

Functions of the Dog Clutch

The Meccano Dog Clutch (part No. 144) consists of one male and one female section. The object of this part is to enable two shafts to be engaged with each other or disengaged whenever desired. The shafts must be mounted end to end and one must be slidable in its bearings so that the clutch sections can be thrown in or out of engagement on operation of a suitable lever.

Alternatively, the Dog Clutch may be used, in conjunction with a Socket Coupling, to enable a Gear Wheel or Pinion, etc., to be mounted on a shaft so that it can either be carried round bodily with the shaft or allowed to remain stationary whilst the shaft carrying it turns in its boss. A typical example of the Dog Clutch used in this way has already been described (see Fig. 6 in last month's "M.M.").

Another typical Dog Clutch mechanism will be found in Fig. 4. In this case the driving Rod carries the Clutch member 1 and on movement of the lever 3 the secondary Rod 2 may be brought in or out of engagement. The lever is pivoted by a bolt and lock-nuts 5 to an Angle Bracket and also to a Single Bent Strip 4 that is held loosely between the Clutch sections 1 and a Collar with set-screw.

Fig. 6 shows the Dog Clutch employed in the construction of a reversing mechanism. In this mechanism either of the horizontal Rods may be used as a driving shaft. Each carries at its inner end one segment of a Dog Clutch 1, and one $\frac{3}{4}$ " Pinion 2, 3. The left-hand horizontal Rod is slidable in its bearings and is controlled by a suitable hand lever, such as that shown in Fig. 4.

In the first position of the hand lever the $\frac{3}{4}$ " Pinion 2 is caused to engage with a $1\frac{1}{2}$ " Contrate Wheel 4 (as in the illustration) whilst in its second position the Pinion is thrown out of engagement and the clutch members are combined. The Pinion 3 remains in constant engagement with the Contrate 4, and in the second position of the lever the Contrate merely revolves idly. Incidentally, this diagram indicates another important use for the $1\frac{1}{2}$ " Contrate Wheel.

In Fig. 5 the Dog Clutch is used to obtain intermittent rotary motion. One portion of the Dog Clutch is secured to the shaft of the Worm 2, which is driven constantly. The other portion 9 of the clutch is mounted on a secondary shaft 1, which is slidable in its bearings, and through the action of the Threaded Pins 4 secured to the revolving Gear Wheel 3, and the lever 5 with its connecting link 7, the Rod 1 is pushed outward at certain regular intervals and after a short period returned to its former position by means of a Compression Spring pressing against the Collar 6. In this way the clutch members are alternately engaged or disengaged, thus imparting intermittent rotary motion to the shaft 1.

Pawl and Ratchet Gear

The Meccano Pawl (part No. 147) and Ratchet Wheel (No. 148) may be said to be in partnership, for the one is never used without the other, except on those rare occasions when use can be found for the Pawl only, as in the safety device fitted to the Meccano Warehouse (special instruction leaflet No. 31) where it forms

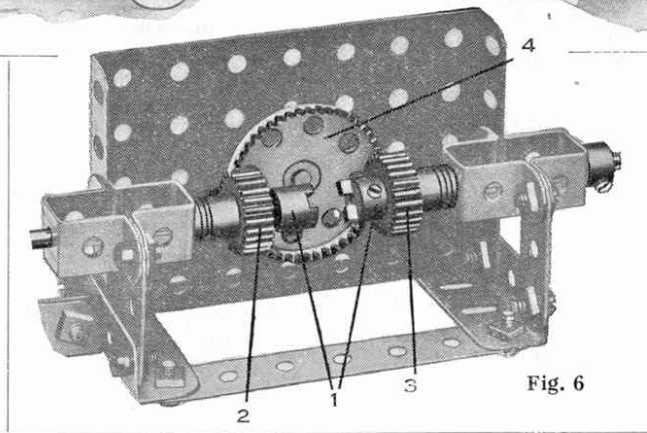
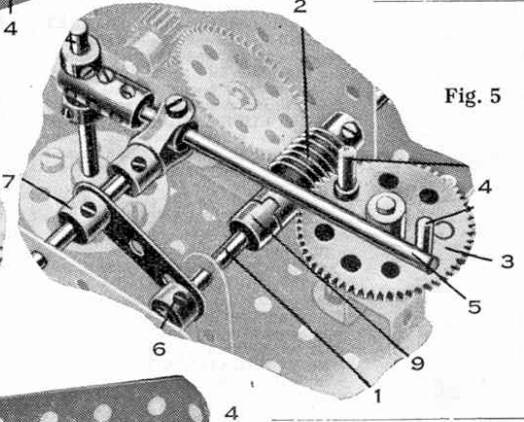
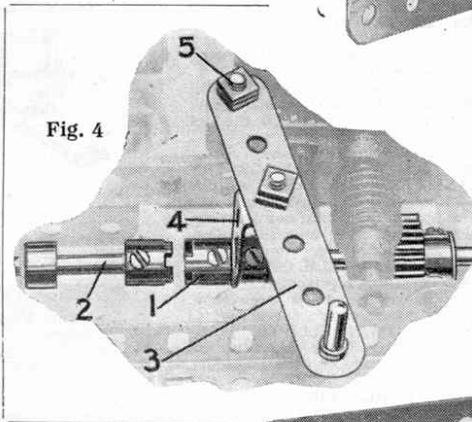
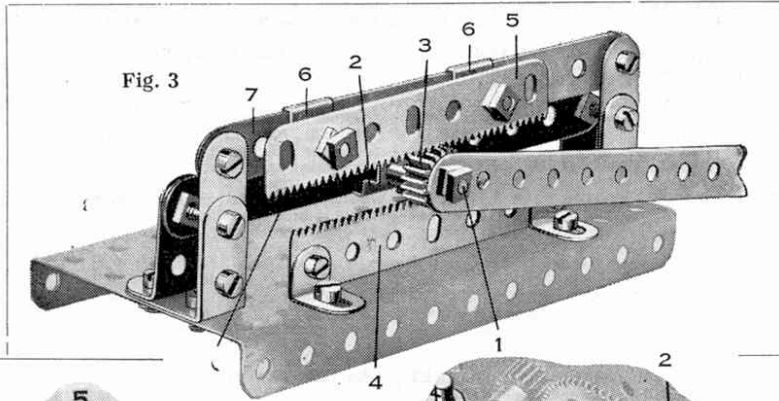
a small catch that engages with the lift guides in the event of accident to the hoisting mechanism. Used in conjunction with each other, the Pawl and Ratchet provide a mechanism that allows the shaft on which the Ratchet Wheel is secured to rotate in one direction only. The advantages of such an arrangement are obvious, especially when attached to model cranes and hoisting

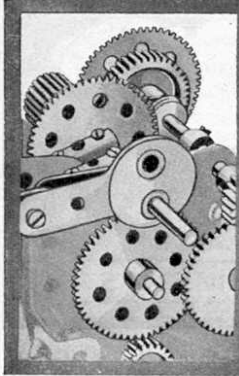
tackle, etc., where the Pawl and Ratchet gear prevents falling-back of the load as it is hoisted.

A slight pressure should always be applied to the Pawl—by means of a spring or weighted lever—to ensure that it is always in proper engagement with the teeth of the Ratchet Wheel.

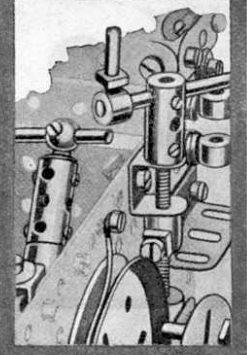
Fig. 2 shows a typical Meccano free-wheel movement employing two Pawls and a Ratchet Wheel. In this mechanism the Pawls are mounted pivotally on the face of the Sprocket by means of Pivot Bolts and lock-nuts, and are held in engagement with the Ratchet Wheel by lengths of Spring Cord attached to set-screws in the Pawls and to the face of the

(Continued on page 772)





HOW TO USE Meccano Parts



X.—Special Accessories (Class P)

For the purpose of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structural and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping is as follows. Structural Section: Class A, Strips; Class B, Gyrders; Class C, Brackets, Trunnions, etc.; Class D, Plates, Boilers, etc.; Class E, Nuts and Bolts, Tools and Literature. Mechanical Section: Class M, Rods, Cranks and Couplings; Class N, Wheels, Pulleys, Bearings, etc.; Class O, Gears and Toothed Parts; Class P, Special Accessories; Class Q, Miscellaneous Mechanical Parts; Class T, Electrical Parts; Class X, Motors, Accumulators, etc.

THE contents of the various classes into which the Meccano parts have been grouped are indicated in the introductory note above, but before describing the parts included in Class P we will endeavour to explain more fully the system of classification that has been adopted in the Mechanical Section.

Having allocated the appropriate accessories to classes M, N, O, T, and X it was found that there still remained a large number of unclassified parts. Of these a certain proportion possess characteristics quite different to the rest; they were therefore collected together under "Class P, Special Accessories," while the remainder were labelled "Class Q, Miscellaneous Mechanical Parts."

By "Special Accessories" we mean those parts that are designed for special purposes, such as Shuttles (for looms), rubber tyres (for fitting to Pulley Wheels, to represent motor car wheels), Signal Arms, etc. Under "Miscellaneous Mechanical Parts" are grouped all those parts that are used in the construction of gear boxes and other working features of a model and yet cannot be grouped under Classes M, N, or O. It must here be mentioned, however, that although the Special Accessories have been introduced for particular purposes, they have been used by Meccano boys for other very different functions, some of which are referred to in these pages. Class P parts not described in this article will be dealt with next month.

The Propeller Blades have recently been improved in design and now conform closely to an actual aeroplane propeller, or airscrew. Fig. 3 shows two of the three engines incorporated in the Meccano Biplane (see Special Instruction Leaflet No. 34). Each airscrew is formed from two Propeller Blades, and it will be observed that each pair of blades is bolted to a Double Arm Crank, the boss of which serves to secure the complete airscrew to the engine shaft. The hub end of each blade is rounded so that it partially encloses the boss; hence one bolt is sufficient to hold the blade perfectly rigid. If a Double Arm Crank is not available the blades may

of course be bolted to a Bush Wheel or similar part.

The broader parts of the blades are turned at an angle to the plane of rotation so that a considerable current of air is created by the airscrew when in motion. As a matter of fact the Propeller Blades have been employed in a Meccano electric fan, although for such a purpose it is better to shape the fan itself from a sheet of tin so that the blades may be as broad as possible. A very interesting small model making use of the Propeller Blades is the "helicopter" described in the 1929 "Meccano Book of New Models."

In Model No. 4.23 (Windmill Scare) in the 4-7 Instruction Manual four Windmill Sails are shown secured to a 1½" Pulley Wheel. Like the Propeller Blade, the Windmill Sail has its hub end cut out so that it will fit round the boss of a wheel or, as in this case, round the raised lip on the wheel on the reverse side to the boss. Amongst other adaptations of the Windmill Sail that have been suggested by Meccano boys are its use to represent cabin sides in model ships (complete with windows!) and wings for small aeroplanes.

