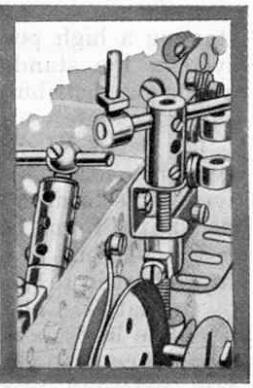
HOW TO USE Meccano Parts

I.—STRIPS (CLASS A)



FIRST ARTICLE OF AN INTERESTING NEW SERIES

THIS article is the first of a series in which we propose to outline the principal functions of the Meccano parts. It would be quite impossible, of course, to enumerate every function of each part, but we believe that by pointing out the uses for which the parts have been specially designed, and mentioning a few others that have been suggested from time to time by Meccano boys themselves, we shall help *"M.M."* readers not only to build better models, but to construct them on really scientific lines.

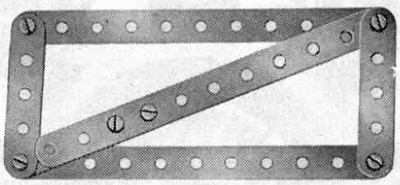


Fig. 1

Before proceeding it must be explained that we have grouped all the Meccano parts into two main Sections, which we have termed the "Structural Section" and the "Mechanical Section." Further, the Sections have been divided into a number of separate classes, and each class will be dealt with separately in this series of articles.

In the Structural Section we have endeavoured to group all those parts that are used principally for the construction of frames, beams, bases, supports, etc., as opposed to parts intended essentially for assembly in mechanical movements (gear boxes, driving mechanisms, etc.), which parts are grouped under the various classes in the Mechanical Section. The grouping of the parts under the different classes will become more obvious on reference to the table printed on this page.

Of course, this classification and grouping should not be taken too literally, for it is impossible to state definitely the functions of any one Meccano part, nor can we say that certain parts are used for frames, beams, girders, etc., and others for gear boxes, driving mechanisms, and other mechanical movements. Although the Meccano Strips, for example, are used principally in the construction of frames, they may also be used as levers, connecting rods, and for similar purposes, when of course they would more correctly be considered as mechanical parts and not structural. From this it will be seen that the grouping of Meccano parts is a difficult matter; nevertheless we think the method that we have adopted will enable anyone who is not already familiar with the numerous components of the system to see at a glance all the parts most likely to fulfil any required function. It should also be of assistance to Meccano boys who find the ever increasing

Classification of Meccano Parts

For the purposes of this series of articles the Meccano parts have been grouped under two main Sections and further divided into different Classes, as follows :

Structural Section	Mechanical Section
Class A—Strips	Class M—Rods, Cranks, and Couplings.
,, B—Girders.	,, N—Wheels, Pulleys, Bearings, etc.
,, C—Brackets, Trunnions, etc.	,, O—Gears and Toothed Parts.
,, D—Plates, Boilers, etc.	,, P—Special Parts (*i.e.*, designed for specific purposes).
,, E—Nuts and Bolts, Tools and Literature.	,, Q—Miscellaneous Mechanical Parts.

List of Parts in Class A : Strips

No.		Price s.	d.
1.	Perforated Strips, 12½" long... ... ½ doz.	1	0
1a.	,, ,, 9½" ,, ... ,,	0	9
1b.	,, ,, 7½" ,, ... ,,	0	8
2.	,, ,, 5½" ,, ... ,,	0	6
2a.	,, ,, 4½" ,, ... ,,	0	5
3.	,, ,, 3½" ,, ... ,,	0	4
4.	,, ,, 3" ,, ... ,,	0	3
5.	,, ,, 2½" ,, ... ,,	0	3
6.	,, ,, 2" ,, ... ,,	0	3
6a.	,, ,, 1½" ,, ... ,,	0	3
46.	Double Angle Strips, 2½" × 1" ... ,,	0	6
47.	,, ,, 2½" × 1½" ... ,,	0	9
47a.	,, ,, 3" × 1½" ... ,,	0	10
48.	,, ,, 1½" × ½" ... ,,	0	4
48a.	Double Angle Strips, 2½" × ½" ... ½ doz.	0	5
48b.	,, ,, 3½" × ½" ... ,,	0	6
48c.	,, ,, 4½" × ½" ... ,,	0	9
48d.	,, ,, 5½" × ½" ... ,,	0	9
55.	Perforated Strips, slotted, 5½" long... each	0	2
55a.	,, ,, 2" ,, ... ,,	0	1
89.	5½" Curved Strips, 10" radius ... ,,	0	2
89a.	3" ,, ,, cranked, 1¾" radius, 4 to circle ... ... ,,	0	2
90.	2½" Curved Strips, 2⅜" radius, 8 to circle ,,	0	1
90a.	2½" ,, ,, cranked, 1⅜" radius, 4 to circle ... ... ,,	0	1
145.	Circular Strips, 7" diam. overall ... ,,	0	9

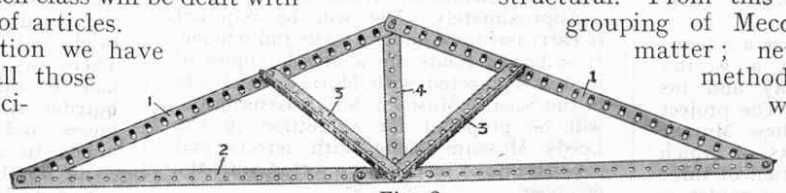


Fig. 2

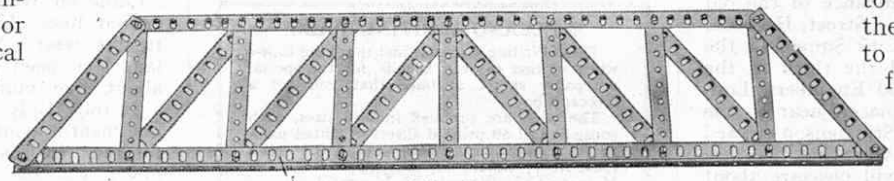


Fig. 3

list of Meccano parts difficult to memorise.

Structural Section, Class A

In this article we shall deal with Class A of the Structural Section. The parts included under this Section are enumerated in full in the accompanying list. They may be said to form the backbone of the Meccano system, for some of them are to be found in practically every model.

Parts Nos. 1 to 6a differ only in their lengths. Each is ½ in. in width and is perforated at ½ in. distances along its length. Hence it is a simple matter to tell the size of a Meccano Strip at a glance, without the use of a measure, simply by counting the number of holes. Similarly the sizes of Meccano Rods and almost any other part can be ascertained in a few seconds by comparing them with Strips.

Meccano Strips are used to construct the framework of towers, bridges, gear boxes, and almost any other type of structure. Provided that they are placed properly, a few Strips can be converted into a perfectly rigid frame, but it is always advisable to use Angle Girders for the larger Meccano structures. Indeed, the really conscientious Meccano boy makes a rule of using Strips only where a tensional stress has to be met, and Angle Girders when it is required to withstand a compressive force. In carrying out this rule he is, of course, following correct engineering practice.

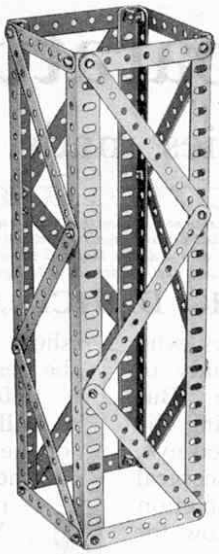


Fig. 4

Fig. 1 shows a simple rectangle built up from two 5½″ Strips and two 3″ Strips. The framework so formed is made perfectly rigid by the addition of a single diagonal tie, which in this case is composed of two 3½″ Strips overlapped two holes and bolted together. The repetition of this figure in a Meccano structure will make the complete model perfectly rigid.

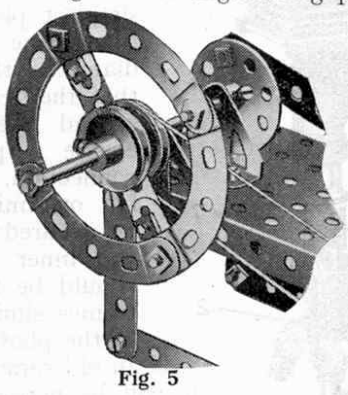


Fig. 5

Fig. 2 is a Meccano model of a simple roof truss. It will be seen that the sides 1 of the truss, which have to withstand a compressive force, are constructed from Angle Girders, whilst the side 2, which is merely in tension, consists of two 12½″ Strips overlapped five holes and bolted together. The triangle so formed would be quite rigid for ordinary purposes, but in practice struts and ties are usually added at 3 and 4 respectively in order to obtain still greater rigidity. (It should be noted here that members in compression are known technically as "struts" and members withstanding tensional forces are termed "ties"). If the reader is able to examine the construction of an actual roof similar in shape to our illustration, he will probably find that the members corresponding to the sides 1 and 3 are all of girder form, resembling the Meccano Angle Girders, whilst the members 2 and 4 are smaller and possibly of flat section, or more probably round like the Meccano Axle Rods.

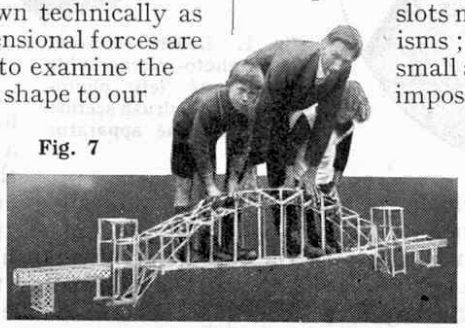


Fig. 7

Rigidity of the Triangle

Fig. 3 shows an openwork girder of the built-up truss type that is used to a large extent in the construction of bridges. It will be noticed that the various members are arranged so that a number of triangles are formed, and it is this arrangement that gives the girder its great rigidity and strength, for the triangle is the only figure that cannot be distorted without altering the length or form of the sides. In the model the ties are represented by 4½″ Strips and the struts by 5½″ Angle Girders. The main girder 1 represents the roadway of the bridge, and the stresses that it has to withstand are distributed over the various ties and struts.

Fig. 4 illustrates a braced tower such as might be used to support a crane, etc. The corner members are composed of Angle Girders, since they must withstand the compressive force exerted by the dead weight upon the structure. In order to make these girders rigid against any liability of bending or distortion, diagonal ties are added. These consist of 5½″ Strips, and it will be noted that they are staggered, or alternated, on each side of the tower.

An example of the great strength and rigidity that can be obtained in Meccano structures by exercising a little thought in placing the ties, struts, and various bracing members, is afforded by the illustration on this page showing a Meccano bridge supporting the combined weight of three people.

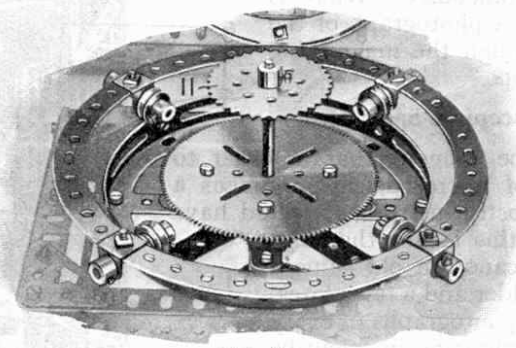


Fig. 6

Double Angle Strips

The Meccano Double Angle Strips (parts Nos. 46 to 48d) are similar to the ordinary Strips except that their ends are bent at right angles. They are extremely useful in the construction of frames and bearings for shafting, etc. A very important advantage of the Double Angle Strips having two or more holes in their turned ends lies in the fact that they can be bolted quite rigidly at right angles to other Meccano parts. Many Meccano boys, if they have not a sufficient number of Double Angle Strips, replace them by bolting the various types of Angle Brackets to the ends of ordinary Strips.

The 5½″ Slotted Strips are provided with three ordinary holes and two slots each 1⅛″ long, while the 2″ Slotted Strip has two ordinary holes and a slot ⅝″ long. These slots may be used as guides for sliding mechanisms; they are also invaluable in obtaining small adjustments between parts that would be impossible with the ½ in. standard holes.

Curved Strips

The Curved Strips—all fairly recent additions to the Meccano system—have played an important part in the production of the new and vastly improved style of model that characterises the modern

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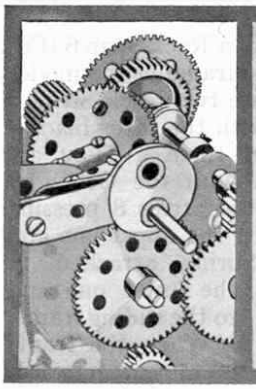
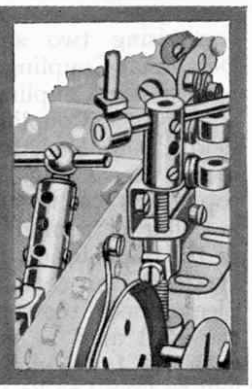


HOW TO USE Meccano Parts

II. GIRDERS (CLASS B)



For the purposes of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structura and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping was published in last month's "M.M." 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. In addition to these classes, the following should be added to the Mechanical Section: Class T, Electrical Parts; Class X, Motors, Accumulators, etc.

MECCANO Girders play a very important part in Meccano engineering. They give great rigidity to any structure in which they are incorporated and serve admirably as bearings for shafting. A few Girders placed together with proper care and braced by one or two Strips or Rods will form a structure capable of supporting a man's weight, without the slightest disruption.

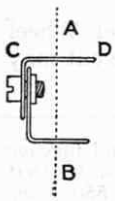


Fig. 1

The secret of the strength of the Meccano Angle Girders is found in the right-angle formation of their flanges, which enables them to withstand bending stresses in any direction. This will become more clear from the following:—

If a wooden beam is mounted so that both ends only are supported, as in Fig. 4, and a heavy load is placed upon it, it will naturally bend. When this happens it is obvious that the upper part of the beam will be in compression and the lower part in tension. These compressive and tensional forces exert a maximum effect along the outer edges (AB, CD in the sketch) of the beam, and decrease toward the centre, in proportion with their distance from the centre, so that there is a zone between the upper and lower portions where the material of the beam is neither in compression nor in tension. It will be obvious that the more material there is above and below the neutral axis, as this zone is termed, the stronger will be the beam. Hence it will be clear that the strength of a beam is determined by its depth rather than by its width.

If a Meccano Strip is laid flat across the two supports shown in Fig. 4 and a small load placed upon it, it will bend considerably, since the areas in compression and tension will be very small, but if the Strip is placed on edge it will withstand a very much greater load. Now a single Angle Girder combines the property of two ordinary Strips secured rigidly at right angles along their lengths; hence its great rigidity. When a Meccano boy runs short of Girders he often improvises by placing two Strips together lengthwise and bolting them at right angles by means of Angle Brackets.

List of Parts in Class B: Girders

Angle Girders (L-Section, $\frac{1}{2}'' \times \frac{5}{8}''$)

No.			s.	d.	No.			s.	d.
7.	24½″ long	... each	0	8	9a.	4½″ long	... ½ doz.	0	10
7a.	18½″ „	... „	0	6	9b.	3½″ „	... „	0	8
8.	12½″ „	... ½ doz.	1	9	9c.	3″ „	... „	0	8
8a.	9½″ „	... „	1	3	9d.	2½″ „	... „	0	7
8b.	7½″ „	... „	1	2	9e.	2″ „	... „	0	6
9.	5½″ „	... „	1	0	9f.	1½″ „	... „	0	6

Braced Girders (2″ deep)

No.			s.	d.	No.			s.	d.
97.	3½″ long	... ½ doz.	0	9	99a.	9½″ long	... ½ doz.	2	0
97a.	3″ „	... „	0	8	99b.	7½″ „	... „	2	0
98.	2½″ „	... „	0	8	100.	5½″ „	... „	1	0
99.	12½″ „	... „	2	6	100a.	4½″ „	... „	0	10

Flat Girders ($1\frac{7}{16}''$ wide)

No.			s.	d.	No.			s.	d.
103.	5½″ long	... ½ doz.	0	10	103e.	3″ long	... ½ doz.	0	6
103a.	9½″ „	... „	1	2	103f.	2½″ „	... „	0	5
103b.	12½″ „	... „	1	3	103g.	2″ „	... „	0	4
103c.	4½″ „	... „	0	9	103h.	1½″ „	... „	0	4
103d.	3½″ „	... „	0	7	103k.	7½″ „	... „	1	0

No. 113. Girder Frames, 5½″ long ... . each 0 3
No. 143. Circular Girders, L-section, 5½″ diam. ... „ 1 0

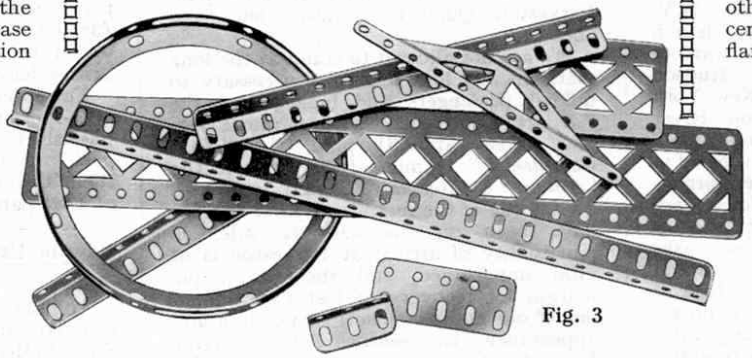


Fig. 3

L-section Angle Girders (Nos. 7 to 9f)

The Meccano Angle Girders, parts Nos. 7-9f, differ only in their lengths. Each is perforated with round holes in one flange and elongated holes in the other. The object of the elongated holes is to provide the "play" that often is necessary when bolting a Girder to other parts. The value of this play is illustrated in Figs. 1 and 2, which represent sections of two Angle Girders that are bolted together to form channel-section girders. Fig. 1 shows the right method of securing the Girders and Fig. 2 the wrong method. In the former the narrow flange of one Girder is bolted to the broad flange of the other, with the result that the centres of the holes in the remaining flanges are exactly opposite, whereas the centres of the corresponding holes in Fig. 2 are not in line.

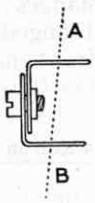


Fig. 2

The importance of thus bolting the Girders correctly together will become at once apparent when it is desired to journal a Rod through the flanges of a channel girder of this type. Of course to journal the Rod in a girder of the form shown in Fig. 1, it will be necessary to bolt a short Strip to the flange CD, so that one of its round holes may be used instead of the elongated hole of the Girder to receive the Rod.

