MECCANO PARTS AND HOW TO USE THEM

A new series for the younger constructor written and illustrated by Bert Love

Fig. 1. Two Meccano Publications from the 30's on how to use Meccano Parts. Both booklets cost 6d (2½p) at the time of publication, the smaller being issued in 1930 and the larger in 1935. Although both are long since out of print, they still make very useful reference manuals.

HOW to use Meccano parts?—surely everybody with a Meccano Set knows how to use Meccano parts! But do they?
Even forty years ago Meccano parts were thirty years old but a small booklet called "How to use Meccano Parts" sold like hot cakes in 1930. A later and enlarged edition with a slight change in title published in 1935 was also a sell-out. A recent photograph of the author's copies is shown. Both books are out of print now and although some of the parts and mechanisms are now obsolete, these manuals are still very useful as reference material and are well worth looking after if the reader is fortunate enough to possess either or both. The two editions sold for 6d. in the U.K. at the time of publishing and they represented excellent value. However, it is not the intention of this series to reproduce the contents of these earlier manuals because both parts and techniques have made considerable strides since the introduction of the two booklets illustrated.

There is nothing like getting down to brass tacks when a new series is started so we will begin by looking at the hardest worked part of any Meccano Set, viz., Nuts and Bolts. Millions of these are turned out at the Binns Road Factory where high speed machines roll the threads on to the Bolt shanks faster than the eye can see. They are well made and finished with a zinc plating so that with reasonable use they will last the constructor literally for a lifetime. However, some thought and care in their use is well worth considering. Since basics should be kept simple, the Pocket Meccano Set is chosen for this introductory chapter and its contents are illustrated in Fig. 2. "Just a handful of parts", . . . you might rightfully exclaim, but judging by the popularity of the 1971 Pocket Meccano Model Building Competition and the amazing range of models submitted for prizes there is enormous scope for simple Nut and Bolt construction.

Consider Fig. 3 in which a Narrow Strip is shown attached to a Trunnion. When the boltheads are neatly aligned the construction is a pleasure to look at. Compare this with the rear view at the right of the illustration where the results of bad "Spannermanship" is all too plainly evident. The enamel on Meccano parts is really quite durable but it will not stand up to deliberate abuse. A rule of thumb for preventing such disfiguring of parts is as follows; if the Nut is against an enamelled part, hold it still and screw up the Bolt with the Screwdriver. This method is clearly illustrated in Fig. 4 and although applied to a simple assembly in this case, the principle applies right up to the largest "Supermodel".

There are occasions when Nuts must be turned against an enamelled surface as shown in Fig. 5 where a Bolt is to be lock-nutted to a Plate. Two items can assist in preventing scoring in this case. The Meccano Washer may be placed between the Nut and the enamel but a word of warning here. The Washers are 'dished', that is to say they are slightly saucer-shaped to give an

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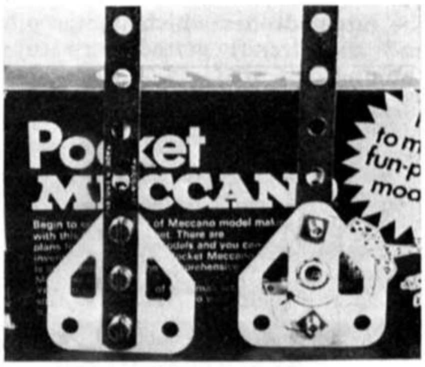
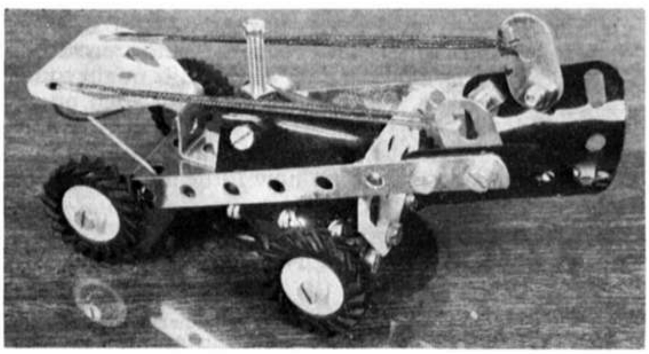
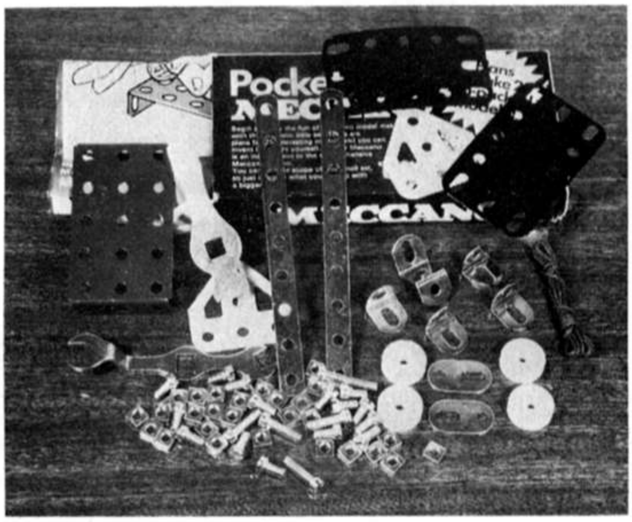


Fig. 3. Samples of both neat and ugly nut and bolt construction. Note neat alignment of boltheads in left-hand Flat Trunnion and the bad scoring of right-hand Flat Trunnion by poor Spanner work.

Fig. 2 (right) Contents of the Pocket Meccano Set. Although comprising only a handful of parts, the scope for Nut and Bolt construction with this Set is enormous. An example of what can be done is shown below—a working Tractor Shovel with bucket hoist made from the Pocket Meccano Set. Dinky Toy tyres add the final touch of realism.





and Ackermann steering. Hand and foot brakes are fitted to the rear wheels.

"I paid a lot of attention to detail in the body construction—note the rivets on the bonnet which can be opened to reveal the "works". Overall length of the model is about 2 ft. 7½ in. Construction of the radiator-grille is simple and neat as I simply used 2½ in. Strips on a Screwed Rod, spacing each Strip with a Nut. The fenders (bumpers) and bodywork are made up from Flat Plates, Flexible Plates and Girders. Please note the "gas" lamps and cylinders!

"The only non-Meccano parts used in either of the models were the Rolls-Royce's tyres, these being kindly supplied by a local tyre manufacturer."

Mr. Smith went on to say that both his models were powdered by Meccano 20 volt Motors. These, as you know, are now obsolete, but I think we can overlook that on this occasion!

Club Report

I would like to finish this month by reprinting the following 1971 Report of the Stevenage Meccano Club which has been supplied by Secretary Mr. D. Higginson, 7 Buckthorn Avenue, Stevenage, Herts.

"The year started with a visit to the Model Engineer Exhibition in London which was enjoyed by all and a good stock of new Meccano parts was purchased by members. We had a very busy year exhibiting our models at various schools and Garden Fetes and raised a grand total of £35 for the various functions we attended, the biggest of which was held by the Pin Green School Parents Association. All members contributed to this display and we were able to show 20 models—all exhibited outdoors without any ill-effects. One of them was the Steam Engine which was re-built from the June M.M. by Peter Walton and which worked very well indeed.

"We have lost a valued member in Philip Hodges who has been granted a place at Rugby and we all wish him the very best at his new school. Several new members have joined the Club, however, including Paul Bourbousson, Phillip Phillipson, Geoff Long, Stephen Kuc, Simon Baker and a very keen adult member, Mr. John Foord, who is our lecturer. We also had the great fortune of a visit from Mr. Ron Fail to give us a lecture, with photographic slides, on mechanisms and general Meccano constructions relating to Clocks and Meccanographs. All in all, it has been a very successful year and bookings are already coming in for Fetes to be held during 1972".

Anybody interested in joining the Stevenage Meccano Club should contact Mr. Higginson at the address given above.

AIR NEWS (*continued from page* 38)

coast of the U.S.A. to show the kind of data that can be expected from the satellite. Carrying four 70 mm. cameras, it makes repeated passes over the test areas at an altitude of 65,000 ft., taking photographs every 18 days at precise local times that coincide with the time-intervals at which the ERTS satellite will pass overhead the same places. Three of the cameras produce the same "pattern" of pictures as those which will be aboard the ERTS; the fourth is loaded with colour infra-red film.

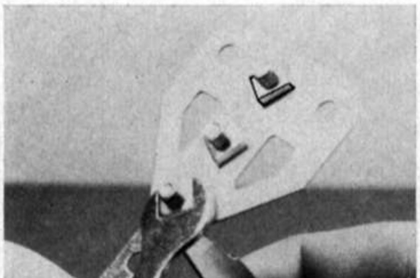
Sky Wedding on "Firework Night"

November 5th, Britain's traditional "firework night", will be remembered for a different reason by 20 Japanese couples. To celebrate the inauguration of its Boeing 747 "Jumbo jet" services from Japan to Europe, Lufthansa German Airlines invited them to be married sky-high on board its first 747 flight on that date and then to spend a 12-day honeymoon in Germany.

The wedding rites, which took place between Tokyo and Hong Kong, were conducted by a Shinto priest from the Shiba Daijingu shrine, in an age-old ceremony. The Lufthansa captain, in accordance with international law, officiated at the wedding. None of the traditional trimmings were omitted. The couples "walked down the aisle" over Kyushu to the strains of Etenraku court music, exchanged vows (seishi) in view of Okinawa, and drank the ceremonial saké over Taipei.

MECCANO PARTS
(*continued from opposite*)

extra strong grip when applied "saucer edge down", but if scoring is to be avoided they should be fitted the other way round. In the absence of Meccano Washers, paper is an excellent anti-score substitute.

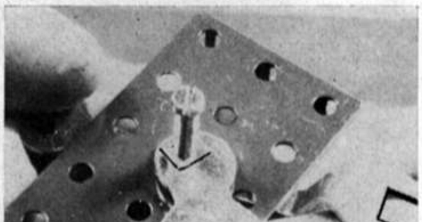


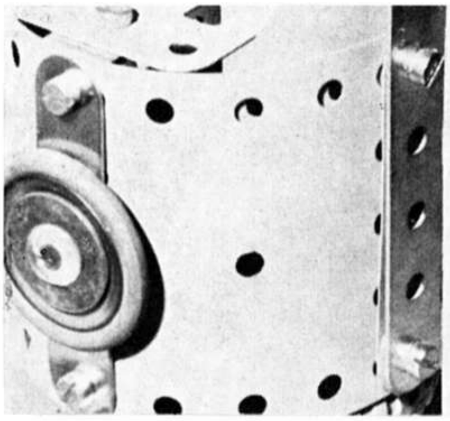
The lock-nut process is one of the most useful for the Meccano constructor. In the Pocket Meccano Set there are no Axle Rods, so wheels must be attached with Bolts. In the illustration of the simple Tractor with Scoop shown in Fig. 2 the wheels are attached to ½ in. Angle Brackets Bolted to the small Flanged Plate forming the tractor chassis. Procedure is as in Fig. 5, but, this time, the wheel is placed on the Bolt shank and a Nut is run on to the Bolt just short of binding against the wheel. The Bolt then goes through the hole in the Angle Bracket and a second Nut is tightened to secure the Bolt and hence the wheel to the Bracket. A simple job but it can make a tremendous difference to the appearance and the smooth running of your model when properly done!

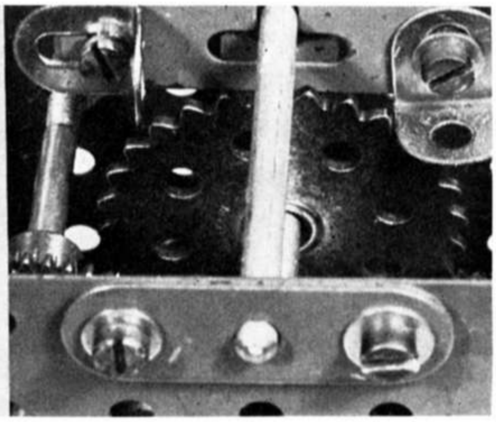
Next month we will have a look at some more basic parts and their uses.