The Weights (parts Nos. 66 and 67) are supplied specially for the benefit of Meccano boys who wish to carry out delicate scientific experiments, wherein perfectly accurate weights are essential. For example, they are used in connection with the lever and pulley demonstration models that were described in detail in the 1928 Standard Mechanisms Manual. In these models the properties of various types of levers and pulley blocks were illustrated, and in order

Parts in Class P: Special Accessories

Part No.	Description	Quantity	Price (s. d.)
41	Propeller Blades	per pair	0 4
61	Windmill Sails	4 for	0 6
66	Weights, 50 grammes	each	1 0
67	" 25	"	1 0
101	Healds, for Looms	doz.	0 9
104	Shuttles, for Looms	each	5 0
106	Wood Rollers, complete with 4½" Rod and 2 Collars	"	1 6
106a	Sand Rollers, complete with 4½" Rod and 2 Collars	"	1 9
107	Tables for Designing Machines, Complete with Bush Wheel	"	1 6
114	Hinges	per pair	0 4
117	Steel Balls, ¾" Diam.	doz.	0 6
120	Buffers	each	0 2
120a	Spring Buffers	per pair	0 8
122	Miniature Loaded Sacks	each	0 2
131	Dredger Bucket	½ doz.	1 0
135	Theodolite Protractors	each	0 3
138	Ship's Funnels	"	0 3
138a-z	" Raked; A series of 25 funnels in colours to represent leading shipping lines	"	0 9
141	Wire Lines (for suspending Clock Weights)	"	0 9
142	Rubber Rings, to fit 3" rim	"	0 3
142a	Dunlop Tyre to fit 2" diam. rim	set of 4	1 6
142b	" " " 3" " "	each	0 6
142c	" " " 1" " "	"	0 3
142d	" " " 1½" " "	"	0 4
149	Collecting Shoes, for Electric Locos	"	1 6
150	Crane Grabs	"	0 7
155	Rubber Rings, ⅝" int. diam. (will fit 1" Pulley)	"	0 1
156	Pointers, 2½" overall, with boss	"	0 4
157	Fans, 2" diam. with boss	"	0 4
158a	Signal Arm, Home	"	0 5
158b	" Distant	"	0 5
159	Circular Saws	"	1 0
169	Digger Buckets	"	2 0

to obtain correct measurements of their

mechanical efficiency, small weights of absolute accuracy were necessary.

The Weights also find numerous other applications in ordinary model-building. Fig. 1 shows a portion of a device for measuring the movement of a beam that is subjected to a bending stress. In order to measure the strength of the beam correctly, the exact amount of the weight applied must be known. In the illustration five 50-gramme Weights 3 are attached to the centre of the beam by means of a Scientific Hook.

The 25-gramme Weight 4 serves to counterbalance

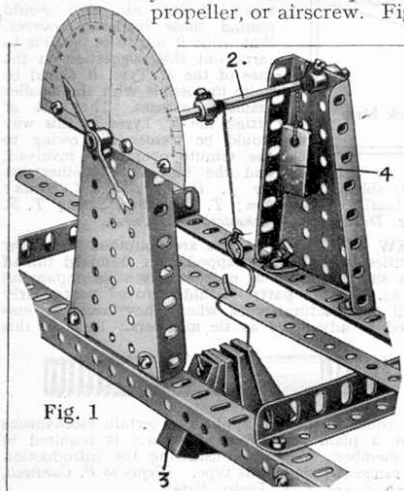


Fig. 1

propeller, or airscrew. Fig. 3 shows two of the three engines incorporated in the Meccano Biplane (see Special Instruction Leaflet No. 34). Each airscrew is formed from two Propeller Blades, and it will be observed that each pair of blades is bolted to a Double Arm Crank, the boss of which serves to secure the complete airscrew to the engine shaft. The hub end of each blade is rounded so that it partially encloses the boss; hence one bolt is sufficient to hold the blade perfectly rigid. If a Double Arm Crank is not available the blades may

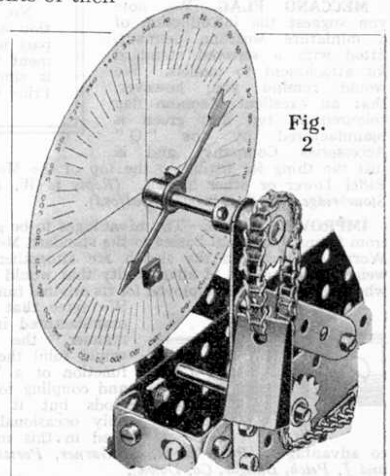


Fig. 2

the weight of the Pointer, so that the latter always returns to the "zero" position when the load is removed from the beam. In Fig. 2 a 25-gramme Weight is used for a similar purpose, i.e. for returning a Pointer to "zero," or neutral, after deflection. Of course, in these two last-mentioned cases it is not essential that the weights should be of great accuracy or even of any particular amount, and if a Meccano boy does not already possess these parts he can use home-made weights, or a Meccano Wheel or two, in their place. This remark applies to several models shown in the Meccano literature.

In addition to the use for which it is specially designed, i.e. as a heald in the Meccano Loom (see Instruction Leaflet No. 16), part No. 101 is frequently employed as a tie in bracing various Meccano structures. In the Meccano Three-engine Biplane (Instruction Leaflet No. 34) Healds are used as the diagonal ties between each pair of upright wing supports. A portion of a pair of these supports, with the Healds in position at 25, can be seen in Fig. 5. Another important use for Healds is found in the Meccano Motor Chassis, where they are employed as the means of connection between the hand brake lever and the brake mechanism on the rear wheels.

Part No. 104, Shuttle, is produced specially for use in the model Loom. It is illustrated and its functions fully explained in the Instruction Leaflet dealing with that model.

In addition to their functions as the take-up rollers in the Loom, the Wood and Sand Rollers (Nos. 106 and 106a), are frequently used as winding drums in Meccano cranes, etc. Both Rollers are provided at each end with a circular recess, to receive a Collar or wheel boss, and with a slot to receive the set-screw inserted in the boss. Each is supplied complete with two Collars secured to a 4½" Axle Rod. The Wood Roller also has a groove along one side, the object of which is to enable the woven material in the Loom to be secured by gripping it under a short Rod dropped into this slot. An ideal winding drum may be formed from the Wood Roller by adding a Bush Wheel at either end as shown at 45 in Fig. 4. A drum so formed has a large capacity.

The Sand Roller differs from the Wood Roller in that it is encircled by a sheet of tin that is specially burled so as to grip the woven material in the Loom as it passes beneath it and is wound on to the Wood Roller.

Part No. 107 is supplied specially for use with the Meccanograph (see Instruction Leaflet No. 13) wherein it is used to hold the paper whilst the design is being drawn by the writing arm. It is 6½" square, of smooth polished wood, and is supplied complete with a Bush Wheel screwed to its under side, by means of which it is secured to the vertical rotating spindle in the model. The part is also very useful as a fixed base for small models.

A Meccano Hinge is shown in Fig. 5, where it is seen connecting one end of the aileron to the main wing in the Meccano Biplane. This part is invaluable for mounting doors and similar hinged parts in Meccano models. It is also frequently used in place of lock-nutted bolts, etc., in making pivotal connections between any two parts of a model.

The Steel Balls (part No. 117) are intended for use in building up ball bearings for swivelling structures. A typical built-up ball bearing unit is described in the Standard Mechanisms Manual (see detail No. 134), and on reference to this it will be found that twenty-one Steel Balls are placed round the circumference of a

Wheel Flange that is bolted to a 3" Pulley Wheel, while a further 3" Pulley, which is bolted to the swivelling superstructure, rests upon the Balls. With this arrangement it is possible to rotate heavy structures easily and smoothly about a central pivot. The Steel Balls are also used in model-building for ballast purposes and for driving "gravity wheels." In the latter case the Balls are arranged to drop one at a time on to the blades of a kind of water-wheel, and the weight of the Balls causes the wheel to rotate, just as the force of the water operates the actual water-wheel.

The Miniature Loaded Sacks add a very realistic touch to Meccano models of cranes, lorries, conveyors and other types of goods-handling machinery. They may also be used with advantage in connection with Hornby goods trains. They are filled with sawdust and provided with a small loop of wire by means of which the crane hook may be attached.

The Meccano Theodolite Protractor consists of a sheet of superfine ivory card on which are printed circular and semi-circular scales, marked out in degrees. These two scales are for use in the Meccano Theodolite (Model No. 6.4), the former for indicating the extent of rotation of the model in a horizontal plane and the latter for indicating the angle of the sighting arm. These scales are also very useful in a number of other models. For example, the semi-circular scale is incorporated in the apparatus shown in Fig. 1, where its markings are used to register the movement of the beam under stress, while in Fig. 2 the circular scale acts as a measure of the extent of vertical rise or fall of a lift.

The Collecting Shoe is intended for use in models of electric locomotives, tramway cars, and other vehicles designed to run on the three-rails system. It consists of a fibre strip 4" long on which is mounted the metal contact pieces that press upon the centre or "live" rail. The Shoe is shown in Fig. 6 secured to the underside of a model electric loco, the fibre strip being held to the chassis by two ¾" Bolts, on which are mounted Threaded

Bosses 9 for spacing purposes. An insulated wire is led from one of the Motor terminals through the loco undercarriage and is secured by the Bolt 13, which also helps to secure the metal part of the Shoe to the fibre strip. The contact pieces, which are rounded and curved so that they slide easily along the rail, are each provided with a small spring to ensure proper contact. The current is picked up from the centre rail by the Shoe and is directed to the Motor by the wire attached to the Bolt 13.

It returns to the accumulator by way of the framework of the model, the running wheels 7, and the outer rails.

The Pointer measures 2½" overall, and is provided with a boss that is set slightly off centre so that if the part is mounted loosely on an axle the Pointer will tend always to remain in a vertical position, with the point uppermost. It can be employed with advantage in all indicating devices; two examples are provided in Figs. 1 and 2. It is also employed in the radius indicator applied to the Meccano Derrick (see Instruction Leaflet No. 6).

The Meccano Fan may be used as a radiator cooling fan in model motor cars, etc. It also adds realism to model workshops.

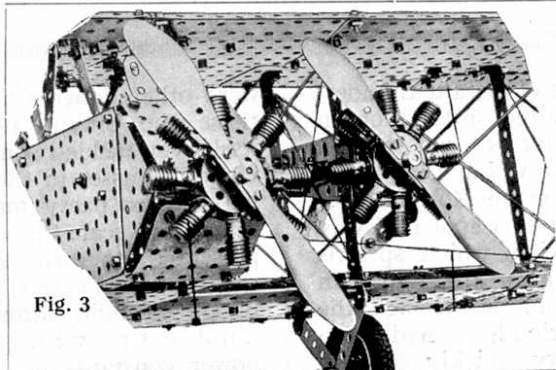


Fig. 3

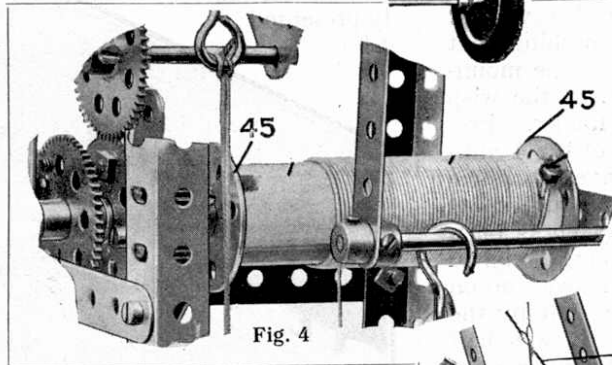


Fig. 4

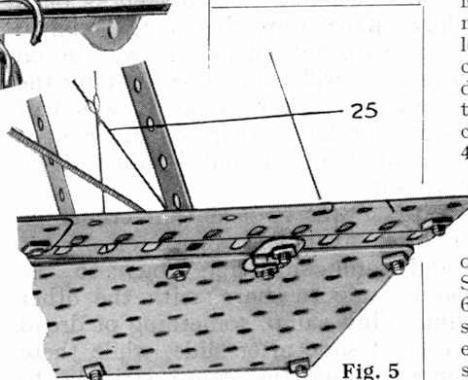


Fig. 5

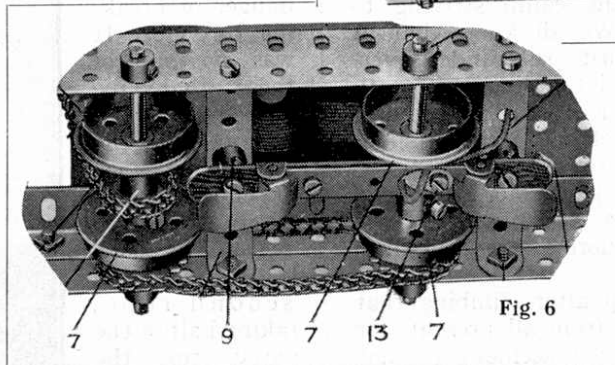
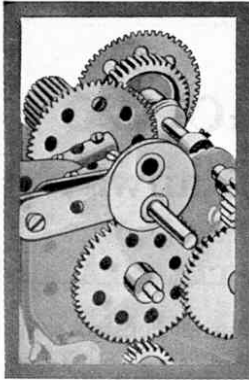
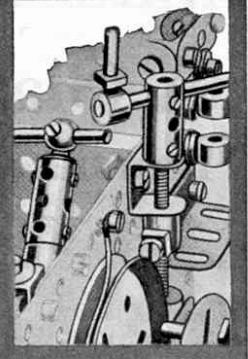


Fig. 6



HOW TO USE Meccano Parts



XI.—Special Accessories (Class P)—cont.