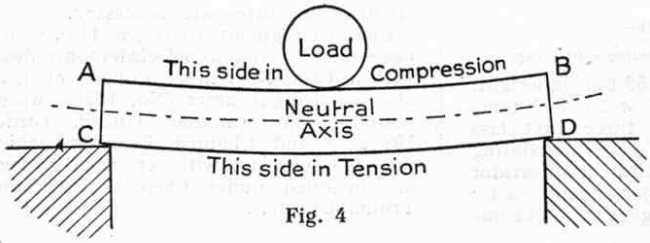


Fig. 4

How Girders are Designed

All Meccano boys will know that girders are of various shapes, but it may not be altogether clear to some why this should be so. It might be thought that if a girder is to be placed across two supports as in Fig. 4 and used to support a heavy compressive force, it should be of a rectangular shape. But a rectangular shape is not always the strongest form, weight for weight. It has already been pointed out that the compressive and tensional forces to which the

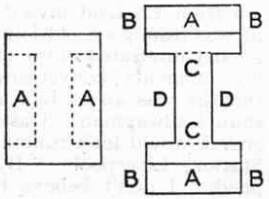


Fig. 5

girder is subjected diminish towards the centre, or neutral axis. Hence if a rectangular girder is used to withstand a bending stress a good deal of material would be subjected to comparatively little strain. Fig. 5 shows rectangular and I-shaped girders having the same sectional area. The I-girder would be stronger than the other, for it is deeper and has a large proportion of its mass concentrated at the points A, where the stresses are greatest. In the rectangular girder the material corresponding with the portions A occupies the positions indicated, where it is subjected to comparatively little compressive or tensional force.

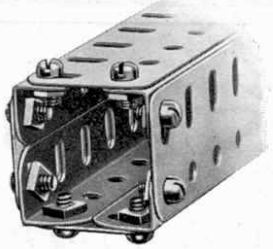


Fig. 6

The parts BB of the I-girder are known as the " flanges " and the vertical part CC is called the " web." In practice the shape of the I-girder shown would be modified still further in order to make the best possible use of the material of which it is composed.

As a rule, I-girders designed for ordinary purposes, such as railway lines, etc., are rolled from the solid, but if they are required to be of exceptional size or to withstand exceptional loads, as may be the case in bridge-building, they are sometimes built up from a number of steel plates or smaller girders. Similarly, in Meccano engineering, it is possible to build up girders of this shape and of almost any size. A typical Meccano I-girder is shown in Fig. 7. It consists of four Angle Girders bolted to a Flat Girder, which forms the web.

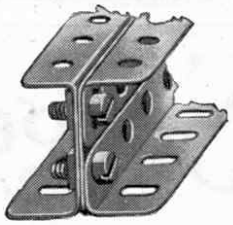


Fig. 7

It will be seen that the I-girder resembles two channel girders bolted together. A simple built-up channel girder, consisting of two Angle Girders connected together by Flat Girders or by Flat Brackets, is illustrated in Fig. 11. It will be found extremely useful in building up large structures.

Figs. 10 and 12 illustrate different types of built-up girders that are capable of withstanding tremendous bending stresses. The jib of the Meccano Stiff Leg Derrick (model No. 7.9, Special Instruction Leaflet No. 6) which has to withstand both bending and compressive forces, consists of Angle Girders bolted together in the formation shown in Fig. 10. Fig. 6 shows a built-up rectangular girder, consisting of four Angle Girders connected together by Flat Girders, which form the four sides. A girder of this type is best suited for use as a supporting column or pillar, for it will withstand very great compressive force.

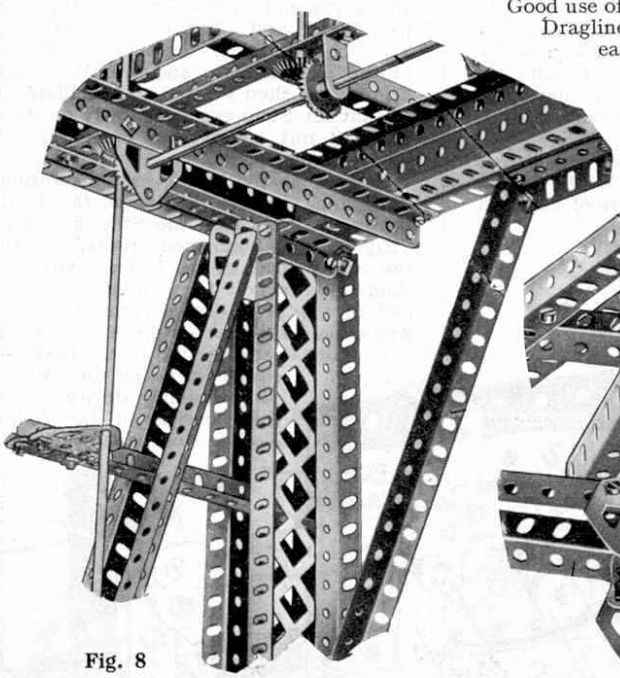


Fig. 8

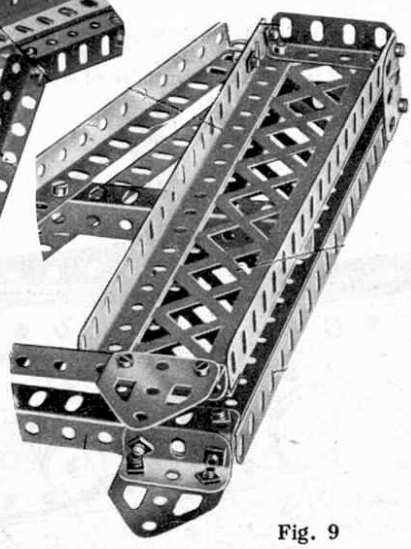


Fig. 9

Two excellent examples of Meccano construction are illustrated in Figs. 8 and 9, the subjects being sections of the Giant Block-setting Crane (Special Instruction Leaflet No. 4). Fig. 8 shows a portion of the travelling gantry, viewed from underneath, while Fig. 9 is a detail view of one of the four columns that support the gantry. It will be noticed that the upper horizontal girders, which have to withstand considerable bending stresses, are of the " I " type, similar to that shown in Fig. 7 but larger. The supporting columns are in reality large rectangular girders; note the use of Braced Girders, which form two sides of the rectangle and serve to strengthen the corner Angle Girders.

Braced and Flat Girders

The Meccano Braced Girders (parts Nos. 97–100A) are not only very useful in building large structures, but are also very ornamental. They consist, in effect, of two parallel strips placed so that the opposite holes are 1½" between centres, and connected together by a series of diagonal ties and struts. They are beautifully made, the perforations being cleanly cut and rounded off so that there is no roughness or sharp edges. Until quite recently the parallel strips were left unconnected at the ends, but all Braced Girders now being made are finished off at the ends by a strip of metal at right angles to the sides, as will be seen in Fig. 3. This of course is a great improvement, as each Braced Girder now forms a complete unit in itself.

When connecting two Braced Girders together by overlapping, they should, wherever possible, be overlapped an odd number of holes, so that the diagonals coincide. If they overlap an even number of holes the diagonals of one Girder appear between those of the other, and the result is not so neat or realistic. The uses of Braced Girders will be obvious and a detailed description of them is not necessary therefore.

Flat Girders (parts Nos. 103–103K) are used principally in connection with Angle Girders in building up large girders. Several of their uses in this connection have already been mentioned (see Figs. 6, 7 and 11). In appearance they resemble an Angle Girder flattened out, and like the latter, they are perforated with one row of round holes and one row of elongated holes.

Good use of Flat Girders is made in various parts of the Meccano Dragline (Special Instruction Leaflet No. 27). For example, each of the four-wheeled bogies upon which this model runs, consists primarily of two 3½" Flat Girders connected together by Double Brackets in such a way that their round holes can be used as bearings for the wheel axles and gearing, etc.

An interesting demonstration of the value of the elongated holes in the Meccano Girders will also be found in this model. The compensating beam, which is pivoted at a central point to the travelling base and is mounted across the rear pair of bogies, consists of an I-shaped girder similar to that shown in Fig. 7. Since the strain on this girder is at a maximum at its centre and diminishes towards the ends, in practice it is made deeper at the centre than at the ends, and this shape has been reproduced very closely in the Meccano model, owing to the fact that the play allowed by the elongated holes enables the lower flanges of the I-girder to be placed on a slant.

Girder Frames and Circular Girders

Part No. 113, Girder Frame, may be likened to a large Trunnion. It consists of a strip perforated with eleven holes, at the centre of which, and at right-angles to it, is a piece 1¼" long supported by two diagonals. The part is clearly shown in Fig. 3. It is particularly useful for bolting to the sides of Meccano wagons, etc., to form bearings for the axles, and it can be used to form journal bearings in many other types of model. It also has a certain ornamental value, as is shown by the Meccano model Flyboats (Special Instruction Leaflet No. 33). In both the Single and Double Flyboats, Girder Frames are used as finishing pieces for the vertical A-frames which support the large revolving wheels.

Circular Girders (No. 143) prove useful wherever it is required to build a rigid circular structure. For example, two or more of these parts may be used as the " ribs " of a Meccano built-up boiler, a series of Strips being bolted round their circumference. (Incidentally, Hub Discs, part No. 118, could be employed equally well for this purpose, but these parts are included under Class N: Wheels, Pulleys, etc.)

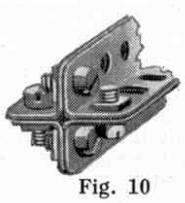


Fig. 10

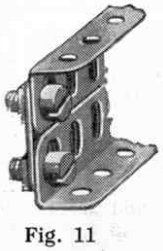
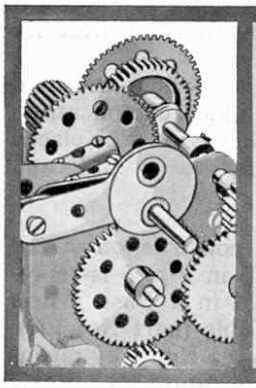


Fig. 11

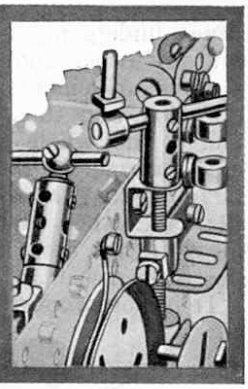
Fig. 12

(Continued on page 133)



HOW TO USE Meccano Parts

III.—BRACKETS, etc. (CLASS C)

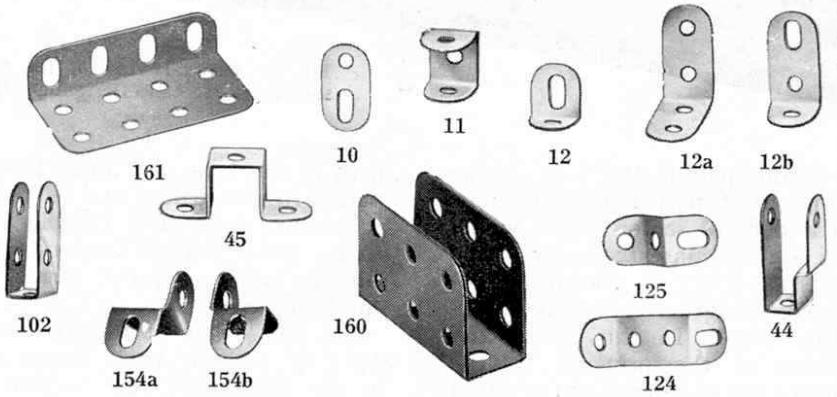


For the purpose of this series of articles we have grouped all the Meccano parts into two main sections, termed the Structural and Mechanical Sections, and these sections have been further divided into a number of separate classes. The complete grouping is as follows. Structural Section: Class A, Strips; 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.

CLASS C, which is the subject of this month's article, comprises the smaller structural accessories. In the first two articles of this series we dealt with Meccano Strips and Girders, which are used primarily for building the framework or "outlines" of Meccano models, and the majority of the parts included in Class C are intended principally to form the connecting links between these larger parts. After a little practice, however, Meccano boys will find many other important uses for them.

The Flat Bracket (part No. 10) is of the standard $\frac{1}{2}$" width and measures $\frac{7}{8}$" in overall length. It is perforated by one round hole and one elongated hole, and the latter enables the part to be used in many cases where it is necessary to make slight adjustments that are not possible with the ordinary equidistant holes. The Flat Bracket is, of course, invaluable for connecting parallel Strips or Girders, as was shown in last month's article (see Figs. 6 and 11 in that issue). The part may also be used as a short Strip for ordinary connecting purposes. For example, in Fig. 10 on the next page two Flat Brackets are shown in use as shackle couplings attached to the end of a Meccano leaf spring of a type frequently used in model motor cars, etc.

Parts in Class C: Brackets, Trunnions, etc.



The following is a complete list of parts in Class C. Most of them are illustrated.

Part No.		Price	Part No.		Price
		s. d.			s. d.
10	Flat Brackets	½ doz. 0 2	125	Reversed Angle Brackets, ½" ...	½ doz. 0 3
11	Double Brackets	each 0 1	126	Trunnions	each 0 2
12	Angle Brackets, ½"×½" ...	doz. 0 3	126a	Flat Trunnions	" 0 1
12a	" " 1"×1" ...	½ doz. 0 4	133	Corner Brackets	" 0 1
12b	" " 1"×½"	" 0 3	139	Flanged Bracket (right) ...	" 0 2
44	Cranked Bent Strips ...	each 0 1	139a	" " (left)	" 0 2
45	Double Bent Strips ...	" 0 1	154a	Corner Angle Brackets (right) ...	½ doz. 0 6
102	Single Bent Strips ...	" 0 1	154b	" " " (left) ...	" 0 6
108	Architraves	" 0 2	160	Channel Bearings, 1½"×1"×½"	each 0 2
124	Reversed Angle Brackets, 1" ...	½ doz. 0 4	161	Girder Brackets, 2"×1"×½" ...	2 for 0 3

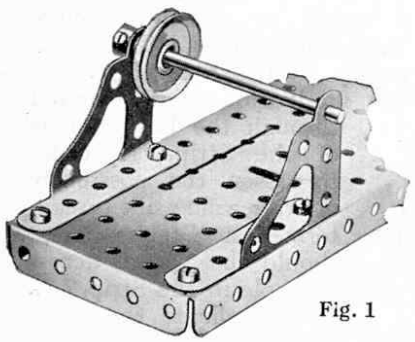


Fig. 1

Double and Angle Brackets

Each of the three sides of the Meccano Double Bracket (part No. 11) measures ½"×½" and is perforated with a single round hole. The part is extremely useful for various connecting purposes. In Fig. 10 it is seen employed as a means of connecting together the shackles mentioned above, while Fig. 12 shows three Double Brackets bolted between two 1½" Pulleys to form a cam. In operation a rocking lever is placed between the Pulleys of this mechanism so that as the cam rotates it is forced up by the Double Brackets and allowed to fall only after all three Double Brackets have passed beneath the lever.

In Fig. 5 a Double Bracket is employed as a means of connecting a piston rod to a connecting rod, the Bracket being mounted on the former and attached pivotally to the latter by means of a bolt and two nuts. In Fig. 6 this part forms a sliding connecting piece that operates a rocking lever in a quick-return motion. The Double Bracket is pivoted to the Bush Wheel and the rocking lever slides freely between its up-turned flanges.

Of Meccano Angle Brackets there are three different types, namely, the ordinary Angle Bracket, Reversed Angle Bracket, and Corner Angle Bracket. The ordinary kind is available in three different sizes, ½"×½", 1"×1", and

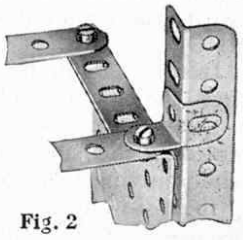


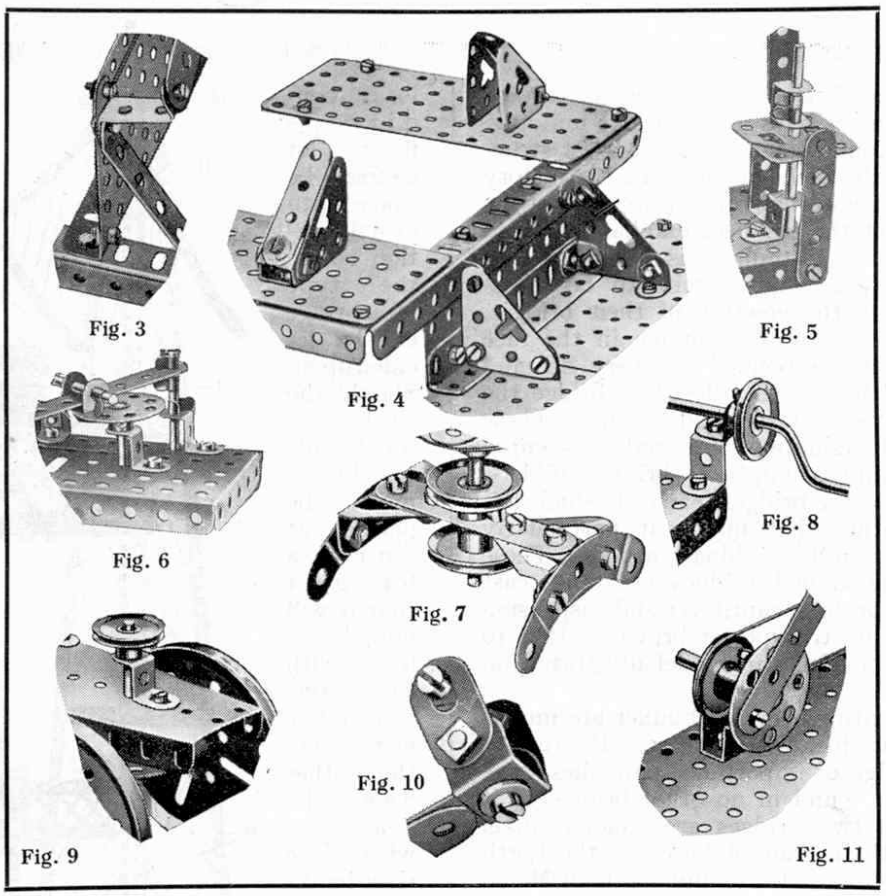
Fig. 2

1″×½″ (Nos. 12, 12a, and 12b respectively). They are designed for connecting any two Meccano parts at right angles to each other, the extra holes provided in Nos. 12a and 12b merely adding to the rigidity of the connection. On occasions they also prove useful as journal bearings for shafting.