Fig. 4 (left) Correct use of the Spanner with a simple assembly. The Nut is held still and the Bolt is tightened with the Screwdriver—*not* the other way round.

Fig. 5 (right) Lock-nutting a Bolt to a Plate with two Nuts. The lower Nut beneath the Plate is held steady with one Spanner, while a second Spanner is applied to the upper Nut. To prevent scoring of the enamel, a Washer should be placed under the upper Nut.







Far left, Fig. 3a
Left, Fig. 3b.
Bottom of page, left, Fig. 5a, and right, Fig. 5b

MECCANO PARTS AND HOW TO USE THEM

Part Two—The Perforated Strip

By B. N. Love

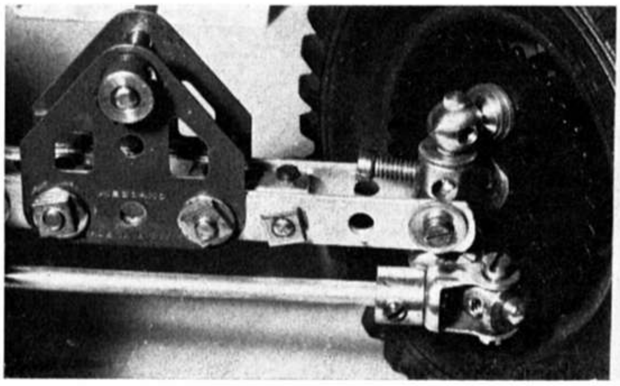
SO common is the Perforated Strip in the Meccano system that the majority of us take it for granted. Its elegant simplicity however, gives a solution to modular construction which taxed the brains of its inventor, Frank Hornby, to a considerable degree at the beginning of this century. His formula of using ½ in. stock material with ½ in. spaced holes has been a successful one for nearly three-quarters of a century and it has been avidly copied by many a competitor from 1901 until the present time.

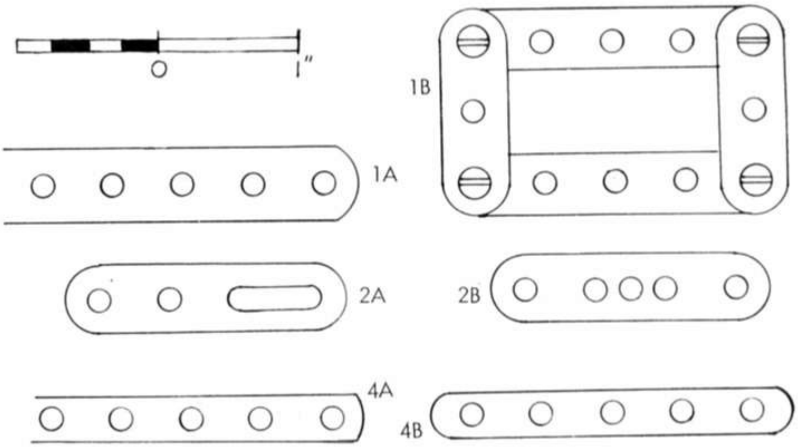
Today we are bound up internationally with a decimal system and one might perhaps wonder if the pressures for metrication will oblige the Meccano factory to go over to centimetre dimensions. This would require the re-tooling of the factory at a quite uneconomical cost and it is significant that at least two of the continental manufacturers of competitive systems adhere rigidly to the original Frank Hornby module of ½ in. spacing. This format is likely to stay with us for a long period to come.

Steel for Perforated Strips is supplied to the Binns Road factory in coils of the correct width and thickness, or gauge, for the relevant length of Strip. Meccano Perforated Strips longer than 5½ in. are made from a thicker gauge of steel than those of 5½ in. and below. This gives the necessary strength to the longer components. Early parts were made from thin tinplate with folded edges to give the material some rigidity, but Frank Hornby soon realised the advantage of using steel strip for a superior product if it was to achieve world-wide fame and reliability. Squared ends on the first Perforated Strips represented a danger to young children and Frank Hornby put a curved end on the Strips before patenting his invention in the first decade of this century. Fig. 1a shows the early radius adopted and this is still in use today for the Perforated Strips of 7½ in. and longer. When re-designing the punch tools for the shorter Strips, a sharper radius was employed to give an elegant curvature to a right angled corner made up in Perforated Strips as shown in Fig. 1b.

As the popularity of Meccano spread, Frank Hornby was inundated with suggestions for improvements to his basic designs and an early improvement, almost from the outset, was the provision of slotted holes in various Meccano parts. This allowed structures other than those bound by the rigid ½ in. spacing concept and the Slotted Strip was introduced in two versions, the 2 in. and the 5½ in. The smaller one is illustrated in Fig. 2 and this arrived on the scene during the '20s.

Shown alongside the 2 in. Slotted Strip is the latest addition to the range of Meccano Perforated Strips, Part No. 6, which is now supplied with a central hole giving a ¼ in. spacing of holes at the centre. Vehicle gearboxes are very popular in Meccano models and it often happens that a 2 in. width is just right for an approximate scale. Previously, the 2 in. Strip had no





centre hole, making it difficult to centralise the main shaft of the gearbox. The new design overcomes this difficulty and shows its versatility in other applications which will be covered later in this series.

How does one use the Perforated Strip? It is so obvious, is an explanation really necessary? Experienced constructors who get the most out of their models and produce the best results are always looking for the full potential offered by *any* individual Meccano part and the Perforated Strip is no exception. Essentially, as a structural part, the Perforated Strip is a strut and will stand up to quite heavy loads if subjected to tension (a stretching force) rather than to compression (buckling force). This should be borne in mind when assembling crane jibs, parts of which are always in tension and where the Strip is an excellent component choice.

Two other applications of the Perforated Strip, used as an ideal reinforcing item, are shown in Fig. 3a. Overlying the ends of Flexible Plates gives a neat appearance by masking the slotted Plate holes beneath and holds the thinner components securely in place. As a bearing for Axle Rods, the Strip has considerable 'slop', deliberately so, to ease construction for junior builders and even to give the advanced constructor some latitude in getting that awkward joint assembled! Fig. 3b, however, illustrates that, by several layers of Strips, the 'slop' can be evened out and a much better bearing surface provided for Axle Rods doing heavy duty. Such a bearing is also needed where an Axle Rod needs to run absolutely concentrically, as required in the case of Fig. 3b which shows the escapement spindle in a Meccano clock.

In 1962, Meccano made a break with tradition by introducing the Narrow Strip range, illustrated in Fig. 4. Although these Strips, Part Nos. 235–235f, were introduced as experimental parts originally, and not included in junior outfits of the time, their potential was soon exploited by the advanced constructor. They provided a nice scaling down of the standard width of Perforated Strips and made the modelling of connecting rods on railway engines and frameworks of vehicle cabs much easier in terms of an acceptable scale. The ratio of perforation to remaining metal, however, is quite high so they are not made in lengths greater than $5\frac{1}{2}$ in. At this length, they are still excellent components for tie-struts in crane jibs, etc.

Two distinct applications are shown in Fig. 5, the tractor axle shown in Fig. 5a being an example of improved scale, while Fig. 5b shows the narrow Strip as a decorative overlay on a Hub Disc, giving a striking impression of narrow spokes in the rear wheel of a showman's engine. The Meccano Price List does give metric dimensions for the range of Narrow Strips from 60 mm to 140 mm, the width in each case being 9 mm.

The drawings of Fig. 4 show up an anomaly among the Narrow Strips in terms of the shape of the Strip ends. Note that Fig. 4a, which shows the end shape of Narrow Strips 235b, 235d, and 235f (90 mm and upwards) has an end radius of $\frac{5}{16}$ in., similar to that used for 'cropping' the end of steel strip used for standard Perforated Strips of $7\frac{1}{2}$ in. upwards. The shorter Narrow Strips 235 and 235a are not punched from strip material; they are pierced in plate form and then blanked out by a multiple punch which has semi-circular ends. This is just a matter of simpler design in the punching tool, but it explains the difference in curvature illustrated in Fig. 4. There has been some conjecture in the past by older Meccano enthusiasts concerning these different shapes, giving rise in some cases to pretty tall stories! However, it is all a question of tool design being most suitable.

Finally, the versatility of the Narrow Strip is shown in Fig. 6, where two forms of leaf springs for model vehicles are illustrated. Fig. 6a shows the normal semi-elliptic spring usually supported at each end with the axle attached at the centre. The second leaf spring in Fig. 6b is known as a "cantilever spring" being secured at one end with the axle attached to the other. Note the close lapping of the 'leaves' effected by clamping up the 'leaves' in 1 in. Triangular Plates secured by Pivot Bolts.

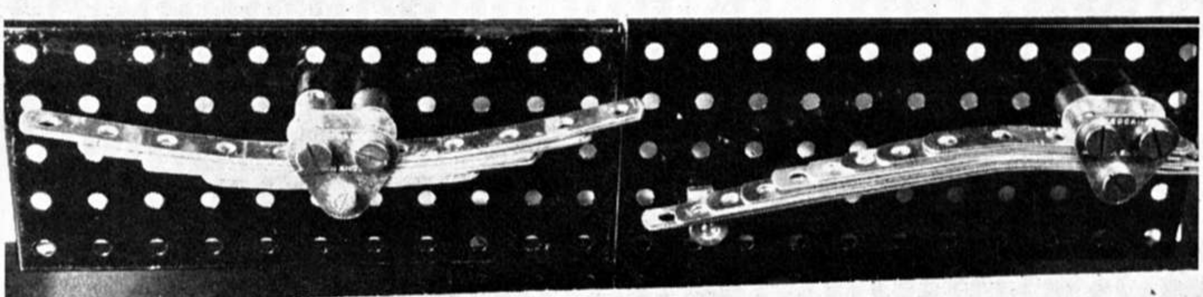


FIG 6a FIG 6b

MECCANO PARTS AND HOW TO USE THEM—PART 3

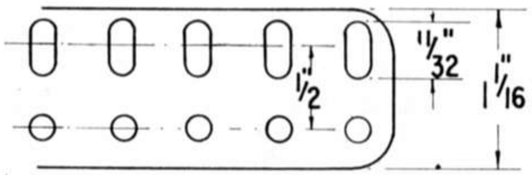


FIG.1

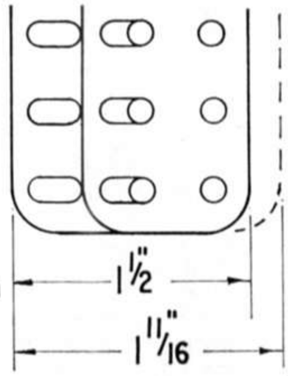


FIG.1a

GIRDERS

BY B. N. LOVE

Strength is a prime consideration for any structural engineer, but so is lightness and economy. Frank Hornby was fully aware of these principles and since he started off with tinplate, design of his basic parts was critical if they were to prove durable. Fortunately the simple process of putting a right-angled bend into a strip of metal alters its characteristics to suit the engineer admirably. Take any strip of notepaper, for instance, which is quite unrigid and floppy and then put a fold down the centre of its length. The strip is still flexible but not so floppy as before. Now open out the fold to a Vee shape and you have instant rigidity along the length of the strip. You have, in fact, formed an elementary girder! It really is as simple as that.

Angle Girders came into the system very early on in its history when the name "Meccano" was rapidly being established as an international household word and its design, being so fundamentally simple and satisfactory, has hardly been altered since. This is certainly true of the Angle Girder which forms the rigid framework of so many Meccano models. Most readers are familiar with its properties but the manufacture of the Angle Girder is a story of its own. Strip steel, $1\frac{1}{16}$ in. wide and $\frac{1}{32}$ in. thick, is passed into a piercing press from which it emerges in a continuous length punched with the familiar pattern of holes shown in Fig. 1. A second machine 'crops' the continuous lengths into standards as required for the full range of Angle Girders and a further machine puts the right-angled fold into the finished parts before the cleaning and plating process.