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THIS month we conclude the description of Meccano parts grouped under Class P (Special Accessories), the first part of which appeared in the November "M.M." By "Special Accessories" we mean those parts that are designed for special purposes, such as Shuttles (for looms), rubber tyres (for fitting to Pulley Wheels to represent motor car wheels), Signal Arms, etc. It must not be imagined, however, that because these parts are designed for special purposes, they cannot be used by ingenious Meccano boys for other very different functions. Some of the novel adaptations that have been found for them are mentioned in this article.

The Buffers (Nos. 120 and 120a) are designed for use in Meccano models of railway vehicles. Both types are mounted on threaded shanks and fitted with standard nuts so that they can easily be incorporated in any Meccano model. No. 120 measures $\frac{1}{2}$ " in length, excluding the shank, and is cut from the solid, while No. 120a, which measures $\frac{5}{8}$ " in length without the shank, is provided with a separate sleeve that encloses a compression spring placed upon the "ram" of the Buffer. Hence the part actually functions as a shock absorber.

The Spring Buffer may also be employed for other very different purposes. In Fig. 9, for example, it serves as a spring catch to hold a hand lever in position after the latter has been moved from one side to the other. The lever passes through the centre hole of a Coupling 19 and carries a second Coupling 20, which presses upon the Spring Buffer 21 and is provided with two $\frac{7}{32}$ " bolts inserted on opposite sides. These bolts act as stops to prevent the lever moving too far in either direction.

One of the most interesting adaptations of the Spring Buffer is included in Standard Mechanism No. 115 (Meccano Electric Controller). This mechanism is reproduced at Fig. 11, and it will be seen that the Spring Buffer 5 acts as a spring-controlled contact-piece, which ensures good contact being made with the studs of the resistance. The sleeve portion of

another Spring Buffer is bolted at 9 to act as a stop to prevent the contact-piece being moved too far in either direction.

The Dredger Bucket is intended for use in models of excavating machinery and conveyors. It is provided with a clip which is intended to be pushed through one of the links in a length of Sprocket Chain, the ends of the clip then being bent back as shown in Fig. 13.

Great care should be exercised in bending the clips to ensure that sufficient space is left between their ends to admit the teeth of the Sprocket round which the chain must pass. The Chain 2 on which the Buckets 1 are mounted should be kept as taut as possible, else there will be a tendency to twist when the buckets are loaded. Fine material, such as sand, grain, etc., may be transported quickly and easily by means of an endless chain of Dredger Buckets arranged as shown. The clips incorporated in the Buckets are frequently removed and used for connecting other Meccano parts to Sprocket Chains.

The very realistic Digger Bucket (Fig. 7) is of course designed principally for use in Meccano steam shovels, or mechanical navvies. The mouth of the Bucket measures about $1\frac{7}{8} \times 2\frac{1}{4}$ ", while the depth (over cutting teeth) is $2\frac{1}{2}$ ". The bottom of the Bucket is mounted on hinged levers and normally is held in place by a sliding lever (the end of which may just be seen in the illustration) that engages with a slot in the front of the Bucket. A cord may be attached to the lever and on pulling this the floor falls open and so discharges the contents of the Bucket. If a small quantity of gravel or grain is available a model excavator fitted with the Digger Bucket can be used to load Hornby railway wagons, etc.

There are two types of Ship's Funnels in the Meccano system. One of these (part No. 138) is placed vertically on its base while the other is raked, i.e., when secured to a model, it lies at an angle to the vertical. Both are provided with two perforated lugs by means of

Parts in Class P: Special Accessories

Part No.	Description	Prices
		s. d.
41	Propeller Blades	per pair 0 4
61	Windmill Sails	4 for 0 6
66	Weights, 50 grammes	each 1 0
67	" 25 "	" 1 0
101	Healds, for Looms	doz. 0 9
104	Shuttles, for Looms	each 5 0
106	Wood Rollers, complete with $4\frac{1}{2}$ " Rod and 2 Collars	" 1 6
106a	Sand Rollers, complete with $4\frac{1}{2}$ " Rod and 2 Collars	" 1 9
107	Tables for Designing Machines, Complete with Bush Wheel	" 1 6
114	Hinges	per pair 0 4
117	Steel Balls, $\frac{3}{8}$ " Diam.	doz. 0 6
120	Buffers	each 0 2
120a	Spring Buffers	per pair 0 8
122	Miniature Loaded Sacks	each 0 2
131	Dredger Bucket	$\frac{1}{2}$ doz. 1 0
135	Theodolite Protractors	each 0 3
138	Ship's Funnels	" 0 3
138a-z	" Raked; A series of 25 funnels in colours to represent leading shipping lines	" 0 9
141	Wire Lines (for suspending Clock Weights)	" 0 9
142	Rubber Rings, to fit 3" rim	" 0 3
142a	Dunlop Tyre to fit 2" diam. rim... ..	set of 4 1 6
142b	" " " 3" "	" 0 6
142c	" " " 1" "	" 0 3
142d	" " " $\frac{1}{2}$ " "	" 0 4
149	Collecting Shoes, for Electric Locos	" 1 6
150	Crane Grabs	" 0 7
155	Rubber Rings, $\frac{5}{8}$ " int. diam. (will fit 1" Pulley)	" 0 1
156	Pointers, 2 $\frac{1}{2}$ " overall, with boss	" 0 4
157	Fans, 2" diam. with boss	" 0 4
158a	Signal Arm, Home	" 0 5
158b	" Distant	" 0 5
159	Circular Saws	" 1 0
169	Digger Buckets	" 2 0

which they may be bolted to any Meccano Strip or Plate. No. 138 is enamelled red and is designed for use in models of tramp steamers, etc. No. 138a is obtainable in twenty-five different colour-combinations to represent all the principal shipping companies. It is also provided with a miniature steampipe attached to the front of the funnel.

The Wire Line (No. 141) has been added to the system specially for the purpose of suspending the 18 lb. weight required to drive the Meccano Grandfather Clock (Instruction Leaflet No. 14), but naturally it can be used in any model where a very heavy load is required to be raised. The line is not suitable for use in small model cranes, owing to its stiffness.

The 3" and 2" sizes of the Dunlop Tyres will be familiar to the majority of Meccano boys, but the 1½" and 1" sizes are recent additions. All four tyres are perfect miniature reproductions of the real thing and are specially made for Meccano Limited by the Dunlop Rubber Company Limited. The dimensions given represent their inside diameters and therefore the four tyres (parts Nos. 142a-d) fit the 2", 3", 1", and 1½" Pulley Wheels respectively. They will lend a very realistic finish to any Meccano model motor car or motor cycle.

The 3" Rubber Ring is designed to fit round the groove of a 3" Pulley Wheel, and thus represent a rubber tyre for use in models of road vehicles. It is also sometimes employed to provide the frictional surface in Meccano Clutch mechanisms and frictional driving apparatus.

The most important use of the 5/8" Rubber Ring is found in the friction clutch incorporated in the Meccano model Motor Chassis (Instruction Leaflet No. 1). The clutch is reproduced in Fig. 10 and the Ring will be seen placed round the groove of a 1" Pulley 1, which is secured to the Rod 2 and forms one portion of the clutch. On operation of the clutch pedal the other clutch member 3—a 1½" Flanged Wheel—may be moved to and fro and thus brought in or out of frictional contact with the Rubber Ring, which is driven continuously from the engine. Other functions of the part are its use for applying tension, for retarding a rotating shaft, or as a shock absorber in vibrating machinery, etc.

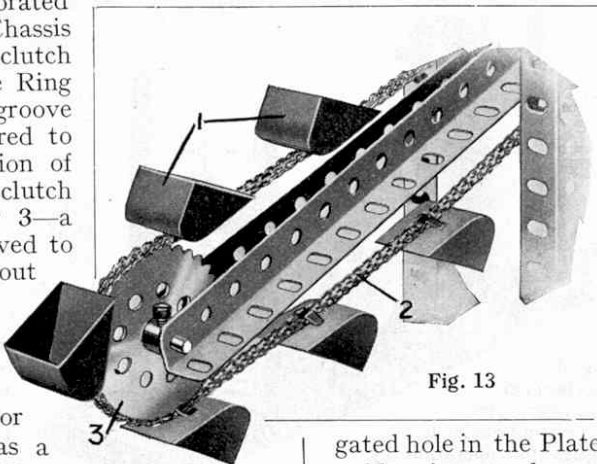
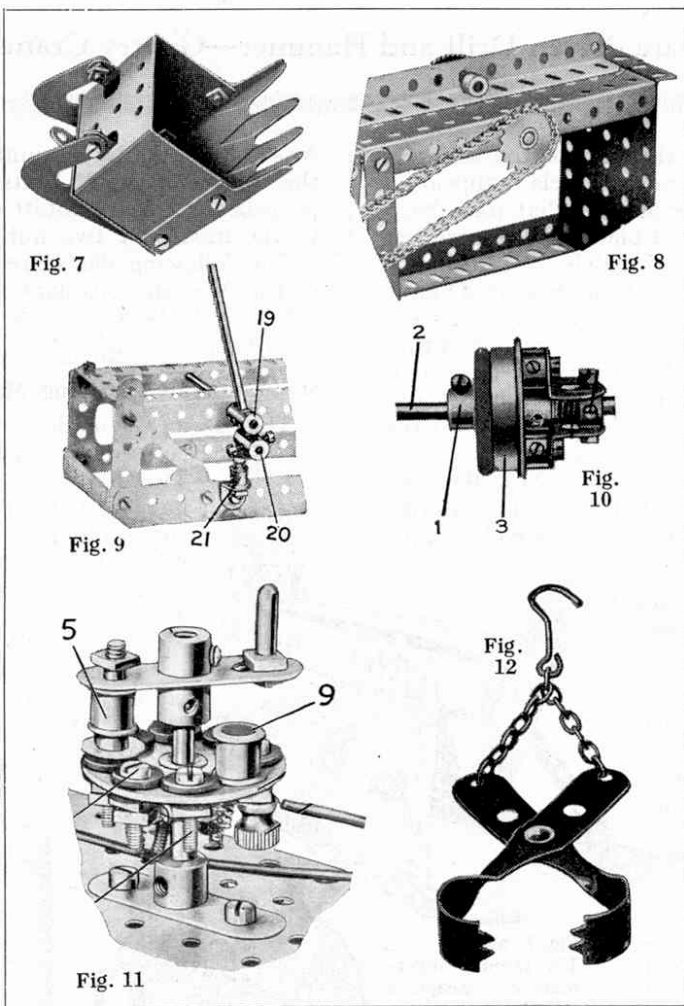
The Crane Grab forms a valuable addition to small models of cranes, etc., for it facilitates the picking up and depositing of loads. As will be seen from Fig. 12, it consists of two jaws fitted with arms that are pivoted together and connected at their upper ends by short chains to a hook, which in turn may be attached to the main crane hook.

