty, however. It is to employ two small batteries in conjunction with a relay, in place of one very large battery. The function of the relay is to bring into action, on receipt of the weak current flowing through the "line wire" from the battery at the sending station, the secondary, or local, battery that operates the sounder or other instrument. The necessary connections for an arrangement of this kind are shown diagramatically in Fig. 4.

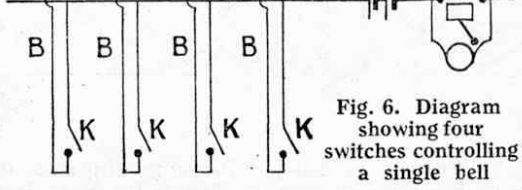


Fig. 6. Diagram showing four switches controlling a single bell

The relay consists essentially of a magnet (M in the drawing), having a large number of turns of wire, and a pivoted armature AP. The switch K is situated at the operating end, and when it is closed it causes current to flow round the magnet. The magnetic effect of the incoming current is thereby enhanced—in accordance with the ampere-turn law mentioned in the "Electricity" article in the March *"M.M."*—sufficiently to move the pivoted armature AP against the contact CP. As will clearly be seen from the diagram, this closes the local circuit, which contains the battery BB and the instrument that it is desired to work. Therefore the relay has enabled the weak "line" current to control the more powerful "local" current, and the latter can be used to operate an instrument that could not have been operated by the weak line current.

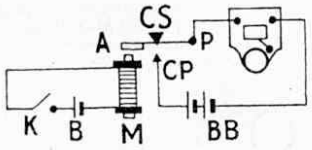


Fig. 4. Diagram showing connections for operation of Bell by Relay

A relay is an extremely interesting instrument, and many instructive experiments can be carried out with its aid. The Meccano relay described below demonstrates very clearly the principles involved, and will function well on an extremely small current.

Construction of the Meccano Relay

First wind a Meccano Bobbin to full capacity with No. 26 S.W.G. Insulated Wire, and mount it on a Pole Piece secured to a $1'' \times \frac{1}{2}''$ Angle Bracket (see Fig. 2). The Angle Bracket is secured to the 6 B.A. Bolt carrying the terminal 3, the Insulating Bush or Washer on the bolt being interposed between the Bracket and the $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate. The Bracket is thus insulated from the Plate and yet in electrical contact with the shank of the terminal 3. The terminals 1 and 2 are insulated from the Plate in the usual manner, and the two ends of the magnet winding are connected to them. The remaining terminal 4 is in metallic contact with the Plate, for reasons that will become apparent later.

The moving armature 6 consists of a $1\frac{1}{2}''$ Rod mounted in the longitudinal bore of a Coupling that, in turn, is secured to a transverse Rod journalled in the upright $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. Part of one of these Strips is cut away in the illustration to disclose the mechanism of the relay.

The movement of the armature is limited by an adjustable stop, which consists of a Threaded Boss 5 mounted on a $\frac{3}{4}''$ Bolt. The latter is secured rigidly to a Trunnion. By altering the position of the Boss 5 on the shank of the $\frac{3}{4}''$

Bolt, the gap between the armature 6 and the Pole Piece may be modified to suit different conditions of working. The smallest gap possible should be used as this makes the instrument sensitive to the effect of very weak currents. When the correct gap has been ascertained the Threaded Boss may be locked on the shank of the ¾" Bolt by a nut. A short length of Spring Cord attached by a nut and bolt to one of the upright 2½" × ½" Double Angle Strips normally holds the armature 6 against the stop 5.

The line battery, which may consist of a single small dry cell, is connected to the terminals 1 and 2 of the relay, and a switch should be included at a convenient operating position in the circuit. The local circuit containing the bell (or other instrument that it is desired to work) and the local battery, which may be a Meccano 4-volt Accumulator, is connected to the terminals 3 and 4 of the relay.

When the switch in the line circuit is closed, a weak current flows through the coil of the relay and energises it. This causes the armature 6 to be attracted to the Pole Piece, which is secured to the 1" × ½" Angle Bracket that is in electrical contact with the terminal 3, and as soon as contact is effected, the local circuit is completed. The current from the Accumulator flows from the terminal 3 along the Pole Piece and armature 6 and back through the frame of the model to the terminal 4. When the line current ceases the magnet no longer holds the armature and the latter flies back under the action of the Spring Cord, thus breaking the local circuit.

The Meccano electric bell and relay form a most interesting combination from which much pleasure and instruction may be derived.

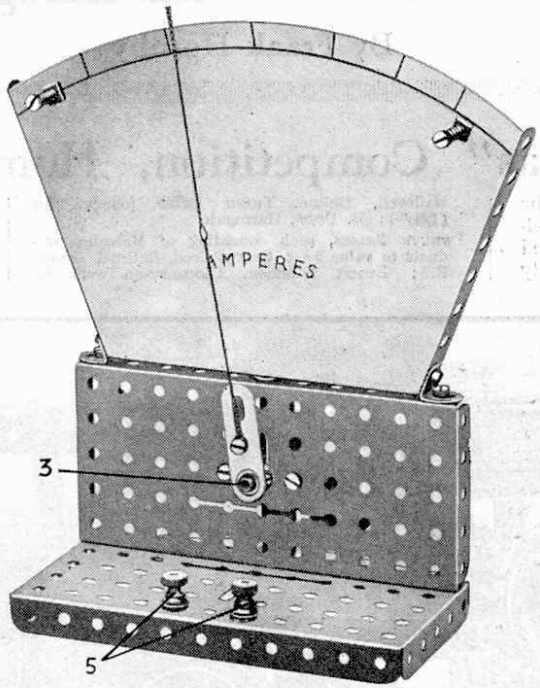


Fig. 7. A practical Hot Wire Ammeter (front view)

Meccano Lamp Standard

The Meccano lamp standard illustrated in Fig. 5 will make an effective addition to a model railway. A few of these accessories placed about the station " yard " lend a touch of realism to any layout. Also, we have no doubt that many Meccano boys make a habit of reading in bed—especially the *"M.M."* It is a practice that generally ought not to be encouraged, of course. Nevertheless, we must say that for a bedside reading lamp the Meccano standard is eminently suitable.

The upright is composed of two 12½" Angle Girders 1 joined together at the top and bottom by ½" × ½" Angle Brackets so as to form a square column. The Girders are secured to the 5½" × 2½" Flanged Plate by four ½" × ½" Angle Brackets placed one on each side of the column.

The Meccano Lamp Holder 4 is secured to the Double Bent Strip 5 by means of a 6 B.A. Bolt, which, with its head inside the lamp holder, is passed through the centre hole in the Double Bent Strip. An Insulating Bush is placed on the shank of the bolt to insulate it from the Strip, and the bolt is secured in place by a nut, which is used also to secure a short length of insulated wire. This wire is led down the centre of the vertical column, under the base Plate, and is attached to the bolt of the terminal 3, which is insulated from the Plate in the usual manner. The terminal 2 is in direct metallic contact with the model.

The Double Bent Strip carrying the lamp holder is bolted to a Wheel Flange, which serves as a reflector, and to a second Double Bent Strip that is secured between the ends of the 5½" Strips projecting horizontally from the vertical 12½" Angle Girders 1. The wires from the Accumulator are connected to the terminals 2 and 3. The lamp is earthed by way of the Holder 4, which is in metallic contact with the Double Bent Strip 5.

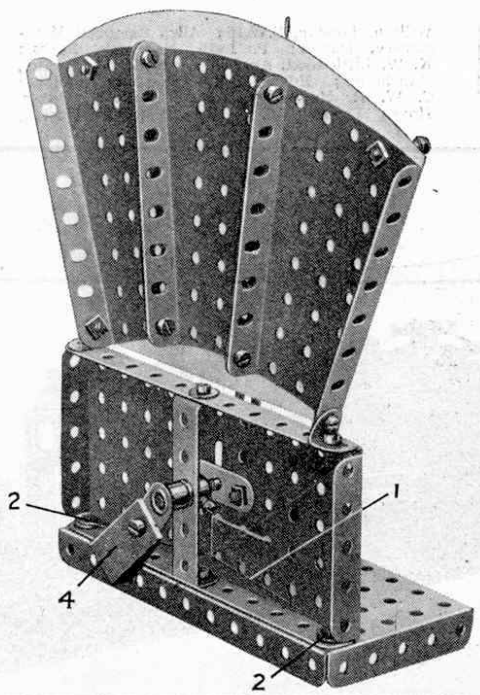


Fig. 8. Rear view of the Meccano Ammeter

Meccano Hot Wire Ammeter

An ammeter is an essential part of the young experimenter's equipment. With its aid he can discover many interesting points in regard to the behaviour of an electric current in any particular circuit. For instance, it is not generally realised that the current is the same in all parts of a circuit; a high resistance and one of lower value connected in series would both have the same number of amperes flowing through them. Perhaps the most interesting use to which an ammeter may be put, is to connect it in series with the Meccano 4-volt Electric Motor. By altering or removing the load on the Motor the current consumed will be seen to vary from a minimum when the motor is running " light "—that is, with no load—to a maximum when the motor is running under its greatest load.

In order to enable Meccano boys to carry out interesting experiments of this kind, we have designed a hot wire ammeter that, with the exception of a short length of fine copper wire, may be made entirely from Meccano parts. The model will work excellently if connected in series with the Meccano 4-volt Motor and Accumulator. It may be useful to explain here that to connect the ammeter " in series," a wire is taken from the Accumulator to one of the terminals 5 of the ammeter. The second terminal of the model is connected to a terminal of the Motor, and the other Motor terminal is connected to the remaining terminal of the Accumulator.

Fig. 7 is a general view of the Meccano Ammeter, and Fig. 8 is a view of the reverse side. The most important part of the model is the length of resistance wire 1 (Fig. 8), termed the " hot wire," which is stretched tightly between the 6 B.A. Bolts 2. These two bolts are attached to and insulated from the 5½" × 2½" Flanged Plate forming the base of the model. Each is connected by a short length of wire to an insulated terminal 5 on the front of the model (Fig. 7). A Collar having an ordinary set-screw substituted for its grub-screw is secured on the 1½" Rod 3, which is journalled in the upright 5½" × 2½" Flanged Plate and also in a 2½" × ½" Double Angle Strip. A short length of fine copper wire attached to the set-screw of the Collar is taken round the Rod 3 several times and then secured to the centre of the wire 1. The 25-gramme Weight 4 is bolted to a Crank that is secured on the Rod 3. The Crank should normally be in a horizontal position so that the weight pulls against the wire 1. The Crank carrying the pointer (which consists of a Loom Heald, part No. 101) is next attached to the front end of the Rod 3 so that the pointer rests lightly against one of the ¾" Bolts at the end of the scale.

When the current flows through the resistance wire 1, the latter becomes hot and expands. Since the weight 4 maintains the wire 1 in a constant state of tension, any slackening of the latter must result in a downward movement of the weight 4, and this movement causes the pointer to commence to travel across the scale. When the current decreases the wire 1 contracts, or tightens, in cooling, and thereby pulls the weight 4 in an upward direction and causes the pointer to move back again across the scale.

If possible the scale should be calibrated with the aid of a standard ammeter, otherwise purely arbitrary divisions will have to be used. The principle employed in the model described is used actually in many well-known makes of ammeter. It is employed mostly in instruments designed for use with alternating current work.

by employing a Meccano Electric Collecting Shoe (part No. 149) in place of the overhead current collector. The locomotive is built to gauge 0 and will run splendidly on Hornby rails.

The construction of the model should be commenced by building the main frame. This consists of 12½" Angle Girders 1 (Fig. 2) spaced apart by 2½"×½" Double Angle Strips 2. The 2½"×1" Double Angle Strip 3, which is bolted to the Angle Girders 1 in the ninth holes from one end, forms the bearings for the 3½" Rod carrying the Flanged Wheels 4.

The 2½" Strip 5 is bolted in the eighth holes from the other end of the main frame, and a Double Arm Crank secured to it forms a reinforced bearing for the bogie pin, which consists of a short Rod held in the longitudinal bore of the Coupling 6. The two Couplings 7 are secured one on each end of a short Rod that is fixed in the centre transverse bore of the Coupling 6. The travelling wheels 8 of the bogie are secured to 2" Rods that are free to revolve in the transverse bores of the Couplings 7. Washers being placed between the bosses of the Flanged Wheels and the Couplings 7 on one side only, in order to obtain the correct gauge between the wheels.

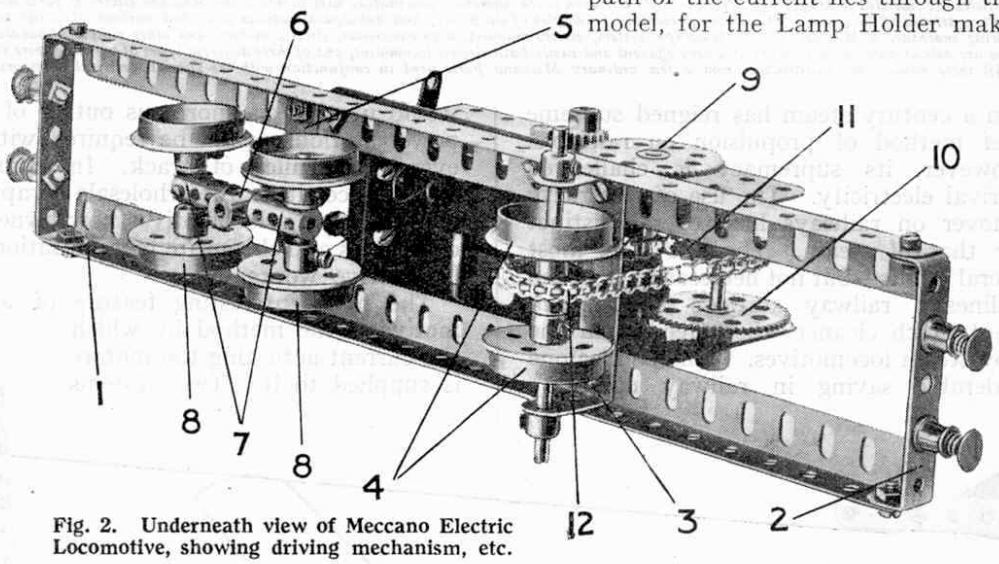


Fig. 2. Underneath view of Meccano Electric Locomotive, showing driving mechanism, etc.

The ½" Pinion on the armature spindle of the Motor meshes with a 57-teeth Gear 9. This Gear 9 is secured on a 2" Rod, which is journalled in the side plates of the Motor and carries another ½" Pinion engaging with a 57-teeth Gear 10 on a second 2" Rod. The drive is transmitted from the latter Rod to the Flanged Wheels 4 by means of a length of Sprocket Chain engaging the 1" Sprocket Wheels 11 and 12.

The body of the locomotive should be built separately from the main frame and machinery and afterwards attached to the frame by eight nuts and bolts. Its construction is indicated clearly in the illustration (Fig. 1) and therefore little comment is necessary. A point worth noticing, however, is the fact that the 5½"×2½" Flat Plates 13 are spaced away from the side vertical 3½" Strips by two Washers placed on each of the retaining bolts. The object of this is to obtain the necessary clearance between the plates and the projecting ends of the armature spindle of the Motor.