In its unfolded form, the Angle Girder is known as the Flat Girder (which is really a contradiction in terms.) It should be more properly named the "Wide Perforated Strip" as it possesses no rigid properties of its own. However, when it is combined with the standard Angle Girders as shown in Fig. 2, it provides a strong web for the compound channel girder thus formed. Flat Girders came on to the Meccano scene as a standard part at about the time of the First World War. They were listed as a part number in $5\frac{1}{2}$ in. length only but were not even included in the top set of the day, Outfit No. 6. Consequently, they seldom featured in the manuals of instructions but they did appear in the first advanced model of the famous Meccano Loom, (beyond the scope of the No. 6 Outfit) in 1919, if not earlier. Since that time they steadily became a popular choice for the model-builder as their versatility was disclosed and exploited. The basic dimensions of the Flat Girder are shown in Fig. 1.

Elongated slots are the key to the versatility of the Flat Girder although 'centre line' dimensions of the holes still conform to the half-inch standard. Fig. 1a shows the 'spread' available when a pair of Flat Girders are lapped over each other and this can be extended by lapping slot to slot. Since Flat Girders are available in ten sizes from $12\frac{1}{2}$ in. downwards, the Meccano constructor has a whole range of adaptable plates at his disposal.

The chassis members of Fig. 2 show one aspect of the Flat Girder

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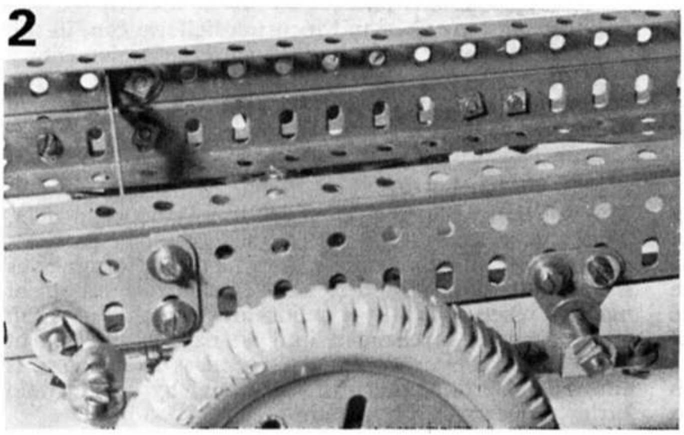

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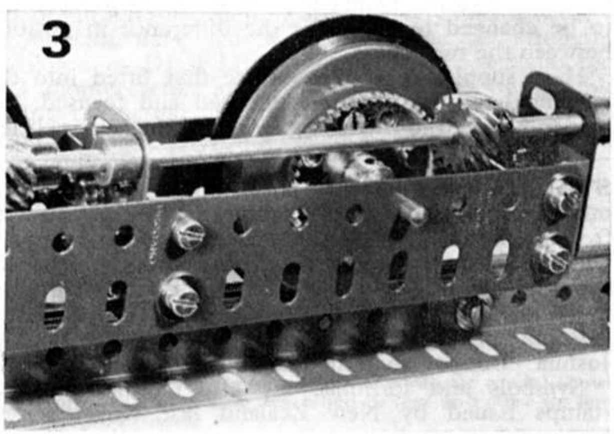
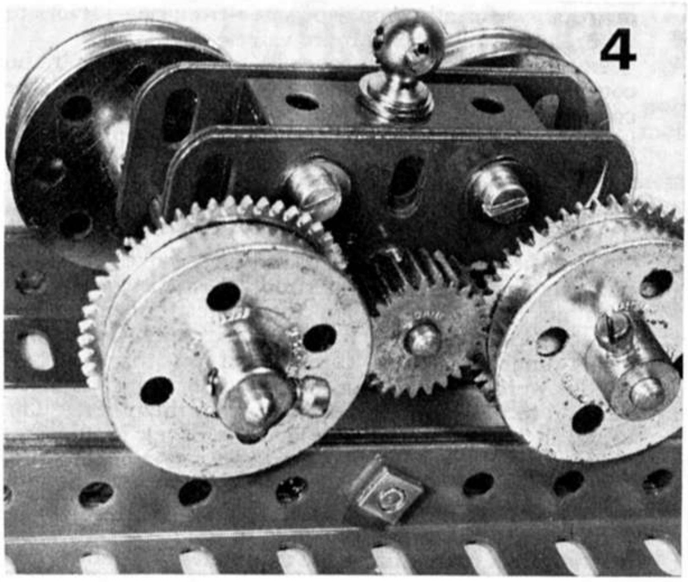
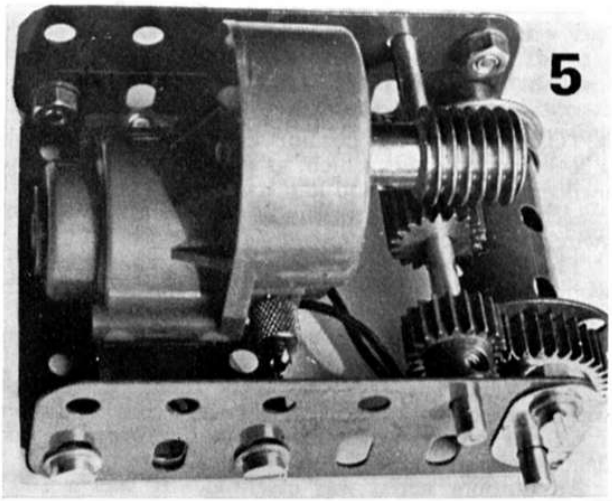




The versatility of Flat Girders is demonstrated especially well in Figs. 4 and 5; both use the elongated slots to maximum advantage.



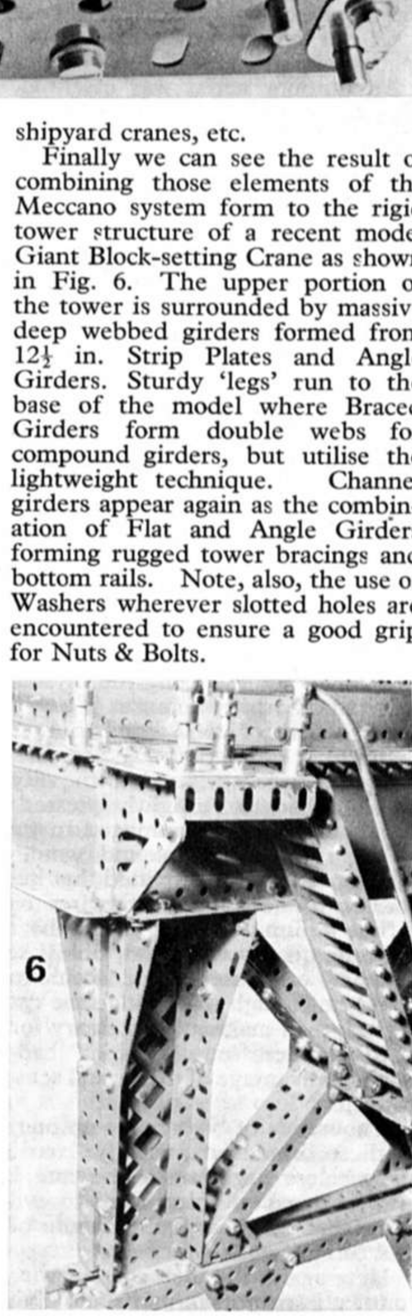
in its use as a web joining standard Angle Girders to form channel girders, but Fig. 3 shows that the Flat Girder can also act as a framework with simple bracings of short Double Angle Strips. Its latitude of adjustment allows an unorthodox meshing of a small helical Gear with a Contrate Wheel in a power-driven crane bogey, short Flat Girders mounted vertically forming the off-set bearings required.

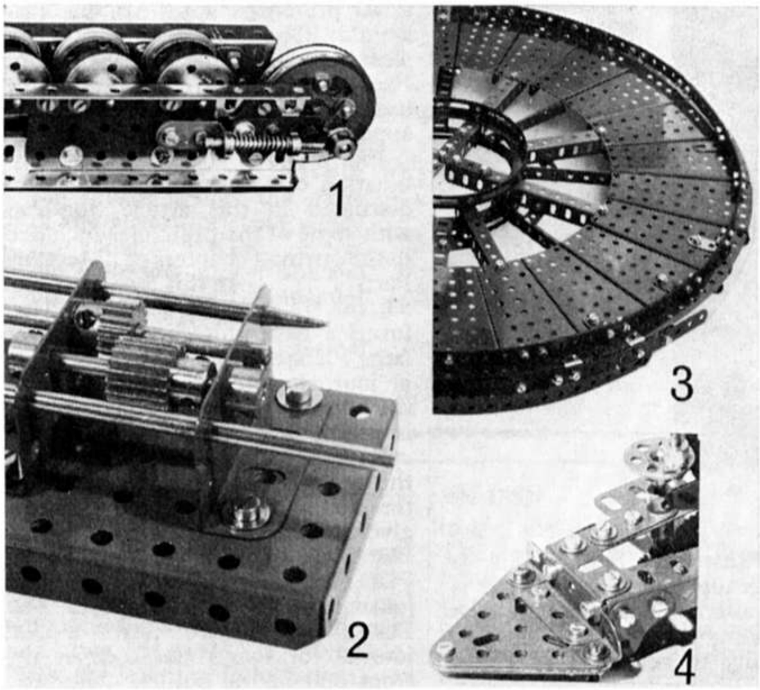
Fig. 5 shows a further example of the Flat Girder's adaptability. In this case a pair of Flat Girders act as the side frames for the lower portion of a light trolley hoist in which the winding drum gear is a 1 in. Gear Wheel. This will not mesh with the ½ in. 19-teeth Pinion shown at standard spacing, but when the Pinion is off-set in the upper row of holes in the Flat Girder, ½ in. inwards from the end, the 1 in. Gear Wheel may be lifted into mesh by securing its shaft in the round holes of a pair of Fishplates mounted at each side of the trolley frame. The resulting drive is a very satisfactory and rugged one, nicely scaled. Bracing of the Flat Plates is done by a 2½ × 1½ in. Flanged Plate which forms an admirable base (adjustable in height by virtue of the slotted holes in the Flat Girders) for the electric motor and its Worm drive to the central 19-teeth Pinion shown.

Quite compact forms of travelling bogies can be made from Flat Girders, as illustrated in Fig. 4 where the principle of double-layer Strips for axle bearings, mentioned in Part 2, is clearly shown. This time a Channel Bearing, Part No. 160, provides full rigidity for the bogey and additional grip for the Bolts is provided by Washers as mentioned in Part 1 of this series. If a fully compensating bogey is required, one pair of the driven flange wheels shown should be capable of independent movement to accommodate irregularities in rail surfaces or heights. In this case the Flat Girders should be turned with the slotted holes at the bottom and the forward axle should be stabilised by a pair of Fishplates as was done in Fig. 5. The rear axle should then be located in a central swivel bearing to allow the axle to 'ride' in the slots of the Flat Girder. Note, once again, the happy complement of Flat and standard Girders, this time the Angle Girders forming substantial rails for the bogey. Long Angle Girders, sandwiching the heavier-gauge Perforated Strips (7½ in. and upwards in overlapping staggered sections) provide a really strong flat-topped rail suitable for the heaviest of model drag-lines or excavators.

The standard Angle Girder of course, has a hallowed place in the outfit (if not the heart!) of the Meccano enthusiast. He is somewhat prone to classify his Meccano status by the number of Angle Girders he has; the longer and more numerous the better, rather like the chieftain who bases his status on the number of goats he possesses! There is no doubt about it though, the Angle Girder is the 'corner post' (in more senses than one) of the Meccano system, although no lad must ever be discouraged by not having them in his outfit. Thousands of excellent and advanced models have been made which do not use a solitary Angle Girder. However, they certainly look an impressive sight on the old familiar shipyard cranes, etc.

Finally we can see the result of combining those elements of the Meccano system form to the rigid tower structure of a recent model Giant Block-setting Crane as shown in Fig. 6. The upper portion of the tower is surrounded by massive deep webbed girders formed from 12½ in. Strip Plates and Angle Girders. Sturdy 'legs' run to the base of the model where Braced Girders form double webs for compound girders, but utilise the lightweight technique. Channel girders appear again as the combination of Flat and Angle Girders forming rugged tower bracings and bottom rails. Note, also, the use of Washers wherever slotted holes are encountered to ensure a good grip for Nuts & Bolts.