The only difference between the two types of Signal Arms (parts Nos. 158a and 158b) is, of course, the "fish-tail" on the "distant" Signal. They measure 3" in overall length and are identical, except for the addition of a standard boss and set-screw, with the Hornby signal arms. Transparent red and green "glasses" are attached to the Signal Arms, and if a light is placed behind them a most realistic effect is obtained. A very fine model of a signal gantry may be built with the aid of these parts and ordinary Meccano Accessories, and if small electric bulbs are incorporated, both day and night signalling may be reproduced with perfect realism.

The Circular Saw is made of finest tempered steel, is 1½" in diameter, and is provided with a boss and set-screw. If driven at maximum speed from a

Meccano Electric Motor, it will cut through thin pieces of wood. Hence it is possible to reproduce with Meccano, models of sawing machinery that can actually be put to practical use.

It has already been mentioned (in connection with Class D) that the 5½" x 2½" Flanged Plate has, in addition to the usual perforations, a slot 2" long, and a hole 5/8" x 3/16" near its centre, for use in connection with the Circular Saw. In Fig. 8 we reproduce an illustration that appeared in the May 1929, "M.M.," showing the Flanged Plate and Circular Saw used in conjunction with each other. The Circular Saw is secured to the Sprocket Wheel shaft, and its blade, which can just be seen above the Angle Girder that forms the guide piece, protrudes through the slot. The Girder is held in place by the Collar shown, and the latter is secured on the shank of a bolt passed through the elongated hole in the Plate. This elongated hole allows the guide piece to be secured in different positions.



HOW TO USE Meccano Parts

XII.—Miscellaneous Parts (Class Q)

For the purpose of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structural and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping is as follows. Structural Section: Class A, Strips; Class B, Girders; Class C, Brackets, Trunnions, etc.; Class D, Plates, Boilers, etc.; Class E, Nuts and Bolts, Tools and Literature, Mechanical Section: Class M, Rods, Cranks and Couplings; Class N, Wheels, Pulleys, Bearings, etc.; Class O, Gears and Toothed Parts; Class P, Special Accessories; Class Q, Miscellaneous Mechanical Parts; Class T, Electrical Parts; Class X, Motors, Accumulators, etc.

It will be recalled that Class Q comprises those parts that are used in the construction of gear boxes and other working features of a model and yet cannot be grouped under any of the other Classes in the Mechanical Section.

Part No. 35 in this Class, Spring Clip, is designed to hold Axle Rods in position in their bearings or to maintain loose parts in place on the Rods. Both these functions can be carried out more efficiently by the Collar with Set-screw, but for reasons of economy Meccano boys usually employ the Spring Clip to a considerable extent in the larger models. It can only be used, however, for light work; in every case where considerable stresses are met with a Collar should be used.

Novel Friction Clutch

A very ingenious use for the Spring Clip was incorporated recently in a small Meccano Clock. In this model the Gear Wheel that transmits the drive to the minute hand and, through further reduction gearing, to the hour hand, is not secured directly to its Rod, but carries bolted to its face an Angle Bracket, the flange of which engages with the arms of a Spring Clip mounted on the Rod. Hence the drive from the Gear Wheel is directed to the Rod through the Spring Clip, so that if the hands are turned in resetting the Clock, the Rod is able to slip round in the Spring Clip without turning the Gear Wheel. On the other hand, when the clock is set in motion, the "stiffness" of the Spring Clip on the Rod is quite sufficient to transmit the power of the main spring to the hands. Many Meccano boys use a similar arrangement to this as a safety device to prevent too great a load being thrown on a Meccano Electric Motor.

In the mechanism shown in Fig. 1 it was required to mount the Rod 5 so that it could be moved longitudinally in its bearings, but not rotated. Consequently two Spring Clips were placed upon it with their arms towards the Double Angle Strip in which the Rod is mounted, with the result that, should the Rod start to turn, they strike against the Strip and prevent further movement.

The Washers (No. 38) are designed principally, of course, to decrease friction between moving parts. They are also invaluable for spacing purposes. A single Washer is approximately equal in thickness to an ordinary Meccano Strip; hence it frequently proves invaluable for obtaining correct spacing when building various Meccano structures. For example, a Meccano Plate may be secured to an Angle Girder by a bolt at each end, but one of the bolts may have a Strip placed upon it between the Plate and the Girder. Then, if the Plate is to lie perfectly parallel to the Girder, a Washer must be placed between the two parts on the other bolt.

Many model-builders make a rule of placing a Washer immediately underneath the head of any bolt that is passed through an elongated hole, such as those in the wider flanges of the

Angle Girders, etc., in order to obtain a better grip. If two enamelled parts are connected pivotally by bolt and nut, Washers should be placed against the parts to prevent the bolt head and nuts wearing away the enamel.

The Meccano Cord is red in colour and of the appropriate thickness for use in the majority of models. It is strong and may be used for hoisting mechanisms, pulley and belt gear, or for bracing Meccano structures and any other similar purposes.

The Meccano tension Spring (No. 43) measures 2" in length contracted and is fitted with a loop at each end to facilitate its connection to other Meccano parts. Its functions as a spring will be apparent to every Meccano boy. A somewhat novel use

for the part is included in Fig. 2, where it may be seen at 79 mounted on the buffer beam of the Meccano Tank Locomotive (see Special Instruction Leaflet No. 15) to represent the vacuum brake pipe connection. The Spring is frequently used in models of petrol and steam engines for a similar purpose, i.e., to represent a pipe.

Reliable Safety Catch

The Compression Spring normally measures $\frac{1}{2}$ " in length, and is used to control movement and as a shock absorber, etc. In Fig. 5 a Compression Spring 3 is placed on a Crank Handle so that normally a Collar 2 having an ordinary bolt inserted in its set-screw hole, is held against the bearing and the Crank Handle is prevented from rotating by the stop 5. The Handle can only be turned by compressing the Spring; hence an efficient safety device is provided.

The Compression Spring 4 in Fig. 6 is placed over the shanks of two opposite $\frac{3}{8}$ " Bolts and acts as a shock absorber for both axles attached to the $2\frac{1}{2}$ " Strip.

A Compression Spring does important service in the clutch of the Meccano Motor Chassis. The clutch was reproduced at Fig. 10 in last month's article, and if reference is made to that illustration it will be seen that the Spring holds the clutch member 3 in engagement with the member 1 until the operating pedal is pressed. The Spring is placed between the Collar, which is fixed to the Rod, and the Flanged Wheel, which is free on the Rod. In this case, however, the ordinary Compression Spring would be too large to go in the small space available; it is therefore cut in two, by means of pliers, etc., and a portion only used.

The Eye Piece, which is now supplied complete with boss, is particularly useful as a guide for sliding mechanisms, such as an engine crosshead. The slotted portion will fit over any Meccano Strip, which thus becomes a guide rail. Fig. 4 shows the crosshead of a Meccano horizontal steam engine, in which the two Eye Pieces 4 act as "slippers" sliding on the "guide bars" 3.

The ordinary Meccano Hooks (No. 57) require little explanation. They are

Parts in Class Q: Miscellaneous Mechanical Parts

Part No.	Description	Quantity	Prices
			£. d.
35	Spring Clips	per box (doz.)	0 3
38	Washers	per doz.	0 1
40	Hanks of Cord	2 for	0 3
43	Springs (tension)	each	0 2
120b	Compression Springs		0 1
50a	Eye Pieces, with boss		0 4
57	Hooks	2 for	0 1
57a	" Scientific	each	0 1
57b	" Loaded	each	0 3
58	Spring Cord	per 40" length	0 9
58a	Coupling Screws, for Spring Cord	per doz.	0 6
59	Collars with Set-screws	2 for	0 3
64	Threaded Bosses	each	0 2
65	Centre Forks		0 1
94	Sprocket Chain	per 40" length	0 6
115	Threaded Pins	each	0 2
116	Fork Pieces, large		0 3
116a	" small		0 3
130	Triple Throw Eccentrics ($\frac{1}{4}$ ", $\frac{3}{8}$ ", and $\frac{1}{2}$ " throws)		1 0
170	Eccentric, $\frac{1}{4}$ " throw		0 9
136	Handrail Supports		0 3

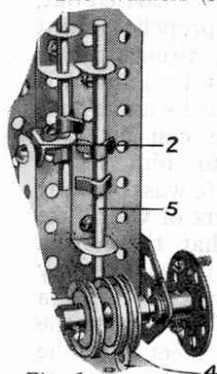


Fig. 1

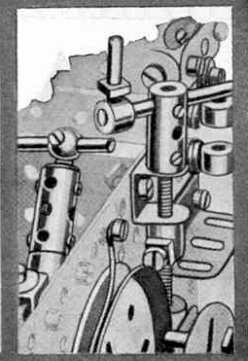


Fig. 2

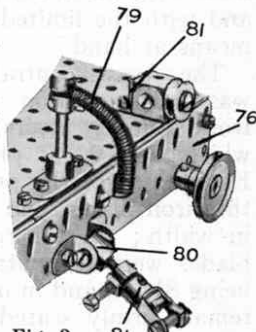


Fig. 4

of a suitable size for use as the load hooks in the majority of Meccano cranes. The Scientific Hooks (No. 57a) are provided for the benefit of those boys who wish to carry out delicate scientific experiments, wherein it is required to add accurately-measured weights to some portion of a model, and where it is important that the hook used to attach the weights should have as little effect on the moving parts as possible. The lower portion of the hook is straight and long so that three or four Meccano Weights (parts Nos. 66 and 67) may be added at one time.

The Loaded Hook (No. 57b) is an improvement on part No. 57. It is of much more massive construction and is complete with a lead ball, the weight of which is intended to keep the hoisting cord of a crane taut round the circumference of the guide Pulley when no load is attached to the hook, and when lowering, etc.

The Spring Cord has many varied uses. First, of course, is its function as a driving belt between two Pulleys. To make an endless driving belt, the necessary length of Spring Cord should be measured and cut off (by means of a pair of scissors, wire-cutters, etc.) and the two ends then connected together by means of the special Coupling Screw (part No. 58a), which has only recently been introduced for this purpose. The Coupling Screw is $3/32"$ long and is provided with a thread of such a pitch that when it is screwed into the end of the Spring Cord the thread engages with the turns of the spring. The screw should of course be inserted half-way into one end of the Spring Cord, and the other end then screwed upon it in the same way as a nut is screwed on to a bolt. Once the Coupling Screw is inserted the Cord cannot be removed merely by unscrewing; the ends can only be separated by pulling them apart forcibly. Driving belts so constructed can only be used where very light stresses obtain, although the efficiency of the drive can, of course, be improved by duplicating the pulleys and belts.

Fixing Spring Cord

Where it is required to attach Spring Cord to a Meccano bolt or other part, its end should be heated in a lighted match so as to take the springiness out of the metal. It may then be twisted round the bolt as easily as a piece of thread.

Occasionally the Spring Cord is used as a kind of Bowden wire or cable to encase an operating wire or string. In article No. IV in this series, which appeared in the May, 1929, "M.M.," we illustrated a Meccano siphon lubricator, in which the "wicks" used to conduct the oil to the journal bearings were encased in short lengths of Spring Cord.