The 6 B.A. Bolt securing the Lamp Holder 14 is passed through a ½"×½" Angle Bracket that is bolted to the 5½"×2½" Flanged Plate forming the roof of the locomotive, but it is insulated therefrom by means of an Insulating Bush placed on the shank of the bolt against the Bracket. The current is led to the lamp by means of a wire that is twisted round the shank of the 6 B.A. Bolt and securely gripped between the Insulating Bush and the nut that holds the bolt in position. The return path of the current lies through the frame of the model, for the Lamp Holder makes contact with the ½"×½" Angle Bracket. The wire connected to the lamp is also connected to one of two 6 B.A. Bolts 15 secured one on each side of the roof of the locomotive. These bolts must be insulated from the Flanged Plate by means of Insulating Bushes and Washers.

The collector bow consists of a length of 22 S.W.G. Bare Copper Wire (or 23 S.W.G. Copper Wire stripped of its insulation) bent to the shape shown. Its ends are twisted round the shanks of the 6 B.A. Bolts 15 and secured rigidly by extra nuts placed on the bolts. A short length of insulated wire is led from one of these Bolts 15 to one terminal of the Motor. The other Motor terminal is earthed through the frame of the model by attaching a short length of wire between the terminal and the frame. Hence the electric current is directed through the overhead wire and the collector bow to the Motor, and back through the frame of the locomotive and the driving wheels to the rails. One terminal of the accumulator, or transformer, supplying the energy should be connected to the overhead wire, and the other terminal to the rails.

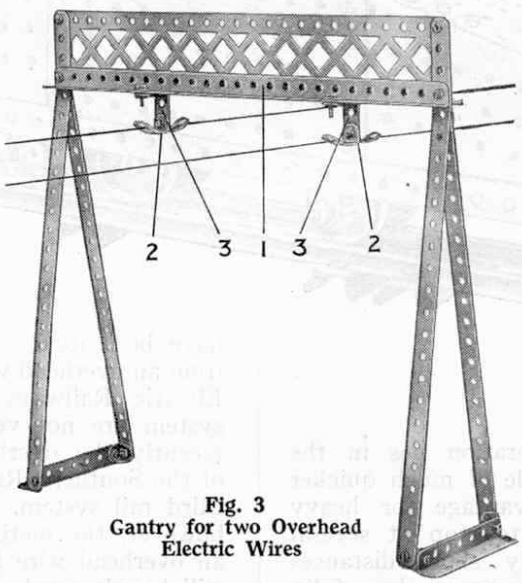


Fig. 3
Gantry for two Overhead Electric Wires

A switch of any convenient type should be inserted in the circuit between the accumulator and the rails or overhead wire so that the locomotive can be started or stopped at will. It will be remembered that several different types of switches were described in the third article of this series (see *"M.M."* for January, 1928). Much additional interest can be obtained if a Meccano Resistance Controller is also placed in the circuit, for the speed of the locomotive can then be varied as desired.

In order to obtain the best possible results from the model, the rails and flanges of the travelling wheels should be kept scrupulously clean, and the collector bow should be adjusted so that it presses firmly against

the overhead wire.

The best type of wire to use for the overhead conductor is 22 or 23 S.W.G. Copper Wire. If the latter type is used the cotton insulation must first be scraped away, of course. Where it is necessary to join the wire the two ends should be twisted together and clamped to one of the standards in the manner described below.

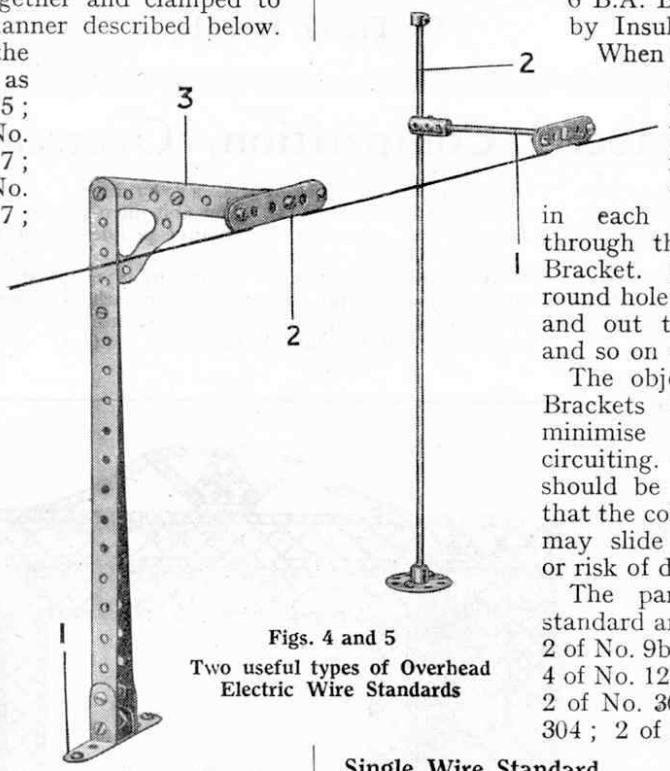
The parts required to build the Meccano electric locomotive are as follows: 4 of No. 3; 9 of No. 5; 2 of No. 8; 1 of No. 12; 1 of No. 16; 2 of No. 16a; 3 of No. 17; 1 of No. 18b; 6 of No. 20; 1 of No. 26; 2 of No. 27a; 63 of No. 37; 1 of No. 46; 6 of No. 48a; 1 of No. 52; 2 of No. 52a; 4 of No. 54; 9 of No. 59; 1 of No. 62b; 3 of No. 63; 2 of No. 72; 2 of No. 96; 4 of No. 120a; 3 of No. 302; 2 of No. 303; 3 of No. 304; 5 of No. 305; 1 of No. 310; 1 of No. 311; length of 22 or 23 Gauge Copper Wire (Parts Nos. 314 and 315); 4-volt Motor.

Types of Overhead Wire Standards

An overhead wire that is required to convey current to a model electric train must be supported at numerous points along the track. No doubt an infinite variety of standards suitable for this purpose will suggest themselves to Meccano boys, and each model-builder will probably prefer to build the standards according to his own particular tastes or requirements. The three different standards illustrated in these pages are intended merely as suggestions. Their principal merits are simplicity of construction and rigidity. In almost any electric railway it is almost essential to screw the rails and standards to the floor or other wooden base and the standards illustrated are designed for this purpose.

The standard shown in Fig. 3 is of gantry form and is suited particularly for parallel track working. A number of standards should be constructed exactly as shown and fastened at intervals along the track. When so arranged they will enhance the appearance of any model railway layout to a very large extent.

Each side of the gantry consists of two 12½" Strips attached by means of Angle Brackets to a base composed of a 3½" Angle Girder. These 3½" Girders should be secured to the wood base by ordinary screws. At the top the side members are connected together by a pair of 12½" Angle Girders 1 and a 12½" Braced Girder, which adds considerably to the finish of the model. Each of the two supports for the wires consists of two 1"×½" Angle Brackets 2 bolted to a 1"×1" Angle Bracket 3. The latter is secured to the Angle Girders 1 by means of 6 B.A. Bolts and insulated therefrom by Insulating Bushes and Washers.



Figs. 4 and 5
Two useful types of Overhead Electric Wire Standards

When the necessary standards have been erected the overhead wire may be fixed in position. The wire should be inserted in the elongated hole of one of the 1"×½" Angle Brackets in each support, and led back through the round hole of the same Bracket. It is then led through the round hole of the second Angle Bracket and out through the elongated hole, and so on to the next standard.

The object of insulating the Angle Brackets 1 from the gantry is to minimise the possibility of short-circuiting. The 1"×½" Angle Brackets should be bent slightly, as shown, so that the collector bow of the locomotive may slide over them without shock or risk of displacement.

The parts required to build this standard are: 4 of No. 1; 2 of No. 8; 2 of No. 9b; 4 of No. 12; 2 of No. 12a; 4 of No. 12b; 14 of No. 37; 1 of No. 99; 2 of No. 302; 2 of No. 303; 2 of No. 304; 2 of No. 305.

Single Wire Standard

Fig. 4 shows a simple type of standard suitable for single track operation. It is this type that is shown used in connection with the electric locomotive in Fig. 1. Quite a number of these standards could be made even with a small Outfit. If desired the 9½" Strips illustrated may be substituted by 5½" Strips overlapped and bolted together.

As will be seen, the 9½" Strips are splayed out at the bottom by a Double Bracket, and two 1"×1" Angle Brackets 1 are provided with which to secure the model to the floor or baseboard. The support for the electric conductor wire consists of two 3" Strips 2 spaced apart at each end by a Flat Bracket. The Strips 2 are bolted to an Angle Bracket that is insulated from the top of the standard by means of a 6 B.A. Bolt and an Insulating Bush and Washer.

The overhead wire is led round the end of one of the Flat Brackets, between the 3" Strips, over the shank of the bolt that secures the Strips to the Angle Bracket, and then round the lower edge of the other Flat Bracket.

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When the wire has been placed in position it should be clamped tightly between the 3" Strips by screwing up the centre nut and bolt. This method of attaching the overhead wire to the standard will be found perfectly satisfactory in operation, for it allows the collector bow of the locomotive to pass smoothly and easily over the connection.

The following are the parts required to build the standard shown in Fig. 4: 2 of No. 1; 1 of No. 3; 2 of No. 4; 2 of No. 10; 1 of No. 11; 1 of No. 12; 2 of No. 12a; 10 of No. 37; 2 of No. 38; 1 of No. 108; 1 of No. 302; 1 of No. 303; 1 of No. 304; 1 of No 305.

Another type of Single Wire Standard

The third type of standard (Fig. 5) is designed principally for use in connection with the tramcar type of collector, which consists of a small pulley mounted at the end of a spring-controlled trolley arm, which presses against the overhead wire. (It will be noticed that the supports for the overhead wire in the two previous examples would not permit the trolley pulley to pass smoothly over the connection).

The wire connecting piece is of similar construction to that employed in Fig. 4, except that it consists of two $2\frac{1}{2}$" Strips instead of two 3" Strips. The $3\frac{1}{2}$" Threaded Rod 1, which supports the wire connecting piece, is secured in a Coupling 2 attached to an $11\frac{1}{2}$" vertical Rod. The latter is secured rigidly in the boss of a Bush Wheel that is screwed down to the wooden base. After passing along the lower edges of the two Flat Brackets in the wire connecting piece, the electric conductor wire is inserted between the $2\frac{1}{2}$" Strips and led over the Threaded Rod 1. It is then securely clamped in position.

An important advantage of this type of standard lies in the fact that the elevation of the conductor wire above rail level may easily be adjusted, if desired, by altering the position of the Coupling 2 on the vertical Rod.

The standard is composed of the following parts: 2 of No. 5; 1 of No. 13; 1 of No. 24; 2 of No. 37; 2 of No. 37a; 2 of No. 38; 1 of No. 59; 1 of No. 63; 1 of No. 80a.

Famous Inventions—(*continued from page* 374)

of the country in order to find out the extent to which his invention had been adopted. He found that while 156,000 spindles were being worked by means of Hargreaves' spinning jenny, and 311,000 spindles by means of Arkwright's invention, 4,650,000 spindles were in operation on his mules. During this tour Crompton visited Glasgow where the spinning mule had been adopted very extensively and with great profit to the manufacturers. A few of the millowners learned of his presence in the city and organised a public dinner in his honour, but this belated recognition was too much for Crompton and he did not attend. "I first hid myself," he related afterwards, "and then fairly bolted from the city!"

At the conclusion of his tour Crompton embodied the statistics he had obtained in a claim that he submitted to the Government in 1812. His application was favourably received by Mr. Spencer Perceval, then Prime Minister, and Crompton began to hope that the service the spinning mule had rendered to the cotton industry was at last about to be recognised. Once more ill-luck dogged him, however, for while the fate of his claim was still in the balance Perceval was assassinated in the Lobby of the House of Commons by a bankrupt broker. It is said that at the time of Perceval's death his portfolio contained a paper showing that he had intended to urge the House to award Crompton £20,000. The claim fared badly without the Prime Minister's influence in its favour, however, and although the Government ultimately did make a grant, it amounted to only £5,000.

With this new capital Crompton entered the bleaching trade and later became a partner in a firm of spinners and weavers. He was very lacking in business knowledge and ability, however, and in spite of his efforts he was unsuccessful and once more became reduced to poverty. His continued misfortune aroused the sympathy of some of his friends and between them they bought him, in 1824, an annuity of £63, and on this meagre income Crompton lived up to his death on 26th June, 1827.

Electricity Applied to Meccano

IX—Electric Flashing Sign

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil winding machine, a Meccano electric telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, ammeter, etc. This month we describe a remarkably interesting Meccano model, an electric sign. The letters in the sign appear and disappear one after the other automatically, and the sign can be used for all kinds of practical purposes.

As will be seen from Fig. 1, which is a general view of the apparatus, the sign is built separately from the operating switch gear. It may be hung like a picture from any convenient point. The Motor and switch gear can be placed out of sight and the connecting wires arranged neatly and as unobtrusively as possible.

The model should prove invaluable for such purposes as shop window displays and Meccano Club exhibitions, etc. The lettering in the sign may be changed, of course, to suit individual requirements, and the number of lamps employed may be increased or decreased as desired.

Fig. 2 is a rear view of the sign and switch gear, etc., while two of the switch units are shown in detail in Fig. 3. It will be seen from Fig. 2 that the framework is composed of 18½" Angle Girders connected at their ends by 7½" Girders. The letters may easily be cut out from a sheet of cardboard with the aid of a fret-saw or very sharp knife. In order that each letter may be illuminated evenly, transparent paper should be stuck on the rear of the cardboard so as to cover the stencilled lettering. By using transparent papers of different colours a very striking and handsome sign will be obtained.

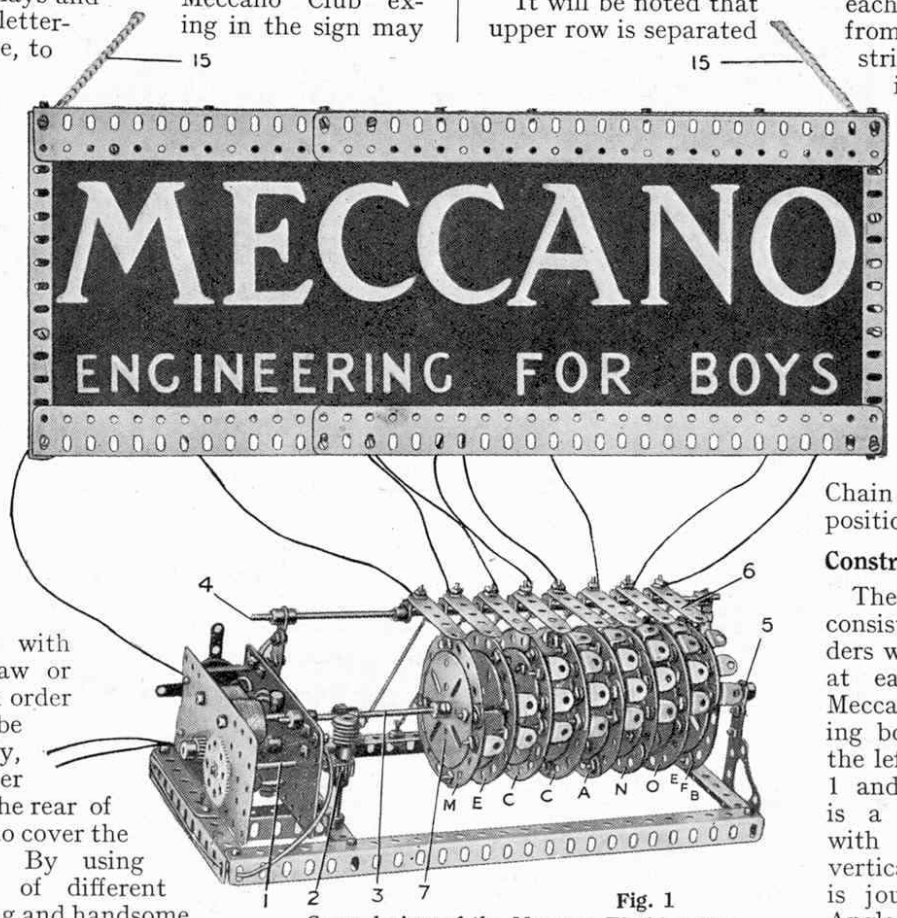


Fig. 1
General view of the Meccano Flashing Sign

The lamps that spell out the word "Meccano" are screwed into Meccano Lamp Holders that are secured to the Angle Girder 13 in the following manner. A 6 B.A. Bolt, with its head inside the Lamp Holder is passed through a hole in the Angle Girder 13 and an Insulating Bush is then placed on the shank of the bolt so as to insulate it from the Angle Girder. The metal portion of the Lamp Holder should be in contact with the other side of the Girder. The 6 B.A. Bolt is held in place by a 6 B.A. Nut, under which a length of insulated wire is clamped. This wire serves to connect the lamp to its respective brush on the "flasher."