Meccano Parts and how to use them

Part 4 — Plates

By B. N. Love

So far in this series we have considered Strips and Girders, together with the means of fastening them together to form the 'skeleton' of a model structure. In many cases, the lattice construction resulting is adequate for bridges, towers, crane jibs etc., but in a majority of models some kind of plating is required to add rigidity or to cover in unwanted open spaces and to provide, at the same time, journals for running shafts and anchoring points for other parts of the model.

Two basic forms of rigid Plates are provided in the Meccano system, namely, Flat Plates and Flanged Plates. The latter adopt the same principle for rigid edges as that used in the manufacture of Angle Girders, i.e. the edges of the Plates are folded over at Right Angles. Most common of the Flanged Plates is the $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plate which has been included in virtually every Meccano Outfit since the birth of the system in 1901. It even featured in the pre-Second World War OOO Outfit! Choice of $5\frac{1}{2} \times 2\frac{1}{2}$ in. dimensions proved to be very acceptable from the outset for this particular Flanged Plate, which has featured as the baseplate in many thousands of different models. Flat Plates are often required where a Flanged Plate would prove awkward to fit and to give Flat Plates some strength they are manufactured in a thicker gauge of steel. These items should not be confused with the Meccano Flexible Plates which are of much thinner material and which will be covered in a later part of the series.

An inspection of a list of Meccano Parts will show that Plates in general feature in two or three separate parts of the price list and to familiarise readers with the part numbers a table is shown here which includes a description of Meccano Plates, in order of size, with the part numbers shown in the final column. With such a range of perforated Plates, the constructor has a wide choice at his disposal and some of their applications are illustrated in the accompanying photographs.

Typical applications of Part No. 52 appear in Figs. 2, 5 and 6. Fig. 2 shows a common arrangement in which the Flanged Plate makes a general base for mounting journal brackets upon it in models requiring gear boxes etc. The surprising strength of the $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plate is demonstrated by its use as the baseplate of a production tool, part of which is shown in Fig. 5. When fitted together, the tool will actually form short Meccano Strips into a special shape for caterpillar tracks and although the finished Strip is bent to a perfect shape each time, no distortion whatsoever occurs in the Flanged Plate. A $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate is also featured as part of the tool and its job is to hold four locating pins in the correct position when inserted through holes in the base Flanged Plate from below. Again, no distortion occurs in this Plate even after repeated use.

Perhaps the most interesting of the Flanged Plates is the Sector Plate, so called (quite correctly) because it forms part of the sector of a complete circle. It is very rarely featured in such a form because no less than 24 of them are required to complete a full circle! They are, nevertheless, supplied in all current Meccano Outfits from No. 5 upwards, the manuals for which show many applications of the Sector Plate. Models requiring tapered effects such as sand hoppers, car chassis, ships' decking etc., make good use of Part No. 54, but, for the record, Fig. 3 shows that the Sector Plate does match up in circular form and this part illustration shows how a very large base can be constructed for a really giant model of a dragline.

Of comparable interest in the Flat Plate section are the Triangular Plates, Part Nos. 76 and 77. Fig. 4 shows four of the $2\frac{1}{2}$ in. Triangular Plates bolted together to form the heavy spade trail of a Field Gun model and the slotted holes in this size of Plate are shown clearly. These add versatility to the Plate which may be used as the side journals of a winding mechanism for a winch etc., in which case the slotted holes permit the non-standard spacing of Meccano Gears which do not normally mesh together, such as the 1 in. Gear and the 15-teeth Pinion. As the 1 in. Gear has 38 teeth, the reduction ratio obtained is close to $2\frac{1}{2} : 1$ which makes a nice scale speed reduction. To locate the second shaft in such a winch, a Fishplate,

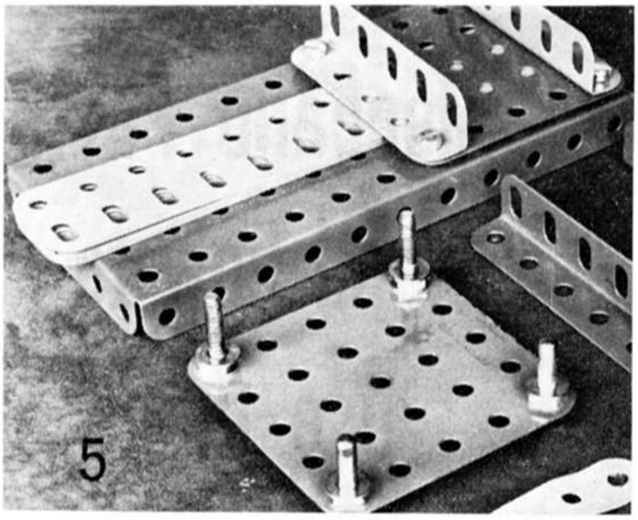


Fig. 5 shows a production tool for forming caterpillar track components. This and the other illustrations are all referred to in the text.

Part No. 10, would be bolted by its slotted hole to a corner hole of the Triangular Plate and its round hole would be set over the slot in the Triangular Plate to locate the Axle Rod in the required position for gear meshing.

Part No. 77 is the smallest three-holed Plate in the Meccano system, but it is also one of the most versatile. An equilaterial triangle with holes at ½ in. centre spacing is provided by the 1 in. Triangular Plate and one application of this part is shown in Fig. 1 where two of them are combined to make a 'diamond' plate. This allows a 2 in. Slotted Strip to be critically located in the side frame of an excavator base. Note also the use of the 3 × 1½ in. Flat Plate, Part No. 73, to hold the Girder members of the side frame and the number of anchoring points it provides for attachments.

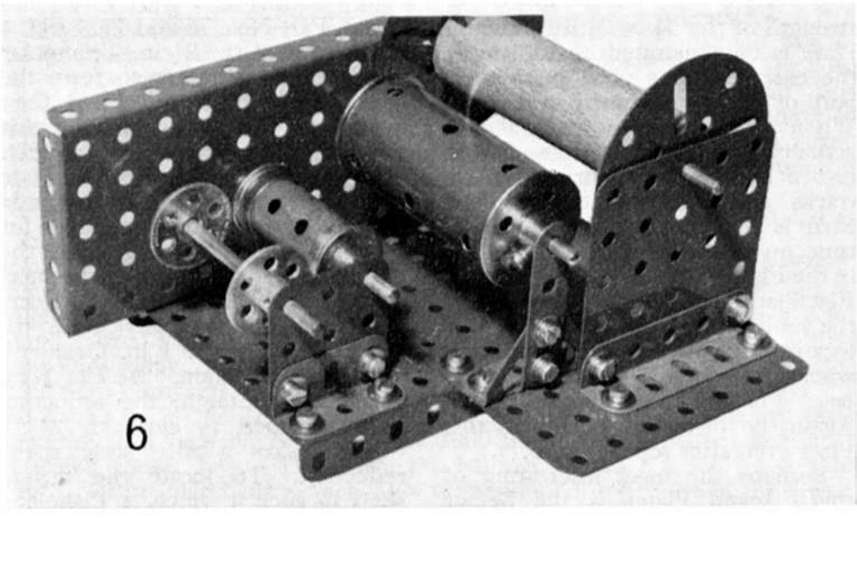
Readers who have been following the series will have noticed the frequent appearance of Angle Girders (featured in Part 3) in the models illustrated here. This is simply because the Angle Girder is the natural complement to the Flat Plate, adding strength at the base and rigidity to vertical Flat Plates used as journal sides for gear boxes, crane cabs and general side plating. This continuous feature throughout this series shows the natural tie-up between the parts in the Meccano system so that, while it is impossible to feature a large number of applications of particular parts in a single Chapter, the series as a whole will show repeated examples of parts already discussed at a basic level.

There is of course, a whole family of other Meccano Plates known as Flexible and Strip Plates in rectangular form from 12½ in. in length down to 1½ in., but, generally speaking, they are perforated at their edges only, for attachment, and are not designed to act as journal plates, their job being to cover in model frameworks in the most economical manner with enhanced appearance of a non-perforated surface. The same principles apply to the Triangular Flexible Plates, the gauge of steel being the same as that used for Flexible Plates and examples of the use of all of these thinner plates will appear elsewhere in the series.

Fig. 6 shows an interesting combination of a number of the Plates discussed in this article, together with some of the principles included in the opening chapters of "Meccano Parts . . . . .". In this case, Part No. 53, the 3½ × 2½ in. Flanged Plate, forms a base unit and the popular large Flanged Plate forms a bearing, or journal plate, for the far side of the model. This particular model is purely a demonstration unit for cylindrical parts so the near side of the model is 'cut-away' mechanically, for the sake of clarity. Width is given to the base by a 5½ × 3½ in. Flat Plate on which a 2½ × 2½ in. Flat Plate is erected for use as a journal plate. The smallest Flat Plate, Part No. 76, forms a neat journal for two Axle Rods at the front end of the model. Note the use of Angle Girders to support the vertical Flat Plates and the use of Washers under the Boltheads for added strength.

The use of Plates alone is not always sufficient for mechanical rigidity and constructors should bear this in mind, particularly if there is any side thrust occurring in the model. For instance, if any of the winding drums in Fig. 6 were subject to heavy side movement, the Flat Plates would not be sufficiently braced for this and additional brackets, set at right angles to the Flat Plates and reaching well up their edges, would be necessary for reliable performance.

As with any other Meccano part, the constructor should always have a keen eye open for exploiting the Flanged Plate and Flat Plate. To give a simple example, a lift cage of rigid construction with centralising guides can be built from two of No. 52, two of No. 72, four of No. 10 and *four* of No. 37! The reader is invited to try this one for himself!

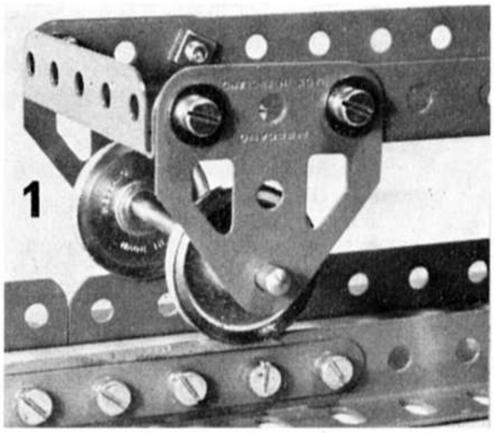


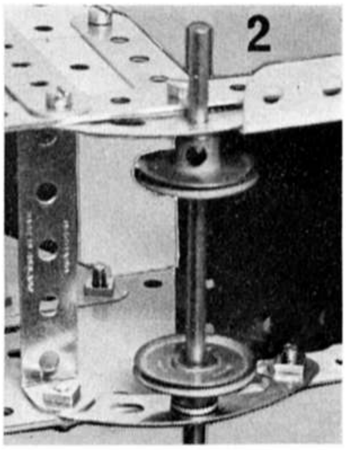
Description of Plate		Part No.
Flanged Plate	5½ in. × 2½ in.	52
,, ,,	3½ in. × 2½ in.	53
,, ,,	2½ in. × 1½ in.	51
Flanged Sector Plate 4½ in. long		54
Flat Plate	5½ in. × 3½ in.	52a
,, ,,	5½ in. × 2½ in.	70
,, ,,	4½ in. × 2½ in.	53a
,, ,,	2½ in. × 2½ in.	72
,, ,,	3 in. × 1½ in.	73
,, ,,	1½ in. × 1½ in.	76
Triangular Plate	2½ in. side	76
,, ,,	1 in. side	77

MECCANO PARTS AND HOW TO USE THEM: No. 5

WHEELS and AXLES

BY B. N. LOVE





PROBABLY the greatest appeal of Meccano models lies in the manner in which they may be animated by mechanical movement. Having dealt with the basic components for frameworks, we may now turn to those parts which give us motion in our models, namely, wheels and axles. With more than a dozen lengths of Axle Rods in the system (apart from the special Pivot Rods among the Electrical Parts), the Meccano constructor has a wide range of spindles to choose from and an even greater variety of wheels. These latter include Pulleys, Bush Wheels, Road Wheels, Spoked Wheels, Flanged Wheels and, of course, the entire range of Gear Wheels, although these will be dealt with as a separate class.