Yet another example of the adaptability of the Spring Cord will be found in Standard Mechanism No. 115 (Meccano Electric Controller) which was reproduced at Fig. 11 last month. In this case the Spring Cord is used as resistance wire, and short lengths of it are connected between the studs on the switch. Portions of the Spring Cord may also be used as tension springs for light purposes. Small springs so formed are used frequently, for example, for holding Pawls in engagement with Ratchet Wheels (see Fig. 15). Again, in the internal-expanding brakes fitted to the Meccano Motor Chassis (see Special Instruction Leaflet No. 1) short pieces of Spring Cord serve to return the

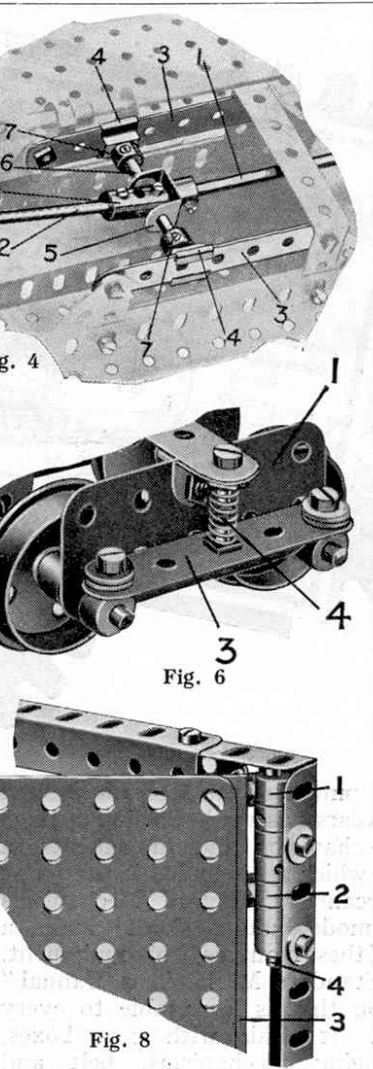
brake shoes to the "off" position when the lever is released. Part of the brake mechanism is reproduced at Fig. 7, wherein a small piece of Spring Cord can be seen connected between ordinary bolts inserted in the set-screw holes of the Collars 3 that form the brake shoes.

The Collars with Set-screws, like the Spring Clips, are intended for holding shafts in place in their bearings, or for holding Strips, etc., loosely on Axle Rods. There are, however, many other novel uses for them. For instance, it has just been mentioned that they form the brake shoes of the internal-expanding brake shown in Fig. 7, whilst in Fig. 6 Collars secured to the $2\frac{1}{2}"$ Strip 3 form journal bearings for axles. The bolts holding the Collars are spaced by Washers so that they do not grip the axles. In Fig. 8 a series of Collars are employed to form a hinge, the Collars 1 and 2 being secured to the door 3 whilst two other Collars are secured to the jamb and to the Rod 4. The remaining three Collars are inserted for spacing purposes.

The Threaded Boss is of the same diameter as the Collar but measures $\frac{3}{8}"$ in length and is perforated longitudinally and transversely with threaded bores. Hence the part is particularly valuable in Meccano screw gearing. In Fig. 3 a Threaded Boss is shown mounted on a short Screwed Rod. It is prevented from rotating with the Rod; consequently, when the hand wheel is turned, the Boss travels longitudinally, and in the example illustrated this movement is utilised to control a simple brake mechanism.

In Fig. 2 the Threaded Boss 80 serves to attach the Coupling unit to the front buffer beam of the Meccano Tank Locomotive. The $1"$ Screwed Rod that carries the unit 81 (a small Fork Piece fitted with $\frac{3}{8}"$ Bolt) is inserted in one end of the Threaded Boss and two bolts passed through Angle Brackets are inserted in opposite sides of the Boss and thus hold it pivotally to the buffer beam. The Threaded Boss is also useful for connecting Strips and other parts to Screwed Rods. The Strips may be secured to the Boss by inserting ordinary bolts in its threaded bores.

The Centre Fork may be used as a small pointer in certain Meccano indicating appliances, etc. Perhaps its most important function, however, is its use in intermittent motion, where it engages at intervals with the teeth of a Meccano Gear or Sprocket Wheel. It is shown used in this way in a Meccano distance indicator in Fig. 14. Here the Centre Fork is secured by a Coupling to a vertical rotating Rod, in such a way that once in each revolution of this Rod it engages with and partially turns a Sprocket secured to a second vertical Rod. The first Rod might be used for counting units and the second Rod tens, and to effect this the Centre Fork should be so adjusted that it moves the Sprocket through $1/10"$ of a revolution each time it engages with it.



Constructing a Meccano "Knife-edge" Bearing

A somewhat novel use for the Centre Fork is illustrated in Fig. 10. Here it forms the "knife edge" in a Meccano knife-edge bearing. As most Meccano boys will know, the knife-edge is employed wherever it is necessary to reduce friction in a moving lever to an absolute minimum. Fig. 10 is a section of the Meccano

Harmonograph (see Special Instruction Leaflet No. 26) the Pinion 16 being secured to the pendulum. This Pinion rests upon the edge of the Centre Fork 17, the teeth of which lie between two of the teeth in the Pinion, and the Centre Fork is secured in the boss of a Crank 18 that is bolted to the fixed part of the model. The pendulum rocks about the extreme edge of the Centre Fork.

The primary function of the Sprocket Chain is, of course, to provide a means of transmitting power between any two shafts where ordinary gearing would be impracticable and belt or cord drive insufficiently positive. It engages with the Meccano Sprocket Wheels, of which there are five different sizes. The Sprocket Wheels and the different speed ratios that are obtainable with their aid, were described at length in the article in this series dealing with Class 0 (Gears and Toothed Parts) which appeared in the September, 1929 "M.M."

The Chain is supplied in lengths of 40 ins., and comprises 12 links to the inch. It may easily be separated and joined again when the requisite length has been measured off. To separate, the ends of one of the links should be gently prised up with the blade of a screwdriver so that the adjacent link may be slipped out. After re-joining, the ends should be bent back again carefully so that they do not grip the next link too tightly, and care should be taken to see that all the links remain of the correct shape to pass easily round the teeth of the Sprockets. The Chain should be passed round the wheels so that the turned-over ends of the links face outward or away from the wheel, as this will result in smoother running.

Chain Gearing

Sprocket Chain may also be used for operating a shaft by hand power, an endless length of chain being passed round a Sprocket Wheel on the shaft, which is turned on hauling upon one side of the chain. An example of this kind of operating gear is shown under detail No. 203 in the Standard Mechanisms Manual. The same detail includes a novel hoist gear constructed with the aid of the Sprocket Chain. In this gear a length of Chain is passed round a Sprocket that is secured to a shaft driven through Worm gear, and one of its ends, depending from the Sprocket, is attached to the load hook. A novel driving gear making use of Sprocket Chain was illustrated in Fig. 2 in the "How to Use Meccano Parts" article in the "M.M." for November last.

The smooth portion of the Threaded Pin, which is of a standard diameter with the Meccano Axle Rods, terminates in a squared shoulder and short threaded shank. Until recently the shoulder was rounded instead of squared, but the new shape constitutes an important improvement in that it permits of the Pin being secured rigidly with the aid of a spanner. The part is intended principally for use as a handle or as a fixed pivot for a 1/2" or 1" loose Pulley. In Fig. 9 two Threaded Pins 11 and 14 are used as handles for operating sliding Axle Rods, the Pins being secured to the Rods with the aid of Collars. Another kind of handle, formed from two Threaded Pins and a Collar, is shown in Fig. 11, whilst in Fig. 15 a Threaded Pin is seen inserted in the set-screw hole of a Pawl, to serve as a handle by which the Pawl may be lifted clear of the Ratchet Wheel.

The Fork Pieces (large and small) are designed for pivotal connections between Rods and Strips or between two Rods meeting at right angles. In Fig. 4 a Large Fork Piece forms a connection between the piston rod 1 and the cross piece 6, whilst in Fig. 9

the same part may be seen employed as a neat journal bearing for a short horizontal Rod. The Small Fork Piece in Fig. 2 has already been alluded to; In Fig. 12 this part is seen employed as a bearing for a 1/2" loose Pulley, which is free to run on a 1/2" Bolt passed through its arms.

Uses and Advantages of Eccentrics

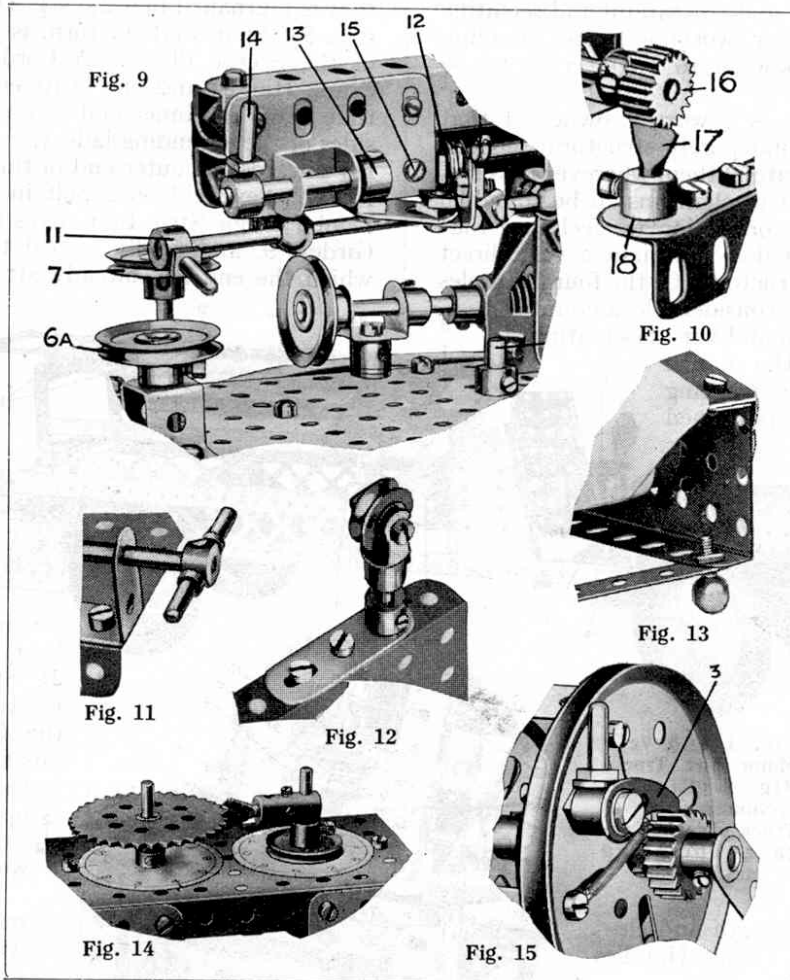
There are two kinds of Meccano Eccentrics, part No. 130 giving three different throws (1/4", 3/8", and 1/2") and No. 170 one throw only (1/4"). The term "throw" means the radius of eccentricity, so that the total rectilinear movements obtained for the three throws of No. 130 are 1/2", 3/4", and 1" respectively, while that of No. 170 is 1/2".

The great advantage of an eccentric is the fact that it permits reciprocating movements being obtained from a rotating shaft without breaking the line of the latter. On the other hand a disadvantage lies in the fact that unlike the crank, it can only transform rotary movement to reciprocating and cannot be used to produce rotary motion from a reciprocating motion. In Meccano model-building, as in actual engineering, the most common use for the eccentric is found in the operation of valve mechanism for reciprocating engines. The 1/4" Throw Eccentric is employed to produce the valve movement on the Meccano Traction Engine (see Special Instruction Leaflet No. 22), while the Triple Throw Eccentric is used in the Meccano Horizontal Steam Engine (see Instruction Leaflet No. 11) and in the Vertical Steam Engine (Manual Model No. 6.13). The arm of either type of Eccentric may be extended by bolting a Meccano Strip to it or connecting it to an Axle Rod with the aid of a Strip Coupling. An Eccentric requires ample lubrication.

The Handrail Support, in addition to the function indicated by its name, may be employed as a journal bearing for rotating shafts. When used for this purpose, however, great care must be taken in mounting the support to prevent binding on the shaft. If mounted properly, ample bearing surfaces are provided. In Fig. 9 the part is seen employed as a bearing for the sliding Rod carrying the handle 11.

In addition, the Handrail Support may of course be used in innumerable cases where it is required to secure an Axle Rod to a Strip or other part. Another very different use for the Handrail support is indicated in Fig. 13, where it is shown used as a foot-support for a desk agenda. The great advantage obtained from using foot-supports of this type lies in the fact that the smooth, rounded surface of the Handrail Support allows a model so equipped to be placed on highly polished surfaces without fear of causing scratches, which, of course, is a particularly important consideration in the case of a desk agenda. The Handrail Supports are used also to a large extent as ornamental tops for columns; for this purpose, their shanks usually are screwed into the longitudinal tapped bores of Threaded Couplings, which may then be secured on Axle Rods.