In order that the four lamps on the lower Angle Girder 12 that illuminate the words "Engineering for Boys" shall light up simultaneously, the shanks of the 6 B.A. Bolts securing the Lamp Holders to the Girder 12 are all connected together by a length of wire 9. A continuation of the wire 9 serves to connect all four lamps to the last brush of the "flasher."

It will be noted that each of the lamps in the upper row is separated from its neighbour by a strip of cardboard that is bolted to a 4½" Double Angle Strip secured to the longitudinal 18½" Angle Girders. This is done so that each lamp shall illuminate only its own particular letter. A cardboard back may be provided to give a neat finish to the sign, which may then be suspended by the Sprocket Chain 15 in a conspicuous position.

Construction of the Flasher

The base of the "Flasher" consists of 12½" Angle Girders with 5½" Angle Girders at each end, the 4-volt Meccano Electric Motor being bolted down rigidly at the left hand end (see Figs. 1 and 2). On the Rod 1 is a Worm that meshes with a ½" Pinion 2 on a vertical 2½" Rod. This Rod is journalled in a 1"×1" Angle Bracket bolted to the Motor side plate and also in the 5½" Angle Girder that forms part of the base. The Rod carries at its upper end a second Worm that meshes with a ½" Pinion on the 11½" Rod 3, which is journalled in one of the Motor side plates. The other end of the Rod 3 is journalled in a Crank 5 that is bolted to an Architrave secured to the 5½" Angle Girder at the end of the base. Collars are used at each end of the Rod 3 to prevent side play.

One end of the 11½" Rod 4 is secured in a Crank bolted to a Corner Bracket on the Motor, the other end being held in a second Crank that is attached to an upright 3½" Angle Girder (Fig. 2).

Each of the Brushes 6 (Figs. 1, 2 and 3) consists of a $2\frac{1}{2}$" Strip that is attached to a Double Bracket by means of a 6 B.A. Bolt and Nut, the Strip being insulated from the Double Bracket in the usual way by an Insulating Bush and Washer. The completed brushes are threaded on the Rod 4, and spaced at the correct distances by means of Collars. Lengths of Spring Cord 14 are secured to each of the Brushes to keep them in close contact with the revolving switches, the free ends of the Cord being anchored to insulated 6 B.A. Bolts. The 6 B.A. Bolts are secured to the $12\frac{1}{2}$" Girder by means of a nut on each side of the Girder, so that the heads of the bolts project some distance above the Angle Girder.

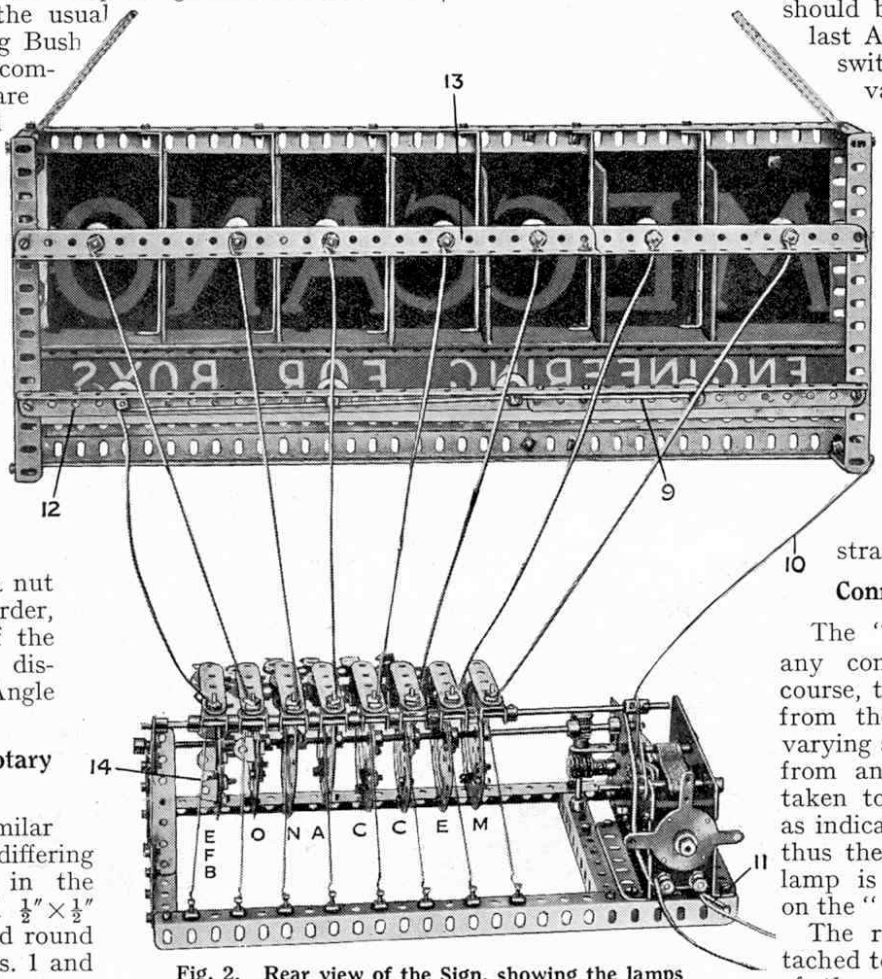


Fig. 2. Rear view of the Sign, showing the lamps that illuminate each letter

Construction of the Rotary Switches

Each switch is similar in construction, one differing only from another in the number of insulated $\frac{1}{2}$"×$\frac{1}{2}$" Angle Brackets placed round its periphery. In Figs. 1 and 2 the switches have been marked with the letters they control, in order to make the wiring of the model as easy as possible to follow.

First take the "M" switch (the right hand one in Fig. 3). It consists of a Face Plate 7, to which is secured by means of Flat Brackets a "rim" composed of four $2\frac{1}{2}$" small radius Curved Strips. A $\frac{1}{2}$"×$\frac{1}{2}$" Angle Bracket 8 is secured to, and insulated from, the rim by means of a 6 B.A. Bolt with an Insulating Bush and Washer.

The "E" switch is constructed in precisely the same manner, except that it carries two insulated Angle Brackets instead of one. The number of Angle Brackets increases progressively toward the last switch, which controls the E.F.B. ("Engineering for Boys") lamps and has eight Brackets. The other switch shown in detail in Fig. 3 is the "O" switch, which carries seven Angle Brackets arranged round its periphery, as will be seen from the illustration.

The switches should now be arranged in their correct order on the Rod 3 and secured rigidly in place. They should be placed so that the last Angle Bracket on each switch is slightly in advance of the preceding one, commencing with the "M" switch and working through the entire series of switches. This particular adjustment ensures that the letters on the sign run out rapidly backward and do not black out simultaneously. The latter effect may be obtained by arranging all the switches in a straight line.

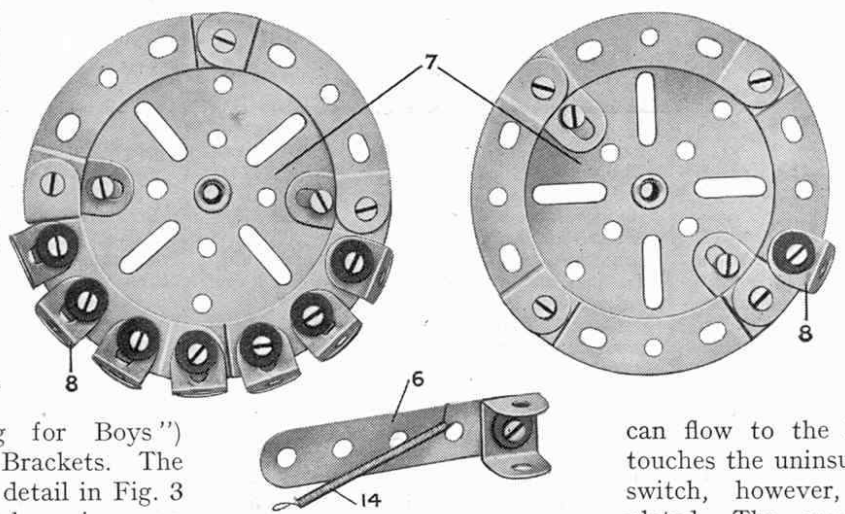


Fig. 3. Detail of two of the rotary switch units and brush gear

Connecting up the Model

The "flasher" may be in any convenient position, of course, the length of the wires from the lamps in the sign varying accordingly. The wire from any particular lamp is taken to its respective brush as indicated in Figs. 1 and 2; thus the wire from the "M" lamp is taken to the brush on the "M" switch, and so on.

The return wire 10 is attached to a point on the frame of the sign so that it is in metallic contact with the latter. The wire is taken then to one of the Motor terminals. A wire 11 is taken from the remaining terminal of the Motor and attached to a point on the Motor side plate close to the Rod 3.

On no account must the 8 amp. Meccano Accumulator be used, for the current taken by the model is large and would be beyond the capacity of the Accumulator. The latter would rapidly be spoilt if used for the purpose. The 20 amp. Meccano Accumulator, on the other hand, is quite suitable as a means of driving the model.

Action of the Model

So long as the insulated brushes 6 rest on the insulated Angle Brackets 8, no current can flow to the lamps. When a brush touches the uninsulated part of a rotating switch, however, the circuit is completed. The current then flows from the Motor terminal

(*Continued on page* 618)

Electricity Applied to Meccano—

(*Continued from page* 597)

along the wire 11 and Rod 3, through the particular switch and brush that are in contact, and so along the wire to the lamp. The current returns through the frame of the sign to the return wire 10.

As the insulated portion of each rotating switch is twice the length of the preceding one, an interval elapses before each lamp lights up. When the last brush has made contact the entire sign is illuminated and remains so until the insulated Angle Brackets lift the brushes one after the other, thereby causing the lamps to black out in rapid sequence, commencing from the end of the sign. Thus the "M" is the last letter to go out and the first to re-appear when the mechanism again starts to spell out the sign.

It is very important that plated parts be used in all parts of the model where good electrical contact is essential, as in the case of the brushes 6 and the switches 7. The Angle Girders 12 and 13 and the upright Girders to which they are bolted should be plated also, otherwise the Lamp Holders of all the lamps will have to be connected to the wire 10 by additional lengths of wire.

This model is sure to appeal to Club Secretaries and many others on account of its simplicity, reliability, and more particularly, its capacity for attracting immediate attention! It may be set working with the certain knowledge that there is nothing to get out of order. It will continue to tell the good news that "Meccano is Engineering for Boys" until the current is switched off, or all the lamps are destroyed!

"Christmas" Competition, Overseas Section)

(*Continued from page* 599)

hull and other principal features of the battleship have been designed most carefully, but it is the minute detail in the deck fittings that is the outstanding feature of Robinson's model. The model is built to scale and it is obvious that very few details have been omitted.

The construction of typewriters in Meccano is a somewhat difficult problem, but W. Sangers has succeeded in building a most interesting model of a machine of this kind. Naturally it would be very difficult, if not impossible, to construct a model that will include all the letters of the alphabet. Sangers therefore has fitted his machine with numbers in place of letters. The model is capable of typing on to a sheet of paper placed in the machine any number from 1 to 9 in any order whatsoever—certainly a remarkable piece of model-building!

An interesting effort was the motor dump lorry entered by T. C. Walker. The model incorporates a clutch mechanism consisting of two ¾″ Contrate Wheels mounted on separate shafts. One of the wheels may be brought in or out of engagement with the other, and the teeth of the Contrates form the clutch jaws.

Just as English Meccano boys have directed their attention recently to the construction of models of the Supermarine-Napier Seaplane, so Italian boys in accordance with patriotic instincts have attempted the building of the Italian machines which, though unsuccessful, put up an excellent performance in the Schneider Trophy Race. Enzo Bernardini's model of one of the Macci Fiat Machines is designed cleverly and although small is constructed very neatly.

Edward Holder submitted as his entry a model of a power hack saw. The eccentric motion imparted to the saw guides automatically alters the position of the saw blade as the material is cut. Holder's method of constructing the "feed motion" is very ingenious and the complete model is of a high standard.

Famous Inventions—(*continued from page* 577)

invention, but his efforts met with a discouraging reception. Later he returned to America and designed and built a submarine capable of carrying 100 men. It was 80 ft. in length, 21 ft. in width and 14 ft. in depth, and travelled so silently that it became known as the "*Mute*." Fulton died before this vessel was completed.

The "*Mute*" was used during the second American War of Independence and it is possible that it was the vessel that took part in the attempt to blow up the British warship "*Ramillies*," anchored off New London. The attempt was a failure, and it resulted in so great a public outcry against this method of warfare that the use of submarines was abandoned.

(*To be continued*)

Electricity Applied to Meccano

X.—Automatic Block System Control for Electric Railway

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil winding machine, a Meccano electric telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, an ammeter, an electric sign, etc. Below we describe a simple method by which two locomotives on a model railway may be controlled simultaneously. The engines stop and start each other automatically and always keep a safe distance apart!

IT is a far cry from the hand signalling of the first railways to the elaborate systems now used. In the early days comparatively crude methods of signalling were relied upon, for trains were few and far between and the speed of the engines was not high. As both the density and rapidity of railway traffic increased, however, more reliable systems became necessary. The signalling was improved or modified constantly until the well-known block system emerged in its present form. Thanks to the care with which this system has been designed and to the skill of its operators, the dense railway traffic of this country is controlled with remarkable speed and safety.

In the block system the track is divided into a number of sections, each section having its own signal cabin. Before a train enters any particular section, the signalman of that section asks the signalman in the next section ahead whether he will accept the train. If the reply is in the affirmative, he allows the train to proceed, and as soon as the train has passed the signals he returns them to the "danger" position. Meanwhile the signalman in the box ahead is ascertaining whether the next signalman along the line will accept the train. If he cannot for any reason, the second signalman holds the train in his section until he receives the information that the next section ahead is clear. From this it will be seen that two trains cannot be in the same section at the same time. Hence the possibility of accidents is reduced to a minimum.