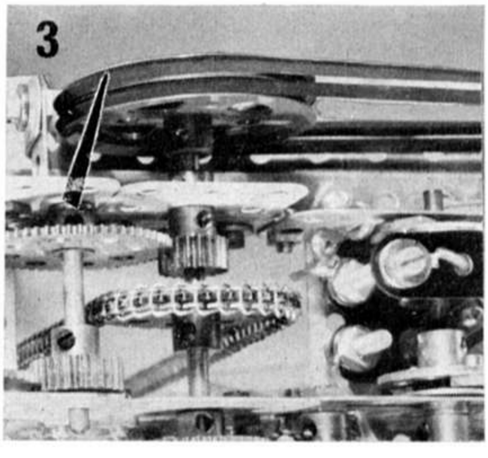
Once again, in using wheels and axles, the emphasis is on not taking things for granted. Both groups need looking after, as too many models are spoiled by bent shafts and distorted wheels, usually caused through rough handling or carelessness. Neither shafts nor wheels will stand up to excessive loads or abuse, but, properly used, they can carry substantial drives and surprising weights. Axle Rods should be carefully chosen whenever accuracy of running is required, especially in belt-driven or gear-driven mechanisms. Give these running parts a fair chance by lining up bearings with care and by seeing that the shafts turn without binding, or undue side play. Part of a simple four-wheeled truck shown in Fig. 1 demonstrates this principle. 1 in. Pulleys, mounted on 3 in. Axle Rods, are journalled in a pair of Flat Trunnions attached to the side of the standard Flanged Plate, but Washers are used under the Bolt heads for firm grip and the careful alignment of front and rear Axle Rods permitted this model to run on Girder rails.

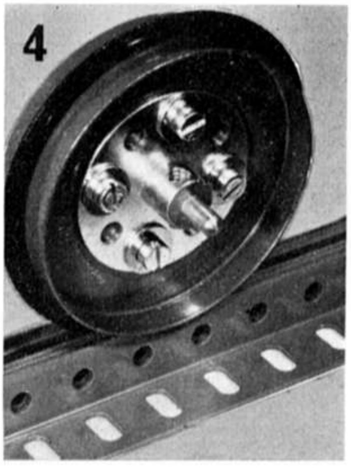
Although not apparent from the illustration, each of the Axle Rods on the simple truck carry Washers between the Pulley Wheel bosses and the inside of the Trunnions. The principle is illustrated in Fig. 2 where a similar construction is used for a model tram. By inserting the Washers shown, the 'scrubbing' action of the Pulley Wheel boss against the Trunnion is very much reduced and, if a small drop of sewing machine oil is applied to the bearing, scrubbing, and subsequent scoring of enamelled surfaces, is almost eliminated. Both the Trunnion and the 2½ in. Stepped Curved Strip appear in the majority of Meccano Outfits, so are readily available for the journals shown in Figs 1 and 2.

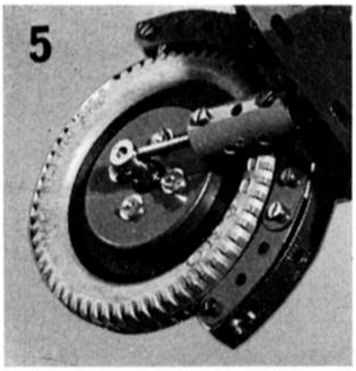
The Pulley Wheel comes into its own when used for a belt drive, an outstanding example of which is illustrated in Fig. 3. In this instance two 2 in. Pulleys, Part No. 20a, are used to receive a belt drive in a fairground model, the doubling-up of the belts providing a very powerful drive. A full range of Rubber Driving Bands are provided in the Meccano system, ranging from 2½ in. to 20 in. in light and heavy gauge to suit a wide range of models and power requirements. The smaller and lighter bands, Part Nos. 186, 186a and 186b, are used in junior models with hand or clockwork drive, while the longer and heavy-gauge Bands, Part Nos. 186c, 186d and 186e may be used with electric motor drive in the heavier models.

Several advantages arise in using the Driving Bands. They enable moving parts located at a distance across the model to be coupled by Pulleys. They are silent in operation, have sufficient stretch to accommodate awkward shaft spacing, and a single twist in the loop of the Driving Band gives a reversal of drive.

When running models on rails, the Meccano Flanged Wheels, Part Nos. 20 or 20B, should be employed. These are wheels which can be easily put out of shape by carelessness or overloading, but it is a fairly simple matter to straighten them to run without wobbling. They should always be spun on an Axle Rod before use to ensure that they are running true or they will not give a level performance on rail-mounted models. Fig. 6 shows the larger Flanged Wheels as a pair, sandwiching a Wheel Disc to form a centre flanged wheel. This provides a very strong component for heavy







model cranes etc. and it will track on a hollow rail made from Perforated Strips and Angle Girders.

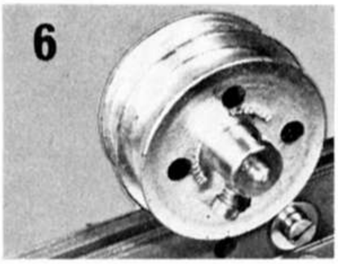
Fig. 4 shows an extension of this idea in which some of the 'disc' type wheels in the system are put to good use. In this case, a Face Plate, Part No. 109, forms a central flange and provides one boss with Grub Screw. Two Wheel Flanges, Parts No. 137 are clamped on either side of the Face Plate using an 8-hole Bush Wheel for extra rigidity. The hollow rail construction can be clearly seen in Fig. 4.

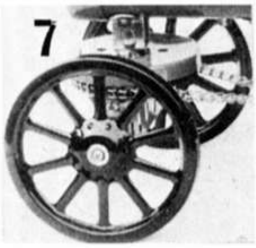
A further use of the Wheel Flange is shown in Fig. 5, where it is used to simulate the drum brake of a model motor cycle. This time, the 3 in. Pulley, Part No. 19b, is employed with the Meccano Motor Tyre supplied to fit this particular size of Pulley. The resulting combination is both neat and realistic.

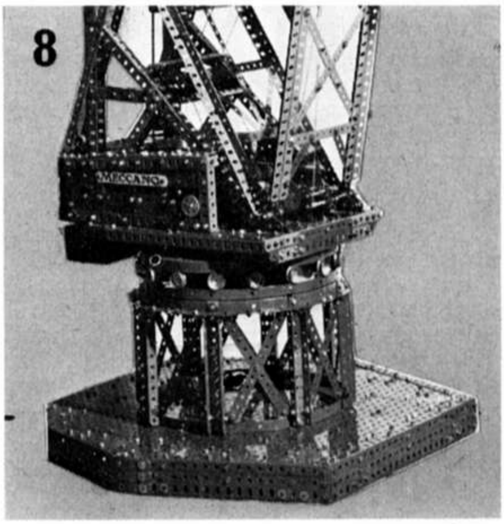
Constructors who are fond of building vintage road vehicles have employed the 3 in. Spoked Wheel, Part No. 19a, to advantage. In Fig. 7 we can see an early and common use for the Spoked Wheel on the front axle of a model Traction Engine. Because of its smooth rim, it is not normally thought of as a suitable wheel for rubber-shod vehicles, but it has been used quite successfully in a number of vintage car and lorry models in conjunction with the 3 in. Motor Tyre. However, the Meccano Motor Tyres have central ridges moulded into them so that they locate positively in the Vee grooves of the Pulleys. In order to use the standard Meccano Motor Tyre with the 3 in. Spoked Wheel, it is therefore necessary first to remove this central ridge from the Tyre by means of a sharp-bladed modelling knife.

In many cases, modellers have preserved or inherited some of the earlier Meccano Motor Tyres, many of which have lost a degree of elasticity and have become slightly stretched so that they are no longer a good fit on the original 3 in. Pulleys. Such Tyres are ideal for trimming to fit the 3 in. Spoked Wheels, particularly if the vintage car model is to be exhibited as a "glass case" model and is not expected to do a great deal of running about. Good Tyres, carefully trimmed, can be made quite a tight fit on the Spoked Wheels and in this case, the model may be run in the normal manner.

Finally, Fig. 8 combines much of what this series has been about so far. The obvious Strip and Girder construction of the rugged base on the model of a French Floating Crane and the use of Flat Plates ties up the first four parts of the series and the neat application of the smaller Flanged Wheels for an elegant roller bearing gives a further application of our Wheels and Axles theme. We shall see these basic essentials occurring again and again through the discourse on various models and mechanisms so that we shall be able to revise and establish the use of Meccano Parts in each succeeding chapter. Part 6 will extend this idea with a discussion on simple gearing.







DINKY TOY NEWS *(Continued from page 225)*

incorporates, like the original, a 3-part telescopic jib fitted with simulated hydraulic rams. The jib is raised and lowered by a positive rack and pinion mechanism, controlled by a knurled handwheel at the left-hand side of the crane body. A ratchet mechanism is included in the movement to ensure that the jib remains in the chosen attitude under load, the ratchet being disengaged for lowering by pulling the control wheel outwards. Its shaft, incidentally, is spring-loaded so that the wheel is automatically pulled in to engage the ratchet, when released.

On the opposite side of the crane body is another knurled handwheel, controlling the load-hoisting cord. This does not incorporate a ratchet mechanism, but it does include a friction brake which effectively prevents the weight of the load unwinding the cord on its own. In fact, a simple test I have carried out as I write (pulling the cord by hand!) shows that the model will tip over before the cord unwinds without the control wheel being turned.

Thanks to its telescopic nature, the jib itself will extend from approximately 7 in. when closed to nearly 13 in. when fully extended. Extension is achieved by pulling the sections out by hand and care must be taken here that sufficient cord is first run out so that the load hook does not prevent the sections from being extended. The cord passes down the centre of the jib and the hook will thus foul the jib if the length of "free" cord available is less than the length by which the jib sections are to be extended. For travelling, the closed jib is lowered onto a special support bracket on the cab roof, the load hook being located on another special bracket projecting from the front of the chassis, beneath the radiator-grille. Projecting from the front of the crane body is a simulated spare wheel, incorporated in the body casting, but carrying a removable spare tyre.

As already mentioned, the Dinky is also fitted, like the original, with stabiliser legs to support it during

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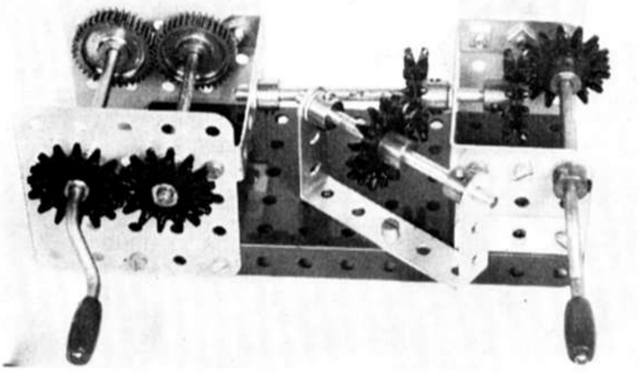

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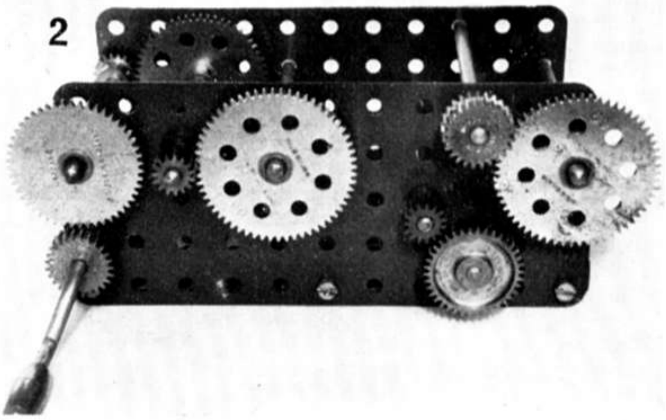


MECCANO PARTS AND HOW TO USE THEM

Part 6 — Basic Gear Trains

By B. N. Love

BEFORE continuing with this part, the reader's attention is drawn to an error in the table of Part 4, on page 202 of the April, 1972 Meccano Magazine. The 1½ × 1½ in. Flat Plate is listed as Part No. 76 but should read Part No. 74.