The Reversed Angle Brackets (Nos. 124 and 125) are in two sizes, ½″ and 1″. These dimensions refer to the centre portions of the parts only, and in each case the ends are turned at right angles to form a flange that is about ½″ long and perforated with a round or elongated hole. The Corner Angle Brackets (Nos. 154a and 154b) are similar to part No. 12 but have an additional flange. There are two types, right and left-hand.

Various examples of the use of the different Meccano Brackets are illustrated. Fig. 2 shows a Corner Angle Bracket used as a guide for a lift cage. As will be seen, the Bracket is secured by one of its flanges to the top of the cage, thus leaving the other two flanges free to slide against the vertical Angle Girder which forms one of the guides for the lift.

Fig. 3 shows the 1″ Reversed Angle Bracket used as a support for one end of the dashboard in a Meccano motor chassis. Both types of Reversed Angle Brackets form excellent reinforced bearings for Axle Rods, and typical examples of the use of the ½″ size for this purpose will be found in Figs. 5, 6, and 9. Fig. 8 is another illustration of the adaptability of this part.



Single and Cranked Bent Strips

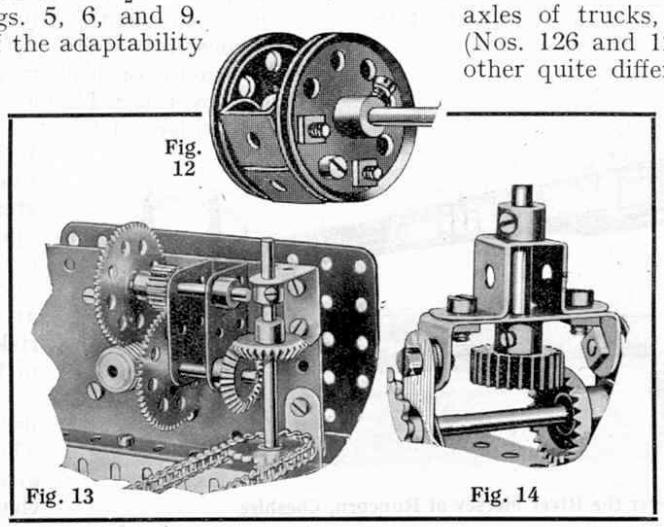
Parts Nos. 44 (Cranked Bent Strip) and 102 (Single Bent Strip) are similar in appearance except that the latter has two holes in each side instead of one and one side of the former is cranked so as to allow more space between the ends. The principal function of both parts is to form a simple and compact bearing for short Axle Rods (see Fig. 11). They are also used in the construction of innumerable small mechanisms, such as pulley blocks, castors, guides, etc., or as "claws" for gear-shifting levers, etc.

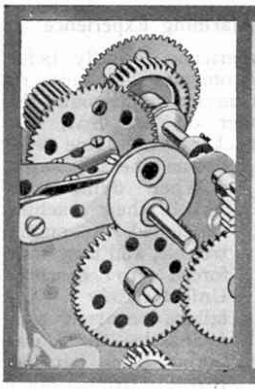
The Double Bent Strip (No. 45) is designed to form reinforced, "footstep," or extended bearings for Axle Rods, etc. (see Fig. 14). It is invaluable where space is restricted, for when bolted to a Strip or Plate ample journal bearings are provided for a short Axle Rod, the Rod passing through the Strip, of course, and through the centre hole of the Double Bent Strip.

Part No. 108, Architrave, is intended for strengthening corners of frames, as will be fairly obvious from its design. It resembles 2½″ and 2″ Strips meeting together at right angles and strengthened by a narrow diagonal piece. It is not only extremely useful but also ornamental, as is shown in the Meccano Eiffel Tower (model No. 7.15 in the 4-7 Instruction Manual), the top of which consists principally of four Architraves!

The right and left-hand Flanged Brackets resemble the Architraves except that in each of the former one side is bent over to form a flange. These parts are illustrated in Fig. 1, where they appear as bearings for a horizontal shaft. They are also extremely useful for strengthening various structures.

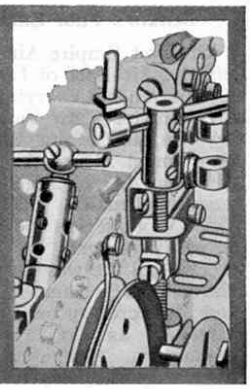
In addition to their obvious use as bearings for axles of trucks, etc., the Meccano Trunnions (Nos. 126 and 126a) lend themselves to many other quite different adaptations. In Fig. 5, for example, two Flat Trunnions are shown bolted together in such a way that they form a small plate 1½″ square. In Fig. 7 two ordinary Trunnions, which differ from the Flat Trunnions only by the fact that one end is bent over to form a flange, are used to form a very rigid base or pedestal for a small swivelling structure. There are, of course, many hundreds of similar applications for the Meccano Trunnions. (Continued on page 265)





HOW TO USE Meccano Parts

IV.—PLATES, etc. (CLASS D)



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IN Classes A and B we described the more important uses of the Meccano Strips and Girders, which are designed primarily for building the framework or "outlines" of Meccano models, and in Class C we dealt with Brackets and Trunnions, etc., the chief function of which is the forming of connecting links between the larger parts. Class D, which is the subject of this month's article, comprises the Meccano Plates, Boilers, and associate parts. These are intended principally for "filling in" the framework of models and for building gear boxes, floors, roofs, etc. Of course, certain parts, such as the Circular Plates, Chimney Adaptor, etc., included in this Class have other very different uses.

Flanged and Flat Plates

The Perforated Flanged Plates are in two sizes, $5\frac{1}{2}'' \times 2\frac{1}{2}''$ and $3\frac{1}{2}'' \times 2\frac{1}{2}''$ (parts Nos. 52 and 53 respectively). The former has flanges on all four sides, whilst the latter is flanged on only two sides. Part No. 52 is used to a large extent as a base for small models, and in the construction of work-tables, platforms and sides of gear boxes, etc. In addition to the usual perforations it has a slot 2" long and a hole $\frac{5}{8}'' \times 3/16''$ near its centre. The purpose of the slot is to receive the blade of a Circular Saw when the latter is mounted beneath the Plate, whilst the elongated hole is intended to facilitate the adjustment of the Saw guide piece.

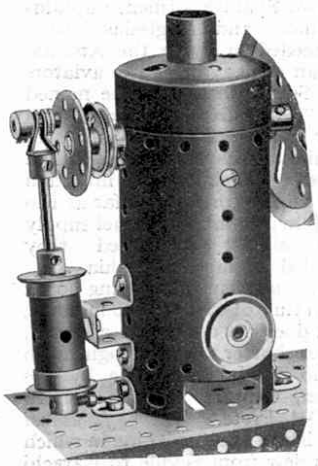


Fig. 1

Fig. 3 shows the Plate incorporated in a model saw bench. The blade of the Saw, which is secured to the Sprocket Wheel shaft, can just be seen above the Angle Girder that forms the guide piece. This Girder is held in place by the Collar shown, and the latter is secured on to the shank of a bolt passed through the elongated hole in the Plate.

The slot and hole increase the adaptability of the Plate in several other ways. If the Plate is used as the side of a gear box, for example, a change-gear lever may be arranged to work in the slot, and the inner end of the lever may then be connected direct to the shaft, clutch member or gear that it controls.

There are four sizes of Flat Plates, i.e., $5\frac{1}{2}'' \times 3\frac{1}{2}''$, $5\frac{1}{2}'' \times 2\frac{1}{2}''$, $4\frac{1}{2}'' \times 2\frac{1}{2}''$, and $2\frac{1}{2}'' \times 2\frac{1}{2}''$. If plates are required larger than these it is of course a simple matter to build them up by joining two or three Flat Plates together. Fig. 17 shows two of No. 52a connected together to form a platform measuring $6\frac{1}{2}'' \times 5\frac{1}{2}''$. The various types of Flat Plate, used in conjunction with the Flanged Plates, etc., enable covered structures of all kinds to be built-up speedily and in a sturdy and realistic manner.

The Sector Plate

The Sector Plate (part No. 54) is an extremely useful accessory. It measures $2\frac{1}{2}''$ across at its widest end and tapers down to $1\frac{1}{2}''$ at its other end, and its sides are provided with flanges which are punched with slightly elongated holes. The tapered shape so obtained enables the part to be used in many structures and mechanisms where it would be impossible to achieve similar results from other parts. Fig. 9 shows two Sector Plates used to form the movable receptacle in a Meccano model of a foundry ladle. Fig. 8 illustrates a Sector Plate employed to form the bonnet of a motor car, and Figs. 12 and 16 indicate two ways in which the part can be used with great advantage in building-up bases or supports for machinery.

When a Sector Plate is bolted by one of its flanges to a Girder or other part, its other flange and the rows of holes punched in its face lie at an angle to the part, and this fact proves advantageous in numerous cases. In Fig. 10, for example, a Sector Plate is shown secured to the base of a rotating crane. Another is bolted to the opposite side of the

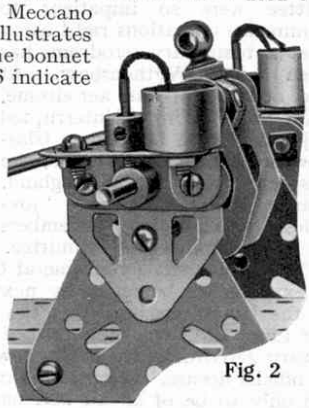
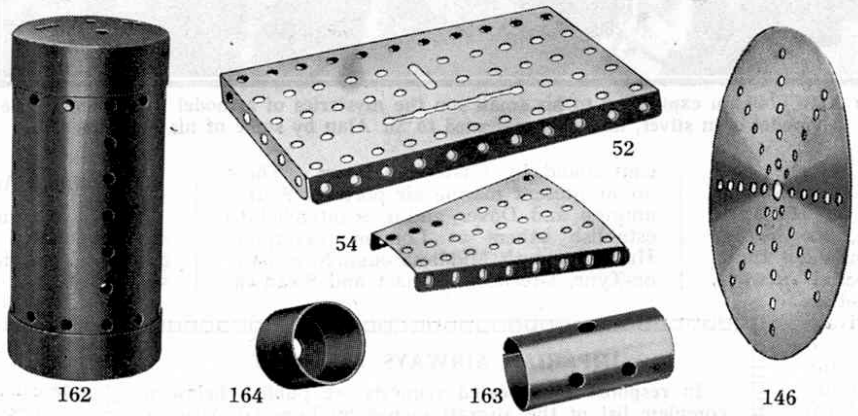


Fig. 2

Parts in Class D: Plates, Boilers, etc.



The following is a complete list of parts in Class D. Some of the parts are illustrated above.

Parts No.		Price	Parts No.		Price
		s. d.			s. d.
52	Perforated Flanged Plates, $5\frac{1}{2}'' \times 2\frac{1}{2}''$ each	0 5	76	Triangular Plates, $2\frac{1}{2}''$ ... ... each	0 2
53	Perforated Flanged Plates, $3\frac{1}{2}'' \times 2\frac{1}{2}''$,,	0 3	77	Triangular Plates, 1" ... ... ,,	0 1
52a	Flat Plates, $5\frac{1}{2}'' \times 3\frac{1}{2}''$ ... ... ,,	0 5	146	Circular Plates, 6" ... ... ,,	1 0
53a	Flat Plates, $4\frac{1}{2}'' \times 2\frac{1}{2}''$ ... ... ,,	0 3	162	Boiler, Complete with Ends ... ... ,,	1 0
70	Flat Plates, $5\frac{1}{2}'' \times 2\frac{1}{2}''$ ... ... ,,	0 4	162a	Boiler Ends ... ... ,,	0 3
72	Flat Plates, $2\frac{1}{2}'' \times 2\frac{1}{2}''$ ... ... ,,	0 2	163	Sleeve Pieces ... ... pair	0 6
54	Perforated Flanged Sector Plates ... ,,	0 3	164	Chimney Adaptors ... ... each	0 2

base, so that Axle Rods journalled in Angle Brackets bolted to the Sector Plates are disposed radially to a fixed point near the rear of the model. These Rods carry the travelling wheels. Hence the model is capable of rotating completely about the fixed point.

Parts No. 76 and 77, 2½″ and 1″ Triangular Plates, are intended principally for use as supports for journal bearings, as shown in Figs. 2, 13 and 15, but they have numerous other important uses. In Fig. 7 for example, four 2½″ Triangular Plates form the sides of a grab and in Fig. 11 two are used in the construction of a pulley block.

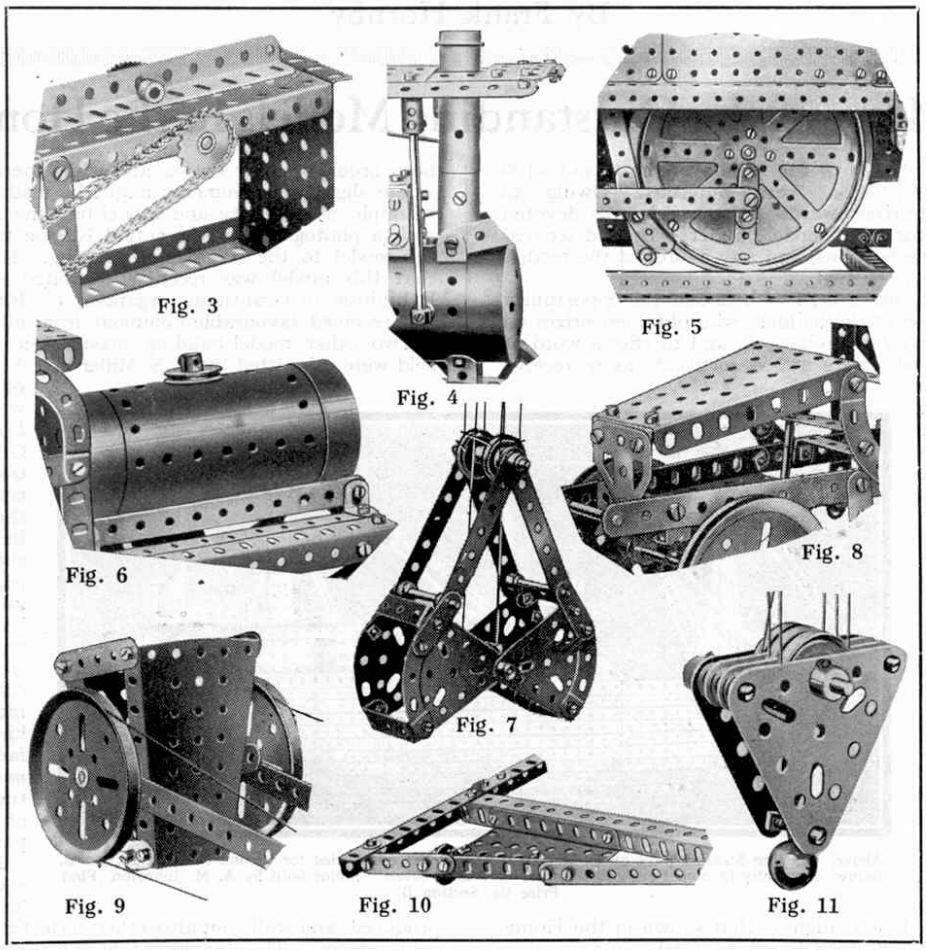
An important feature of the 1″ Triangular Plate is the fact that it enables ¼″ distances to be obtained, which is not always easy with the ordinary parts perforated at intervals of ½″. Fig. 14 shows two of these parts attached to the rear of the Meccano Traction Engine, to receive the end of the drawbar attached to a trailer. The rear of the Traction Engine is 3″ wide (six holes); hence it would not be possible to attach the drawbar pin direct to one of the holes in the rear plate, since it would be out of centre. By attaching two 1″ Triangular Plates as shown, however, and securing the pin to their protruding ends, the drawbar is connected centrally.

The Circular Plates (part No. 146) may be employed as large flywheels or turntables, etc., or as circular fixed bases for machinery. Another important use for them is found in the construction of driving wheels for giant Meccano locomotives. Fig. 5 shows one of the six driving wheels of the Baltic Tank Engine. It consists of a Circular Plate having a Hub Disc bolted to it to form the flange or "tread." The heads of the rails on which this type of wheel is intended to run should be at least ¼″ wide, and if the rails are built-up from Angle Girders as in the illustration, the extra width can be obtained by fixing ordinary Strips to the inner sides of the vertical Girder flanges.

The Circular Plate has a large perforation at its centre and the boss of a wheel may be slipped through this if desired. The Plate is secured to an Axle Rod by first bolting it to a Bush Wheel or similar part mounted on the Rod.

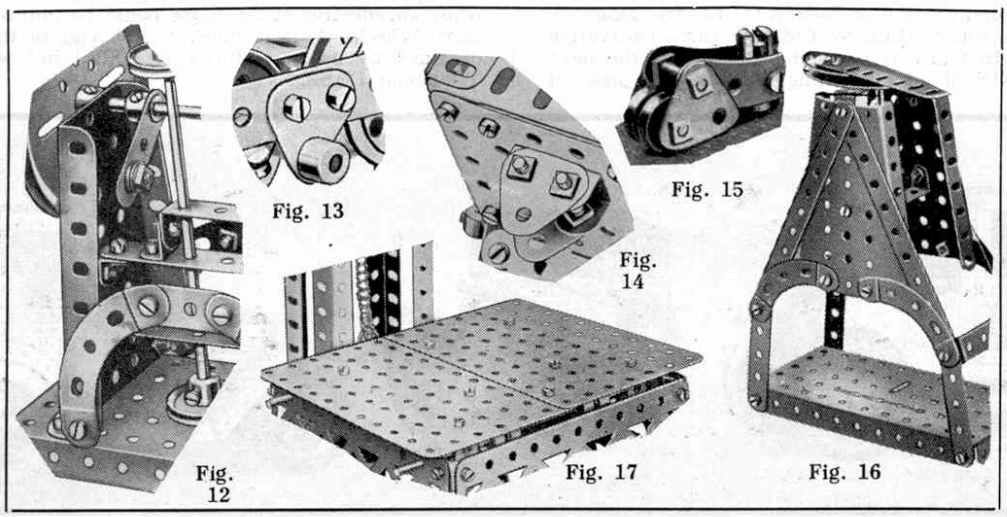
Boiler, Sleeve Piece, and Chimney Adaptor

The Meccano Boiler is perforated with the standard equidistant holes and can be incorporated in Meccano locomotives, stationary engines and numerous other models of a similar type. It measures 4¾″ by 2″, and is fitted at each end with a movable cap or Boiler End. With one Boiler End removed it may be incorporated in a model as a vertical boiler, or with both ends closed it will serve equally well as a horizontal boiler. Fig. 1 shows it in the former capacity, whilst in Fig. 6 it is seen in the horizontal position. In the latter illustration it represents the rear portion of a model tank lorry. When employed to represent a steam boiler, suitable boiler fittings can easily be improvised from existing parts. A very different function of the part is its use as a cylindrical supporting column for machinery of various kinds.