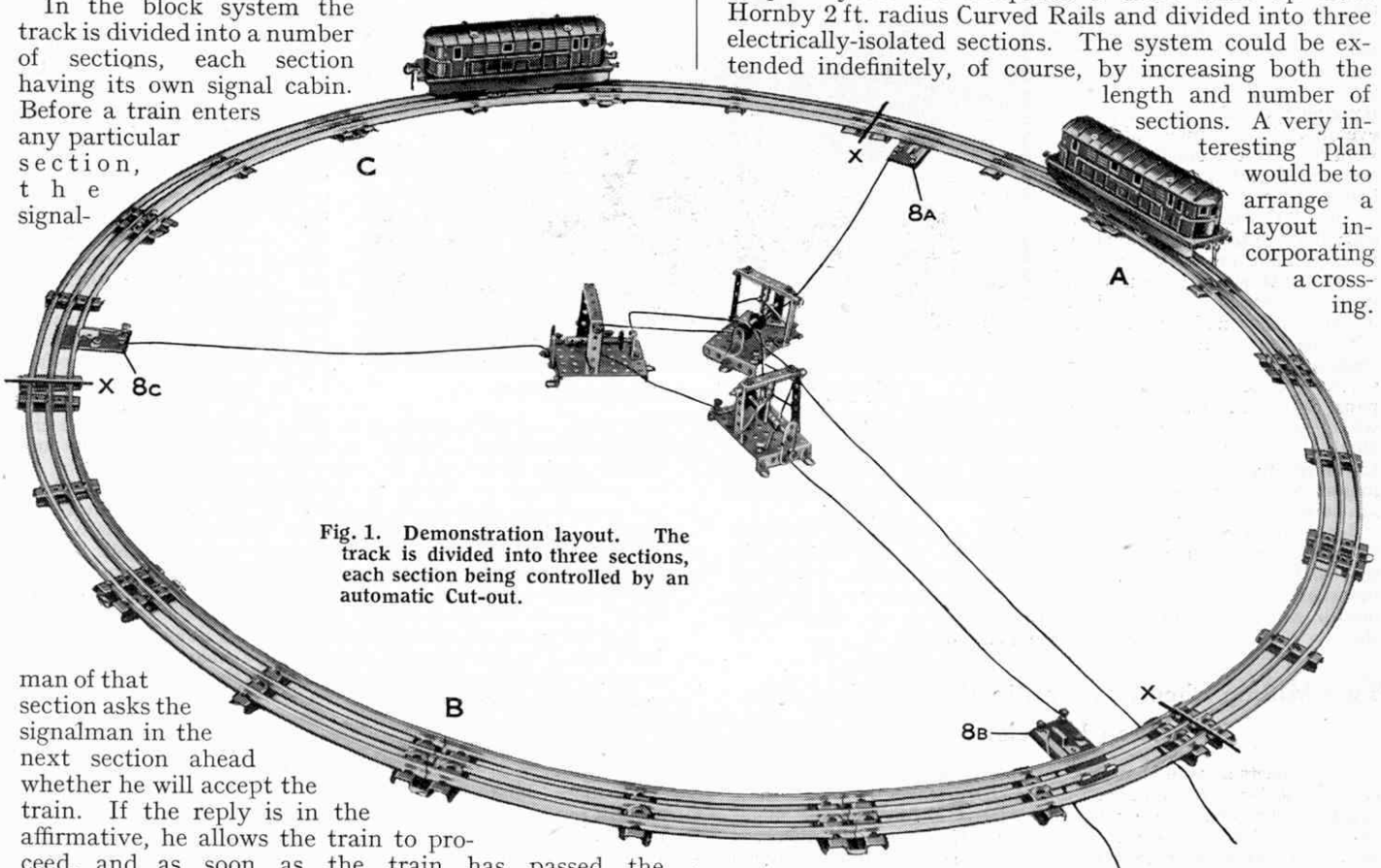


Fig. 1. Demonstration layout. The track is divided into three sections, each section being controlled by an automatic Cut-out.

On the underground railways of London the signals are operated electrically by the trains themselves, the signals in any section being held at danger so long as a train is on the section immediately in front. With this system the trains can follow one another at intervals of a minute or less and at a high speed with perfect safety, for even if the driver disregards a signal, the current is cut off and the brakes applied automatically.

Fig. 1 shows a simple arrangement by means of which a model railway may be controlled automatically by the block system. In order to make the necessary arrangements as clear as possible we have designed a very simple layout. It comprises a circle built up from Hornby 2 ft. radius Curved Rails and divided into three electrically-isolated sections. The system could be extended indefinitely, of course, by increasing both the length and number of sections. A very interesting plan would be to arrange a layout incorporating a crossing. Matters could be so arranged that power would be cut off from one train whilst the other passes over the crossing, the first train remaining immovable, of course, until the second is quite clear of the crossing. This is only one suggestion; no doubt the fertile brains of Meccano boys will produce innumerable others, resulting in some extremely interesting layouts.

An automatically-controlled model railway forms an ideal demonstration for Meccano Club purposes, etc., for

it will continue to function for long periods without any attention whatever. It is very fascinating to watch the trains stopping and starting without human intervention.

The current supply for the layout should be obtained from a Meccano 4-volt Accumulator, and not from the main through a transformer, for the alternating current so obtained rapidly makes the contacts of the cut-outs sooty, thereby impairing their efficiency.

Construction of the Meccano Cut-outs

As the most important features of the model are the electro-magnetic cut-outs, or switches, their construction will be described first. The number of cut-outs required depends upon the number of sections in which the layout is divided, for a separate cut-out is required for each section. Three cut-outs are necessary for the layout illustrated in Fig. 1. One of them is shown more clearly in Fig. 2.

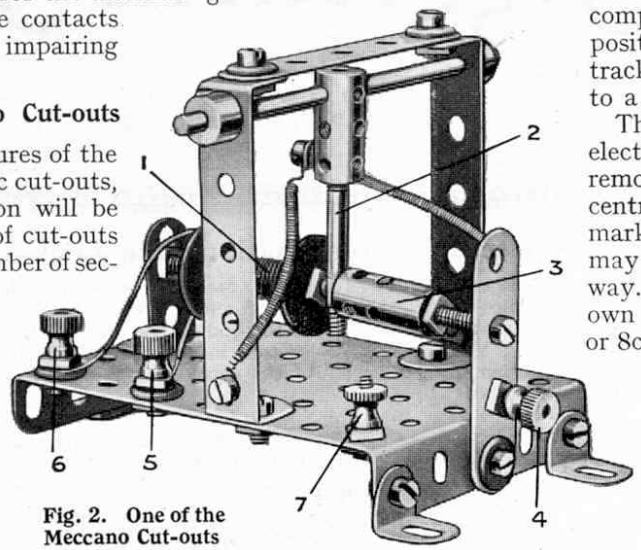


Fig. 2. One of the Meccano Cut-outs

The magnet coil 1 consists of two layers of No. 23 S.W.G. Wire wound on a Meccano Bobbin. The Bobbin is mounted on a Pole Piece that is secured to a $1'' \times \frac{1}{2}''$ Angle Bracket, which, in turn, is bolted to the $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate forming the base of the apparatus. Two $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips are bolted to the base and their top ends are connected together by a $2\frac{1}{2}''$ Strip.

The armature 2 consists of a Pole Piece (part No. 308) held in the bore of a Coupling that is secured to a 3″ Rod journalled in the $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. Two short lengths of Spring Cord are attached to a set-screw, which is inserted in one of the tapped holes of the Coupling, and also, by means of nuts and bolts, to the $2\frac{1}{2}''$ Double Angle Strips.

The contact 3 consists of a Threaded Coupling mounted on the end of a $\frac{3}{4}''$ Bolt and secured in place by a nut. The bolt is fastened, by means of a second nut, to a 2″ Strip. This Strip is secured to and insulated from the $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate by a 6 B.A. Nut and Bolt, with an insulating Bush and Washer on the shank of the Bolt.

The tension exerted by the Spring Cord should be very light, but sufficient to hold the armature against the contact 3 when no current is flowing through the magnet.

The distance between the armature 2 and the pole face of the magnet must be adjusted very carefully by altering the position of the Threaded Coupling 3 on the $\frac{3}{4}''$ Bolt. The correct gap is the thickness of a visiting card. In order to prevent the armature sticking to the magnet pole face on account of residual magnetism after the current is switched off, it is advisable to stick a small piece of paper over the pole face.

Each of the terminals 5 and 6 is insulated from the base plate by Insulating Bushes and Washers placed on the 6 B.A. Bolts that form the shanks of the terminals. The third terminal 7 is in direct metallic contact with the base plate, and therefore it is in electrical contact with the armature 2. Another terminal 4 is secured to the 2″ Strip that carries the contact 3.

When the three cut-outs have been completed they may be secured in position in the centre of the circle of track, which should be screwed down to a suitable base board.

The track is divided into three electrically-isolated sections A, B, C, by removing the connecting pegs of the centre collecting rails at the points marked X in Fig. 1. The running rails may be continuous as in the ordinary way. Each section is provided with its own Terminal Collecting Plate 8a, 8b, or 8c, which is connected to its respective cut-out.

Wiring up the Model

The theoretical wiring diagram is shown in Fig. 3. The terminals on the cut-outs are numbered in the diagram as in Fig. 2, but the numbers are followed by letters, which refer to the rail section (A, B, or C) controlled by each cut-out. The terminals on the Terminal Collecting Plates 8a, 8b, 8c, which communicate with the centre rails, are connected to the terminals 4a, 4b, and 4c, on the cut-outs. Terminals 6a, 6b, 6c, are all connected together by a length of wire, an extension of which forms one of the wires or leads to the Meccano 4-volt Accumulator. This lead is marked + in the wiring diagram. Lastly, 5a is connected to 7b, 5b to 7c, and 5c to 7a. The other wire from the Accumulator is attached to the terminal of one of the Collecting Plates, as indicated in Fig. 1. (The terminal to be used is the one communicating with the outside, or running rails).

On referring to Fig. 3 it will be seen that, supposing a train is running on section A, the current passes from the Accumulator through the electro magnet of the cut-out the contact and armature of which form part of the circuit supplying section C. After leaving the magnet of this cut-out the current passes along the armature and contact of a second cut-out to the centre rail of section A. The electro magnet of the first cut-out, thus energised, attracts the armature, and the movement of the latter breaks the circuit in section C (since the armature and contact of this cut-out form part of C's circuit). Therefore any train on this section would be unable to move.

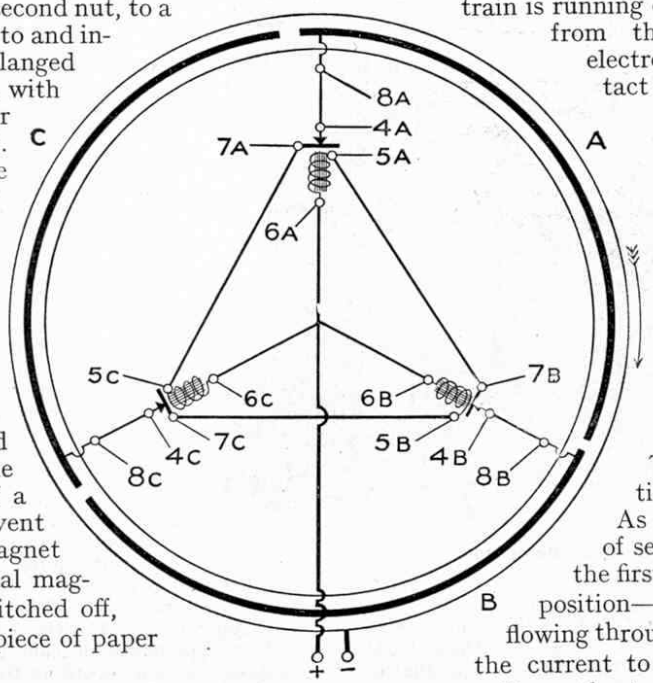


Fig. 3. Diagram showing Connections

As soon as the train has passed out of section A into B, the armature of the first cut-out flies back to its original position—because current is no longer flowing through the magnet—and thus allows the current to flow again through section C. Hence the train in section C can move into section A. The process is then repeated.

Electricity Applied to Meccano

XI—Electric Beam and Horizontal Engines

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil winding machine, a Meccano electric telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, an ammeter, an electric sign, and an electrically-controlled Hornby Railway. This month we describe two novel electric engines. Although developing no great power, they are extremely interesting to build and set in motion.

THIS month we describe the construction of two electrically-operated engines. One is of the horizontal type and the other is of the overhead beam type. Both depend for their operation upon the action of solenoids. It was explained in the article on the Electrically-operated Signal (described in the "*M.M.*" for March, 1928) that the solenoid is an electro-magnet with a hollow core, and when a current flows through the wires of the coil, magnetisable objects, such as iron rods, etc., are drawn into the core of the solenoid.

In the model beam engine (Fig. 1) two solenoids are mounted one above the other. They are energised alternately, and draw the steel "piston rod" first in an upward direction into the core of the upper solenoid and then downward into the lower one. The reciprocating movement so produced is converted into a rotary one by the crank and beam mechanism that is the characteristic feature of the prototype.

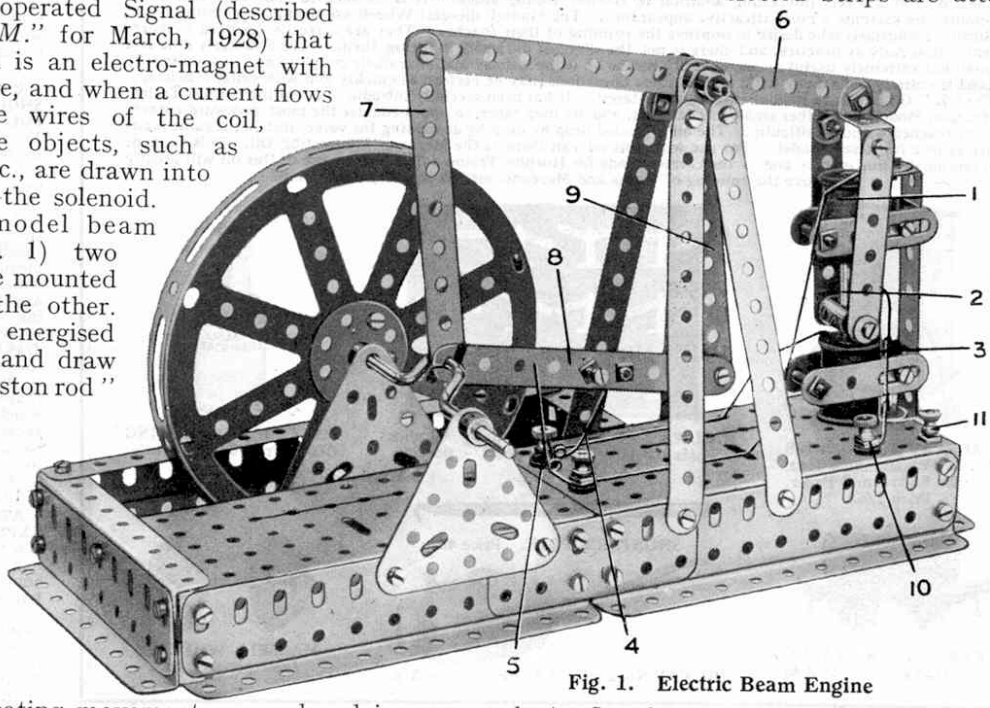


Fig. 1. Electric Beam Engine

Construction of the Beam Engine

The erection of the model should be commenced by building the base. This consists of two $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates bolted end to end. At one end of the base so formed a $4\frac{1}{2}''$ Angle Girder is bolted, and secured at right angles to this is a $7\frac{1}{2}''$ Girder. The other end of the $7\frac{1}{2}''$ Girder is attached to the side flange of one of the $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates forming the base by a $2''$ Angle Girder and an Angle Bracket.