Basic Gear Trains

Most Meccano modellers would agree that their first sense of real engineering comes when they are fitting up the gear trains in their models. Until a few years ago, it was necessary for the enthusias to have an Outfit well up the list in order to have a versatile range of gears at his disposal, but with the introduction of Part No. 27f, Multi-purpose Gear Wheel, the younger modeller will find all the versatility he could wish for in any Meccano Outfit from 3X upwards. Fig. 1 shows just three applications of the new plastic gear wheel. Looking at the left-hand end of the model, a pair of 27f are mounted on the same shafts as a pair of 1 in. brass Gear Wheels. Although the 1 in. Gears have 38 teeth and the plastic gears have only 14, the rotation of the shafts remains in a 1 : 1 ratio. It is instructive to try this arrangement if only to convince the advanced modeller that he can frequently, without loss of mechanical efficiency, substitute the cheaper plastic gears for the more expensive brass ones when he wants such a ratio at 1 in. centre spacing.

A glance at the right hand end of the rig in Fig. 1 shows how the angle of drive may be varied—virtually through any angle from 0 deg. to 360 deg.—a remarkable achievement of design. At 0 deg. meshing, the two gears would be face to face and would then act as a positive clutch mechanism. Incidentally, the groove form in the plastic gear provides a deep-throated pulley wheel which will take a rubber Driving Band or a hoisting cord. When the Multi-purpose Gear Wheel is used for an angular drive as shown, care must be taken in meshing the teeth with sufficient clearance to give a smooth drive. So long as the gears are adjusted on their shafts so that they engage each other with the same overlap of teeth without binding, they will provide a smooth and quiet drive which requires no lubrication of the teeth. The principal limitation of the plastic gear, however, is that it will give a simple 1:1 ratio. This means that one revolution of the crank handle will cause the second shaft to revolve once, in the opposite direction. At a pinch, the Multi-purpose Gear can be mounted as a driving pinion for a complete circle of large Toothed Quadrants (more about those in a later part of the series). When adjusted to mesh with the external teeth, an exact ratio of 12:1 is achieved which may well be of interest to clock-makers!

Fig. 2 shows the more conventional range of gears in the Meccano system. The left-hand grouping shows a complete chain of gears starting with the 25-teeth Pinion, Part No. 25, on the Crank Handle. This meshes with a No. 27 Gear Wheel having 50 teeth, so two turns of the Crank Handle are required for one turn of the 50-teeth gear. The gear ratio thus obtained is therefore 2 : 1. The chain continues by means of a No. 26, 19-teeth Pinion meshing with a No. 27a, 57-teeth Gear Wheel. Three turns of the Pinion are required for one turn of the Gear Wheel, hence a 3 : 1 ratio. These last two gears are shown at the rear of the framework of Fig. 2. Finally, a No. 26c, 15-teeth Pinion meshes with a No. 27d, 60-teeth Gear Wheel giving a 4:1 ratio.

How many turns of the Crank Handle at the left are required for one turn of the 60-teeth Gear? Adding the ratios 2:1 plus 3:1 plus 4:1 would give 9:1—but this would be wrong as a count of turns would quickly show! The true ratio is obtained by *multiplying*, (2 × 3 × 4); answer, 24:1.

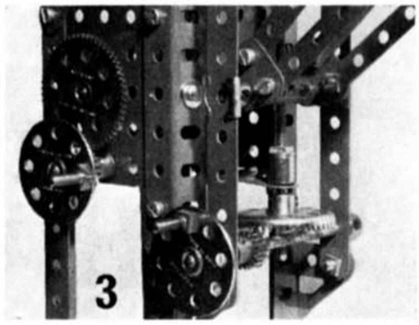
All the gears discussed so far are designed to mesh at 1 in. centre spacing, but unorthodox meshing can be achieved by spacing any pair of gears at critical meshing distance. Two examples of this are shown at the right hand end of Fig. 2. A No. 25 will mesh with a 27d when placed two holes along and one hole down as shown. The No. 26c will mesh with the 31 (1 in. Gear Wheel) when spaced at two holes diagonally, again, as shown. It is interesting to try other parts in the system for their varied hole spacing to see what other unorthodox meshings can be achieved. Advanced constructors make use of this feature in some of their planetary gear-boxes which require some rather peculiar gear ratios.

For normal running, thin Gear wheels should be set to run in the central portion of the wider face of the Pinions unless the model is to run for long periods. There would then be a tendency for the Gear Wheel to wear a groove in the Pinion face. This can be prevented by changing the position of the Gear wheel laterally across the pinion face, or by using two thin gear wheels back-to-back to provide additional contact area. Always test Axle Rods for straightness before setting up gear trains and use the best you can find. Set up the axles with Collars and Washers to take the lateral play out of the shafts and be sure that they are running true before locking the gears to the Axle Rods.

Gears may be mounted inside or outside of the framework forming gearbox journals, as shown in Fig. 3. Here we see a 3:1 gear reduction to a winding shaft of a model crane. A further type of Meccano gearing is also illustrated in this model and it is known as contrate gearing. The Pinion is mounted on the hand wheel shaft and it meshes with a Contrate Gear to give a change of direction (90 deg.) and a gear reduction ratio. Other right-angle drives are illustrated in the remaining figures and they are well worth a little consideration.

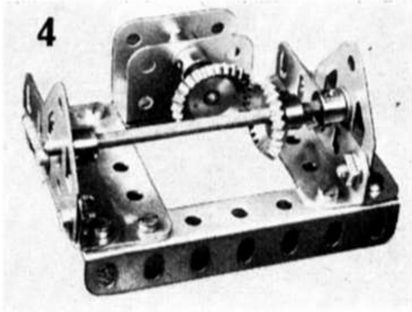
Meccano does not claim to be a high-precision system, although surprising accuracy may be achieved by careful design and construction of a Meccano model. Indeed, the somewhat generous tolerance in hole and axle size is to help the youngster to make a working model without recourse to precision alignment. However, the even greater tolerance permitted by slotted Meccano parts can be put to good use by the modeller in adjusting his shafts for smooth running. the demonstration models in Figs 4, 5 and 6 use a similar module for setting up shaft journals. In each case a pair of $3\frac{1}{2}$ in. Angle Girders is joined by a pair of $2\frac{1}{2}$ in. Angle Girders made rigid by "sandwiching" $2\frac{1}{2}$ in. Flat Girders at each end. Flat Trunnions are mounted as shown, using the slotted holes of the end Girders.

Consider Fig. 4 which shows a simple Bevel Gear Drive. To ensure correct alignment of shafts, a Channel Bearing, Part No. 160, is used as a fixed journal for the driven shaft. The driving shaft is mounted in the Trunnions which are then carefully lined up so that, when the driven shaft is pulled through the Channel Bearing, it makes perfect register with the driving shaft. A final check should then be made to see that both shafts are at right angles. They may then be set up with Collars and Washers after sliding the two $\frac{7}{8}$ in. Bevel Gears into place. Again, mutual meshing of the Bevels is essential for smooth running and they should be adjusted on their shafts accordingly. This is very good practice



for the novice and for the modeller who experiences difficulty in getting his gears to run smoothly. It is quite possible that one or both Bevels may run with a slight wobble causing a binding at a critical point. If this happens, first try unmeshing the Bevels and rotating one half a turn before carefully setting up again. If the wobble is still pronounced, try double Grub Screws in the Bevel Gear bosses, or simply transfer the Grub Screw to the opposite hole. This will often do the trick.

The same principles of setting up apply to Fig. 5, showing a Worm drive. Critical spacing this time is required to ensure a correct depth of the Worm spiral into the 1 in. Gear teeth. Strictly speaking, because the Gear teeth are parallel to its axis and the worm spiral is not, the shafts should be at a greater angle than 90 deg. although a satsifactory drive is usually obtained at standard spacing in the three planes. Fig. 6 shows the Helical Gears, Parts No. 211a and 211b, which require the most careful setting up. When properly aligned they give a smooth right-angle drive where one shaft passes over the top of the other. The Worm Gear moves one tooth of the gear with which it meshes at each turn of the Worm, therefore the gear ratio of a worm drive is the easiest to calculate. It is only necessary to know the number of teeth on the gear being driven by the Worm, and so the gear ratio illustrated in Fig. 5 is 38 : 1, the 1 in. Gear having

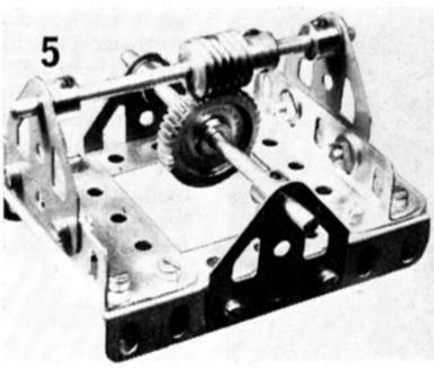


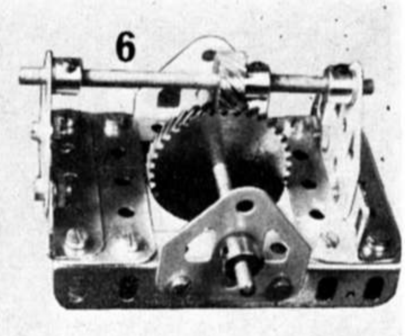
38 teeth.

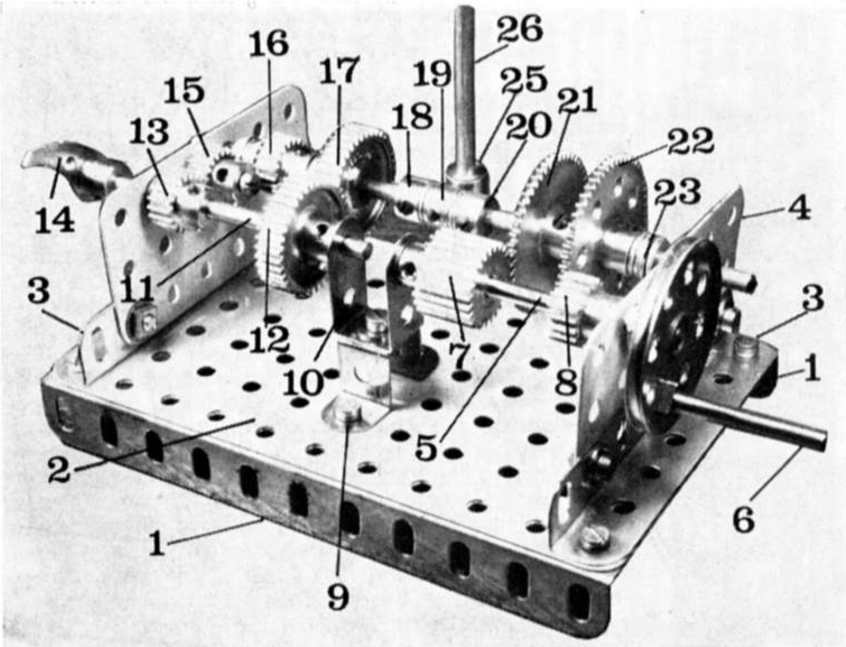
Meccano Worm drives cannot be reverse driven, i.e. from the Gear back to the Worm, but this has the advantage of providing an automatic brake in any mechanism. Helical drives, on the other hand, can be driven by either shaft, but location of one Helical Gear over another is critical. Shafts must be at right angles and at the correct meshing height above each other. The centre line through the gear face of one Helical must coincide with the shaft axis of the other, and vice versa. Any misalignment will cause the Helical Gears to bind, or to fail to mesh. Once set up properly, however, they perform admirably.

Much of the advice on setting up Meccano gear trains is self-evident to the experienced constructor, but the grinding of overloaded or badly meshed gear wheels still occurs in adult models which are incorrectly adjusted. Given a fair chance, standard Meccano gears will do all that the reasonable and careful builder wants of them—and much more besides in many instances. When accuracies of ratios to 12 places of decimals are achieved and loads of 1 cwt. or more can be raised by standard gearing there is little to complain about in a system which must compete in costs and quality with all of the various available constructional hobbies.