Perhaps the most novel use of the Handrail Support is that suggested recently by a Meccano boy who hit upon the idea of building a Meccano model of a deep sea diver. He purposely made the model so small that a Handrail Support could be used for the diver's helmet, which it resembles very closely. A Coupling formed the body of the diver, and long bolts, etc., represented his arms and legs, whilst the tube that was supposed to supply him with air from the surface was formed by a length of Spring Cord.



HOW TO USE Meccano Parts

XIII.—Electrical Parts (Class T)

For the purpose of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structural and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping is as follows. Structural Section: Class A, Strips; Class B, Girders; Class C, Brackets, Trunnions, etc.; Class D, Plates, Boilers, etc.; Class E, Nuts and Bolts, Tools and Literature. Mechanical Section: Class M, Rods, Cranks and Couplings; Class N, Wheels, Pulleys, Bearings, etc.; Class O, Gears and Toothed Parts; Class P, Special Accessories; Class Q, Miscellaneous Mechanical Parts; Class T, Electrical Parts; Class X, Motors, Accumulators, etc.

LAST month's article, which dealt with Class Q, "Miscellaneous Mechanical Parts," completed the description of the "regular" Meccano accessories, and we now come to the special electrical parts which comprise Class T. As will be noted from the list printed in the centre of this page, each part in this Class is numbered above 300, although the last number in the regular accessories is 171; the object of this is to make a more marked division between the regular and electrical components of the Meccano system.

Part No. 301, Bobbin, is designed for use in the construction of small electro-magnets and solenoids. It is about 1" in length and its centre, which is of brass, is bored to fit round a Meccano Axle Rod. The ends are of fibre and are $\frac{3}{4}$ " in diameter.

Solenoids and Magnets

Fig. 6 shows two solenoids, formed from Meccano Bobbins, used to impart reciprocating motion to the "piston rods" 3 and 4 of a small horizontal engine. Each Bobbin is wound with several layers of No. 26 S.C.C. Wire and is covered with a strip of brown paper as extra protection. The Rods 3 and 4 are free to slide in the centre bores of the Bobbins, and matters are so arranged that current is supplied to the coils of wire alternately, thus imparting motion to the piston rods and thence to the crankshaft of the engine. Solenoids constructed in this way can be used for innumerable purposes in Meccano model-building. For example, an electric railway signal may be brought to the "off" position by supplying current to a solenoid that operates the signal arm through a "plunger" and suitable lever mechanism as shown in Fig. 2.

A very useful electro magnet may easily be formed by winding a Bobbin to capacity with 26 S.C.C. Wire and inserting in its centre a Core or Pole Piece (part No. 308). The latter consists of soft iron and may be secured in position by the nuts supplied with it. A great advantage of the electro magnet lies in the fact that the Pole Piece is magnetised only whilst current flows through

the coils. Hence, if a magnet of this type is attached to the lifting hook of a model crane, metal objects can be picked up or dropped merely by closing or opening a switch. Other obvious adaptations for the electro magnet—such as in bells, buzzers, relay switches and electric indicators, etc.—will immediately suggest themselves to Meccano boys. The special Pole Pieces should always be used for the magnet core, for if the ordinary Meccano steel Rods are employed they will be found to retain the magnetism after the current has ceased to flow through the coils.

Fig. 4 shows a Meccano electro magnet incorporated in a buzzer. The magnet is seen at 1, with the end of the Pole Piece at 2 just beneath the vibrating lever or "armature" 3. This illustration also shows two Silver-tipped Contact Screws at 4 and 5. These screws are cut with 6 B.A. Thread and are $\frac{1}{2}$ " in length overall. They should always be used where a rapid make-and-break is required, for they ensure perfect contact and do not "soot up" like ordinary screws. The gap between the contact points may

easily be adjusted by turning one of the screws.

The 6 B.A. Bolts and Nuts (parts Nos. 304 and 305) are supplied so that Meccano parts can be bolted together and yet insulated from each other by using these bolts in conjunction with the special Insulating Bushes and Washers (parts Nos. 302 and 303). These latter parts are similar except that the Insulating Bush has a small "shoulder" which fits inside a standard Meccano hole. Whenever it is necessary to insulate a bolt from a Meccano Strip, an Insulating Bush should be placed on

one side of the Strip, with its shoulder inside a hole in the Strip, and an Insulating Washer on the other side; a 6 B.A. Bolt should then be passed through the two and secured by its nut in the ordinary way. In this manner the bolt is prevented from making contact with the metal of the Strip. This simple means of insulation is, of course, invaluable in Meccano model-building.

The Terminal (No. 306) consists of a milled brass knob bored and tapped to fit the 6 B.A.

Parts in Class T: Electrical Parts

Part No.	Description	Price s. d.
301	Bobbin	each 0 4
302	Insulating Bush	doz. 0 6
303	Insulating Washer	" 0 3
304	6 B.A. Bolts	" 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 (6 volt)	" 0 10
312	27 Gauge Bare Iron Wire, per length of 30'	" 0 1
313	26 Gauge S.C.C. Copper Wire, Reels of 50 yds.	2 3
314	23 Gauge S.C.C. Copper Wire, Reels of 25 yds.	2 0
315	22 Gauge Bare Copper Wire, Reels of 4 yds.	0 3

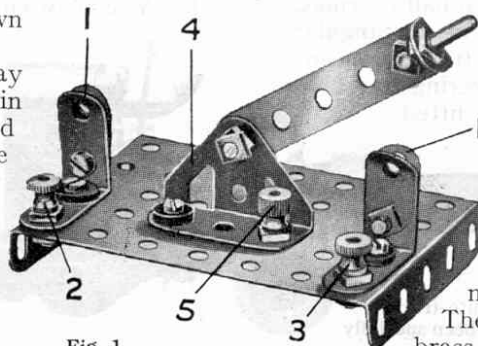


Fig. 1

Bolts. Fig. 4 shows two terminals mounted on the shanks of bolts at 6 and 8. It will be noted that an Insulating Washer is placed under the terminal 6; an Insulating Bush is used on the other side of the plate, so that this terminal is insulated from the model. Terminal 8 is in metallic contact with the model.

Fig. 1 shows a two-way Meccano switch. In this the switch arm is attached pivotally to a Trunnion that is insulated from the base plate in the manner just described, and the two contact pieces 1 carrying the Terminals 2 and 3 are also insulated. Hence, by engaging one or other of the latter with the switch arm the electric circuit can be led from terminal 5 to terminal 3 or, alternatively, from terminal 5 to terminal 2.

Fig. 3 shows a 6 B.A. Bolt 5 used as the contact stud in a Meccano Morse key, or tapper. The bolt is insulated from the base plate, but the key 4 is in metallic contact with it. One wire is attached to the bolt 5 and another to the base plate, so that the circuit is completed whenever the bolt 8 of the key touches bolt 5.

The Coil Cheek (No. 309) consists of $\frac{1}{8}$ " fibre and measures $1\frac{1}{4}$ " square. An oblong perforation is cut in its centre, so that Meccano Strips can be passed through it, and four small holes are provided to admit wire. The object of the part is, of course, to facilitate the construction of large magnetic coils, such as that required in the Meccano Shocking Coil, which was illustrated and described in the March, 1928, "M.M."

Illuminating Meccano Models

The Lamp Holder (No. 310) is designed to form a screw socket for the Meccano 6-volt Lamp (No. 311). Its end is of fibre and it should be secured to Meccano models as follows. A 6 B.A. Bolt is passed through the small perforation in its end, and then through a hole in a Meccano Strip, and an Insulating Bush is placed on the shank of the bolt so that its shoulder fits into the hole in the Strip. The bolt can then be secured by a nut or Terminal. When the latter is screwed up tight, the metal of the Lamp Holder will be in contact with the Strip, so that the electric current may be conducted to the lamp by attaching one wire to the 6 B.A. Bolt (the head of which presses against the contact in the end of the lamp itself), and another wire to the Meccano Strip.

Fig. 5 shows a Lamp and Holder mounted in the front of a model electric

locomotive, the Holder 14 being bolted to an Angle Bracket. Current is led to the Lamp by an insulated wire slipped under the nut on the 6 B.A. Bolt by which the Holder is secured, and returned to the source of supply through the Holder itself and through the frame of the model.

As will be seen from the list of parts in Class T, there are four kinds of wire included in the Meccano Electrical Parts (Nos. 312-315). The 27 gauge Bare Iron Wire is intended for use when it is required to insert a resistance in an electric circuit, such as in the construction of electric speed controllers, etc. The 26 gauge Single Cotton Covered Copper Wire is usually employed in constructing electro magnets, bobbins, etc., although it can be used for ordinary connecting purposes. The 23 Gauge Copper Wire is intended for making all kinds of electrical connections in Meccano models, and the 22 gauge Bare Copper Wire is supplied for use where a conductor wire is required, such as in electric locomotives and similar models.

It can scarcely be necessary to give Meccano boys instructions on the subject of wiring their models. We should like to remind them, however, of the importance of the following. All connections should be made as tight as possible—that is, when connecting a wire to some part of a model it should not be merely twisted round a Strip, but secured by a nut and bolt. Insulated wire should never be allowed to rub against metal, else short circuits will quickly occur.

Another point to remember is the fact that wire exerts a certain resistance against the flow of the electric current, just as a water pipe resists the flow of water through it by the friction created between its walls and the moving liquid. In ordinary Meccano model-building, the resistance likely to be exerted by the wiring is negligible, especially if the Meccano 23 gauge

Wire is used, but in exceptional cases where the current is directed over considerable distances, such as in Morse Telegraph Instruments, electric signals and indicators, etc., a considerable loss of current will result if thin conductor wire is used, and the Motor, bell, or whatever it is required to energise, will fail to function properly. The resistance in the conductor can, however, be decreased by increasing the diameter of the wire or, if a larger wire is not obtainable, by connecting additional lengths of wire in parallel with the first.

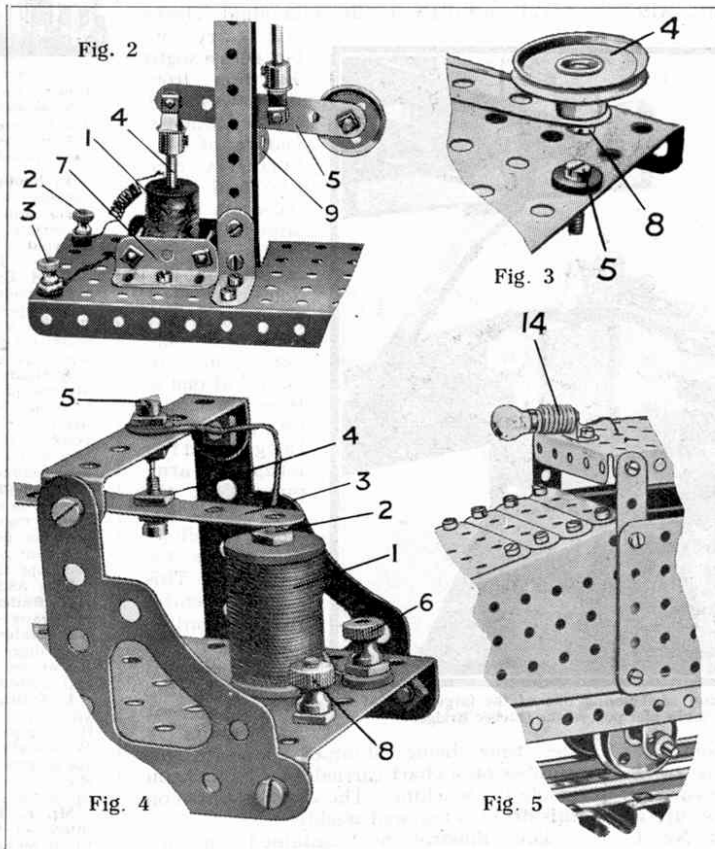
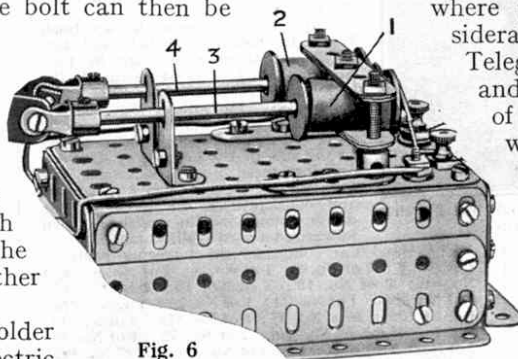


Fig. 6



HOW TO USE Meccano Parts

XIV.—Power Units (Class X)

For the purpose of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structural and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping is as follows. Structural Section: Class A, Strips; Class B, Girders; Class C, Brackets, Trunnions, etc.; Class D, Plates, Boilers, etc.; Class E, Nuts and Bolts, Tools and Literature. Mechanical Section: Class M, Rods, Cranks and Couplings; Class N, Wheels, Pulleys, Bearings, etc.; Class O, Gears and Toothed Parts; Class P, Special Accessories; Class Q, Miscellaneous Mechanical Parts; Class T, Electrical Parts; Class X, Power Units and Accessories.