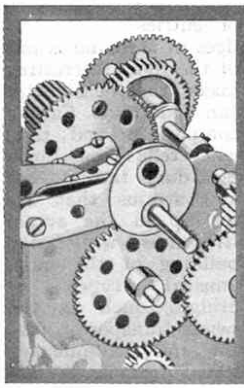
The Sleeve Pieces (part No. 163) are intended primarily for use in the construction of cylinders and chimneys. To form a complete cylinder, two ¾″ Flanged Wheels should be pushed over the ends of a Sleeve Piece as shown in Fig. 1. The Sleeve Piece may be secured in position by bolts inserted in the holes punched round its centre. In the example illustrated the cylinder is of the oscillating type and is pivoted to the Double Bent Strip by means of a bolt that is secured to the Sleeve Piece by two nuts, as in Standard Mechanism No. 262.

When used as a chimney the Sleeve Piece may be secured to a model by means of a ¾″ Flanged Wheel clamped over one end or by a Chimney Adaptor (part No. 164). The diameter of the latter is such that it will make a firm fit when pushed into one end of the Sleeve Piece. In building up longer chimneys, two Sleeve Pieces may be connected together by pushing them over opposite ends of a Chimney Adaptor, but a more rigid and efficient method is that adopted in the chimney shown in Fig. 4.



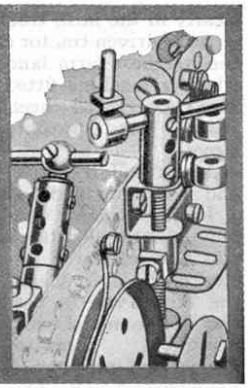
This consists of three Sleeve Pieces placed end to end with the centre Sleeve Piece overlapping each of the other two by ⅜″. A 3½″ Rod passed lengthwise through the centre of the three Sleeve Pieces carries at one end a ¾″ Flanged Wheel that forms the top of the chimney. The top and bottom Sleeve Pieces are held in place by means of bolts passed

(Continued on page 425)



HOW TO USE Meccano Parts

V.—NUTS & BOLTS, etc. (CLASS E)



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IN the preceding articles in this series we have dealt with all those Meccano parts that are ordinarily used for simple structural work. Before proceeding with the Mechanical Section it will be advisable to refer to certain Meccano accessories that are indispensable for all kinds of Meccano model-building, namely, Nuts and Bolts, Screwdrivers, and Spanners. For convenience these parts have been grouped, together with the Meccano literature and other miscellaneous items, under Class E in the Structural Section.

Nuts and Bolts

Nuts and bolts are naturally amongst the most important of the Meccano accessories. When it is remembered that those that fall into the hands of the really industrious Meccano boy must withstand the strain of being screwed up tightly and unscrewed literally hundreds of times, it is not surprising that they should be carefully turned—not stamped—from the finest steel.

Quite a number of Meccano boys have written to enquire which is the best method of securing nuts and bolts—whether with the nuts or the bolt heads towards the outer side of the model. By far the greater majority of Meccano boys place the bolts with the heads outside, and this, in our opinion, is the better plan, for the Screwdriver forms a speedier method of tightening the nuts and bolts than the Spanner. Also, a model having all the bolt heads on the outer side will have a much neater appearance than one in which the nuts and shanks are all exposed.

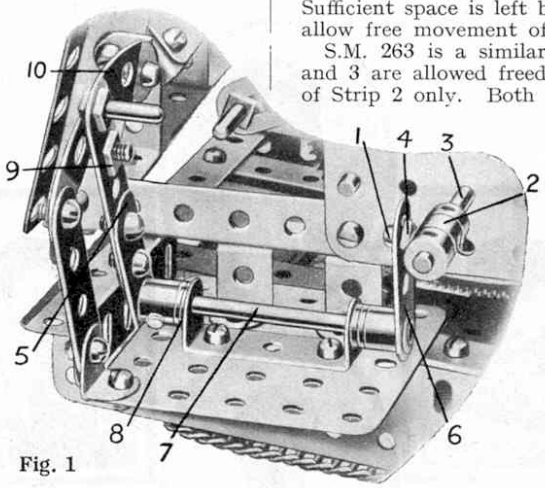


Fig. 1

For ordinary model building, sufficient rigidity can be obtained by using the Screwdriver only, merely steadying the nut with the fingers, but wherever excessive strain is expected, both Spanner and Screwdriver should be used simultaneously, the nut being held immovable by the Spanner in one hand while the bolt is turned by the Screwdriver in the other hand.

Until quite recently the heads of Meccano bolts were cylindrical in shape, but they are now rounded. This is a great improvement, for not only is a much neater appearance obtained in a model constructed with the new bolts, but the improved shape increases their adaptability to an important extent.

For example, Fig. 1 shows a Meccano gear changing lever in which a single bolt plays a novel and important part. The lever 5 is spaced by Washers 8 from the end of the Double Angle Strip that forms its bearing so that the bolt 9 presses firmly against a 2½″ small radius Curved Strip 10, which forms the quadrant. The head of the bolt tends to slip into the holes in the Strip 10 and thus retain the lever 5 firmly in any one of three different positions. The gearing on the shaft 3, which is controlled by the lever, should be arranged so that the different engagements are brought about in these three positions of the lever 5; then the gears will not easily ride out of engagement once the lever has been moved. A similar result could not be obtained, of course, with an old-style bolt.

A very important use of the nut and bolt is found in the making of pivotal connections between various Meccano parts. Typical pivots so formed are described under Standard Mechanisms Nos. 262 and 263. S.M. 262 is reproduced herewith (Fig. 2). In this case the bolt 1 passes through the Strip 2 and is securely held to Strip 3 by means of two nuts 4 and 5, which are screwed tight against opposite sides of the Strip. If possible two Spanners should be used so that the nuts can be turned simultaneously and in opposite directions. Sufficient space is left between the nut 5 and the bolt head to allow free movement of the Strip 2.

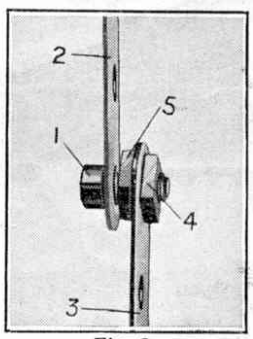


Fig. 2

S.M. 263 is a similar arrangement except that both Strips 2 and 3 are allowed freedom of movement about the bolt instead of Strip 2 only. Both Strips are first placed on the bolt 1 and the nuts 4 and 5 are then placed together on its shank. The nuts are turned in opposite directions until they securely grip each other in position on the bolt. S.M. 262 is to be preferred wherever it is required to move only one Strip about the bolt, for this method affords a minimum amount of " play " or slackness in the joint.

Another kind of pivot formed from a bolt and nut is included in Fig. 1. Bolt 1 in this illustration passes through the end hole of a Crank 6 and enters the threaded bore of a Collar 2, without touching the Rod 3. It is secured rigidly in this position by locking a nut 4 against the Collar. Sufficient freedom is allowed for the Crank 6 to turn easily about the bolt, and the Collar 2, which is free on the shaft 3, is held in position by two further Collars. By means of this pivotal connection, easy longitudinal movement of the Rod 3 is obtained on operation of the Crank 6.

There are four different sizes of Meccano bolts, i.e., ¾″, 1″, ⅜″, and 7/32″ (parts Nos. 111, 111a, 111c, and 37b respectively) but the pitch of the thread is the same in every case (32 threads to the inch). This pitch is, of course, standard throughout the Meccano system, with the exception of the 6 B.A. Bolts and other special electrical accessories which will be dealt with under Class T.

The 7/32″ Bolt may be obtained separately (under part No. 37b) or complete with nut (under part No. 37). It is this size of bolt that is supplied in considerable quantities, complete with nuts in all the Meccano Outfits. The other three kinds of bolts are for use in special cases where an extra long shank is required.

In addition to these bolts there are the Set-screws (part No. 69). These are of similar shape to the bolts but are only 3/16″ in length, and are, of course, designed primarily for securing the various Meccano wheels to the Axle Rods. The Grub Screws (parts Nos. 69a and 69b) have no head at all, a slot merely being cut across one end to receive the Screwdriver. These are employed for securing the smaller Meccano parts, such as Collars, Couplings, etc., to the Rods, and are much neater than the Set-screws. It will sometimes be found that the Set-screw of a Meccano Pulley or Gear Wheel fouls some other part of the model, in which case it may be substituted by a Grub Screw, which will fit almost flush with the boss.

The Pivot Bolt (part No. 147b) is of a quite different design to the ordinary bolts. The greater portion of its shank is smooth and the part is particularly suitable for use as a small pivot or fixed pin about which a small pulley or lever may rotate. It is

secured in position by clamping the two nuts on its shank to a Meccano Strip or other part, as in Fig. 2.

Wood Screws are also included in the Meccano system. These are, of course, for the benefit of those boys who wish to secure their models to wooden bases. They are supplied in ½" length only. Any model that does not travel will be improved in appearance and operation if it is screwed down to a wooden base.

The Meccano Tools

It is one of the great advantages of the Meccano system that the only tools required for ordinary model-building are a spanner and a screwdriver. Parts Nos. 34 and 36 are the tools that are found in every Meccano Outfit, and are the only essential ones. There are one or two other tools, however, which the model-builder finds invaluable.

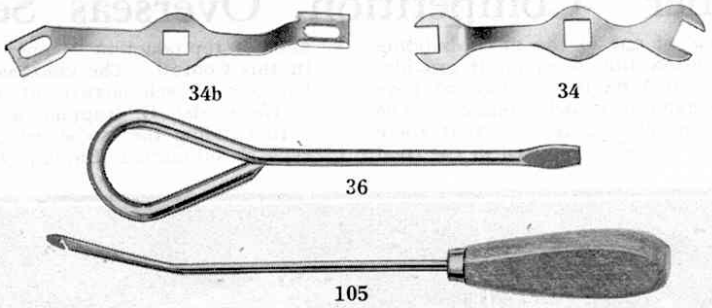
The Box Spanner (part No. 34b) has a kind of slot at each end into which the nut may be slipped. With the aid of this tool a nut may be placed in positions where it would be impossible to reach with the fingers.

The Extra Long Screwdriver (No. 36a) is of similar pattern to part No. 36, but the blade is 5" long instead of 3½", and instead of the end being flattened slightly as shown in the accompanying illustration it is of the same diameter as the shaft. This enables the shaft to be passed completely through the standard Meccano holes. This is a very valuable feature and enables one to reach bolts placed in the most awkward positions.

The Special Screwdriver is also illustrated. It is all-metal and measures 8" in overall length. Like part No. 36a the blade of this tool is of such a diameter that it may be passed through standard Meccano holes.

Another Meccano tool that we illustrate is the Reed Hook (No. 105). This is designed to facilitate the threading of the warp threads through the Meccano Loom. The tool is not indispensable but those boys who have tried passing the threads one by one through the eyes of the healds and through the reed frame will find it a great boon.

Parts in Class E: Nuts and Bolts, Tools, and Literature



Nuts and Bolts

Part No.		Prices s.	d.	Part No.		Prices s.	d.
37	Nuts and Bolts, 7/32" per box (doz.)	0	6	69a	Grub Screws, 5/32" ... doz.	0	4
37a	Nuts ... ... " "	0	3	69b	" 7/32" ... "	0	5
37b	Bolts, 7/32" ... " "	0	3	111f	Bolts, ¾" ... ... 2 for	0	1
68	Woodscrews, ½" ... doz.	0	3	111a	" ½" ... ... 3 "	0	1
69	Set Screws ... ... "	0	3	111c	" ⅜" ... ... doz.	0	3
				147b	Pivot Bolt with 2 nuts each	0	2

Tools, etc.

34	Spanners ... ... each	0	2	Oil Can No. 1 (ordinary type) each	0	6
34b	Box Spanners ... "	0	4	Oil Can No. 2 (" K " type) "	3	6
36	Screwdrivers ... ... "	0	3	Meccano Lubricating Oil per bottle	0	6
36a	" extra long "	0	6	Meccano Enamel (red, grey, or green) ... ... per tin	0	8
36b	Special Screwdrivers "	1	0			
105	Reed Hooks, for looms "	0	4			

Literature

56	Instruction Manuals for Outfits Nos. 4-7 each	1	6	56c	Meccano Standard Mechanisms Manual each	1	0
56a	Instruction Manuals, for Outfits Nos. 00-3 "	1	6	56d	Meccano Book of New Models ... ... "	0	6
56b	Instruction Manuals, for Outfit No. 0 ... "	0	4	56f	Meccano Bound Manual "	7	6

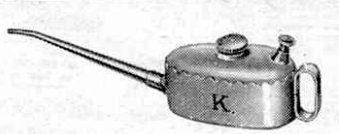
For particulars of the Meccano Super Model Instruction Leaflets, please write to Meccano Ltd., Binns Road, Old Swan, Liverpool, for illustrated price list.

Useful Lubricating Accessories

Other accessories that may be classified with tools and which must not be omitted are the special Meccano Oil Cans. There are two designs, No. 1 (ordinary type) and No. 2 (" K " type). The latter is reproduced herewith and Meccano boys will note that besides forming a very efficient lubricator it is also a very clever reproduction in miniature of a famous type of oil can largely used by engineers. The oil may be ejected drop by drop by depressing the valve, as in the full size model. The No. 2 Oil Can measures 5" in overall length and is probably the smallest of its type ever manufactured for practical use. One of the Meccano " K " type oil cans was recently sent to H.R.H. the Prince of Wales and a gracious letter of acknowledgment was received expressing H.R.H.'s admiration of the beautiful lines and perfect finish of the model.

It is very important to remember that, like actual machinery, Meccano models must be kept well lubricated. This is specially important where gearing of any kind is concerned. The teeth of the gears should be kept always moist, as should all journal bearings, pivots, etc. A specially prepared lubricating oil is included in the Meccano system and may be obtained in small bottles. This oil is particularly suitable for lubricating Meccano Clockwork and Electric Motors.

Another important accessory included in this Class is the Meccano Enamel. As every "*M.M.*" reader will know, nearly all Meccano parts may now be obtained enamelled in colours, and for the benefit of those boys who wish to convert nickelled parts to coloured ones, or to touch up coloured parts should such treatment become necessary through mishandling or excessive wear, the Meccano Enamel is supplied in small tins. There are three colours available, red, grey, and green, each colour being identical in shade with the enamel used in the Meccano factory for spraying Meccano parts. The enamel should be applied with a small brush, the surface of the part having first been cleaned thoroughly with fine emery cloth. When quite dry the enamel gives a splendid finish to the Meccano parts.



This is an illustration of the Meccano Oil Can No. 2 (" K " type). As will be seen it is complete with filler with screwed cap and a spring plunger or valve. By depressing the latter the oil is ejected drop by drop.

The Meccano special Screwdriver (part No. 36b) is a strong and useful tool. It is all metal and the shaft is fitted to the handle in such a manner that it is impossible for one to slip round without the other.

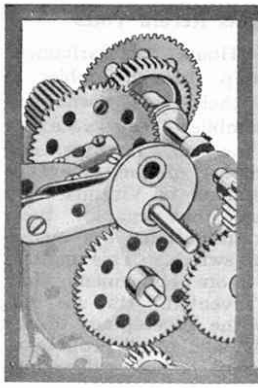
The Meccano Literature

The greatest thrill of Meccano model-building is to be derived from building according to one's own ideas, but before a Meccano boy attempts to do this he should make a point of building all the models shown in the Meccano Instructional Manuals that are within the range of his Outfit. By doing so he obtains that familiarity with the Meccano parts and their uses which is essential for successful " inventing." A very large selection of models is included in the Instruction Manuals. They are arranged according to the Outfits with which they may be built, so that the boy who starts at the beginning of his Manual and goes on building each example shown, will find his models growing ever more complicated and interesting.

Instructions are included wherever the illustrations are not sufficiently clear, but for the rest the Meccano boy is expected to use his own eyes and ingenuity! After a little practice it is surprising how easy it becomes to build the most elaborate model from quite a small illustration. It should be remembered that wherever there is any doubt about the size or position of any part in a model, the necessary information can easily be obtained by counting the holes in adjacent Strips.

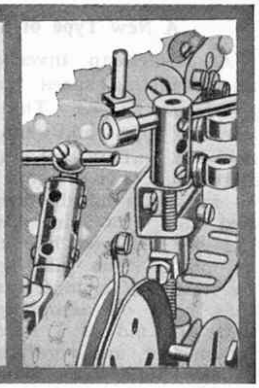
Some of the models included in the Manuals require so many illustrations in order to show each detail clearly that they would occupy several pages. Such models therefore are dealt with in special instruction leaflets, which are beautifully printed and profusely illustrated from actual photographs. These leaflets are included in the Outfits with which the respective models can be built, and they may also be obtained separately.

The Meccano Standard Mechanisms Manual is designed for the use of the more advanced model-builder. Its object is to provide ready reference to a large number of Meccano movements that are to a large extent standardised, in that they may be applied to more than one model with very little alteration. (*Cont. on page 505*)



HOW TO USE Meccano Parts

VI.—RODS, CRANKS, etc. (CLASS M)



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.

THIS month we describe the Meccano parts included in Class M, the first class in the Mechanical Section. The grouping of the Meccano Accessories was fully described in the first article of this series, but it may be advisable to repeat that in the Mechanical Section we have endeavoured to group all those parts that are intended principally for assembly in mechanical movements (gear boxes, driving mechanisms, etc.), as opposed to parts that are used principally in the construction of the frames and bases, etc., of models.

The Meccano Axle Rods

The Meccano Axle Rods are made to a diameter of .160 inches and are supplied in lengths from 1″ to 11½″. If greater lengths are required two Axle Rods may be joined end to end by means of a Coupling. In addition to their obvious uses as shafting or spindles for rotating machinery, the Rods are often employed as levers, guides for sliding mechanisms such as the work-table of a lathe or planing machine, tie rods or struts in structural work, etc.