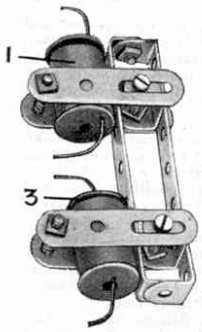


Fig. 2 Electro-magnets of Beam Engine

Flat Girders are bolted to all sides of the base and Angle Girders are secured to the bottom edges of these Flat Girders to strengthen the construction and also enhance the appearance of the finished model. Two $2\frac{1}{2}''$ Triangular Plates are bolted to the base as shown to form bearings for the Crankshaft. The flywheel consists of a Hub Disc bolted to a Bush Wheel that, in turn, is secured to the end of the Crankshaft.

Two Bobbins 1 and 3 (Figs. 1 and 2) are wound with seven layers of No. 26 S.C.C. wire on each. A layer of brown paper should be placed round each finished coil to protect the insulation of the windings.

Four $2''$ Slotted Strips are attached to two $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips by means of Double Brackets, and each solenoid is placed between a pair of Slotted Strips and clamped in position by a $1''$ Screwed Rod passed through the end holes of the Slotted Strips and secured by nuts at each end. It is important that both solenoids are in line so that the "piston rod" may work with perfect freedom.

The "piston rod" 2, which consists of a $2''$ Rod, has a Coupling secured to its centre and two $3''$ Strips are attached pivotally to the Coupling by means of $\frac{3}{8}''$ Bolts that are inserted in the ends of the Coupling and gripped by the set-screws. Two $\frac{1}{2}''$ Reversed Angle Brackets are bolted to the upper ends of the $3''$ Strips to form means of attachment to the beam 6.

The beam 6 is mounted together with a $4\frac{1}{2}''$ Strip 9 on a $1\frac{1}{2}''$ Rod that is carried by two $1''$ Triangular Plates secured to the tops of four vertical $5\frac{1}{2}''$ Strips, the other ends of which are bolted to the base of the model. Two $4\frac{1}{2}''$ Strips 7 and 8 are placed together on the

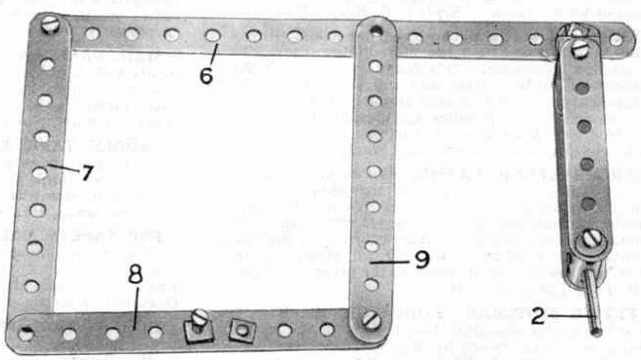


Fig. 3. Reciprocating Parts of Beam Engine

crankshaft and retained in position by means of Spring Clips. The Strip 7 is attached pivotally to the end of the beam 6 by a lock-nutted bolt and the Strip 9 is attached in a similar manner to Strip 8. Two $\frac{3}{8}$" bolts are secured to the Strip 8 by double nuts, so that they protrude from opposite sides of the Strip 8. (Fig. 3). The various lock-nutted joints should be quite free yet have no appreciable side play.

All that now remains to be accomplished is the wiring of the model. The brushes 4 and 5 are merely short lengths of bare 23 S.W.G. Copper Wire. A loop is formed in each brush (by twisting it round a Rod) to increase its springiness. The brushes are attached to two terminals that are insulated from the base plate by Insulating Bushes and Washers.

One wire from each solenoid is taken to a brush terminal, the remaining wires of the solenoids being attached to the insulated terminal 10, the terminal 11 being in metallic contact with the base plate. The brushes may be regarded as a type of switch, operated by the model itself, that complete the circuits of the solenoids alternately.

In Fig. 1 the piston rod 2 is shown in the act of completing its downward stroke. The flywheel is rotating in an anticlockwise direction, a fact which causes the Strip 8 to move to the left and one of the $\frac{3}{8}$" Bolts on it to make contact with the brush 5. This completes the circuit of the solenoid, energising it and causing it to draw the piston rod up into its core.

As the crank nears its lowest position — or bottom dead centre as it is termed — the Strip 8 commences to move to the right, eventually causing the brush 5 and its bolt to part. Thus the solenoid 1 is de-energised. The Strip 8 continues moving to the right and the second $\frac{3}{8}$" Bolt secured to it presently makes contact with the brush 4, which energises solenoid 3. The latter pulls the Rod 2 downward until the brush 4 breaks contact with its bolt. The cycle of operations is then repeated.

The brushes 4 and 5 must be so adjusted that they commence to make contact with the respective bolts on the Strip 8 when the crank is just past its dead centre, otherwise the model will not work properly.

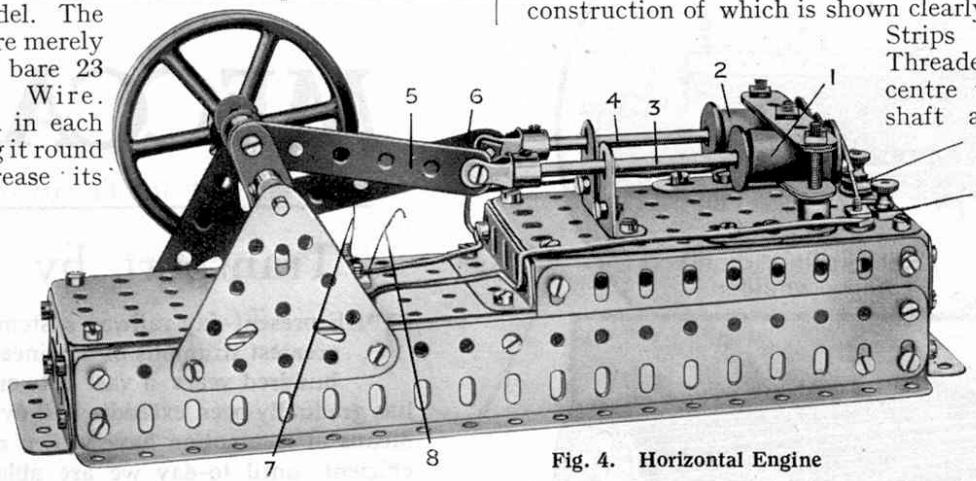


Fig. 4. Horizontal Engine

Electric Horizontal Engine

The interesting little horizontal engine shown in Fig. 4 may be run off a 4-volt Accumulator or from a transformer connected to the house supply, provided that the latter is alternating current. It works exceedingly well and may be used to drive small models.

Two $2\frac{1}{2}$" Triangular Plates are bolted to the sides of the base to form bearings for the crankshaft, the construction of which is shown clearly in Fig. 5. Two $1\frac{1}{2}$" Strips spaced apart by Threaded Bosses form the centre web of the crankshaft and Double Arm Cranks are secured on each side by means of $\frac{1}{2}$" Bolts. The 3" Strips 5 and 6 forming the connecting rods are journalled on these Bolts and are spaced thereon by means of Washers. The bolts and nuts used in the construction of the crankshaft must be secured very tightly.

Two Bobbins are each wound with seven layers of No. 26 S.C.C. wire and when finished a strip of brown paper is gummed round each coil. The finished coils 1 and 2 are held in position by means of $2\frac{1}{2}$" Strips secured by means of 1" Threaded Rods and nuts to Threaded Cranks bolted to the base.

Two terminals are secured at the end of the model, one being insulated and the other in metallic contact with the Plate. One wire from each coil is secured to the terminal insulated from the Plate, each of the other coil wires being secured to a 6 B.A. Nut and Bolt secured to the base Plate near the terminals and insulated from it by Insulating Bushes and Washers. Each of these 6 B.A. Bolts is connected by means of wire to similar nuts and bolts which carry pieces of bare copper wire 7 and 8. These bolts must also be insulated from the Plate, of course.

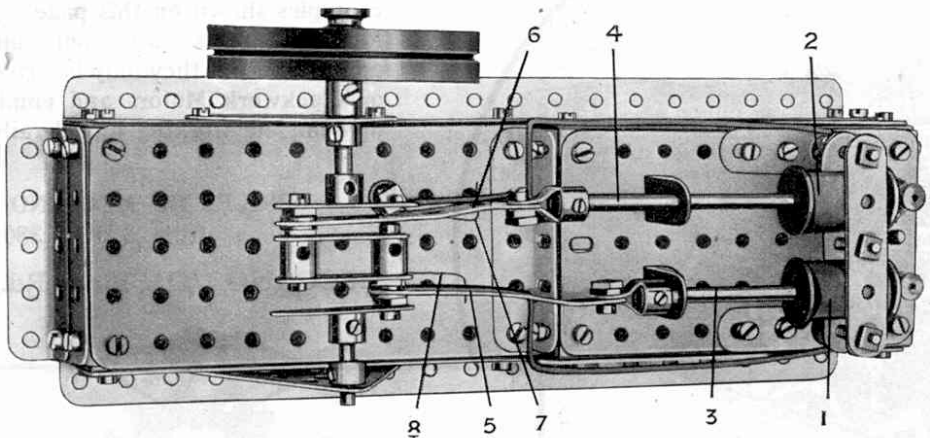


Fig. 5. Plan view of Horizontal Engine

These wires or "brushes" are adjusted so that when the connecting rods 5 and 6 are on their respective dead centres the wires are just below them. As the connecting rods fall in following the rotation of the crankshaft, the brushes make contact with them and so cause the coils 1 and 2 to become energised alternately.

Before using the model care should be taken to ensure that all movable parts move freely and that the points of contact between the connecting rods and the brushes are thoroughly clean.

Electricity Applied to Meccano

XII—Electrically-controlled Drop Hammer; Remote Control for Radio Set

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described Meccano switches, a coil winding machine, a telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, an ammeter, an electric sign, an electrically-controlled railway, and electric beam and horizontal engines. This month we describe a model drop hammer that is caused to operate automatically by electrical means, and an extremely simple device by means of which a wireless set may be switched on or off from any part of the house.

AS every Meccano boy knows, hammers range in size from the "tack" or "toffee" hammer to the great steam hammer that is capable of delivering blows of a force equivalent to many tons. The latter is, of course, the type of hammer used to shape masses of white hot metal into parts of engines, etc. Another extensively used type is the "drop" hammer, and it is to this class of hammer that the model illustrated on this page belongs.

The most interesting feature of the model is the method by which the hammer is dropped automatically by electrical means. Once in motion the model may be allowed to go on working independently, the hammer falling at regular intervals from a maximum height, or by moving a lever the stroke of the hammer—and therefore the power of the blow—may be increased or decreased as desired. Hence the model is an excellent one for demonstration purposes. As illustrated on these pages, it may be made with comparatively few parts, but if desired it may of course be elaborated considerably.

Building the Electric Drop Hammer

The construction of the framework should be commenced first. Two 12½" Angle Girders (Fig. 1) form the base, to one end of which the four upright 9½" Angle Girders are attached. These last Girders form the supporting frame for the hammer and its attendant mechanism, and are stayed by Strips.

The hammer, or "tup," consists of a number of 3½", 2½" and 1½" Strips arranged in a pile and held together by ¾" Bolts. A Double Bent Strip is secured to the bottom or striking end of the hammer and another Double Bent Strip is secured to the base of the model to form an anvil. The hammer runs on guides consisting of 11½" Rods carried by Strips that form part of the containing frame, and its weight is increased by the addition of 25-gramme weights.

The two electro magnets 1 each consist of a Meccano Bobbin wound to capacity with No. 26 S.C.C. Copper Wire and secured to the Motor side plates by Pole Pieces.

A ¾" Pinion on the armature spindle meshes with a 50-teeth Gear Wheel on the end of a 2½" Rod (see Fig. 3). On the other end of the latter Rod is secured a ½" Pinion that meshes with the 57-teeth Gear Wheel 4, which is mounted on the end of a 3½" Rod that carries a ¾" Pinion 2 and a Compression Spring. On the other end of the 3½" Rod a Face Plate 5 (Fig. 1) is secured so that it is about 3/16" from the pole faces of the magnets when the boss of the Gear 4 is pressed against the Motor side plate. (The Face Plate is not shown in Fig. 3). In this position of the Rod the ¾" Pinion 2 should be just in mesh with a 50-teeth Gear 3 secured to the winding shaft.

The Compression Spring on the shaft of the Gear 4 normally holds the Pinion 2 in engagement with the Gear 3, the shaft of which winds up the length of cord that is attached to the hammer. At a given moment the electro magnets 1 are energised, with the result that they attract toward the pole faces the Face Plate 5. The movement of the latter compresses the Spring and throws the Pinion 2 out of engagement with the Gear Wheel 3. The Rod of the latter Wheel is then free to rotate and the hammer falls by its own weight.

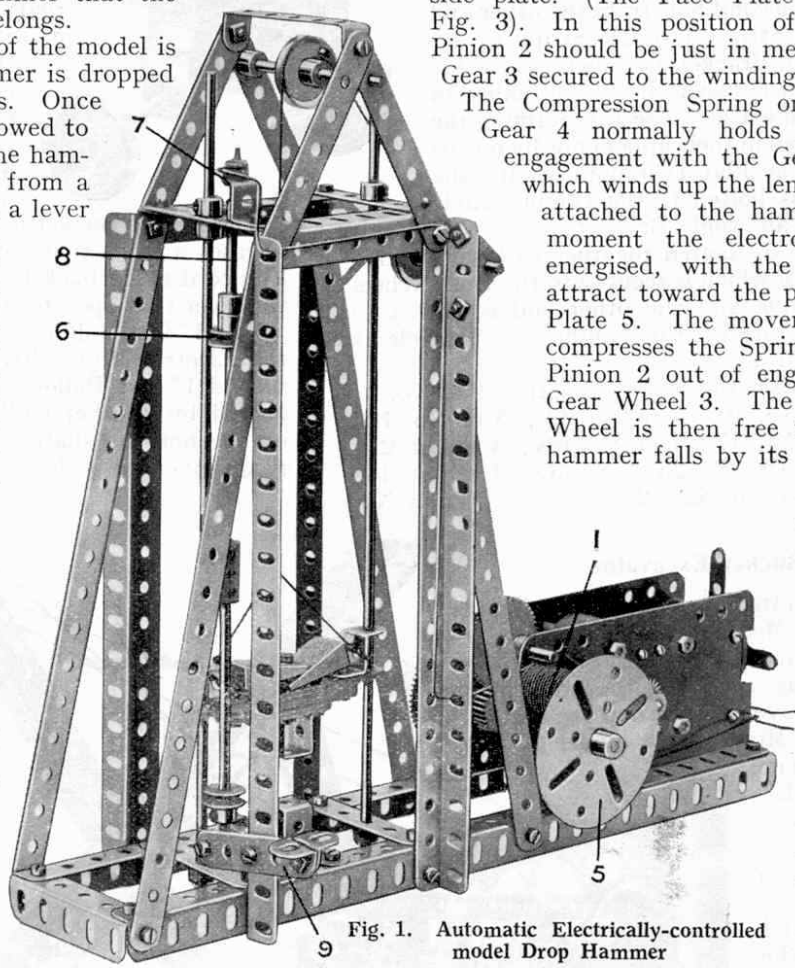


Fig. 1. Automatic Electrically-controlled model Drop Hammer

Arrangement of the Automatic Switch

The automatic switch controlling the magnets 1 consists essentially of a Rod 8 (Fig. 1) that is slidable in the Strips carrying the 11½" Rods which form the hammer guides. The Rod 8 is made 9½" in length by connecting 5" and 4½" Rods together with the aid of a Coupling, and two ½" Pulleys are secured to it in the positions shown. A 6 B.A. Bolt 7 is fastened head downward to a ½" Reversed Angle Bracket that is bolted to the Strip carrying the Rod 8; the bolt is insulated from the Reversed Angle Bracket by an Insulating Bush and Washer.