In the next part of this series we will be considering the effect of linking various gear trains together to produce some of the well-known engineering mechanisms.







MECCANO PARTS AND HOW TO USE THEM

By B. N. LOVE

Part 7
Making Gears Work

EXPERIENCED Meccano constructors take most of the standard gear arrangements for granted, but we all have to learn the basic forms at some stage and it is with the younger reader in mind that the first mechanism described is done so at some length. Since we are all familiar with the motor car as common transport these days, its gearbox is a convenient starting point and Fig. 1 shows a very elementary type which is simple to construct, but which will show the novice precisely what is happening. For the purposes of our discussion, the car engine is taken for granted and is replaced in the model by a hand-wheel.

There are three shafts common to most car gear-boxes, known as the input shaft, the layshaft and the output shaft, and these are made from standard Meccano Axle Rods in the mechanism of Fig. 1. Each shaft has a special job to do and this will become clearer as construction proceeds.

Start by building the baseplate from a 5½ × 3½ in. Flat Plate 2 bolted to two 5½ in. Angle Girders 1 and reinforced by two 3½ in. Angle Girders 3 to form a rigid platform. (Note how we are continually using Girders and Plates in basic construction.) Bearings for the gearbox shafts are provided by 3 × 1½ in. Flat Plates 4 bolted *inside* the slotted flanges of the 3½ in. Angle Girders to give maximum adjustment of height when aligning the shafts. It is important that the input shaft 5 and the output shaft 11 are in line and at this stage the pedestal bearing which supports these shafts in the middle of the gearbox should be fitted. This is made from a Double Bent Strip 9 and a 1 × ½ in. Double Bracket 10 bolted together as shown. Washers are placed on the Bolt holding these two parts to give a tight grip and to prevent the Double Bracket from turning out of line. Before finally tightening up the pedestal bearing, pass a long Meccano Rod through the end plates and the pedestal bearing and adjust the alignment so that the Rod is reasonably free to revolve in all four holes.

For the input shaft take a 2½ in. Rod and fix a 1½ in. Pulley to its outer end. This Pulley is fitted with a Long Threaded Pin 6, Part No. 115a, to form the hand wheel. Slide a Washer on to the Rod and pass it through the second top hole of the right-hand end plate, then slip on a 19-teeth Pinion 8 and a 25-teeth Pinion with a ½ in. face, Part No. 25a, and finish with a second Washer. Now tighten Pinion 8 with enough adjustment from the end plate to make a smooth-running bearing without too much end play and do the same for Pinion 7. Spin the input shaft to see that it is running nicely and then make up the output shaft 11. This is a 3 in. Rod carrying a 1 in. Gear Wheel 12 and a 19-teeth Pinion 13. Both gears are secured to rod 11 and spaced with one Washer at each end between the left-hand end plates and the centre pedestal bearing. A Pawl with Boss 14, Part No. 147a, is fixed to the end of the output shaft to act as a rotation indicator when studying the completed gearbox. Again, test the shaft for free-running, without excessive slop. In the next hole immediately to the rear of Pinion 12, a second 19-teeth Pinion 15 is freely mounted on a ¾ in. Bolt, lock-nutted to the end plate. This Pinion remains in constant mesh with Pinion 13 and is the only gear in the box not fitted with a Grub Screw. Its purpose is to act as a reversing gear.

The long shaft at the rear of the gearbox is known as the layshaft and, by contrast with the other two shafts, it is deliberately given end play to allow the set of gears fixed on it to be slid bodily left or right across the gearbox by the gear-change lever 26. A 6½ in. Rod is required and this is passed through the right-hand end plate in the top row of holes, three holes in from the rear. Parts required for the layshaft operation should be slipped on to the 6½ in. Rod in the following order. First, four Washers 23, to act as spacers, followed by a 57-teeth Gear Wheel 22 and a 50-teeth Gear wheel 21. These are followed by three Collars, with Washers between them, placed approximately in the centres of the layshaft, all Grub Screws being left slack for the moment. Finally, a 1 in. Gear Wheel 17, a 19-teeth Pinion 16 and four more Washers are slipped over the end of the layshaft before it is pushed through the corresponding hole in the left-hand end plate. Gear Wheel 22 can then be locked to the 6½ in. Rod so that, when it is pushed to the right, about 1 in. of Rod overhangs the right-hand end plate. In this position, Gear Wheel 22 will mesh with Pinion 8 on the input shaft.

Keep the layshaft in this position and then set Gear 21 so that it clears Pinion 7 on its right-hand side by about ⅛ in. Lock Gear 21 in place and then slide the layshaft to the left, bringing Gear 22 out of mesh with Pinion 8 and, after a slight further movement, bringing Gear 21 into mesh with Pinion 7. The 1 in. Gear Wheel 17 can now be set to mesh with its partner, Gear 12, and it must remain in mesh while either Gear 21 or 22 is engaged. However, it must also be set so that, when there is further movement to the left by the layshaft, Gear 17 must come out of mesh before Pinion 16 engages with Pinion 15 for the reverse drive. These last two gears require critical spacing and some experimenting with their positions is necessary together with the number of packing Washers used at either end of the layshaft.

It remains only to install the gear-change lever and this requires care plus a fine-bladed electrician's screwdriver. Any suitable Axle Rod may act as a gear lever and this carries a Collar 25. Before fitting the Collar, its standard Grub Screw is removed and the longer $\frac{7}{32}$ in. Grub Screw, Part No. 69b, is fitted in its place, but screwed right through the tapped bore by means of the fine screwdriver until the Grub Screw shows on the far side of Collar 25. It is then offered up to the tapped hole of Collar 19 and screwed in a few turns until both Collars each have a portion of the long Grub Screw which forms a pivot joint between them. The original Grub Screw of Collar 25 is then inserted from the rear of the gearbox to lock the change lever in place. No other fixing is required as the lower end of the gear lever rests in a hole in the baseplate. Two other Collars, 18 and 20, are locked to the layshaft to keep Collar 19 in position. A movement of the gear lever will now move the layshaft to left or right.

Now we can study the gearbox motion. Going back to the input shaft 5, this is assumed to be revolving while the engine is running. By sliding the gear lever to its extreme right, Pinion 8 will be engaged by Gear 22 to give a 3:1 step-down ratio. This would be known as first gear. The layshaft will then turn in the opposite direction to that of the input shaft. At the same time, Gears 17 and 12 are in mesh so that the layshaft motion is passed on to the output shaft 11 which will then be turning in the same direction as the input shaft, but three times slower. This is conveniently observed by watching the Pawl 14 when the hand wheel on the input shaft is turned.

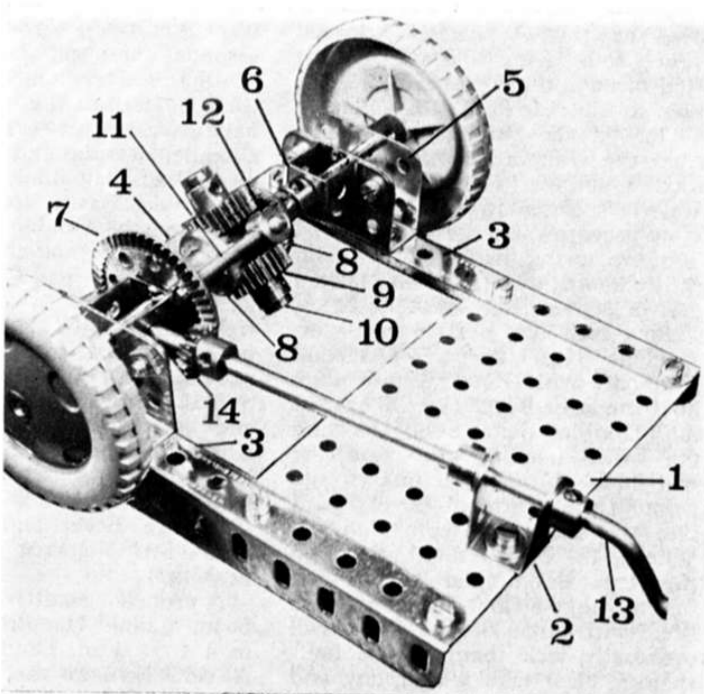
A slight movement of the gear lever to the left will disengage Gear 22 from Pinion 8, thus disconnecting the engine drive to the lay shaft. This position is known as neutral. A further slight movement to the left will bring Gear 21 into mesh with the broad-face Pinion 7, giving a 2:1 step-down ratio, known as second gear. This time the layshaft is turning at one-half of the speed of the input shaft and, again, its motion is passed to output shaft 11 by Gears 17 and 12 which are still in mesh. A final movement of the gear lever to its extreme left will take Gears 17 and 12 out of mesh. Gear 21 will still be in mesh with long-face Pinion 7 so that the layshaft will continue to rotate at half input speed, in the opposite direction. At the same time, Pinion 16 engages with Pinion 15 which is in constant mesh with Pinion 13. The result is that the output shaft 11 is now running at half the speed of the input shaft 5, but in the reverse direction, as will be plainly shown by the movement of Pawl 14.

It must be emphasised that the two-speed forward-and-reverse gearbox illustrated is a very elementary design to show the principles of the mechanics involved in changing the speed of coupled shafts and reversing them. Modern car gearboxes are very sophisticated and, generally speaking, the gears inside the box are never moved out of mesh. Instead, they are fitted with driving 'dogs' which virtually lock or unlock the gears on to their respective shafts. However, the model is simple to build and most instructive in operation. As an extension of the exercise, the reader might add a 15-teeth Pinion to the input shaft and a corresponding 60-teeth Gear Wheel to the layshaft to produce a three-speed gearbox.

Differential Gear

Our second mechanism is shown in Fig. 2 and represents a working model of the differential gear fitted to car driving axles. Even experienced Meccano modellers have difficulty in adjusting differential gears to run smoothly, but there have been several excellent designs published in Meccano Magazine over the years. Most of them employ some kind of box cover over the differential gears themselves so that it is not always easy to observe the gears in motion and this is essential to the visual understanding of the differential gear.

Any simple Meccano model fitted with a pair of road wheels on a "solid" axle will just not turn corners. Some arrangement is essential to allow one wheel to travel faster than the other when cornering and the real problem is to make



Heading picture opposite is Fig. 1, a car-type gear-box. Fig. 2, on the right, demonstrates how a differential gear arrangement works.

sure that the engine is still driving the wheels even though one is going faster than the other. When a moving object like a vehicle changes direction, such as in cornering, it requires additional power to cope with the forces set up in opposition to its change of direction. This is catered for by selecting a lower gear when cornering, but we must still get drive to the road wheels. Once again, it is much easier to build a working model and to examine its motion than it is to discuss or describe it theoretically, so instructions are given here for making the model differential shown in Fig. 2.

Start by bolting a pair of 5½ in. Angle Girders 3 to a 4½ in. × 2½ in. Flat Plate 1 to form a base. A 4½ in. Angle Girder 4 braces the frame at the rear behind the differential gear. An essential part of the car differential is a split axle divided into what are known as half-shafts. In a full-size vehicle these are supported in bearings carried in an axle tube of stout construction running right across the car between the suspension, and with a differential casing enclosing the gears in the centre. So that we may dispense with this casing and observe all of the gears in motion, however, the half-shafts in the model—which are 2½ in. Rods—are carried in bearings on either side made from a Channel Bearing 5 reinforced by a Double Bent Strip 6. This gives each half-shaft a three-point support and raises the Road Wheels off the ground for demonstration purposes.

The gears themselves are assembled as follows: Attach a Road Wheel to a 2½ in. Rod and pass the Rod through the Channel Bearing 5, seen to the rear in Fig. 2. Place a Collar on the Rod as it emerges from the Double Bent Strip 6 and then mount a 25-teeth Contrate Wheel 8 close up to the Collar. Now prepare the large Bevel Wheel 7 by removing its Set Screw and fitting it with two ⅛ in. Bolts 11 in a pair of diametrically opposite holes, locking each long Bolt in place with a single Nut. Prepare a second half-shaft with Road Wheel, then hold the large Bevel Gear 7 against the Double Bent Strip forming the other bearing and pass the half-shaft through, letting it go through the centre of Bevel 7 and into the second 25-teeth Contrate Wheel 8. Note that, although the large Bevel Gear has no Set Screw, the two Contrate Gears 8 are fitted with Grub Screws which will eventually lock them to the half-shafts. Now take a Coupling and place it between the two Contrate Gears 8 so that the inner ends of the half-shafts may be entered part way into the long bore of the Coupling. At this stage, the Contrate Gears may be fixed in place, temporarily, by their Grub Screws, just to hold things in position ready for the next stage.