In assembling rotating machinery the bearings should receive very careful attention, especially if the shafts are to rotate at great speed or are to withstand excessive strain. In either case it is a good plan, instead of journalling the Rod in a hole in a single Plate or Strip, to reinforce the bearing by bolting a Wheel or Crank to the Plate so that the Rod may turn freely in the boss. If the Wheel is bolted so that the set-screw hole is uppermost, an excellent oil receptacle will be provided. Alternatively, several short Strips can be bolted to the Plate so that the width of the bearing surface is increased. Unless these precautions are adopted the rotating shaft will gradually increase the diameter of the hole in which it is journalled.

Fig. 1

For all ordinary purposes the set-screws provided with the various Meccano Wheels and Cranks should be sufficient to hold the parts rigidly in position on the Axle Rods. In the latest Meccano parts, however, the set-screw hole has been extended right through the boss so that two set-screws can be inserted if desired, one on each side. In certain cases, even two set-screws may not be sufficient to prevent the wheels slipping upon the shafts. A case in point is the winding drum of the Meccano Clock, which must withstand over many hours the direct pull of the 18 lb. weight. To meet such conditions a small flat should be filed on each side of the Rod to receive the ends of the set-screws. If these flats are filed very carefully a wheel may be made quite immovable on the shaft, and yet when required it may easily be slipped off merely by loosening the set-screws. On the other hand, unless the flats are cut very carefully the set-screw will slip partially round the Rod and become firmly wedged.

The Crank Handles, which are obtainable with either 3½″ or 5″ shafts are in reality ordinary Axle Rods with their ends bent to form convenient handles. In addition to their obvious uses, they may be employed where a bent handrail is required, or as a crankshaft when the crank is required at one end only and not in the centre as in part No. 134. The stroke of the crank so provided is roughly 1¼″.

Part No. 134 may be used in numerous cases where it is required to convert rotary motion to reciprocating motion, or vice versa. It gives a stroke or total rectiliniar movement of 1″. An ordinary Meccano Strip is intended to be used as the connecting rod. It should be slipped into place in the centre of the crank portion and held in position by two Spring Clips. If desired a more elaborate connecting rod may be built-up as shown in Fig. 11. As will be seen, it consists of an Axle Rod 2, the big-end bearing being formed from two 1½″ Strips mounted on the crank and bolted to a Coupling 1. The Strips are held in place by a ½″ Bolt 3 passing completely through the end of the Coupling, and by a pair of set-screws 4, which serve also to grip the connecting rod in the Coupling. The position of the connecting rod in the centre of the crank is maintained by a Spring Clip 5 mounted between two Washers.

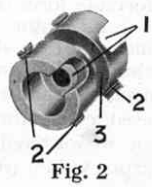
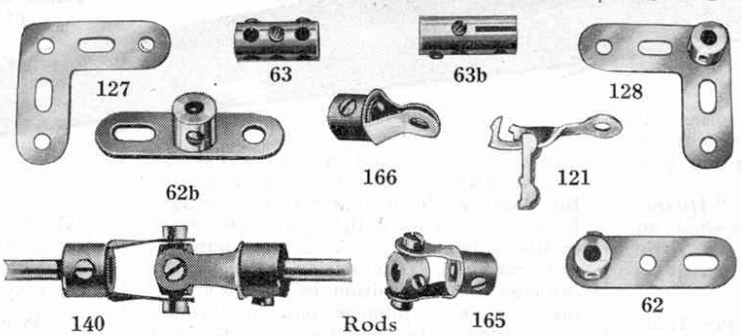


Fig. 2

Screwed Rods and Their Uses

The Meccano Screwed Rods are cut throughout their lengths with the Meccano standard thread

Parts in Class M: Rods, Cranks and Couplings



Part No.		Price s.	d.
13	Axle Rod, 11½″ long ... each	0	2
13a	„ 8″ „ ... „	0	2
14	„ 6½″ „ ... „	0	1
15	„ 5″ „ ... „	0	1
15a	„ 4½″ „ ... 2 for	0	1
16	„ 3½″ „ ... „	0	1
16b	„ 3″ „ ... „	0	1
16a	„ 2½″ „ ... „	0	1
17	„ 2″ „ ... 3 for	0	1
18a	„ 1½″ „ ... „	0	1
18b	„ 1″ „ ... „	0	1

Part No.		Price s.	d.
19	Crank Handles, Large each	0	2
19s	„ „ Small „	0	2
134	Crankshafts, 1″ stroke „	0	2
78	Screwed Rods, 11½″ ... „	0	6
79	„ 8″ ... „	0	5
79a	„ 6″ ... „	0	4
80	„ 5″ ... „	0	3
80b	„ 4½″ ... „	0	3
80a	„ 3½″ ... „	0	3
81	„ 2½″ ... „	0	2
82	„ 1″ ... „	0	1

Cranks

62	Cranks ... ... each	0	3		
62a	Threaded Cranks ... „	0	4		
62b	Double Arm Cranks ... „	0	3		
127	Simple Bell Cranks ... each	0	1		
128	Boss Bell Cranks ... „	0	3		

Couplings

63	Couplings ... ... each	0	6		
63b	Strip Couplings ... ... „	0	8		
63c	Threaded Couplings ... „	0	6		
63a	Octagonal Couplings „	0	8		
121	Train Couplings ... „	0	2		
140	Universal Couplings ... each	0	10		
171	Socket Couplings ... „	0	9		
165	Swivel Bearings ... „	0	6		
166	End Bearing ... ... „	0	3		

(32 threads to the inch). They form extremely valuable parts, their principal function being the conversion of rotary motion to longitudinal motion, as in screw elevating machinery, etc. Also, in cases where a longer bolt is required than part No. 111, which is the longest in the system, one of the shorter Screwed Rods may be used with advantage.

Several Meccano parts are specially designed for use in connection with the Screwed Rods, such as the Threaded Boss, Threaded Crank and Threaded Coupling. If one of these parts is secured to a portion of a model and a Screwed Rod threaded through it, then the latter may be caused to move longitudinally as it rotates, or this movement may be prevented and instead that portion of the model carrying the threaded part caused to move up and down the Rod. If it is required to fix a Threaded Boss or Threaded Coupling on a Screwed Rod, a nut should be placed on the Rod and screwed tightly against the part. It should never be secured by a set-screw, as this will inevitably damage the thread of the Rod. Any other Meccano Wheel, Pinion, etc., may be attached rigidly to a Screwed Rod by gripping it tightly between two nuts threaded on the Rod.

When it is required to journal a Screwed Rod between bearings so that it may rotate like an ordinary Axle Rod, it should be connected by Couplings to Axle Rods so that the latter may be journalled in the bearings instead of the Threaded Rod. If this is not possible the Rod should be journalled in the boss of a Crank or Wheel, etc., in order that the bearing surfaces shall be as large as possible.

It should be remembered that the Screwed Rod proves invaluable as a means of increasing the available power, although at a considerable loss of speed. It should be used wherever it is necessary to cope with specially heavy loads, such as in raising the jib of a large model crane or in elevating a lift bridge, etc.

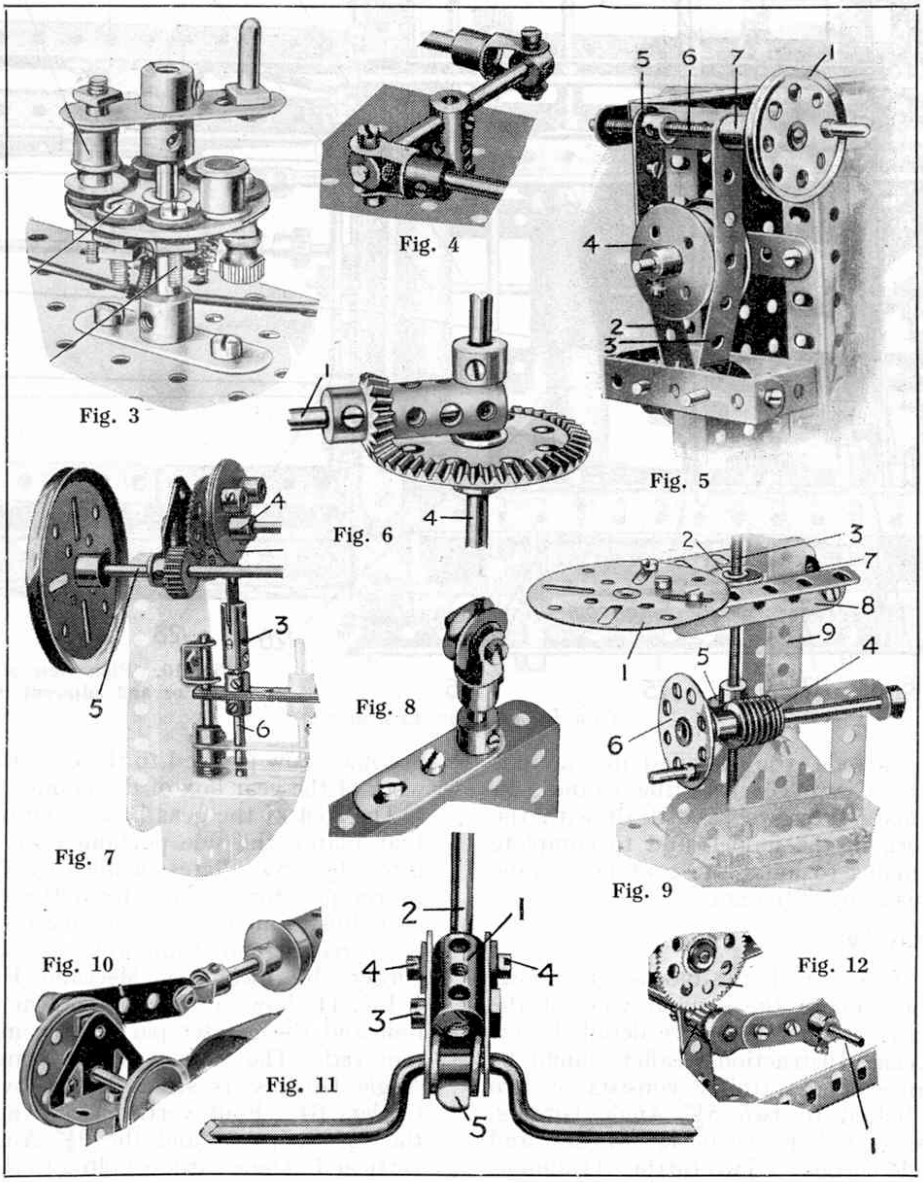


Fig. 5 shows a Screwed Rod employed to expand or contract the bands of a brake. The Strip 2 is bolted to Threaded Crank 5 engaging the Screwed Rod 6 and the Strip 3 presses against a Threaded Boss 7. The Threaded Boss revolves with the Rod 6, to which it is locked by means of a nut also mounted on the Rod and screwed tight against the outer end of the Boss. The position of the Boss 7 on the Rod does not change, but the Threaded Crank 5 travels forward or backward according to the direction of rotation of the hand wheel 1, thus applying or releasing the brake. The Rod 6 should be allowed sufficient play to move longitudinally in its bearings as the brake bands contract or open, so that the pressure on each band is equal.

In Fig. 9 a Screwed Rod is employed as a simple means of elevating or lowering the worktable in a model drilling machine. The table 1 is bolted to the Threaded Crank 2, the boss of which engages the vertical Screwed Rod 3. The latter may be rotated from the hand wheel 6, and since the Crank 2 cannot turn with the Screwed Rod, it must either rise or fall, according to the direction of rotation.

There are numerous other important uses for the Screwed Rod, such as in jib-raising mechanisms and elevating and adjusting gear for all kinds of machine tools, etc., and for further particulars of these we would refer Meccano boys to Section IX of the Standard Mechanisms Manual.

The Meccano Cranks

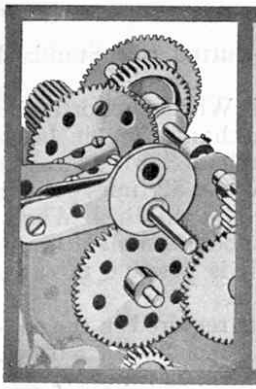
The Meccano Cranks are in reality short Strips fitted with bosses so that they may be attached easily to Axle Rods. Part No. 62 is 1½" in overall length and has a boss secured to one end. In addition to its obvious uses as a crank, it may be employed to secure an Axle Rod to any other Meccano part as in Fig. 8, where a Crank is used to fix a 1" Rod rigidly to a Flanged Plate, or to form handles as in Fig. 12. In the latter illustration two Cranks are bolted together, the boss of one being secured to the driving spindle whilst the boss of the other holds a short Rod 1 which serves as the handle proper.

The Threaded Crank is similar to the ordinary Crank except that the longitudinal bore of the boss is tapped, or threaded. The functions of this part have already been indicated in connection with the Screwed Rods and it is illustrated in Fig. 9.

The Double Arm Crank has similar functions to part No. 62, but when a crank stroke of only 1" is required it proves far more adaptable. It is ideal for securing Rods to Strips or Plates, as will be seen from Fig. 3. This illustration shows a Meccano electric controller and it will be seen that another Double Arm Crank is used as the controller handle. The Crank is free to turn about the fixed vertical Rod, being held in position by a Collar placed on the extreme upper end of the Rod, and one arm is used to carry the spring contact whilst the other is fitted with the Threaded Pin that forms the handle proper.

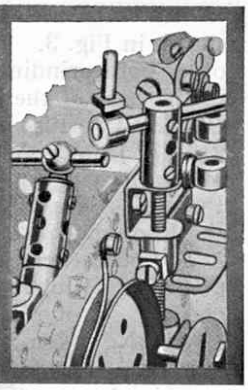
The only difference between parts Nos. 127 and 128 is that the Simple Bell Crank has no boss. The Meccano Bell Crank is a lever of the first order and is employed as a means of changing the direction of a force through a right angle. For example, supposing the Bell Crank is mounted on a horizontal Rod, a downward pull on one arm may be converted to a transverse pull or push on the other. Another important use of the Bell Crank that does not often occur to the Meccano boy is found in strengthening the corners of a square or rectangular framework of Strips, where it forms a very neat connecting piece.

The Meccano Coupling (part No. 63) is (*Continued on page 543*)



HOW TO USE Meccano Parts

VII.—WHEELS, PULLEYS, etc. (CLASS N)



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THE parts grouped under Classes N and O comprise some of the most interesting and important components of the Meccano system, for they form the means whereby a model may be set in motion. It is a thrilling moment when, having completed the main structural portions, one proceeds to insert the Gears, Pulleys, etc. that will enable the model to function exactly like its prototype.

The Meccano Wheels are extremely varied in design and application. Part No. 19a, 3" diameter Wheel, has a smooth circumference and is provided with ten spokes. It is intended for use as a travelling wheel in vehicles of all descriptions.

The ¾" and 1⅛" Flanged Wheels are intended primarily for use in all kinds of models that are required to run upon rails, such as locomotives, tramway cars, etc. They have other important uses, however, chief of which is their employment as belt pulleys. An excellent belt pulley may be formed by bolting two Flanged Wheels together as shown in Fig. 2. This illustration represents a model governor driven by an endless cord, and the wide belt pulley is used to take the drive because the axis of the driving pulley is horizontal whilst that of the driven pulley is vertical. If an ordinary grooved pulley were employed, there would be a danger of the cord leaving the groove owing to the fact that it would not be in direct line with it.

In Fig. 4 the Flanged Wheels form part of a belt reversing gear. In this case each belt pulley consists of two 1⅛" Flanged Wheels, and one wheel in each pair is fixed while the other is loose. The mechanism is so designed that while one belt is driving on to a fixed Flanged Wheel the other rides on a loose wheel, and the arrangement may be reversed when desired by slipping each belt simultaneously from one Flanged Wheel to the other.

An important adaptation of the ¾" Flanged Wheel was described in connection with the Sleeve Piece (Class D) in the May, 1929, "*M.M.*" An illustration in that issue showed two of these wheels forming the ends of a realistic cylinder, the centre portion of which was formed by a Sleeve Piece. Incidentally, another novel use for the part was shown in Fig. 4 in the same issue, for the chimney of the Meccano Traction Engine illustrated therein is topped by a ¾" Flanged Wheel, the boss of which is inserted in the upper Sleeve Piece.

If larger flanged wheels are required they may be built up from existing parts. Fig. 6 shows two sizes of flanged wheels used in a large Meccano locomotive. The bogie wheels of this model each consist of a Wheel Flange bolted to a Face Plate, whilst the main driving wheels are formed from a Hub Disc secured to a Circular Plate (the latter part is grouped under Class D).

In addition to this important adaptation, the Hub Disc is admirably suited to form a flywheel or large travelling wheel. Fig. 7 shows one of the rear travelling wheels of the Meccano Traction Engine, and as will be seen it consists of two Hub Discs bolted together so that a wheel of specially wide tread is obtained. As this model is sometimes called upon to draw very heavy loads, a number of nuts and bolts are inserted round the circumfer-

Parts in Class N: Wheels, Pulleys, Bearings, etc.