The lever 9 consists of a 2½" Strip attached pivotally at its centre by means of a lock-nutted bolt to the 9½" Angle Girder and at its end hole by a bolt inserted in a Collar that is secured to the Rod 8 just below the lower ½" Pulley. The lever should work rather stiffly on its pivot so that the rod 8 remains in whatever position

it may be struck by the hammer.

The Electrical Connections

The wiring diagram (Fig. 2) gives a clear idea of the various connections. One of the wires from each of the magnets 1 are connected together, the remaining wire of one magnet being taken to one of the Motor terminals whilst that of the other magnet is connected to the insulated bolt 7. The second terminal of the Motor is earthed by connecting it to a part of the frame of the model. The wires to the Accumulator are joined to the Motor terminals.

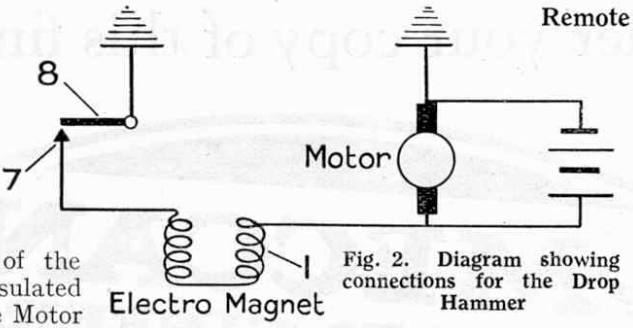


Fig. 2. Diagram showing connections for the Drop Hammer

When the Motor is started, the winding shaft on which the Gear 3 is secured rotates and hoists the hammer. As the hammer nears the top it hits the ½" Pulley 6, thereby striking the Rod 8 upward into contact with the 6 B.A. Bolt 7. This completes the circuit of the magnets, energising them and causing the Face Plate 5 to be drawn to them, a movement which, as already explained, causes the disengagement of the Pinion 2 with the Gear 3. The hammer then falls and strikes the lower ½" Pulley on the Rod 8 thereby returning the latter to its original position. The magnet circuit is now broken and the Gear and Pinion come into mesh once more, owing to the action of the Compression Spring. This cycle of operations is repeated for as long as the current is running.

By moving the Strip 9 the circuit of the magnet may be completed before the hammer reaches the top of its stroke. Thus the force of the blow may be regulated to a nicety by causing the hammer to fall through a shorter distance.

The 11½" Rods on which the hammer slides and the various gears, etc., must be kept well oiled to ensure the correct working of the model. The Rod 8, however, should not be oiled.

The parts required to build the complete model drop hammer are as follows:—

4	of No.	1A	3	of No.	16B	2	of No.	111C
7	" "	3	2	" "	22	1	" "	120B
12	" "	5	2	" "	23A	3	" "	125
4	" "	6A	2	" "	25	2	" "	126
2	" "	8	1	" "	26	2	" "	301
4	" "	8A	2	" "	27	1	" "	302
2	" "	9B	1	" "	27A	1	" "	303
2	" "	9D	39	" "	37	1	" "	304
2	" "	12	2	" "	45	1	" "	305
2	" "	13	1	" "	48A	2	" "	308
1	" "	15	12	" "	59	1	" "	314
1	" "	15A	1	" "	63	1	Electric Motor, 4 volt.	
1	" "	16	1	" "	109			
2	" "	16A	2	" "	111A			

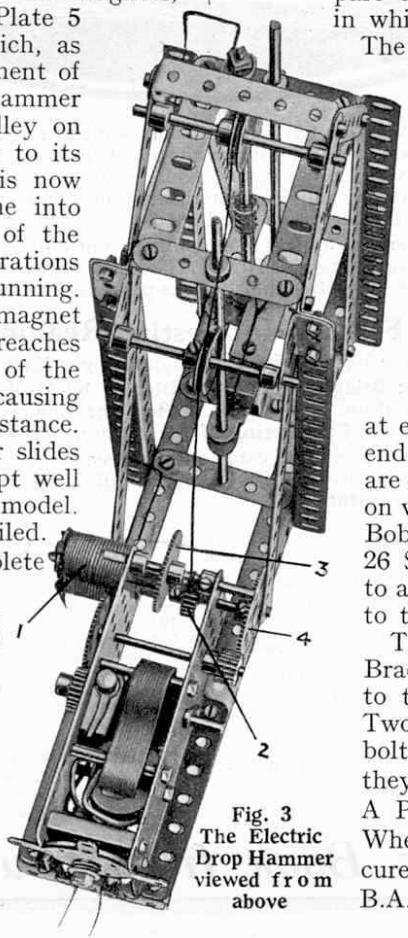


Fig. 3 The Electric Drop Hammer viewed from above

MECCANO ELECTRICAL PARTS

The following is a complete price list of the Meccano Electrical Accessory Parts. These parts are standardised with the rest of the Meccano system. They can be adapted with advantage to innumerable existing models, and they make possible many entirely new ones. They may be obtained through any Meccano dealer.

Part No.			s.	d.
301.	Bobbin	each	0	4
302.	Insulating Bush	doz.	0	6
303.	Insulating Washer	"	0	3
304.	6 B.A. Screws	"	0	6
305.	6 B.A. Nuts	"	0	3
306.	Terminal	each	0	1
307.	Silver-tipped Contact Screw	"	0	5
308.	Core or Pole Piece	"	0	3
309.	Coil Cheek	"	0	3
310.	Lamp Holder	"	0	3
311.	Best Metal Filament Lamp ...	each	0	6
312.	27 Gauge Bare Iron Wire, per length of 30"		0	1
313.	26 Gauge SCC Copper Wire, Reels of 50 yds.	each	2	3
314.	23 Gauge SCC Copper Wire, Reels of 25 yds.	"	2	0
315.	22 Gauge Bare Copper Wire, Reels of 4 yds. ...	"	0	3

Remote Control for Radio Sets

Nearly everyone nowadays is the happy possessor of a wireless set, and any innovation tending to increase the interest or enjoyment that may be obtained from it is always very welcome. The Remote Control device described below is a particularly useful accessory that any Meccano boy may construct for use in connection with any type of wireless set. It makes possible the switching on and off of the set from a distance, merely by pressing a small push button switch.

For example, the set might be in one room and one or more control switches placed in convenient positions in the other rooms so that the set could be switched off or on from any part of the house, without entering the room in which the set is situated.

The leads between the set and the remote control must be as short as possible in order that minimum resistance is inserted in the L.T. circuit. This is specially important with a multi-valve set which may consume a large amount of L.T. current. On the other hand the wires from the remote control device to the push button switch or switches may be of practically any length, since the current required to operate the magnet is quite small, of course.

The base of the instrument consists of two 5½" Angle Girders connected together at each end by 2½" Angle Girders. Near one end of the base so formed, two vertical Strips are secured to form the bearings for the Rod on which the Gear Wheel 9 is mounted. Two Bobbins next are wound to capacity with No. 26 S.C.C. Wire and attached by Pole Pieces to a 2½"×½" Double Angle Strip that is bolted to the two upright Strips.

The end of a Strip 8 is bolted to a Double Bracket that is journalled on a Rod attached to the base by two ½"×½" Angle Brackets. Two 1½" Strips, laid one upon the other, are bolted to the Strip 8 in such a position that they are opposite the pole faces of the magnets. A Pawl engages with the teeth of the Gear Wheel 9 and is mounted on a Pivot Bolt secured at the top end of the Strip 8. Four 6 B.A. Bolts are secured

(*Continued on page* 839)

Results of Meccano Model-Building Contests

By Frank Hornby

"April" Competition, "Home" Sections

ORIGINALITY of design was a very prominent feature of the entries in this contest, and many of the models bear witness to considerable ingenuity and constructional skill on the part of their builders. The prizes have been awarded as follows:—

Section A (competitors over 14 years of age):

FIRST PRIZE (Cheque to value £3-3s.): W. P. Cole, Felbridge, Sussex. SECOND PRIZE (cheque to value £2-2s.): L. Lacey, St. Leonards-on-Sea. THIRD PRIZE (cheque to value £1-1s.): R. Mason, Leeds.

SIX PRIZES, each consisting of Meccano Radio Crystal Receiving Sets: J. C. Adams, West Hallam, near Derby; Dennis Toms, West Bridgford, Nottingham; W. R. Marsh, Bath, Somerset; R. C. Ashton, Devonport, Plymouth; H. Sarfas, Ilford; Thomas W. Baker, Taunton.

TWELVE PRIZES, each consisting of Meccano Single Telephone Receivers: E. Whatley, New Moston; T. Abbot, London, S.W.2; C. E. Wrayford, Teigngrace, near Newton Abbot; M. F. Couchman, Bognor; S. Gross, Colne; H. A. Davies, Gwytherin, Abergele; B. F. and G. A. Buckley, Wolverley; M. V. Jackson, Berkhamstead; G. E. Abecassis, Clifton, Bristol; F. Kennedy Oxten, Enfield; Herbert Clegg, Bradford; F. T. Dyer, Felsted.

SPECIAL COMMENDATION (Certificate of Merit and Standard Mechanisms Manual): Rodney S. Weaver, Prestwich, Manchester; H. Rutter, Consett, Co. Durham; John W. Rid, Birkenhead; A. P. Pallant, Wherstead, near Ipswich; E. C. Reeder, Mawgan-in-Meneage, Cornwall; Fred Bearne, Grantham; N. Downey, Sutton, Surrey.

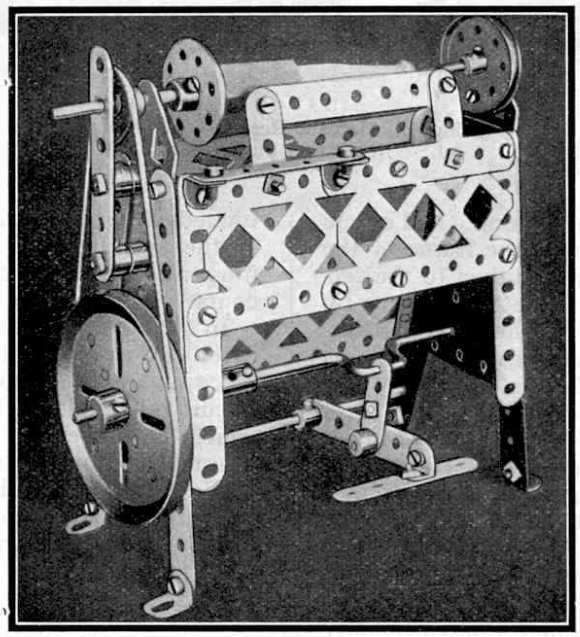
Section B (for competitors under 14 years of age):

FIRST PRIZE (Meccano products to value £2-2s.): M. H. Maufe, Ilkley. SECOND PRIZE (Meccano products to value £1-1s.): L. D. Smart, Kingston-on-Thames. THIRD PRIZE (Meccano Radio Crystal Receiving Set): P. Peacock, West Byfleet.

SIX PRIZES, each consisting of Meccano Single Telephone Receivers: R. H. Pike, London, W.1; L. A. Frayn, Plymouth; A. Diwell, Hastings; F. Hayes, Porthcawl; T. G. Pickavance, St. Helens; T. Sheppard, Wellingborough.

TWELVE PRIZES, each consisting of Complete Instruction Manuals: W. Raybould, Walsall; G. W. Garton, Leicester; A. E. T. Huggins, Gloucester; R. Dwight, Chesham; David Fevez, Addlestone; D. McLean, Manchester; N. R. Reid, London, S.E.2; R. H. Thomas, Coventry; T. B. Paisley, Brechin, Forfarshire; R. P. Atkins, London, W.C.1; N. Slater, Bournemouth; L. Randles, Wrexham.

SPECIAL COMMENDATION (Certificate of Merit and Standard Mechanisms Manual): H. Fazakerley, Heapey, near Chorley; R. Bush, Bromley; N. L. Mills, London, S.W.2; D. B. Kimber, Bedford; W. E. Blundell, London, E.3; G. Atherton, Littleborough, near Manchester; M. Mackirdy, Malmesbury; K. Black, London, N.21; B. K. Merson, Rotherham; O. S. Johnston, Stoke-on-Trent.



A practical model of a Wood-turning Lathe, built by T. Sheppard

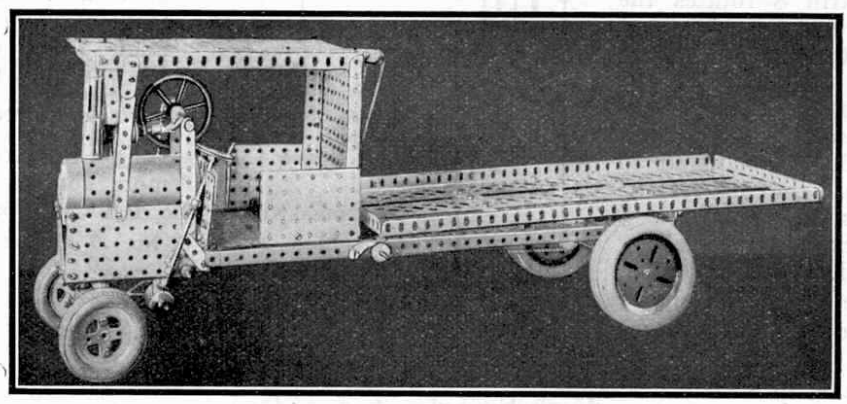
Everyone knows how the screw has been used to propel ships through the sea or aeroplanes through the air, but it is not generally known that the principle can be used to drive a machine over the land. In the *"M.M."* for December, 1927, we described a "snow motor," and it is on this machine that W. P. Cole (First Prize-winner, Section A) based the interesting model shown at the foot of the opposite page. It may be recalled that the novel method of propulsion of the snow motor consists of two large drums placed on either side of the power unit. To the surface of these drums a narrow strip of metal is attached in the form of a spiral, so that the finished drums are in reality huge screws.

The drums are coupled by means of Sprocket Drive to the propeller shaft of the motor, and on starting up the latter the drums are caused to rotate. When placed on snow or sand, or even soft earth, the spirals on the drums force or worm the machine forward in a manner somewhat similar to that in which the screw propeller fitted to a ship or aeroplane forces its way through the water or air.