THIS is the final article of a series in which we have endeavoured to describe the principal functions of each Meccano accessory. Hitherto, when referring to Class X, which is the subject of this month's article, we have designated its contents as "Motors and Accumulators," but the recent addition to the Meccano system of a Steam Engine necessitated a more comprehensive title. Therefore the units in this Class are now grouped under the heading "Power Units and Accessories."

For setting his model in motion, the Meccano boy has a choice of "prime movers" employing the three principal sources of power used by the model engineer—electricity, steam and clockwork. Many boys find it very difficult to decide which of these three methods to adopt. Of course, the ideal plan is to use all three methods, so that when building, say, a model electric train the Electric Motor can be employed, whilst if it is desired to represent a steam shovel or similar machine, the Steam Engine can be used, and so on, but very few boys are in a position to collect the necessary equipment!

The Clockwork Motor (Fig. 2) is the cheapest form of power, barring "gravity" and "wind" motors, which the Meccano boy sometimes fixes up for himself. As for choosing between the Electric Motor and the Steam Engine, the former is, perhaps, slightly more adaptable, but the question must finally be decided by individual preference, for some boys' interests naturally lean toward the electrical side of engineering whilst others prefer steam or purely mechanical engineering.

The Meccano Electric Motors and Steam Engine are each capable of driving practically every Meccano model, provided that the intermediate gearing is designed and constructed properly. No matter what type of model is to be driven, the Motor or Engine should always be allowed to rotate at maximum speed. This means that if it is required to operate a slow-moving model, a gear that will provide a considerable reduction in speed must be employed. The simplest means of obtaining the necessary reduction is provided by the ordinary Meccano toothed gearing (see Section 1, Standard Mechanisms Manual). If gears are not available the drive from the Motor can be transmitted through belt mechanism, and the speed can be reduced at the same time by taking the drive from a small Pulley to one of much larger diameter (see Section 2, Standard Mechanisms Manual). Sprocket Wheel and Chain gearing may, of course, be used equally well in place of belts. Meccano gearing was dealt with fully in articles VIII and IX of this series.

How to Cope with Heavy Loads

Whatever type of gearing is employed it is important to remember that, if the driven shaft moves more slowly than the driving shaft, a mechanical advantage is obtained and increased loads may be overcome, the apparent gain in power being roughly in proportion to the loss in speed. If the drive is led through 1:1 gearing (i.e., two Gears of equal size meshing together or two Pulleys

of equal diameter connected by a belt), there is no gain in power to counteract the loss through friction. Such gearing should therefore be avoided as far as possible, and when it is necessary to transmit the power from one point to another, the gearing should always result in some reduction in speed in the driven shaft, unless it happens that speed is a more important consideration than power.

Another very important means by which the Engine or Motor may be used to overcome increased loads, consists of pulley blocks. By incorporating a cord and pulley system in a model, a reduction in speed is obtained, the reduction increasing in proportion to the number of pulleys or "sheaves," to give them their correct term, employed. For example, if a crane can lift a load of 10 lbs. coupled directly to the hoisting cord, then by using a single-sheave pulley block, so that the load is raised in just twice the time formerly taken, the model should be capable of lifting 20 lbs. (not allowing for loss through friction). Similarly,

if a two-sheave pulley block is used so that the crane hook is raised in four times the period occupied originally, then a load of nearly 40 lb. could be raised. Therefore the mechanical advantage is "2" and "4" respectively in these examples.

Of course, the same mechanical advantage could be obtained by using extra gearing and retaining the single hoisting cord, but the use of the pulley blocks is the better method, for it is more economical and it has the very important advantage of distributing the load over several lengths of cord instead of one only, with the result that a lighter and more flexible cord can safely be used.

Fig. 1 shows the Steam Engine applied to the Meccano Stiff Leg Derrick (see Special Instruction Leaflet No. 6). In this case the gearing mounted between the side plates of the Engine gives a ratio of 58.5:1, that is, the crankshaft of the Engine turns 58½ times to each revolution of the winding shaft. This ratio is obtained as follows: Engine crankshaft to secondary shaft, 6.5:1 (the Pinion and Gear Wheel giving this ratio are supplied with the Steam Engine); secondary shaft to intermediate shaft, 3:1 (½" Pinion driving on to a 57-teeth Gear Wheel); intermediate shaft to winding shaft, 3:1 (½" Pinion and 57-teeth Gear).

Now, if we apply a load direct to the end of the hoisting cord, we shall find that the Engine can lift 9 lb. 13 oz. If we decrease still further the speed at which the load is raised by adding pulley blocks, then the amount of the load that can be raised should increase proportionately for, as already stated, power is gained in proportion to the loss in speed. In Fig. 1 a three-sheave pulley block is used, and the hoisting cord is passed between this and the jib head six times, so that the load is raised six times as slowly as it would be if attached direct to the cord. Hence it should now be possible to lift a load of nearly 59 lb. The load illustrated actually weighs 56 lb., and this the engine will raise easily, the difference between 56 and 59 representing the amount of power lost through the increased friction now

Class X: Power Units and Accessories

	s.	d.
Electric Motor No. 6, 6-volt	each 15	6
Electric Motor No. 20, 20-volt	" 21	0
This new Meccano accessory is not yet available, but it is hoped to have supplies ready next month.		
Accumulator, 6-volt, 20 ampere-hours ..	28	6
Transformer, for 6-volt Motor... ..	" 30	0
Resistance Controller	" 4	6
Clockwork Motor	" 7	6
Steam Engine	" 25	0

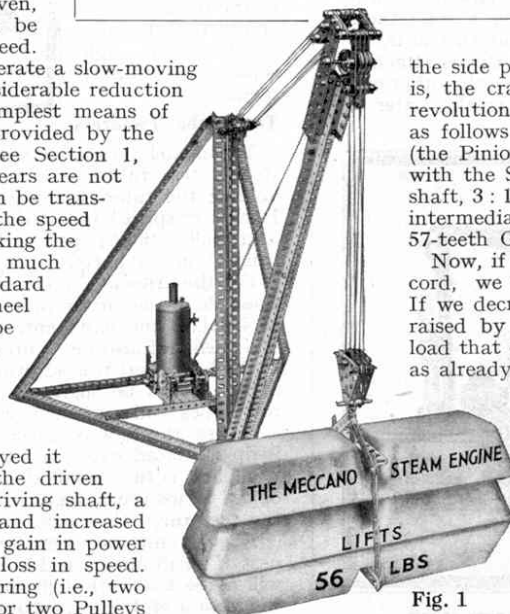


Fig. 1

existing in the various working parts of the model.

Meccano boys who have built the model Motor Chassis (Special Instruction Leaflet No. 1) will readily appreciate the importance of gear ratios when fitting motors to Meccano models. The chassis has three forward speeds, and the very great difference in the load that can be carried at the different speeds is obvious.

Hauling a Tremendous Load

A striking illustration of the power of the Meccano 6-volt Electric Motor is afforded by the Traction Engine (Special Instruction Leaflet No. 22). This model has two forward speeds. In the first a total ratio between the Motor armature and back axle of 283.5:1 is obtained, but the second provides the big ratio of 567:1, and with this gearing truly great loads can be overcome. The Traction Engine has been made to pull over a hard, smooth surface a load of no less than 10 stone, excluding its own weight and that of the accumulator and ballast. The latter, which was necessary to obtain sufficient adhesion on the ground, consisted of lead blocks fitted inside the boiler. Fig. 8 shows the Traction Engine hauling its driver along.

The two Meccano Electric Motors are described as Nos. 6 and 20 merely for easy reference purposes. They are identical in every way except for the windings and both are fitted with reversing switches. The side plates measure $5" \times 2\frac{1}{2}"$ and are perforated with the Meccano standard holes. Hence the Motors may actually form parts of the models that they are required to drive, and they can be bolted in any position. In the Traction Engine the Motor is secured on end at the rear of the boiler, in the position occupied by the fire box in the prototype, and the holes in its plates form bearings for the engine crankshaft and other parts. Fig. 4 shows an Electric Motor fitted with typical reduction gear giving a ratio of 171:1, the bearings for the various shafts being provided by a Channel Bearing and two $1" \times 1"$ Angle Brackets bolted to one of the Motor side plates.

The 6-volt Motor may be run from a 6-volt accumulator or from a suitable transformer connected to the main electric house supply, provided that the latter is alternating current. The Motor takes about 0.8 amperes when running free, but on load this increases up to 2.5 amps. Fig. 7 shows the Meccano 6-volt 20 ampere-hour Accumulator, and Fig. 6 the special Meccano Transformer designed for running the 6-volt Motor from the house supply. This transformer is available for all standard supply voltages from 100 to 250 inclusive at all standard frequencies, and is supplied complete with a length of flex and adapter for connection to an ordinary lamp socket.

The 20-volt Electric Motor is an entirely new addition to the Meccano system. It is designed for running from the main supply through a transformer, and is slightly more powerful than the 6-volt Motor. We hope shortly to be able to supply a transformer for use in connection with it, and particulars and prices of this accessory will appear in an early issue of the "M.M."

Accumulator or Transformer?

With regard to the rival merits of the two methods of running the 6-volt Motor—by accumulator or transformer—the following points should be noted. In models that are required to travel along, such as motor cars, traction engines, etc., an accumulator can be

incorporated in the model or carried on a trailer behind it, and the model then becomes a self-contained power unit. The accumulator, however, will require charging at intervals. A transformer can be neatly stored in a model, but the radius of movement will always be limited by the length of the flex to the lamp socket. When using a transformer with normal loads on the Motor, the consumption of current will be something like one unit per 20 hours. The Meccano 6-volt 20 amp. Accumulator will drive the Motor continuously for 10 or 15 hours, so it will

be seen that whichever method is adopted, the running of Meccano Electric Motors is not an expensive matter.

Until recently a 4-volt Meccano Motor was supplied but this has been converted to the new 6-volt type. There are many Meccano boys who still possess 4-volt Motors and we would remind them that they can have their Motors converted to the new style at a cost of 3/6 (including return postage). They should hand their Motors to their dealers or forward them direct to the Service Department, Meccano Ltd. Also, to enable these boys to use their 4-volt Accumulators for the new Motors, we supply a special 2-volt Accumulator (price 10/6) which may be connected to their 4-volt cells.

A very useful gadget for use in connection with the 6-volt Electric Motor is the Resistance Controller (Fig. 5). By connecting this in series with the Motor the speed of the latter can be varied.

The Steam Engine (Fig. 3) possesses several features of interest, foremost among which is the single control lever that enables the Engine to be started, stopped, and reversed. The boiler proper is mounted centrally in the boiler casing so that the hot gases from the lamp surround it for practically the whole of its outside surface.