Wheels

Part No.		Prices s. d.
19a	Wheels, 3" diam. with set screws ... ... each	0 6
20	Flanged Wheels, 1½" diam. „	0 5
20b	„ „ ¾" „ „	0 4
24	Bush Wheels ... ... „	0 4
109	Face Plates, 2½" diam. ... „	0 4
118	Hub Disc, 5½" diam. ... each	1 3
119	Channel Segments (8 to circle, 11½" diam.) ... „	0 4
132	Flywheels, 2¾" diam. ... „	2 0
137	Wheel Flanges ... ... „	0 3

Pulleys

19b	Pulley Wheels, 3" diam. with centre boss and set-screw ... ... each	0 7
19c	„ „ 6" „ „ „ „ „ ... ... „	2 0
20a	„ „ 2" „ „ „ „ „ ... ... „	0 5
21	„ „ 1½" „ „ „ „ „ ... ... „	0 4
22	„ „ 1" „ „ „ „ „ ... ... „	0 3
23a	„ „ ½" „ „ „ „ „ ... ... „	0 3
22a	„ „ 1" „ without „ „ „ ... ... „	0 2
23	„ „ ½" „ „ „ „ ... ... „	0 2
123	Cone Pulleys ... ... „	1 3
151	Pulley Blocks, Single Sheave ... ... „	0 8
152	„ „ Two „ ... ... „	0 9
153	„ „ Three „ ... ... „	1 0

Bearings

		s. d.
167	Geared Roller Bearings, complete ... ... each	20 0
167a	Roller Races, geared, 192 teeth ... ... „	4 6
167b	Ring Frames for Rollers ... „	3 0
167c	Pinions for Roller Bearings, 16 teeth ... ... „	1 0
168	Ball Bearings, 4" diam. ... each	3 0
168a	Ball Races, Flanged ... „	0 6
168b	„ „ Geared ... „	0 9
168c	Ball Casings, complete with Balls ... ... „	1 9

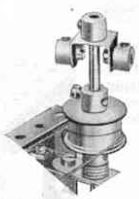

Fig. 2

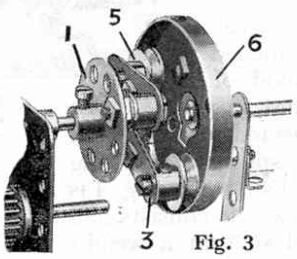

Fig. 3

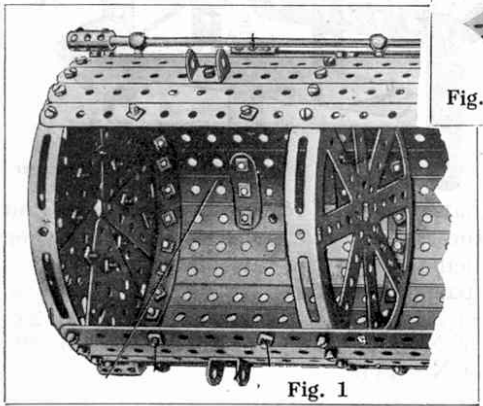

Fig. 1

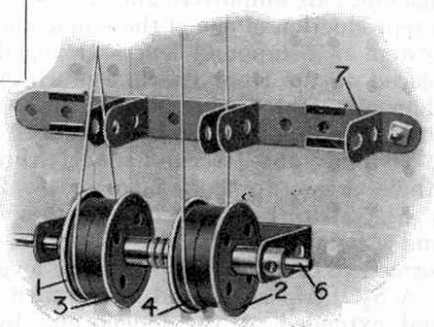

Fig. 4

ence of the Hub Discs to obtain a better grip on the road.

When it is desired to secure a Hub Disc to an Axle Rod it will be necessary first to bolt the Disc to a Bush Wheel or 1½" Pulley, etc., so that the set-screw of the latter may be utilised to grip the Rod. The central hole in the Hub Disc is made of such a diameter that a boss may be passed through it. In Fig. 1 a Hub Disc forms the end plate of a Boiler, while another serves as an internal supporting rib.

The Face Plate also fulfils other functions. Its obvious use is in a lathe, where it serves as a face plate and thereby justifies its name. It is 2½" in diameter and the slots and holes punched in its face enable other parts to be clamped to it. In Fig. 8 two Face Plates are shown employed as a hub for a large built-up flywheel. In the Meccano Grandfather Clock a Face Plate and a few Reversed Angle Brackets form the escapement wheel.

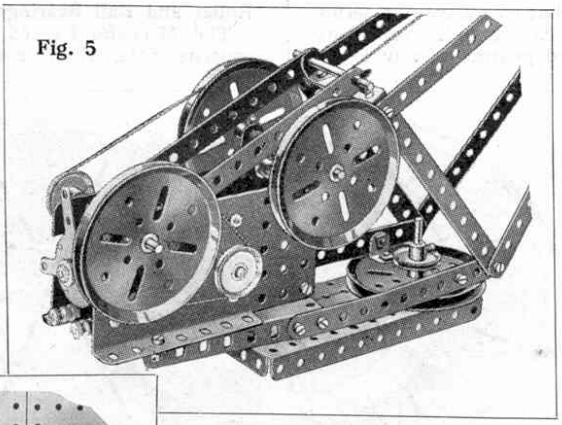

Fig. 5

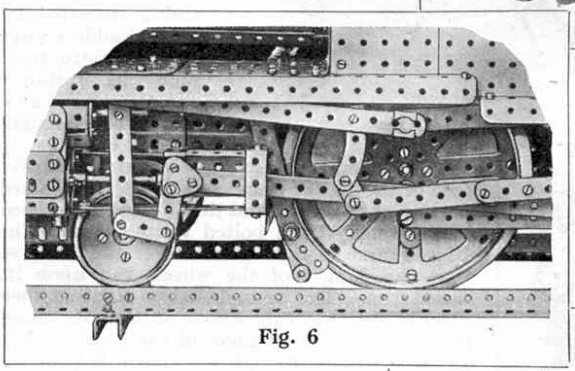

Fig. 6

The Wheel Flange, in addition to the use already mentioned, has many widely different adaptations. Fig. 3 shows a Wheel Flange used as part of a centrifugal governor. In this mechanism the governor weights 5, which are attached to short Strips 3 carried on a Bush Wheel 1, fly outward when the latter rotates and press against the inside of the Wheel Flange, so preventing the Bush Wheel exceeding a certain speed limit. In the Motor Chassis Wheel Flanges form the brake drums for the internal expanding brakes on the rear axle.

The functions of the Bush Wheel are too numerous to mention in detail, but the chief are its use as a boss to which other Meccano parts, such as Hub Discs, etc., may be bolted, or as an end plate for a cylinder, etc. In the latter case Double Angle Strips can be used as the sides of the cylinder, and they may be bolted directly to the holes in the face of the Bush Wheel.

The Channel Segments are intended to be bolted together end to end to form a circle or portions of a circle. Eight Segments connected will form a complete circle 11½" in diameter. This can be used as a large flywheel, or as a circular base for rotating structures. Fig. 8 shows a heavy flywheel built up from two circles of Channel Segments connected together and supported by 5½" Strips radiating from a central hub.

The Flywheel (part No. 132) is 2¾" in diameter, weighs 5 oz., and is of lead alloy except for the hub and boss, which are of brass. It may be employed wherever it is required to smooth over unequal stresses in rotating machinery. The hub is ½" in diameter and incorporates a groove to receive a belt drive. The circumference of the wheel itself is also provided with a groove, so that an endless cord may be passed round it. The groove is milled or serrated to prevent the cord slipping.

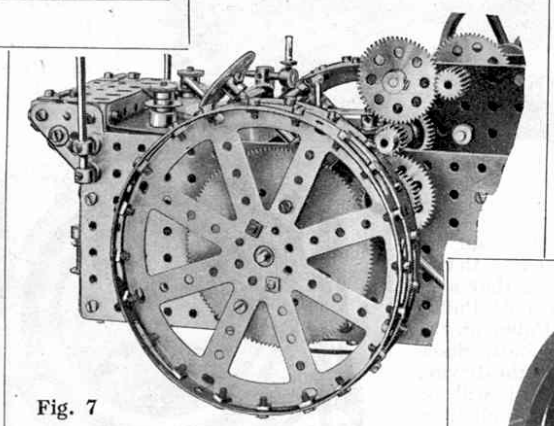

Fig. 7

Other Meccano parts that are used sometimes in the construction of wheels are the Circular Girder (see Class B) and the Circular Strip (Class A).

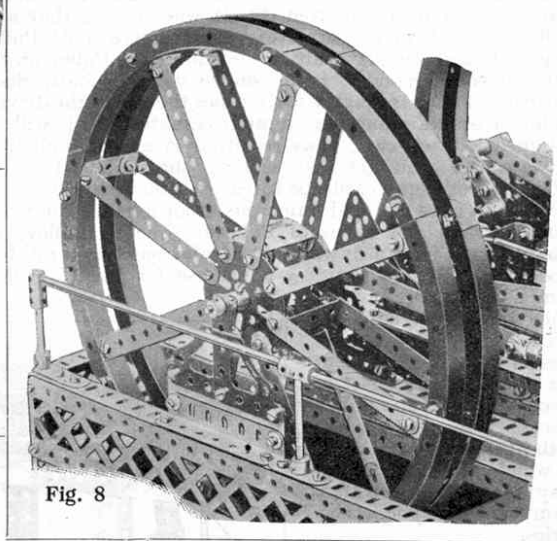

Fig. 8

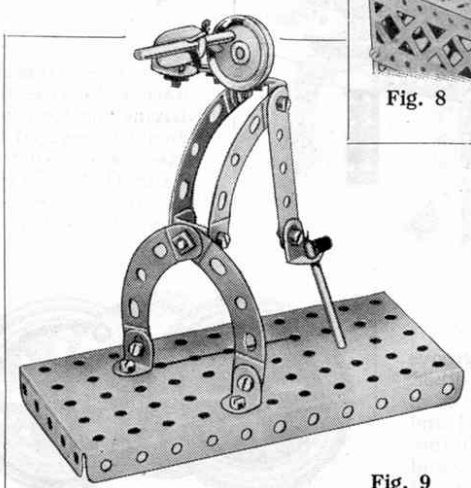

Fig. 9

The Meccano Pulleys

Pulleys form one of the mechanical powers, and by coupling a series of them to a Meccano Motor or even to a Crank Handle, considerable loads may be lifted with comparative ease. It would take up too much space to describe their principles in this article, but it will be useful to remember that pulleys enable a small force to overcome a greater load by reason of the fact that they enable the force to move through a greater distance than the load, just as a lever enables one, by moving one end through a certain distance, easily to raise a heavy load through a smaller distance at the other end.

It must here be explained that a pulley block consists of a frame comprising one or more wheels, or "sheaves," capable of rotating independently, and round which a rope may be passed or "rove." Hence if Meccano Pulleys are employed to construct a model pulley block, they are referred to in technical language as "sheaves."

Supposing a model crane is capable of lifting a load of 1 lb. attached directly to the crane hook, then if the hoisting cord, instead of being attached to the hook, is led round the sheave of a pulley block and taken back and fastened to the jib of the crane, a load of 2 lbs. could be raised with only a very slight increase in the power, this slight increase being necessary to overcome friction created in the pulley block, and in the bending of the cord. The load of 2 lbs. could only be raised at half the speed of the former load, however.

Similarly, if an extra sheave is incorporated in the suspended pulley block and the hoisting cord, after passing round the first sheave, is led back and round another pulley at the jib head, then round the second sheave in the pulley block, and finally is fastened to the jib head, then the crane hook will move at a quarter of its original speed and the crane will be capable of raising a load of 4 lbs. (or slightly less, allowing for friction). If further sheaves are added the load may be increased still further, but always a proportionate amount of

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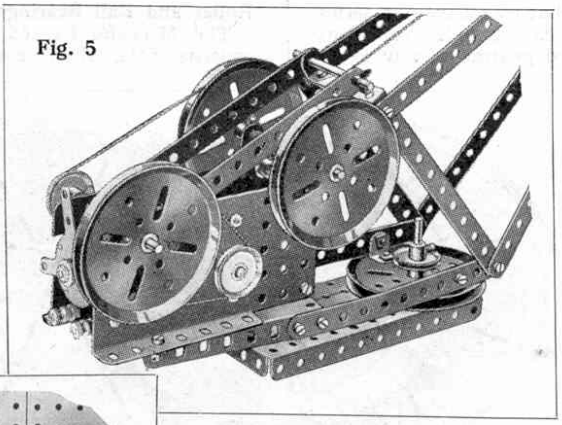
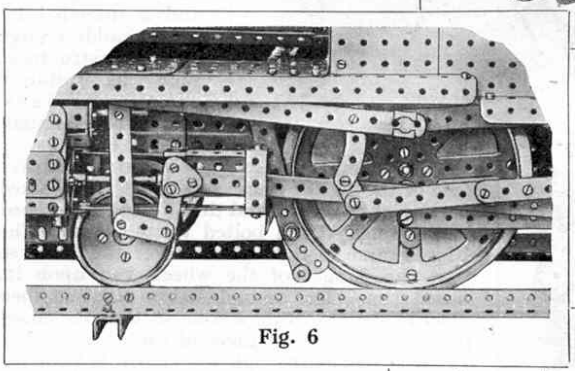


Fig. 5



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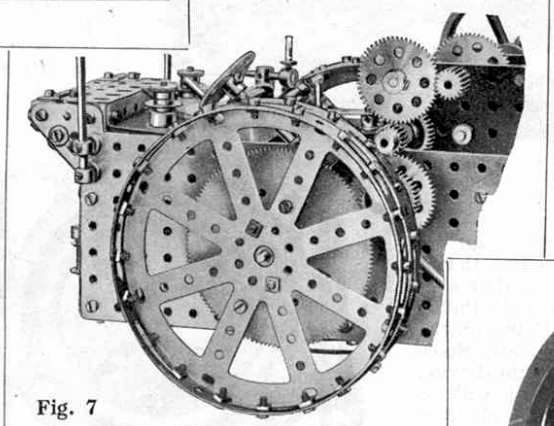

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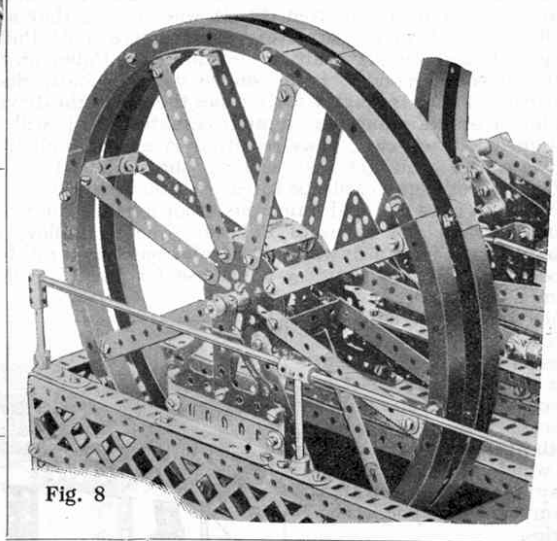
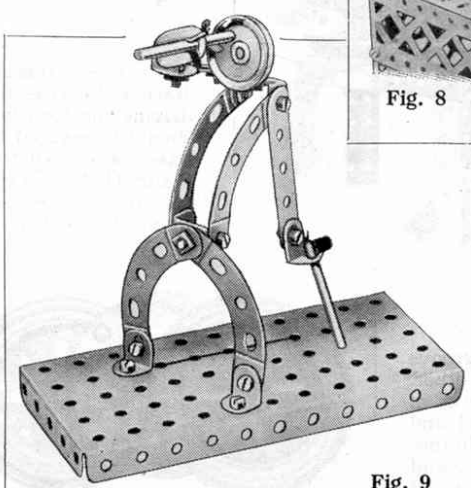


Fig. 8



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Similarly, if an extra sheave is incorporated in the suspended pulley block and the hoisting cord, after passing round the first sheave, is led back and round another pulley at the jib head, then round the second sheave in the pulley block, and finally is fastened to the jib head, then the crane hook will move at a quarter of its original speed and the crane will be capable of raising a load of 4 lbs. (or slightly less, allowing for friction). If further sheaves are added the load may be increased still further, but always a proportionate amount of

speed will be lost. Hence it will be seen that by means of a series of pulley blocks a Meccano Motor may be caused to lift very considerable loads without the use of toothed gearing of any kind.

Besides their use as sheaves for pulley systems, the Meccano Pulleys may be used as the running wheels of travelling models of all descriptions and, most important function of all, they make possible the construction of belt gearing. Meccano cord may be used for all belt driving purposes in Meccano models but if comparatively light drives only are required, Spring Cord (part No. 58) forms an excellent means whereby power may be transmitted from one Pulley to another. More will be said about the use of Spring Cord in Class Q, in which the part is included.

In preparing endless cords for driving purposes, they should be stretched as tightly as possible between the Pulleys and the ends should be connected together by a reef knot. If there is any possibility of the cord slipping round the groove of the Pulleys the drive should be duplicated.

Pulleys are invaluable for transmitting the drive from a Meccano Motor when gears are not available. Fig. 5 shows a belt system constructed with their aid, by which the speed of an Electric Motor is reduced so that a crane may be operated from it. It will be seen that a 1″ Pulley secured to the armature shaft drives a 3″ Pulley secured to a secondary shaft, while another 1″ Pulley on the latter drives a second 3″ Pulley on the winding shaft. Since the driven pulley is roughly three times the size of the driving pulley a speed reduction of approximately 3 : 1 will be obtained in each case, thus resulting in a total reduction between the armature and winding shaft of 9 : 1. Considerable loads may easily be lifted with this gearing.

Meccano boys will find numerous other uses for the many different sizes and types of Pulleys. The 6″ Pulley, for example, will form a flywheel or circular base for a rotating model, etc. Fig. 9 shows a novel use for the 1″ Pulley, namely, as the head of the "Meccano Coastguard"!

The Pulley Blocks (part Nos. 151, 152, and 153) are intended for use in place of built-up pulley blocks. They are complete with lifting hook and a lug to which the hoisting cord may be attached, and they form very realistic accessories.

A single Cone Pulley corresponds to three ordinary Pulleys of ¾″, 1″, and 1¼″ diameters formed into a unit. Cone Pulleys are intended for use in pairs, so that a drive can be transmitted from one Cone Pulley to the other by a belt passing round, say, the ¾″ diameter groove of one and round the 1¼″ groove of the other. Then if it is desired to vary the relative speeds of the shafts, the belt may quickly be removed and placed over the 1″ groove in each Pulley, or alternatively, round the 1¼″ groove of the first Pulley and round the ¾″ of the second. The respective speed ratios so obtained are roughly 5 : 3 ; 1 : 1 ; 3 : 5.