The drums have been represented in the model by means of a number of Strips and two Face Plates and a series of 2½" Curved Strips constituting the spirals. Each drum is rotated by means of the Electric Motor, the drive being transmitted to the Sprocket Wheels seen at the rear through a clutch and a two-speed and reverse gear box. The method of taking the drive from the gear box to the Sprockets is quite original and worthy of mention.

The final shaft protruding from the gear box carries a Bevel Wheel that meshes with a second Bevel Wheel mounted in the centre of a Rod that carries two Pulleys fitted with Rubber Rings. Each of these Rings normally is held in engagement with further Rings mounted on Pulleys that are secured to the shafts carrying the Sprockets (see underneath view of model). The two Rods carrying the Sprocket Wheels may be moved longitudinally in their journals and the frictional right angle gearing or "clutch" on each shaft can thus be engaged or disengaged. The steering column is connected by means of a series of levers to the shafts carrying the Sprockets, and by rotating the steering wheel either of the drums can be stopped at will and the snow motor thereby deflected to the right or left as required.

It will be apparent from the foregoing that the design of the model (which conforms accurately to the principles embodied in the actual motor) has formed no small task for its builder. Cole has been completely successful, however, in his efforts to reproduce an accurate model of the prototype.



Meccano Steam Lorry fitted with tipping platform and Dunlop Tyres. The work of M. H. Maufe

An exceedingly well designed model of a steam lorry was submitted in Section B by M.H. Maufe. The model is illustratedat the foot of this page and it will be seen that it closely resembles a type frequently seen on the roads. Note should be made of the neat mechanism whereby the rear platform is tipped. The steering gear is also quite ingenious, and its design conforms closely to actual practice.

Electricity Applied to Meccano—(*continued from page 837*)

to the Gear 9 and insulated by Insulating Bushes.

The vertical 4½" Double Angle Strip to which the wire 10 is attached, is secured to and insulated from the 2½" Angle Girder on which it is mounted by a 6 B.A. Bolt and an Insulating Bush and Washer on the shank of the bolt. The wire 10 consists of a length of No. 22 Bare Copper Wire, bent as shown in the illustration in order that its end may dip into the centre hole of the Threaded Boss 1.

The bottom of the hole of the Threaded Boss should be plugged by a bolt and a drop of mercury placed in the hole. The tip of the wire 10 is submerged in the mercury to complete the L.T. circuit.

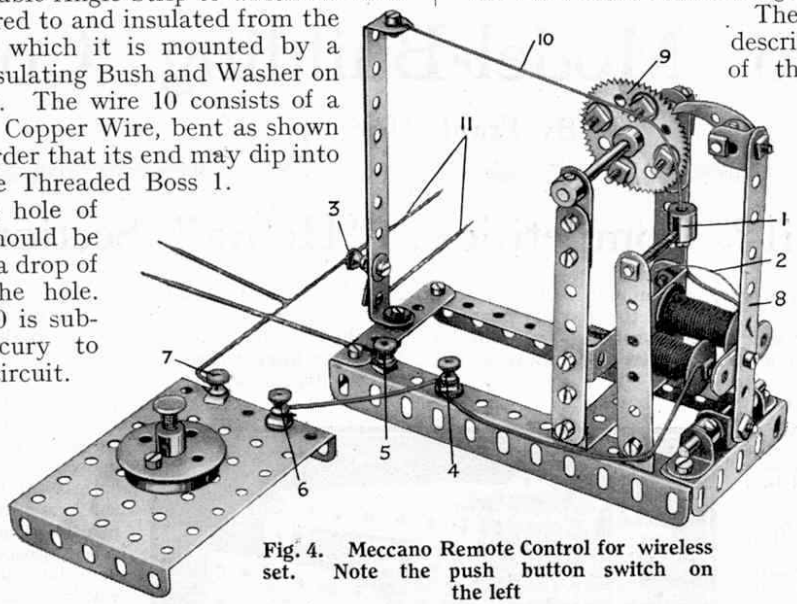


Fig. 4. Meccano Remote Control for wireless set. Note the push button switch on the left

Wiring the Apparatus

The wiring diagram (Fig. 5) should be consulted when making the connections. One end of the winding of one magnet is connected to one end of the other magnet winding. The remaining end of one magnet is earthed (by attaching it to the frame of the model) whilst the other magnet end is taken to the terminal 4. The latter is insulated from the Angle Girder by means of an Insulating Bush and Washer, but the terminal 5 is in direct metallic contact with the Girder, as also is the terminal 3 attached to the vertical 4½" Double Angle Strip.

One of the wires 11 is held by the terminal 3 and taken to an L.T. terminal of the set, the other L.T. terminal being connected to the Accumulator. A continuation of the latter wire is led to the terminal 7 on the push switch. The other terminal of the Accumulator is connected to the terminal 5 of the remote control.

As already stated, the wires connecting the push switch to the remote control and the Accumulator may be of any convenient length, of course, as is indicated by the break in these wires shown in Fig. 5. The remote control and the wireless set should be arranged close together, however.

Normally the wire 10 rests on one of the insulated 6 B.A. Bolts projecting from the face of the 57-teeth Gear Wheel 9, but when the push of the switch is pressed down, the magnet circuit is closed and the Strip 8 drawn toward the pole faces of the magnets. This motion of the Strip 8 rotates the Gear 9 partially—through the action of the Pawl—and lowers the tip of the wire 10 into the mercury contained in the Threaded Boss 1. The L.T. circuit of the set is now complete. A single push of the button is all that is required to actuate the switch as the instrument functions practically instantaneously.

The Strip 8 is returned to normal by a short length of B.I. Wire 2, which acts as a spring. One end of this wire is attached to the Double Angle Strip carrying the magnets whilst the other end presses against the Strip 8.

When it is desired to discontinue using the set, the push is pressed once more. This rotates the Gear Wheel and lifting the wire 10, breaks the L.T. circuit and extinguishes the valves.

The push button switch was described fully in the third article of this series, which appeared in the "*M.M.*" for January, 1928, but for those of our readers who are unable to turn to a copy of this number of the "*M.M.*" we append a short description of the construction of the switch.

It consists essentially of a Flanged Wheel and Pivot Bolt. A small compression spring, obtained by cutting two or three turns off part No. 120b, is placed between the head of the bolt and the boss of the wheel. The contact piece consists of a 6 B.A. Bolt secured with its head immediately beneath the shank of the Pivot Bolt. If the switch is mounted on a metal base as in the illustration the contact bolt must be insulated, of course, by means of Insulating Bushes and Washers.

In making the connections, one wire should be secured to the ½" Bolt holding the Flanged Wheel in place and another to the insulated contact bolt. The circuit is completed by pressing down the Pivot Bolt, which is prevented from falling out of position by a nut placed on its extreme inner end.

Of course, any other type of switch may be used, such as the Meccano single way switch that also was described in the January article, but the push button switch is the most suitable, since it is necessary only to energise the electro-magnets momentarily.

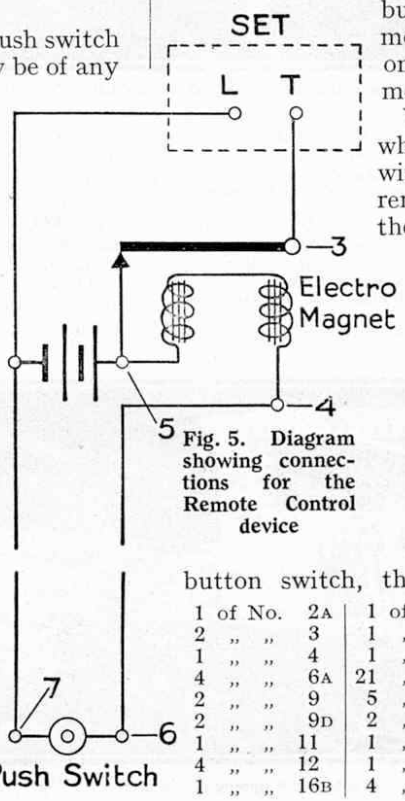


Fig. 5. Diagram showing connections for the Remote Control device

We would refer those of our readers who are not clear as to the method of wiring the switches to operate the remote control from several rooms to the diagram on page 516 of the June "*M.M.*" This diagram shows four switches controlling a single bell—the bell being substituted by the remote control in this case of course. By careful perusal of this diagram matters should be made quite clear with regard to the wiring of the switches.

Parts Required

For the construction of the remote control apparatus, with push button switch, the following parts are necessary:—

1 of No. 2A	1 of No. 17	1 of No. 64	10 of No. 305
2 „ „ 3	1 „ „ 20	1 „ „ 81	5 „ „ 306
1 „ „ 4	1 „ „ 27A	1 „ „ 111C	2 „ „ 308
4 „ „ 6A	21 „ „ 37	1 „ „ 120A	2″ „ „ 312
2 „ „ 9	5 „ „ 37A	1 „ „ 147	1 „ „ 314
2 „ „ 9D	2 „ „ 48A	2 „ „ 301	6″ „ „ 315
1 „ „ 11	1 „ „ 48C	8 „ „ 302	
4 „ „ 12	1 „ „ 53	8 „ „ 303	
1 „ „ 16B	4 „ „ 59	10 „ „ 304	

Electricity Applied to Meccano

XIII—Meccano Electric Time-Keeping Apparatus

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described Meccano switches, a coil winding machine, a telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, an ammeter, an electric sign, an electrically-controlled railway, electric beam and horizontal engines, a drop hammer, and a remote control for radio sets. This month we describe a means whereby the Meccano Grandfather Clock may easily be caused to control any number of "slave clocks." Thus the Meccano boy may now have an accurate time-keeper in every room in his house.

THE interest and practical value of the Meccano Grandfather Clock, which is already regarded by most boys as one of the finest Meccano models, may be increased still further by using it as an electric master clock. When so adapted the clock may be made to control any number of electric dials, or "slave clocks," situated in different rooms or even in different buildings, the only connection between the dials and the clock being two insulated wires.

The Meccano Clock is converted to an electric master clock merely by attaching an automatic switch mechanism. This is shown in Fig. 1, and is constructed as follows. The Rod 1 of the clock mechanism proper is normally 3" long, but this must be exchanged for a 3½" Rod to allow a 57-teeth Gear Wheel to be added to the inner end. This Gear Wheel drives the ½" Pinion 2 on the 2" Rod 3, which also carries a 2" Sprocket Wheel 4. As will be seen, one side of the Sprocket Wheel is covered with a circle of thin card (a postcard serves excellently) attached to the wheel by the two bolts 5.

The 5½" Strip 6 carries a 1" Triangular Plate 7 and two Terminals 8 and 9, the former (8) being bolted direct to the Strip 6 while the terminal 9 is insulated therefrom by an Insulating Bush and Washer. A short length of No. 22 bare copper wire is fastened to the terminal 9 and to the insulated 6 B.A. Bolt 10 on the Triangular Plate 7. The wire is bent inward to touch the card on the Sprocket Wheel 4, and its length is such that as this wheel revolves, the bolts 5 just brush against its end and thus switch on the current to work the slave clocks. The length by which the wire overlaps the Wheel 4 should be adjusted in order to make the duration of contact with the bolts 5 as short as possible, consistent with reliability. The points of contact must be kept clean.

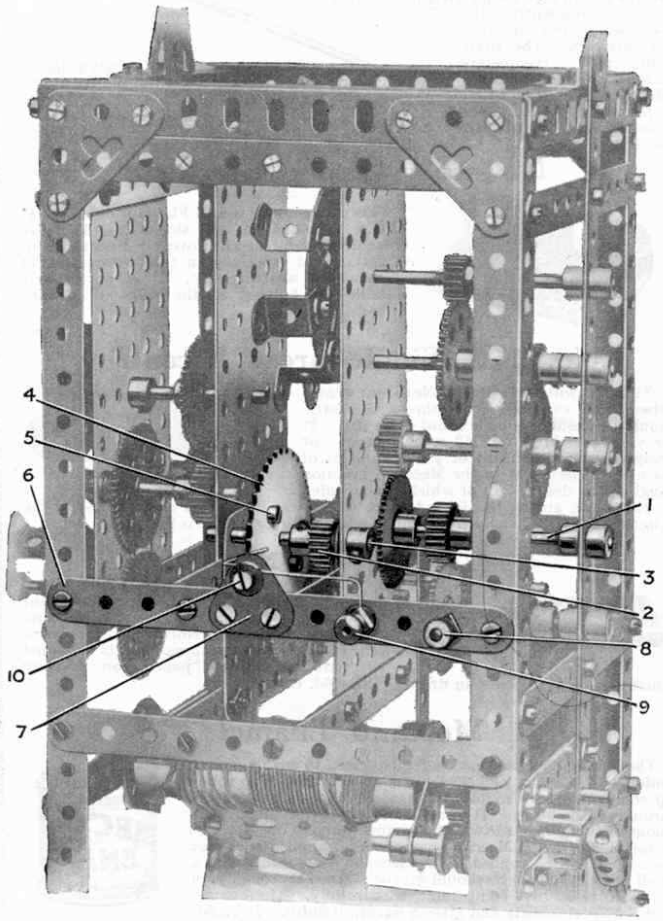


Fig. 1. The Meccano Grandfather Clock mechanism, showing the electric Master Control

The Slave Clock Mechanism

The construction of the slave clock will be fairly clear on reference to Figs. 2 and 4. Fig. 2 is a general view and Fig. 4 is a view of the mechanism at the rear. The frame of the slave clock consists of a 5½"×3½" Flat Plate 11 (Fig. 4) and a 5½"×2½" Flat Plate 12 connected together at the top by two 2½"×½" Double Angle Strips and a 3½" Angle Girder, and at the bottom by two 3½" Angle Girders and two 3½"×½" Double Angle Strips, in the end holes of which are bolts by which the model may be secured to, say, a wall bracket.

The electro magnet consists of two Bobbins 13 wound to capacity with No. 26 gauge S.C.C. wire and supported by a 1½"×½" Double Angle Strip 14, between which and the Bobbins are placed four 1½" Strips.

The propelling arm 15 consists of a 3½" Strip, to the bottom end of which is attached a Boss Bell Crank carrying the counterweight 16 that comprises two Threaded Bosses and two 1½" Strips secured to a 1" Screwed Rod. A 3½" Rod 17 is secured in the boss of the Bell Crank and upon this Rod the arm pivots. The armature 18 consists of four 1½" Strips attached by an Angle Bracket to the propelling arm 15.

A Pawl 19 attached by means of a Pivot Bolt to the top hole of the propelling arm engages with the teeth of the 2" Sprocket Wheel 24. The latter is prevented from turning backward by the second Pawl 25 that is pivoted on a 1" Rod fixed in the boss of the Crank 26. The back stop for the propelling arm is adjustable. It is formed by bolting a Crank 20 to the Flat Plate 11 so as to support a 1" Rod that carries on its outer end a Coupling 21, through which is threaded a 1" Screwed Rod 22. When the correct position for the stop has been found the Rod 22 is locked in position by the Threaded Boss 23.

The inner ends of the wires on the Bobbins 13 are fastened together by a nut and bolt and two Washers 27, and the outer ends are taken to the two Terminals 28 and 29, the latter only being insulated. Care must be taken to ensure that the bolt 27 does not come into

contact with the frame of the model.