The Clockwork Motor

Finally, we come to the Clockwork Motor. This is an ideal power unit for many models. It is strong, easily built into almost any model, and of course, is entirely self-contained. The remarks already given regarding the gearing to be used in connection with the Meccano Electric Motors and Steam Engine refer equally well to the Clockwork Motor, but if considerable loads are to be overcome, one must expect to have to wind the Motor frequently.

Where only a light driving power is required, the period during which the Motor will run for each winding can be increased enormously by using a suitable governing device. One of the simplest of such devices consists of a fan wheel driven by the Motor, the resistance of the atmosphere against the blades of the fan being used to prevent the Motor exceeding a certain speed, with the result that it will run for 10 minutes or more at a single winding. The fan wheel can easily be built up from Meccano parts, but the actual blades should consist of stout cardboard, or Meccano Strips covered with cardboard. Another way to regulate the speed of the Motor is to employ some form of governing device consisting of a friction brake that is applied by the action of weights flying outward under centrifugal force (see Standard Mechanism No. 107).

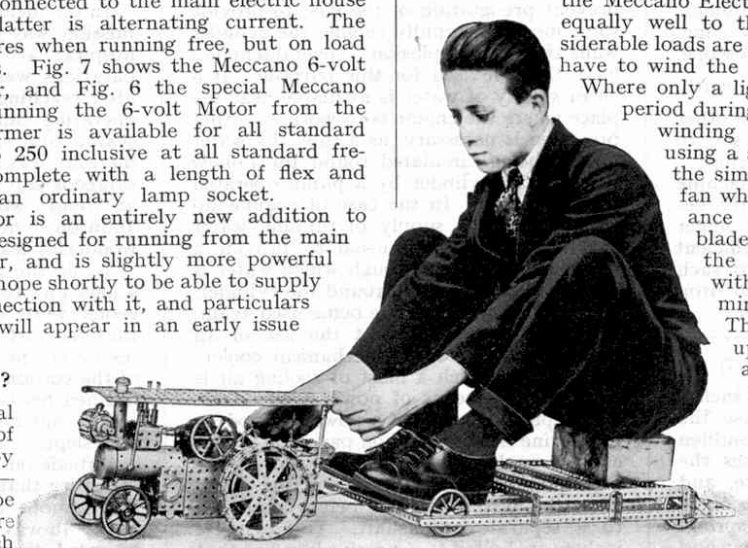
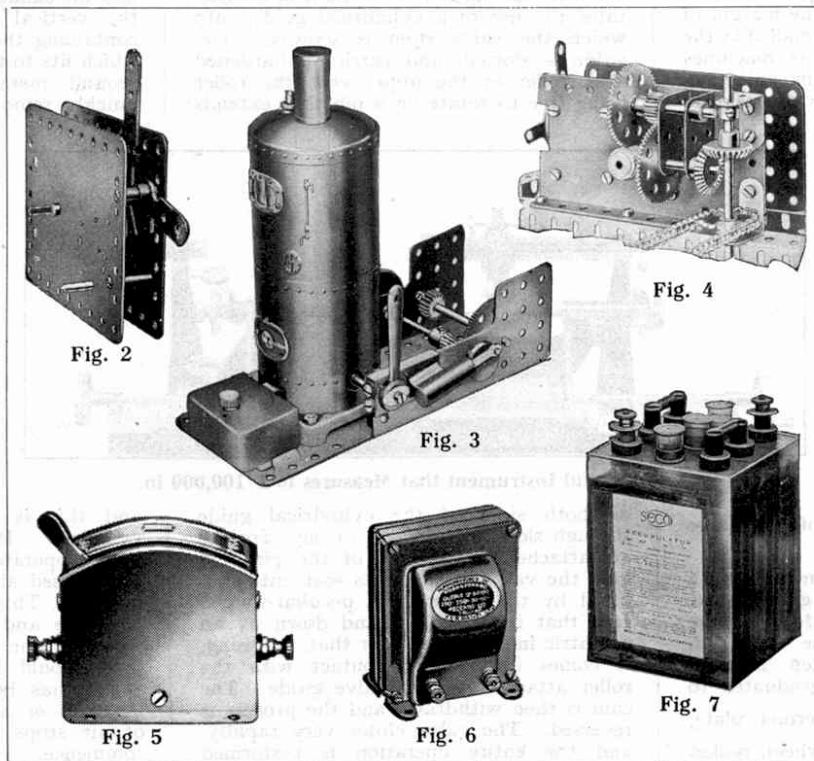


Fig. 8

A Wonderful Instrument That Measures 1/400 Diameter of a Hair!

One of the characteristic features of modern engineering production is that of accuracy of measurement. The margin of error allowed is so extremely small that the tools employed in the various machines must be as perfect as human ingenuity can make them. The importance of ensuring that tools are absolutely right for the particular work they have to do has led to the introduction of some very wonderful measuring and testing instruments. One instrument of this kind, developed by the well-known United States firm, the Brown and Sharpe Mfg. Company, is designed to read to $\frac{1}{100,000}$ in. It seems almost incredible that such a fine degree of precision can be obtained, especially when we realise that this measurement is

practically $\frac{1}{400}$ of the diameter of an average human hair!

The instrument consists principally of a large double 1-beam section, giving great rigidity and resisting any tendency of the measuring points to become deflected. The measurements are taken from a micrometer wheel, which is graduated to read to $\frac{1}{10,000}$ in.; and a vernier plate, used in connection with the wheel, makes it possible to obtain $\frac{1}{100,000}$ in. readings.

In order to secure for the micrometer screw a long life of such a high degree of precision, its bearing is made practically equal in length to the length of the screw. The scale on the bar carries two lines of graduations, one of which, easily visible to the naked eye, is used to locate the scale approximately. The other graduations, which are invisible to the naked eye except under very favourable light conditions, are used for the exact reading of the scale with the help of the microscope. These graduations are extremely fine, as is also the hair line of the microscope, each being only $\frac{1}{10,000}$ in. in width.

It is interesting to learn that at the other extreme the instrument can be set to measure distances as long as 16 inches.

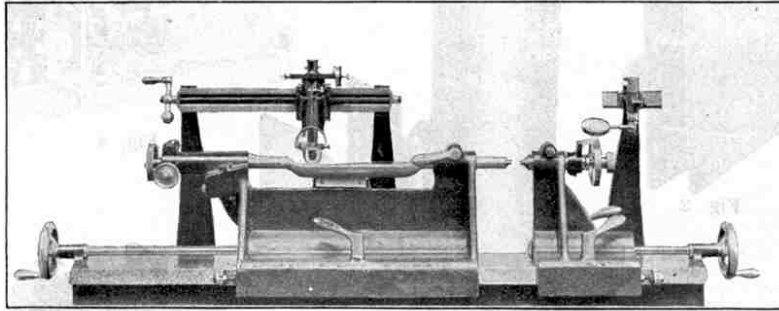
So sensitive is this wonderful machine that, if a gauge is supported lightly between the measuring points, a finger placed on the 1-beam will generate sufficient heat to make the beam expand to such an extent as to cause the gauge to drop from between the measuring points.

The Gas Engine—(Continued from page 277)

satisfactory arrangement, but when such a mechanism is put into practical use the valve is jerked off its seat with a sudden jolt as the point of the cam strikes the valve stem; held open for a space, and then brought with considerable force on to its seating by the pressure of the spring. The result is that the valve is noisy and needs frequent grinding and adjustment; while the stem and the cam are quickly

worn away with a loss in efficiency.

After much valuable experimental work various silent valve gears have been devised. In the Paxman type a rocking cam, operated by an eccentric, is provided in place of the old type rotating cam. This arrangement is a decided improvement, and the valve is raised rapidly and gently, lowered equally rapidly, and eased gently on to its seating. The mechanism necessitates the use of a cylindrical guide, into which the valve stem is screwed. The guide is slotted, and carries a hardened steel roller at the upper end, the roller being free to rotate on a pin that extends



A Wonderful Instrument that Measures to 1/100,000 in.

on both sides of the cylindrical guide through slots in the valve casing. Springs are attached to the ends of the pin and hold the valve down on its seat until it is lifted by the action of a peculiar-shaped cam that is rocked up and down by an eccentric in such a manner that, on rising, it comes into rolling contact with the roller attached to the valve guide. The cam is then withdrawn and the process is reversed. The valve closes very rapidly, and the entire operation is performed with complete absence of shock or noise.

A difficulty that was experienced in the early days of internal combustion engines was the breakage of exhaust valves and the pitting of valve seatings due to corrosion caused by the hot gases that swept over them. To-day this difficulty has been largely overcome by the introduction of resistant alloys that are capable of standing up to high temperatures.

In internal combustion engines great heat is developed in the cylinders, and it is necessary for efficient working and also to prevent pre-ignition of the gas, to provide some means of rapidly cooling the cylinder walls after each explosion. Several schemes have been devised for this purpose. If a clean supply of water is available near the place where the engine is to work, no other provision is necessary, as a rule, the water merely being circulated round the hollow walls of the cylinder by a pump operated by the engine. In the case of engines up to 100 h.p. if a supply of running water is not available, it is usual to provide a water-cooling tank through which water is circulated after passing round the cylinder, so that it may cool before being used again. Where conditions prevent the use of an ordinary water cooler, mechanical coolers are used, in which a blast of cooling air is produced by means of power-driven fans.

A typical example of a powerful modern gas engine is illustrated on page 277. This engine works on the usual four-stroke principle and has four single-acting cylinders, the piston of each being connected to a separate crankshaft. The cylinder jackets are bolted to a massive iron bed that carries also the bearings for the crankshaft. The cranks are completely covered by oil

splash guards and the bearings are supplied with oil by a pump that draws it from a tank situated under the bed of the engine. All the oil that runs off the bearings passes through a strainer and returns to the tank; thus the bearings receive an ample supply of oil, which is used over and over again.

The valves open directly into the cylinders, the admission valve being above and the exhaust valve below. They are of the vertical type, and the valve cage containing the admission and gas valve—which fits to the top of the cylinder with a ground metal to metal joint—can be quickly removed for inspection purposes. The exhaust valve can be readily withdrawn through the same opening.

Ignition is effected by a low-tension magneto operated by an eccentric driven from a camshaft, the timing of the spark being adjustable while the engine is working, by means of special timing gear fitted to the magneto. The ignition plug is placed directly above the centre and at the back of the combustion chamber.

The engine is started by compressed air. Special automatic gear is provided,

and this is connected to two of the cylinders. It consists of a distributing valve, operated by a cam that admits compressed air to the cylinders at correct intervals. This mechanism can be instantly put into and out of operation by hand whatever the position of the crank, but if it should be left in gear after the engine has been started, no harm would be done or air wasted, as the admission of air stops as soon as the explosions commence.

The speed of the engine is controlled by a centrifugal spring-loaded governor driven by screw gear from the engine shaft. It controls the admission of gas by means of a throttle valve, and is actuated from a weigh shaft and connecting rod coupled to the governor lever.

Epic of the Frozen North—

(Continued from page 297)

It was given a clear run, all other traffic being carefully shunted in order to make way for it.

In the meantime the news of the special's mission was sent forward by wire to the hospital at Prince Albert. There preparations were made, and fifteen minutes after reaching the city the girl was on the operating table. The operation was successful and the race was won! But the margin was horribly narrow, for the surgeons stated that a further delay of only an hour would have rendered useless Johnson's heroic dash and "Prince's" wonderful lead.

While the train was rushing the unconscious girl to Prince Albert and the surgeons were carrying out the operation, the man who had started the work of rescue lay fast asleep on the wooden floor of the station at Big River. When he had finished his task, he was too tired to seek a bed, but simply dropped to the ground and slept.

Outside on the snow lay "Prince," little dreaming that his night's work would make him famous throughout Canada. To the husky it was all in the day's work—it is recorded that when the story was being told on the platform on the shore of Lake Waskesiu he merely yawned!