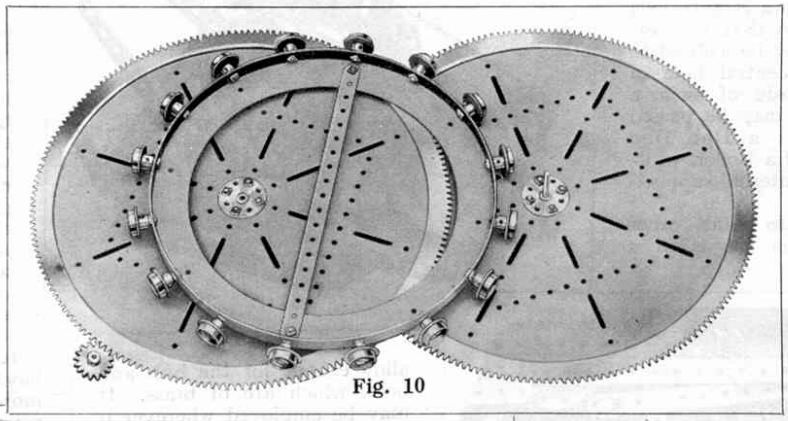


Fig. 10

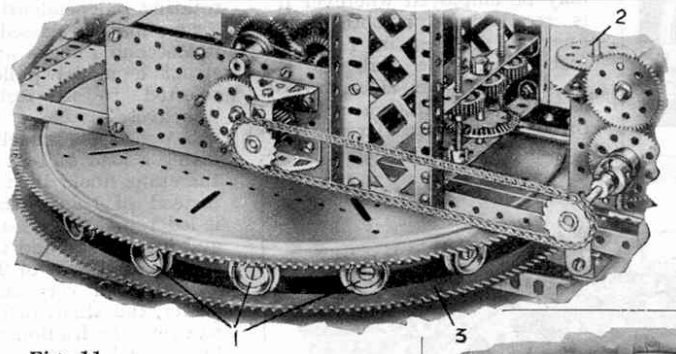


Fig. 11

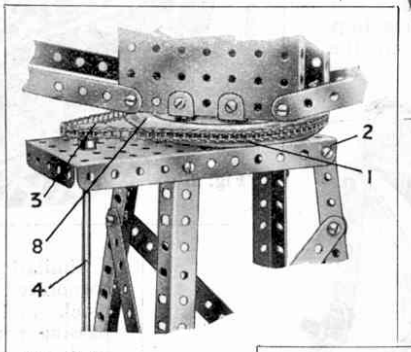


Fig. 13

Roller and Ball Bearings

The Meccano Geared Roller Bearing, illustrated in Fig. 10, consists of the following units : two Geared Roller Races, one Ring Frame, sixteen ¾″ Flanged Wheels, sixteen Pivot Bolts each with two nuts, one 9½″ Strip, two Bush Wheels, one 1½″ Rod, ten Nuts and Bolts, and one special Pinion. The complete bearing, which may be obtained under Part No. 167, measures 12″ overall diameter and is intended for use in building large swivelling structures, such as rotating cranes, bridges, turntables, roundabouts, etc.

The Roller Bearing is assembled as follows : One of the Roller Races is secured to the fixed portion of the model and the 1½″ Rod is fastened in the Bush Wheel bolted to its centre. The Ring Frame is then placed over the Race so that the flanges of the wheels run upon its raised rim. The second Roller Race is then placed over the Ring Frame so that its raised rim rests upon the flanges of the wheels. The 1½″ Rod passes through the centre hole of the 9½″ Strip that is bolted across the Ring Frame, and through the Bush Wheel in the centre of the upper Roller Race.

If the driving mechanism is incorporated in the swivelling superstructure of the model, a simple way to effect the rotation of the superstructure is to mount the special 16-teeth Pinion on a vertical driven Rod so that it engages with the teeth of the lower fixed Roller Race. The vertical Rod should be journalled suitably in the superstructure ; then if it is set in motion, the Pinion travels round the Roller Race and carries the superstructure with it. Alternatively, if the driving mechanism is in the fixed base of the model, the Pinion should be secured to a Rod journalled in a vertical position in the base and caused to engage with the upper Roller Race.

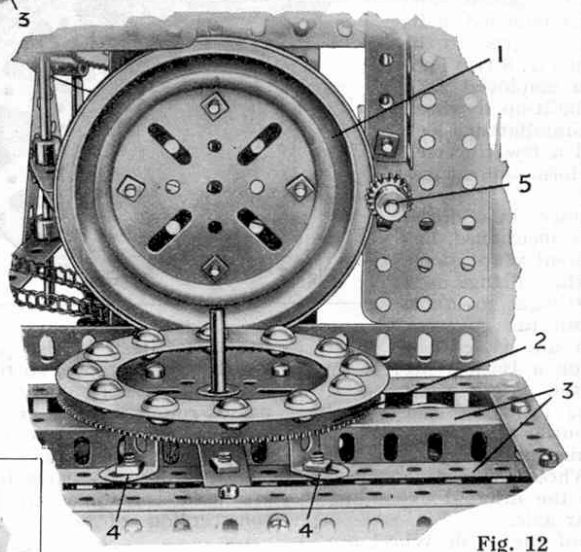


Fig. 12

Fig. 11 shows a typical adaptation of the standard Roller Bearings. In this case the superstructure is caused to turn round on the Flanged Wheels 1 on operation of a certain lever incorporated in the control mechanism. The drive from the Motor controlling the rotational movement is directed to the vertical Rod 2, on the lower end of which is mounted the special 16-teeth Pinion. The latter engages with the teeth of the lower Roller Race 3 ; hence on rotation of Rod 2 the Pinion travels round the Roller Race, carrying the superstructure with it.

If desired a large roller bearing may be built up from existing parts, without

(Continued on page 627)

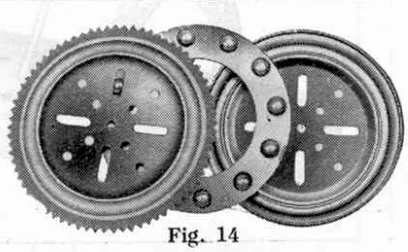
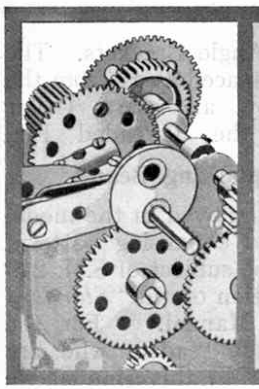
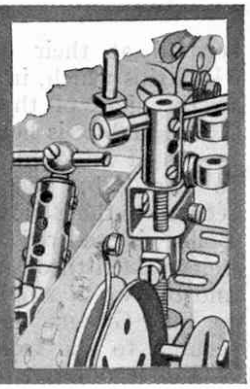


Fig. 14



HOW TO USE Meccano Parts

VIII.—GEARS, etc. (CLASS O)



For the purpose o 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.

THE Meccano parts included in Class O—namely, Gears, Pinions, Sprocket Wheels, Dog Clutches, and other toothed parts—are so important and their adaptations are so varied and numerous that it is impossible to deal with them all, however briefly, in the space available this month. Therefore we refer below to the Gear Wheels, Pinions, Contrates, Bevels, Worms, and Sprocket Gears only, and the remaining toothed parts included in this class will be dealt with next month.

The Meccano range of gear wheels is very comprehensive and enables almost any speed ratio to be obtained. The gears are manufactured from solid brass, with the exception of the 3½″ Gear Wheel and the Sprocket Wheels, which are of specially fine steel. The teeth are cut one at a time, not stamped out, and the precision of the finished parts is such that they are regularly used in the construction of all kinds of scientific apparatus.

The Pinions and Gear Wheels enable ordinary gear trains to be assembled, whilst the Bevel Gears and Contrate Wheels are for transmitting the drive through right angles. The Sprocket Wheels are of course designed for use in connection with chain drive transmission.

The published diameters of the various Meccano Pinions and Gear Wheels do not represent the overall measurements of the Gears, for they are measured from the "pitch line." This is an imaginary line that runs through approximately the centre of the teeth; it indicates the points on the teeth where the actual thrust is imparted from one gear to the other.

Parts in Class O: Gears and Toothed Parts

Part No.		Prices s.	d.
25	Pinion Wheels, ¾″ diam., ½″ wide ... each	0	6
25a	" " ¾″ " ½″ " ... "	0	8
25b	" " ¾″ " ¾″ " ... "	0	10
26	" " ½″ " ½″ " ... "	0	4
26a	" " ½″ " ½″ " ... "	0	6
26b	" " ½″ " ¾″ " ... "	0	8
27b	Gear Wheels 133-teeth (3½″ diam.) ... "	1	3
27a	" " 57 " (1½″ ") ... "	0	6
27	" " 50 " (1 5/16″ diam.) "	0	6
31	" " 38 " (1″ diam.) ... "	1	0
28	Contrate Wheels, 1½″ 50-teeth ... ... "	0	9
29	" " ¾″ 25 " ... ... "	0	6
30	Bevel Gears, ⅞″ 26-teeth ... ... "	0	9
30a	" " ½″ 16 " ... ... "	0	6
30c	" " 1½″ 48 " ... ... "	1	6
32	Worm, 12 threads per inch ... ... "	0	5
95b	Sprocket Wheels, 3″ 56-teeth ... ... "	0	6
95	" " 2″ 36 " ... ... "	0	5
95a	" " 1½″ 28 " ... ... "	0	4
96	" " 1″ 18 " ... ... "	0	3
96a	" " ¾″ 14 " ... ... "	0	3
110	Rack Strips 3½″ ... ... "	0	2
110a	" " 6½″ ... ... "	0	3
129	Rack Segments, 3″ diam. ... ... "	0	5
144	Dog Clutches ... ... "	0	6
147	Pawls, with Pivot Bolts and Nuts ... "	0	3
147a	Pawls ... ... "	0	2
148	Ratchet Wheels ... ... "	0	6
167a	Roller Races, geared, 192 teeth		
167c	Pinions for Roller Bearings, 16-teeth } see class N.		
168b	Ball Races, geared, for Sprocket drive		

In Fig. 2 a ¾″ Pinion is engaged with a 50-teeth Gear Wheel. Let us assume that the Rod upon which the Pinion is fixed is rotated at a speed of 60 revolutions per minute. The ¾″ Pinion has 25 teeth, and for every complete revolution that it makes it will cause the 50-teeth Gear Wheel to turn a distance occupied by 25 of its teeth, which is exactly one half of its circumference. Thus the 50-teeth Gear will turn only 30 revolutions per minute. The difference in speed obtained in this combination of Pinion and Gear is therefore as 2 to 1, and is written "ratio 2 : 1."

A ½″ Pinion having 19 teeth is shown in Fig. 3 in mesh with a 57-teeth Gear Wheel. As the latter has three times as many teeth as the Pinion (and its pitch line diameter is three times as great), three revolutions of the Pinion are required for every complete revolution of the Gear Wheel. The ratio of this combination is therefore 3 : 1.

There are of course numerous other gear ratios obtainable, and the more usual ones are shown below, together with the alternative methods by which they may be produced. Meccano boys may find the list useful for reference purposes :—

Ratio 1 : 1 — two ½″ Pinions (axles ½″ between centres); two 1″ Gear Wheels (axles 1″ between centres); two 57-teeth Gear Wheels (axles 1½″ between centres); two ⅞″ Bevel Gears (see Fig. 4); ¾″ Pinion and ¾″ Contrate Wheel. Ratio 1.24 : 1 — ½″ Pinion and ¾″ Contrate Wheel (Fig. 1).

Ratio 2 : 1 — ¾″ Pinion and 50-teeth Gear Wheel (axles 1″ between centres); ¾″ Pinion and 1½″ Contrate Wheel. 3 : 1 — ½″ Pinion and 57-teeth Gear Wheel (axles 1″ between centres); ½″ Bevel and 1½″ Bevel.

7 : 1 — ½″ Pinion and 3½″ Gear Wheel (axles 2″ between centres). 19 : 1 — ½″ Pinion and Worm. 57 : 1 — 57-teeth Gear and Worm (see Fig. 7).

A variety of gear ratios may of course be obtained by connecting two Sprocket Wheels of varying diameter with a length of Sprocket Chain.

It will be observed from the accompanying price list that the ½″ and ¾″ diam. Pinions are each made in three widths, ¼″, ½″ and ¾″. The ¼″ width Pinion is for ordinary gearing, whilst the wider Pinions are specially designed for use in cases where the shaft on which a Pinion is secured is required to move longitudinally without disengaging the Pinion from its Gear Wheel. This movement is frequently required in Meccano gear boxes.

Fig. 10 shows how three different speeds may easily be obtained from a driving shaft with the aid of one intermediate shaft and a ½″ diam. ½″ width Pinion. Rod 1 is the driving shaft and carries the special Pinion. Rod 2 is the intermediate shaft, and Rod 3 is the driven shaft. Rod 2 may be moved longitudinally in its bearings by means of the sliding hand lever 4, which is connected to Rod 2 by means of the Couplings 5 and 6, the latter being free on the Rod 2. The movement of Rod 2 is so adjusted by Collars 7 that the 57-teeth Gear Wheel 8 remains always in mesh with the ½″ width Pinion 9. On sliding the lever 4, the

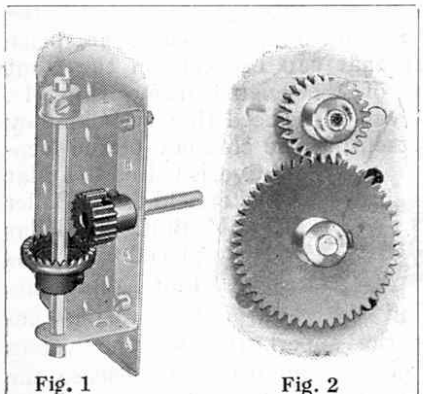


Fig. 1 Fig. 2

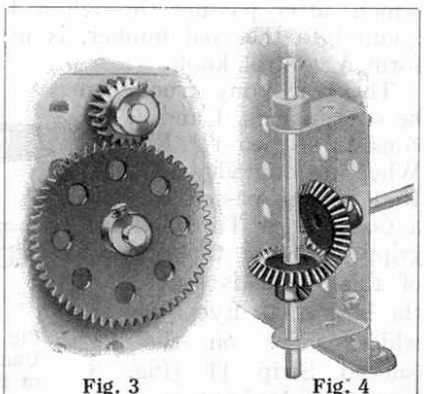


Fig. 3 Fig. 4

drive may be transmitted to the Rod 3 either by way of (a) the Gear 8 and Pinion 10, (b) the 50-teeth Gear Wheel 11 and ¾" Pinion 12, or (c) by the two 1" Gears 13.

A further example of the adaptability of the ½" width Pinion will be found in Fig. 6. In this case a ½" diam. ½" width Pinion 10 is connected by a Socket Coupling 9 to the male portion of a Dog Clutch 11. The unit so formed is free on the vertical Rod 3, but on operation of a lever which carries a bolt that engages with the groove of the Socket Coupling, it may be raised so that the Dog Clutch section is engaged with the female section 12 that is secured to the Rod 3. When out of engagement the sliding unit rests on the Collar 13. The Pinion 10 is in constant engagement with a Worm on the driving shaft; hence the Rod 3 may be thrown in or out of engagement when desired merely by moving the control lever up or down. The ½" width Pinion is necessary because if an ordinary ¼" width Pinion was used it would come out of engagement with the Worm as soon as the lever was raised.

Fig. 14 is another typical Meccano gear box, providing three speeds forward, neutral and reverse gears. This type of gear box is particularly adaptable to model motor cars. The Rod 64 forms the primary driving shaft and the drive is transmitted through the countershaft 71 to the driven shaft 78. The different speeds are obtained by sliding the Rod 71 longitudinally so that the drive is transmitted through different sets of gears. Reverse gear is obtained when the drive passes through the Gears 68, 72, 77, 83 and 81, the speed ratio between the driven shaft 78 and the driving Rod 64 being 1: 2. First speed forward is obtained when the following Gears are engaged: 68, 72, 75 and 79. This gives a ratio between shafts 78 and 64 of 1 : 4. In the second forward speed the drive is directed via 69, 73, 75 and 79 (ratio 1 : 2) and top forward speed is obtained through the Gears 69, 73, 76 and 80 (ratio 1 : 1). In a certain position of the countershaft 71, the only Gears in engagement are 68, 72, 81 and 83. This represents neutral gear, for the Pinion 83 and the countershaft revolve idly and no power is applied to the shaft 78.

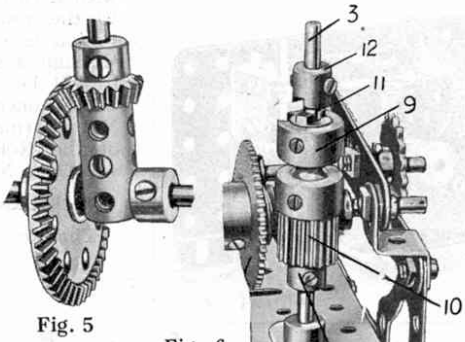


Fig. 5

Fig. 6

Fig. 7

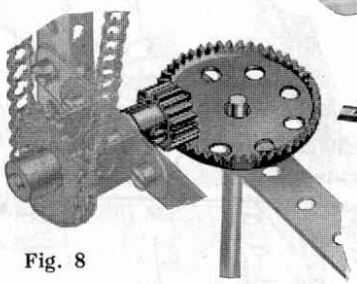


Fig. 8

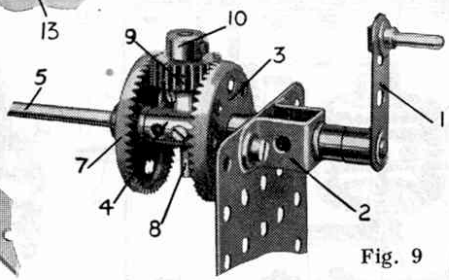


Fig. 9

Contrate and Bevel Gearing

The primary function of the Contrate Wheels (Nos. 27 and 28) is similar to that of the Bevel Gears, i.e., the transmission of driving power at right angles. A 3:1 right angle drive employing a ½" Pinion and a 1½" Contrate Wheel is shown in Fig. 8. In certain cases, however, they lend themselves to adaptations that are not possible with the Bevel Gears. For example, two Contrates of similar size mounted face to face on a common axis so that their teeth interlock will form a very efficient clutch unit, and one may be thrown in or out of gear with the other by a slight movement only.

When it is required to transmit a powerful drive at right angles it is preferable to use Bevel Gears rather than Contrate Wheels since in the former the teeth make contact over a greater area than in the Contrate Wheels. However, those Meccano boys who possess Contrate Wheels but no Bevels will find that they may employ the former in almost every case in place of Bevel Gears, with fairly good results.

In order to reduce friction to a minimum and to obtain a smooth even drive, bevel gearing is always designed so that the surfaces of the teeth of two bevels that mesh with each other lie in planes which, if extended, would all meet in a common point, and this point would coincide with the imaginary point of intersection of the axis of the shafts carrying the bevels. The Meccano Bevels are made with the teeth at such an angle that two ⅞" Bevels may be meshed together or a ½" Bevel may be engaged with a 1½" Bevel. Two 1½" Bevels should not be meshed together, nor should a ⅞" Bevel be engaged with a 1½" Bevel, for although such gearing would work, the teeth would not be properly in line and the arrangement would be bad engineering practice.

Fig. 12 should give a good idea of some of the more important adaptations of the Meccano Bevel Gears. It represents the differential gear incorporated in the Meccano Motor Chassis. The ½" and 1½" Bevel Gears are used to transmit the drive from the propeller shaft to the rear wheels, and the series of ⅞" Bevels 5, 6, and 7 are arranged so that power may be applied to both road wheels under varying working conditions. Normally the Bevels 5, in rotating about the rear axle, carry the Bevels 6 and 7 bodily with them, but should one of the road wheels slow down or stop, as happens when the car turns a corner, etc., one of the Bevels 6 or 7 slows down and the Bevels 5 tend to travel round its teeth, thus causing the opposite Bevel to turn at a greater speed.