How the Slave Clock Operates

When the current is switched on by the automatic switch on the master clock, the magnets 13 attract the armature 18, thus causing the Pawl 19 to move forward and propel the Sprocket Wheel 24 one tooth forward. When the current is switched off, the armature is released and the propelling arm 15, with the Pawl 19, is returned by the counter-weight 16 to its normal position against the back stop 22. It will thus be seen that the Wheel 24 is turned by the action of the pulses of current received by the magnets from the master clock.

The Rod 30, to which the Wheel 24 is attached, carries a $\frac{3}{4}$" Pinion 31 that meshes with a 50-teeth Gear Wheel 32 on the $4\frac{1}{2}$" Rod 33, to which the minute hand 34 is attached. The hands are made of cardboard, for Meccano Strips prove too heavy for the purpose.

The hour hand is driven by the minute hand through gears arranged similarly to those on the master clock. A $\frac{3}{4}$" Pinion on the Rod 33 drives a 50-teeth Gear Wheel on the Rod 35, which carries a $\frac{1}{2}$" Pinion that, in turn, drives the 57-teeth Gear 36. This Wheel meshes with another 57-teeth Gear 37 on the same Rod as the $\frac{3}{4}$" Pinion 38, and the latter engages with the 50-teeth Gear 39 on the Rod of the $1\frac{1}{2}$" Sprocket Wheel 40, which drives the hour hand as shown. The $\frac{1}{2}$" Reversed Angle Bracket that carries the hour hand is separated from the Sprocket Wheel, which is loose on the Rod 33, by two Washers to provide the necessary clearance for the Sprocket Chain.

The face of the slave clock may be attached to the four Double Angle Strips 41, and the whole mechanism may be mounted in any suitable frame.

Wiring Details

The wiring of the master clock, slave clock, and Accumulator is very simple. One wire is taken from the Terminal 8 on the clock (Fig. 1) to one terminal of the Meccano 4-volt Accumulator. Another wire is taken from the other terminal of the Accumulator to the Terminal 28 on the slave clock, and a third wire is taken from the Terminal 29 to the Terminal 9 on the master clock. Thus every time one of the Bolts 5 comes into contact with the wire from the Terminal 9, the Wheel 24 of the slave clock is moved on one tooth. This happens seventy-two times every hour and as this is the number of impulses required to turn the minute hand on the electric dial round once, the master clock and dial keep time with each other.

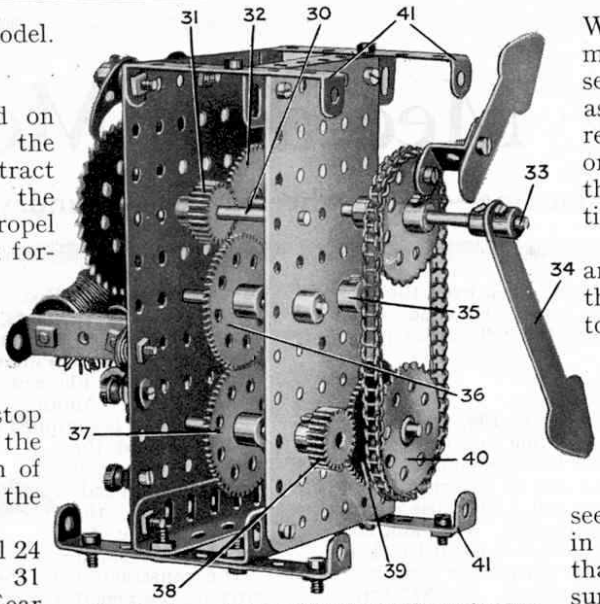


Fig. 2. General view of Slave Clock mechanism

The slave clock may be placed anywhere, its only connection with the clock being the two wires to carry the current. Any number of slave clocks may of course be controlled by the one master clock. (A convenient method of wiring three slave clocks to a master clock is indicated in Fig. 3, where it will be seen that the clocks are connected in parallel. This means of course, that more current will be consumed than is the case when only one slave clock is employed). The Meccano 4-volt 8 amp. Accumulator is quite suitable to operate a single slave clock. With a number of slave clocks connected in parallel, however, it is necessary to use the 4-volt 20 amp. Accumulator.

It is of the utmost importance that all the moving parts of both the slave and master clocks should work with perfect freedom. All the bearings should be in alignment so that the gears mesh correctly, and, of course, the mechanism should be kept well oiled.

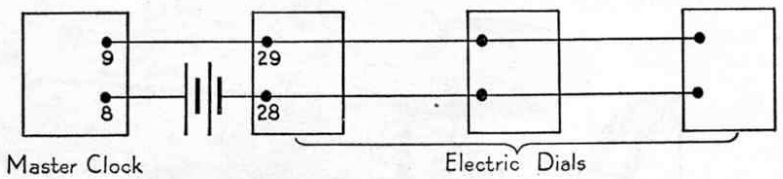


Fig. 3. Diagram showing Master Clock connected to three Slave Clocks

Parts Required for Electric Mechanism

The automatic switch mechanism requires the following parts extra to the ordinary parts embodied in the Grandfather Clock :—

1	of No. 16	1	of No. 78
1	„ „ 17	1	„ „ 95
1	„ „ 26	2	„ „ 302
1	„ „ 27A	2	„ „ 303
4	„ „ 37	3	„ „ 304
2	„ „ 38	3	„ „ 305
1	„ „ 59	2	„ „ 306
		3″	„ „ 315

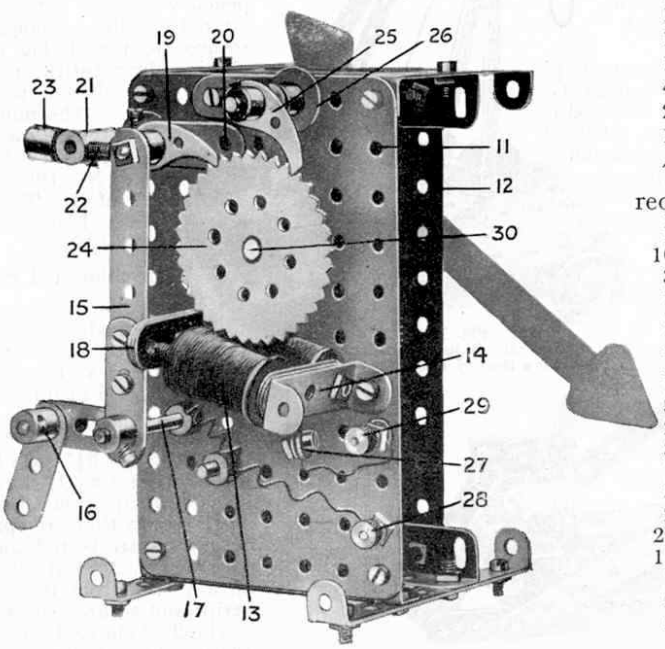


Fig. 4. Rear view of Slave Clock showing electro magnet, etc.

The slave clock mechanism requires the following parts:—

1	of No. 3	13	of No. 59
10	„ „ 6A	2	„ „ 62
3	„ „ 9B	1	„ „ 63
1	„ „ 12	3	„ „ 64
1	„ „ 15A	1	„ „ 70
1	„ „ 16	2	„ „ 82
1	„ „ 16A	10″	„ „ 94
1	„ „ 16B	1	„ „ 95
3	„ „ 17	2	„ „ 95A
2	„ „ 18B	1	„ „ 125
3	„ „ 25	1	„ „ 128
1	„ „ 26	2	„ „ 147
3	„ „ 27	2	„ „ 301
2	„ „ 27A	1	„ „ 302
29	„ „ 37	1	„ „ 303
10	„ „ 38	2	„ „ 304
1	„ „ 48	2	„ „ 305
2	„ „ 48A	2	„ „ 306
2	„ „ 48B	2	„ „ 308
1	„ „ 52A	1	„ „ 313

1 Clock Face
2 Cardboard Hands

Electricity Applied to Meccano

XIV.—Crystal Receiving Set

This is the last of a series of articles intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano Electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described Meccano switches, a coil winding machine, a telegraph system, electro magnets, a galvanometer, motors, an electric locomotive, bells, lamps, an ammeter, an electric sign, an electrically-controlled railway, electric engines, a drop hammer, a remote control for radio sets, and electric clocks. This month we describe an efficient wireless receiving set made principally from Meccano parts.

IT is little more than twenty years since Senator Marconi attained success in transmitting telegraphic messages without the aid of wires. The value of the new invention was soon proved, although by tragic means. In 1912, when the R.M.S. "*Titanic*" struck an iceberg in the Atlantic and rapidly commenced to sink, wireless was used to summon other vessels to its aid, and but for the fact that the "S.O.S." messages were heard and quickly answered, the loss of life—although terrible—would have been much greater.

The development of broadcasting is one of the wonders of the present day. Ten years ago wireless enthusiasts listened-in to telephony with instruments of the crudest description. First came crystal sets tuned with inductance coils, and then valve detector sets with a similar means of tuning, which hardly could be described as "low loss."

Since these early days broadcasting has grown apace. The improvements at the transmitting end have been great and the receiving set, which is now an almost indispensable feature in most homes, also has been improved beyond recognition, both as regards appearance, reception and reproduction. Radio sets may now be obtained for every purpose and to suit every pocket. There is the superheterodyne, for those whose ambition is to "get" Mars (and who also have plenty of money!); the ordinary three or four-valve receiver in its many forms; entirely self-contained "portables" (ideal for the river, picnics, etc.); and lastly, the humble pioneer crystal set.

The crystal set has not much to be ashamed of even in these days, for although its range is strictly limited, it is well known that for clarity of reproduction—as pure as its name implies—the crystal as a means of rectification has never been excelled. Moreover, it costs nothing to maintain—a consideration which, we believe, is of no little importance to most, if not all, Meccano boys!

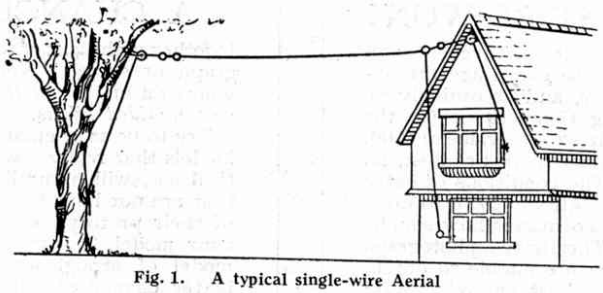


Fig. 1. A typical single-wire Aerial

Parts required to build the Crystal Receiving Set

2 of No. 5	28 of No. 37	1 of No. 80A
6 „ „ 11	5 „ „ 37A	1 „ „ 81
2 „ „ 12A	1 „ „ 44	4 „ „ 304
1 „ „ 16B	1 „ „ 47	4 „ „ 305
1 „ „ 27A	1 „ „ 48A	4 „ „ 306
1 „ „ 32	4 „ „ 59	1 „ „ 313

The following items will be required, but are not included in the Meccano system.

Strip of fibre or stout cardboard, approximately 15″ × 5″.

2 Ebonite Knobs (not essential).

1 Crystal. **1 Catwhisker.**

Building the Meccano Model

The Meccano crystal set is of very simple construction, as will be seen from Fig. 1, but this fact does not detract from its efficiency. It will receive telephony within a radius of approximately 15 miles. With a high power station, such as Daventry (5XX), the range is much greater, but as such stations transmit on a wave length much higher than the normal range of the set, a loading coil is necessary. The latter is connected in series with the variometer. That is to say, one end of the loading coil is connected to the aerial terminal of the set and the other directly to the aerial lead-in. Approximately 150 turns of 26 S.C.C. Wire will be required, wound on a suitable former. The former will of necessity be rather larger than those used for the variometer.

The plates forming the "panel" may be made from stout cardboard or fibre strip. The best way to make the holes is to place the material between two 5½″ × 2½″ Flat Plates; a Meccano Rod may then be punched through the fibre, the holes in the Meccano Plates acting as a guide for the Rod. After the holes have been punched, the edges of the fibre plate may be trimmed. It may be asked why the panel should be made of two 5½″ × 2½″ Plates and why they have so many apparently unnecessary holes. The reason for this is that the plates so made may be used in numerous other models and for a variety of purposes.

The coil formers may be made out of the same material as the panel, or if preferred, they may be bought already shaped in various sizes. If cardboard is used it should be soaked in melted paraffin wax. Sufficient fibre for the panel and formers should be obtainable for about sixpence.

On each of the coil formers 25 turns of 26 S.C.C. Copper Wire are wound. In order to secure its end, the wire is first passed through two small holes that are made near the centre of the former. The winding is then commenced, the wire being laid on alternate sides of each of the segments of the former until the 25 turns have been completed, and the coil is finished off by passing the end of the wire through two other small holes near the circumference.

The coil 1 is attached by a nut and bolt to a 57-teeth Gear Wheel that is secured to a 3″ Rod journalled in a 2½″ × 1½″ Double Angle Strip 3. The latter is bolted to the fibre plates forming the base of the model. The 57-teeth Gear meshes with a Worm on a 3½″ Threaded Rod that is journalled in a 2½″ × ½″ Double Angle Strip, and this Strip is secured to the base at right angles to the Double Angle Strip 3. By rotating the insulating knob that is locked by a nut on the end of the Threaded Rod, the coil 1 may be moved slowly round, thus altering the position in relation to the fixed coil 2. This alteration of the coils tunes the set to the desired wave length.

The fixed coil is attached to a 1″ × 1″ Angle Bracket secured to the base. The 57-teeth Gear with the coil 1 attached should be now adjusted on its Rod so that the two coils are as close to each other as possible without actually touching. The 1″ × 1″ Angle Bracket is provided with a terminal to which the aerial lead-in is attached and the commencement of the winding of the fixed coil 2 should be secured to the bolt that holds the coil to the Angle Bracket.

The crystal is mounted in two Double Brackets that are bolted to 1″ × 1″ Angle Brackets 4. Suitable crystals with catwhisker may easily be obtained, but we recommend readers to use only the best. Several well-known and reliable makes of crystal are on the market.

A Cranked Bent Strip 5, pivotally mounted by a lock-nutted bolt (see Standard Mechanism 263) on the panel, carries at its upper end a Threaded Boss that is attached to the Cranked Bent Strip by bolts. The bolts are inserted in the tapped transverse holes of the Threaded Boss and are locked in position by nuts so that they do not grip the 2″ Threaded Rod passing through the longitudinal bore of the Boss. This Rod carries the catwhisker at one end and an insulating knob at the other. (A suitable knob may be purchased from any wireless stores or, if appearance is of secondary importance, a 1″ fast Pulley fitted with a small Rubber Ring (part

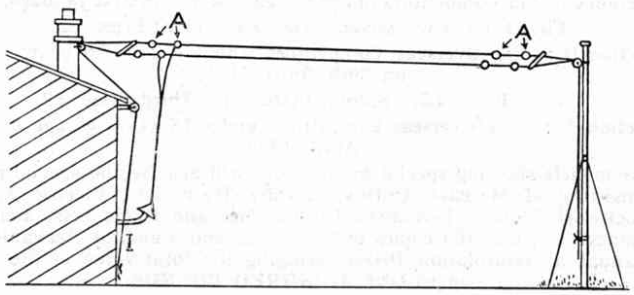


Fig. 2. A two-wire Aerial, for use where space is restricted