In Fig. 13 three ⅞" Bevels are employed to form a simple and compact reversing gear. The driving power is applied to the shaft 2 and is directed via the ½" diam. ½" width Pinion 3 to the Gear Wheel 4, which is secured to the Rod 6 carrying two Bevel Gears 5. The reverse is effected by a hand lever connected to a rocking arm that causes the Rod 6 to move longitudinally in its bearings by striking one of the Collars secured against the faces of the Bevels 5. The direction of rotation of the driven Rod 10 is changed by bringing one or other of the Bevels 5 into engagement with the third Bevel, which is rigidly fastened to the Rod 10. The ½" width Pinion 3 is used so that the Gear 4 may remain in gear with the driving shaft throughout the longitudinal movement of the Rod 6.

Another very useful adaptation of both Bevel and Contrate Gears is found in the assembly of reduction gearing between two shafts that are mounted in direct line with each other. A specimen gearing of this type, in which Contrates are employed, is shown in Fig. 9. The handle 1 is secured to a 2" Axle Rod that is journalled in the bearings 2. This Rod is free to rotate in the boss of a 1½" Contrate Wheel 3, but is secured in one end of the Coupling 4. A further Rod 5, which runs freely in the other end of the Coupling 4, carries the 1½" Contrate Wheel 7 fixed in the position shown.

A 1½" Rod 8 gripped in the central transverse hole of the Coupling 4 carries a ¾" Pinion 9, which is free to rotate about the Rod but is retained in position by a Collar 10. The Pinion is engaged by the teeth of both Contrate Wheels 3 and 7. The Double Bent Strip forming the bearing 2 for the driving Rod is bolted to the Plate

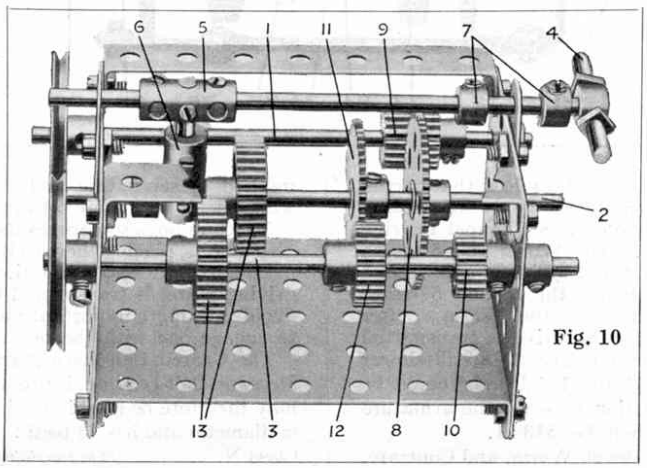


Fig. 10

by two ½″ Bolts, the shanks of which enter holes in the Contrate Wheel 3 and so prevent the latter from rotating.

It will be found that the secondary shaft 5 rotates twice as fast as the driving Rod carrying the handle 1. Alternatively, by using the Rod 5 as the driving shaft, a 1 : 2 reduction gear will be obtained, for the 2″ Rod will revolve once only to every two revolutions of the Rod 5. By repeating the device two or three times in a straight line, a very compact transmission gear may be obtained.

The Meccano Worm has a pitch of twelve threads to the inch, to enable it to mesh properly with the various Meccano Gears. It is extremely useful for speed reducing purposes, although it should be remembered that it absorbs a good deal of power, owing to friction created by the thrust that is produced through the tendency of the Worm to move longitudinally instead of turning the Gear Wheel. A Worm drive should always be kept thoroughly lubricated.

Owing to the fineness of the pitch the Meccano Worm is irreversible, that is, it cannot be rotated from a Gear Wheel but can only be used to impart motion to the Gear Wheel. This irreversibility of the Worm sometimes proves a great advantage. For example, if a Worm drive is applied to the winding drum of a hoisting gear, the load will remain suspended in any position after the power is withdrawn, and there is no danger of the load overrunning.

Each revolution of a Worm results in the Gear Wheel with which it meshes moving through a distance equal to one of its teeth. Hence the number of revolutions that must be made by a Worm in order to complete one revolution of the Gear Wheel or Pinion which it drives, can be ascertained by counting the teeth on the driven wheel.

An idea of the value of the Meccano Worm in speed reduction mechanisms will be obtained when it is remembered that a ratio of 3249 : 1 may be obtained merely by duplicating the gearing shown in Fig. 7, the second Worm being secured to the shaft of the Gear Wheel that is driven by the first Worm.

Fig. 11 is included as a typical example of Meccano reduction gearing. It will be seen that a Worm mounted on the armature shaft of the Electric Motor engages with a 57-teeth Gear which is mounted on a short Rod that carries a ½″ Pinion engaging with another 57-teeth Gear on another short Rod. Both these Rods are journalled in a Channel Bearing bolted to the side plate of the Motor. The Worm and 57-teeth Gear provide a ratio of 57 : 1, while the ½″ Pinion and second 57-teeth Gear produce a 3 : 1 ratio; hence the second 57-teeth Gear turns only once in 171 revolutions of the Worm. After the speed has been reduced in this way the drive is transmitted to a vertical shaft through a 1 : 1 Bevel Gear. If a still slower speed is required a 3 : 1 Bevel drive (½″ and 1½″ Bevels) could be used at this point, and the total reduction between the armature shaft and the vertical Rod would then be 513 : 1.

In all types of right angle drive, i.e., Bevel, Worm, and Contrate, particular care should be paid to the bearings, since considerable torque is set up in the shafts. The bearings should be placed as close to the Gears as possible, and if practicable they should be on either side of each Gear. Such bearings may often be provided with the help of a Coupling mounted as in Fig. 5.

When designing Meccano gearing it should be remembered that the Roller Race of the Geared Roller Bearing unit may be used as a large gear wheel. It is 12″ in diameter and has 192 teeth. It engages with the special 16-teeth Pinion (part No. 167c) and provides a speed ratio of 12 : 1, the axles carrying the two parts being placed 6½″ between centres. The Meccano Roundabout (Special Instruction Leaflet No. 8) is rotated by a 16-teeth Pinion meshing with a Geared Roller Race that is secured to the rotating structure, and since the Pinion is driven from an Electric Motor through a gear train identical to Fig. 11, it will be seen that the Roundabout revolves once in 2,052 revolutions of the Motor armature. For further particulars of the Roller Race and 16-teeth Pinion see Class N., dealt with last month.

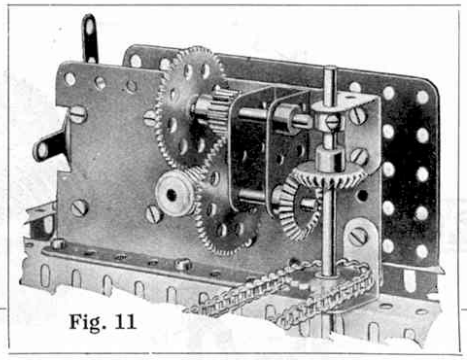


Fig. 11

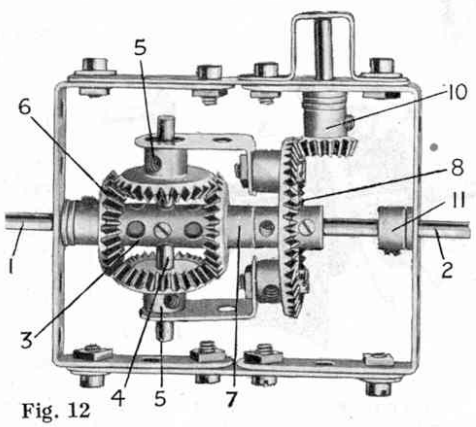


Fig. 12

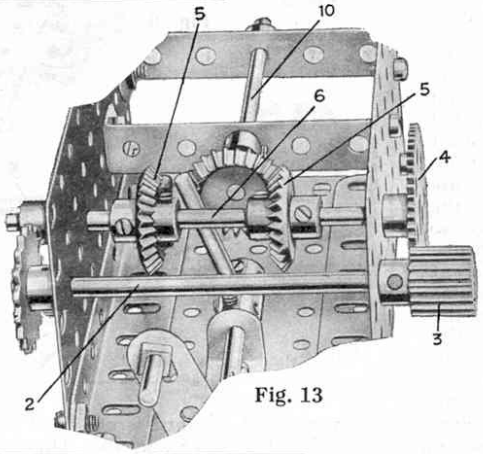


Fig. 13

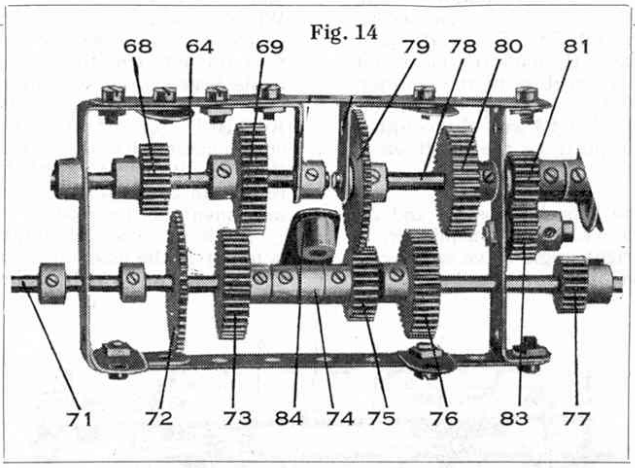


Fig. 14

Sprocket Gearing

The Meccano Sprocket Wheels and Chain provide an invaluable method for transmitting motion between two shafts where the distance is too great to enable gears to be used conveniently, and where a belt drive would not be sufficiently positive. There are five sizes of Sprocket Wheels, and the following are a few of the many different speed ratios that may be obtained with their aid. Certain of the figures shown are approximate only; the exact ratios can be ascertained by dividing the number of teeth on the smaller wheel into the number of teeth on the larger wheel.

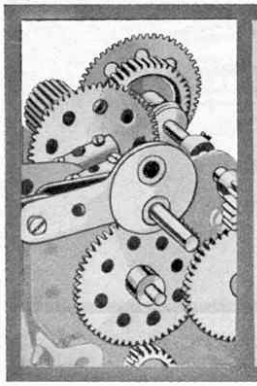
Ratio 4 : 1 — ¾″ and 3″ diam. Sprocket Wheels. Ratio 3 : 1 — 1″ and 3″ diam. Sprocket Wheels. Ratio 2 : 1 — ¾″ and 1½″ diam. Sprocket Wheels. Ratio 1⅓ : 1 — 1½″ and 2″ diam. Sprocket Wheels.

Ratios of 1 : 1 may, of course, be obtained by using any two Sprocket Wheels of like diameter.

The great advantage of Sprocket gearing is that power may be transmitted through almost any distance with very little loss through friction. Conveyors and caterpillar track, etc., may also be built up with its aid. The method of separating and connecting lengths of Sprocket Chain will be dealt with more fully in Class P, in which this part is included.

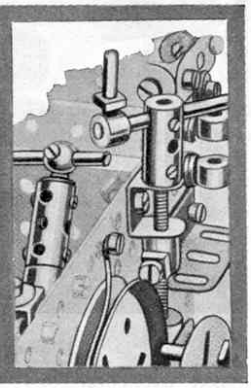
Meccano boys sometimes use their Sprocket Wheels like ordinary gear wheels, placing them so that their teeth engage. This practice is permissible in the construction of simple models where only a light driving power is transmitted through the gearing, but it should be avoided in more important models, since the teeth are not designed to engage one with the other as in ordinary spur gearing.

The Geared Ball Race (part No. 168b), which forms part of the Meccano Ball Bearing, is provided with standard sprocket teeth, and may therefore be used in chain driving mechanisms. It measures 4″ in diameter and has 73 teeth. For further particulars of this part see Class N. *(The remaining parts in Class O will be dealt with next month).*



HOW TO USE Meccano Parts

IX.—GEARS, etc. (CLASS O)



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.

THE Meccano Pinions, Gear Wheels, and Sprocket Wheels, which are included under Class O, formed the subject of last month's article, and below we describe the principal functions of the remaining parts in this class. For the benefit of those readers who are unable to refer to the September issue, we are reproducing on this page the complete list of parts that are grouped under Class O.

The Rack Strips (parts Nos. 110 and 110a) are designed for converting rotary motion to rectiliniar motion, or vice versa. They are invaluable for obtaining the traversing movement of lathe saddles or other parts of machine tools. In model No. 6.17 in the 4–7 Instruction Manual two 3½″ Rack Strips are used to impart up and down motion to a Meccano jack, while in model No. 7.8 (Steam Shovel) Rack Strips are employed to thrust the shovel arm toward or away from the jib. The 6½″ Rack Strip is one of the latest additions to the Meccano system, but it has already found a very large number of uses.

A very ingenious movement produced with the aid of two 3½″ Rack Strips is illustrated in Fig. 3. This is a device designed to increase the length of a crank stroke, and is taken from the Standard Mechanisms Manual, where it appears under detail No. 278. For the benefit of those readers who are unable to refer to the S.M. Manual, we repeat the description:—

The connecting or piston rod is placed on the end of a ¾″ Bolt 1, which passes through an Eye Piece 2 and carries on its shank a ½″ Pinion 3. The latter rolls on a 3½″ Rack Strip 4 secured by Angle Brackets to the base of the model. A second Rack Strip 5 bolted to two Eye Pieces 6 sliding on a 5½″ Strip 7 also engages with the Pinion 3.

At each stroke of the connecting rod the Pinion 3 is caused to rotate, owing to its engagement with the Rack 4, and thereby thrusts the upper Rack Strip in the same direction as that in which the connecting rod moves, but through a distance twice as great. Strip 7 is bolted at each end to 1½″ Strips secured to the base by means of 1″ Angle Brackets. A second guide Strip 8, secured at either end to a 1″×½″ Angle Bracket, forms a support for the Eye Piece 2.

The Rack Segment (part No. 129) is intended principally for use where it is required to rotate a mechanism through part of a revolution only. It should be bolted to a Face Plate or other part that is capable of turning about a centre and a 1″ Gear Wheel should be engaged with its teeth. The Segment has 28 teeth and a radius of 1½″, so if four Segments are placed together to form a circle, the latter will measure 3″ in diameter and will have 112 teeth. Great care should be taken when joining the segments together, because unless the adjoining teeth are spaced correctly they will fail to mesh properly with the Gear Wheel.

Fig. 1 shows two Rack Segments secured to the bottom of one of the davit arms of a boat launching gear. This arm is required to move through less than half a circle, hence two Rack Segments joined together provide a sufficient number of teeth to receive the drive from the 1″ Gear Wheel 6, a reduction ratio of approximately 3:1 being obtained. The Rack Segments (shown at 3 in the illustration) are bolted to the Face Plate 2, which forms part of the arm 1.

Parts in Class O: Gears and Toothed Parts

Part No.		Prices s. d.
25	Pinion Wheels, ¾″ diam., ¼″ wide ... each	0 6
25a	,, ,, ¾″ ,, ½″ ,, ... ,,	0 8
25b	,, ,, ¾″ ,, ¾″ ,, ... ,,	0 10
26	,, ,, ½″ ,, ¼″ ,, ... ,,	0 4
26a	,, ,, ½″ ,, ½″ ,, ... ,,	0 6
26b	,, ,, ½″ ,, ¾″ ,, ... ,,	0 8
27b	Gear Wheels, 133-teeth (3½″ diam.) ... ,,	1 3
27a	,, ,, 57 ,, (1½″ ,,) ... ,,	0 6
27	,, ,, 50 ,, (1 5/16″ diam.) ... ,,	0 6
31	,, ,, 38 ,, (1″ diam.) ... ,,	1 0
28	Contrate Wheels, 1½″ 50-teeth ... ... ,,	0 9
29	,, ,, ¾″ 25 ,, ... ,,	0 6
30	Bevel Gears, ¾″ 26-teeth ... ... ,,	0 9
30a	,, ,, ½″ 16 ,, ... ,,	0 6
30c	,, ,, 1½″ 48 ,, ... ,,	1 6
32	Worm, 12 threads per inch ... ... ,,	0 5
95b	Sprocket Wheels, 3″ 56-teeth ... ... ,,	0 6
95	,, ,, 2″ 36 ,, ... ,,	0 5
95a	,, ,, 1½″ 28 ,, ... ,,	0 4
96	,, ,, 1″ 18 ,, ... ,,	0 3
96a	,, ,, ¾″ 14 ,, ... ,,	0 3
110	Rack Strips, 3½″ ... ... ,,	0 2
110a	,, ,, 6½″ ... ... ,,	0 3
129	Rack Segments, 3″ diam. ... ... ,,	0 5
144	Dog Clutches ... ... ,,	0 6
147	Pawls, with Pivot Bolts and Nuts ... ,,	0 3
147a	Pawls ... ... ,,	0 2
148	Ratchet Wheels ... ... ,,	0 6
167a	Roller Races, geared, 192 teeth	see class N.
167c	Pinions for Roller Bearings, 16-teeth	see class N.
168b	Ball Races, geared, for Sprocket drive	see class N.

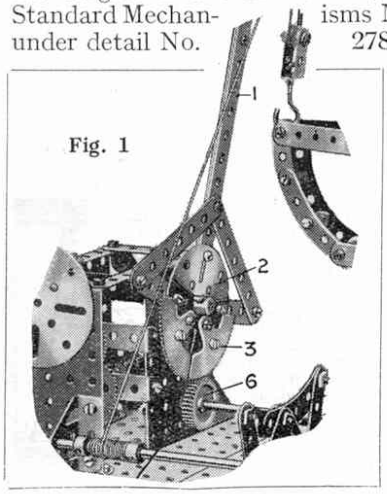


Fig. 1

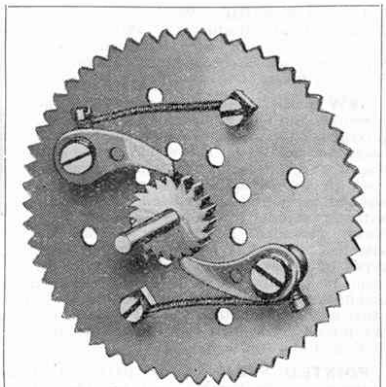


Fig. 2