Mount two 25-teeth Pinions 9 on Pivot Bolts 10 and screw them in a few turns into the centre tapped bores of the Coupling. Two collars 12 are now required and these are screwed for a few turns on to the ends of the 1⅛ in. Bolts sticking out from Bevel 7. Now take a 1½ in. Rod and pass it through Collar 8, shown in Fig. 2, through the smooth bore in the centre of the Coupling and then through the Collar on the second long Bolt hidden from view below the differential. Now screw up the two Pivot Bolts carrying the 25-teeth Pinions 9 and these will lock the 1½ in. Axle Rod in place. Do not attempt to secure the Collars 8 by means of a Grub Screw as they will then tend to bind Bevel Gear 7 when it turns freely on the half-shaft. By leaving the Collars 8 "loose" like this, they provide the necessary turning motion to the differential Pinions carrier with sufficient "give" to prevent binding and they cannot become uncsrewed, despite their not being screwed up tight, or fitted with Grub Screws. This "slack" is deliberately introduced to help smooth running.

It will be necessary at this stage to do some adjusting so that the teeth of the Contrate Gears mesh nicely, but not tightly, with those of Pinions 9. Careful packing with Washers is essential and all bearing points should receive attention. See that the bosses on the Road Wheels have a Washer between them and the Channel Bearings and that the Collar on the half-shaft shown to the rear in Fig. 2 also has a Washer between itself and the Double Bent Strip 6. This particular half-shaft can be set up first and its Contrate Gear locked in place to allow just the right amount of half-shaft to fit into the central Coupling. Careful packing with Washers is also required between the boss of Bevel 7 and its adjacent Contrate Gear. Check that the long Bolts are firmly lock-nutted to the large Bevel and that there is a Washer between the large Bevel and the Double Bent Strip against which it is bearing.

A propellor shaft is provided by a 5 in. Crank Handle 13 mounted in a 1 × ½ in. Double Bracket 2. A side hole in the Double Bent Strip alongside the large Bevel provides a suitable bearing for the small Bevel Gear 14 which should then mesh smoothly with the larger one. If there is any stiffness in the differential gears, check the central Coupling; better still, check it before you put it in for trueness of tapped and cross-bored holes.

Provided that all is running smoothly, it will now be possible to observe the differential in motion Turn the propeller shaft 13 and watch the Road Wheels. They should both turn at the same speed. Keep turning the propeller shaft and put a slight drag on one wheel with a light touch of the finger and notice that the other wheel turns faster. Repeat these trials and this time watch the 25-teeth Pinions 9. When both Road Wheels are running at the same speed, the Pinions will be carried round in space but will not actually spin on their own Pivot Bolts. When there is a difference in speed, however, the "differential" movement of the Pinions begins to show and they will be seen to turn on their own Pivot Bolts.

Hold the propeller shaft still and turn one Road Wheel. It comes as a surprise to many (including adults) to see that the other wheel turns at the same speed but in the *opposite* direction and the differential movement of the Pinions 9 is clearly seen. Finally, turn both Road Wheels at the same speed in the same direction and note the speed of the propeller shaft. Now stop one wheel and turn the other. This will double the speed of the propeller shaft. By turning the model upside down it will perform its "tricks" very well on carpet or similar flooring.

A little thought will show that any of the three shafts in a differential may be used as an input or output shaft to great advantage in various mechanisms requiring differential movement.

MODEL BUILDERS

(*continued from page* 327)

Postscript

In the May issue we featured an illustration of a magnificent veteran car model, based on a 1904 Singer and built by Mr. Cyril Potter of Chatham, Kent. As I said at the time, I have no details of the model, but I have since been advised that it is fully described in one of the GMM Super Model Leaflets, privately produced by the Meccanoman's Club, 248 Woolwich Road, Abbey Wood, London, SE2 0DW. The Leaflet in question is No. 15 in the series and it might well be of interest to advanced builders.

Photographed in Fig. 3 is a simple practice assembly to show the principles of sprocket drive, shaft adjustment, etc.

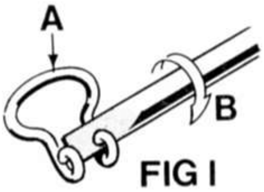


FIG I

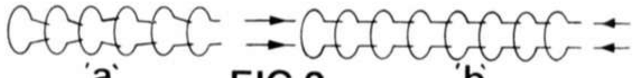


FIG 2

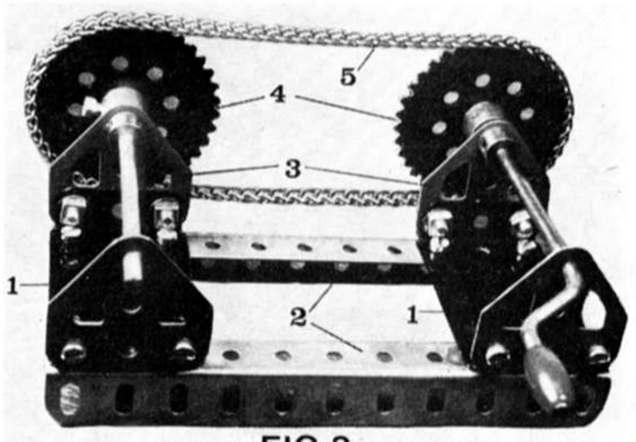


FIG 3

Meccano Parts and How to Use Them

PART 8 **BY B. N. LOVE**

SPROCKET CHAIN AND SPROCKET DRIVES

THERE are many occasions in mechanics where a chain drive is the most acceptable method of passing on a drive from one shaft to another. This may be occasioned by a wide spacing between shafts which would make gear drives, with their extended shafting, too cumbersome or too expensive, or by high speed requirements where low noise and wear are important. Roller chain, which every boy knows as the type used on his bicycle, is also very successfully used in high speed motor car engines for operating the cam shaft which opens and closes the engine valves many times per second. Chain is also capable of transmitting very high torque via sprocket wheels which are relatively simple to produce and do not require the same degree of precision as is required in spur gears when it comes to forming the teeth.

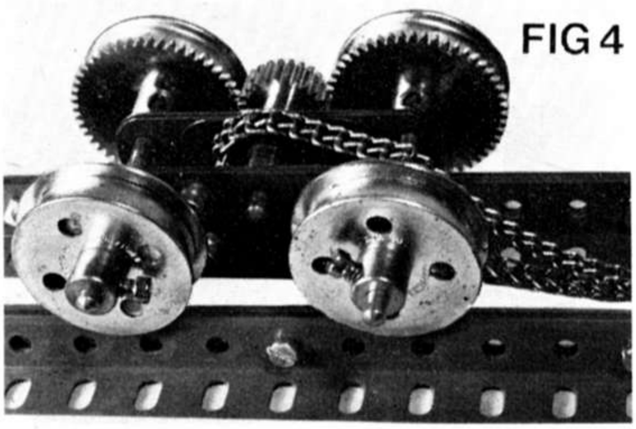
Meccano Sprocket Chain (Part No. 94) is of the simple link type but, when properly applied, it will serve in the same way as roller chain, enabling models to be motivated with great realism. The machine in the Binns Road Factory which produces Meccano Sprocket Chain is fascinating to watch. It is a comparatively small, table-top machine which is fed from a large spool of bright steel wire. This is drawn into the machine which cuts off enough wire to make one chain link and then puts in the rather complicated bends and the two loops required to hitch one link to the next. It actually performs this hitching operation also, forming a continuous chain by closing the loops of one link on to the ring portion of the next. The operator has a pre-set length of 40 in. (1 metre approx.) marked on the bench and, as the Chain comes from the machine, it is measured against the standard and cut with wire nippers as required. Literally miles of Sprocket Chain are used by the Model Room at Binns Road and they normally have it supplied to them from the factory below on wooden reels like small cable drums. In this case, the machine is allowed to make an unbroken length until the drum is filled up.

Most serious constructors have Sprocket Chain in their Meccano collection, often in various lengths and sometimes in peculiar condition! It is so easy to take Sprocket Chain for granted, but it needs looking after like any other Meccano part and an inspection of well-used Chain often reveals some surprising shapes. The first part of Fig. 2 shows the common faults encountered when links have suffered at the hands of heavy-handed enthusiasts, or indifferent tools.

If Sprocket Chain is in good condition it should appear as a continuous parallel arrangement as shown in part B of Fig. 2. In fact, by holding up the Chain, and stretching it at eye-level, a full length should look like a neat run of miniature railway line with no kinks or twists in it. If you have lengths like this, keep them for long-reach jobs. On the other hand, short lengths which are distorted should not be thrown away as they will make quite satisfactory chain slings for crane hoists, or lashings for heavy-duty lorry loads.

There is a simple way of opening the links at any point in a length of Sprocket Chain and this is shown in Fig. 1. A slim-bladed electrician's screwdriver is used to prise open the loops, one at a time, by keeping the back of the link flat on a table with pressure at point A and by rotating the screwdriver in the direction indicated. It is only necessary to open the loop sufficiently to accept the ring portion of the next link. When closing the loops, a small pair of thin-nosed pliers is the most suitable tool, but, again, they must be used with care so that, on closing the loop, it is not crushed out of shape in any direction or made too tight to give adequate freedom of movement in the adjacent link.

Fig. 3 shows a simple rig on which the novice may exercise his skill in producing a Sprocket Chain drive. Construction is very simple and almost self-evident from the illustration. Two 5½ in. Angle Girders 2 are secured at either end by 2½ × 1½ in. Flanged Plates 1 to provide a rigid base. Four Flat Trunnions 3 are mounted on the flanges to form bearings for the Crank Handle at one end and a 3½ in. Axle Rod at the other. The 2 in. Sprocket Wheels 4 are attached to the outer ends of the two shafts and held in place with Set Screws. Two Collars hold the shafts in place. Taking a length of Sprocket Chain longer than required, a full loop of chain is passed half way round both Sprocket Wheels, then the Sprocket Wheels are allowed to turn until a join is indicated by the position of one end



A bogey (shown upside down) from a dragline machine showing use of slack chain drive.

of the Chain lying on, say, the right-hand Sprocket. Note carefully where the break should be made in the length of Chain and then proceed to open the correct link carefully. Don't be the least bit surprised, if, when you offer the Chain up again, you are one link short or one link over. (This can happen with the most advanced modellers!) However, when you are satisfied that the Chain is a reasonable fit—and certainly not a tight one—you may well find that it is just a bit too slack.

On the rig shown in Fig. 3 it is a simple matter to "stretch" the distance between the shafts because the Flat Trunnions 3 are mounted on the slotted holes of the two Flanged Plates and, by careful adjustment of the Nuts and Bolts, the position of the Sprocket Wheels can be adjusted to take up any slack. Care should be taken not to twist the two shafts out of parallel alignment with each other, adjusting all four Trunnions if necessary. This is a point worth noting so that, when the enthusiast designs his own models, some means of lateral adjustment of the shafts should be built in, if possible.

There are many occasions in modelling in Meccano where standard spacing is unavoidable for shafts and this does not always tie up with optimum spacing for Sprocket drives. There are ways round this problem, however. First, if you have an assortment of Chain, try them out—you may find one length a better fit than the other as lengths of Sprocket Chain vary after use owing to natural elongation wear. Secondly, if the fit is loose but the drive is satisfactory, leave it alone. In extreme cases, a slack Chain should be taken up by means of a "jockey" sprocket which is a third Sprocket Wheel mounted on a sprung arm to bear against the slack portion of the chain. Well-experienced constructors can sometimes do the trick by putting a light squeeze on a number of adjacent links to shorten their loops fractionally, but this requires skill if a jammed and distorted Chain is to be avoided.

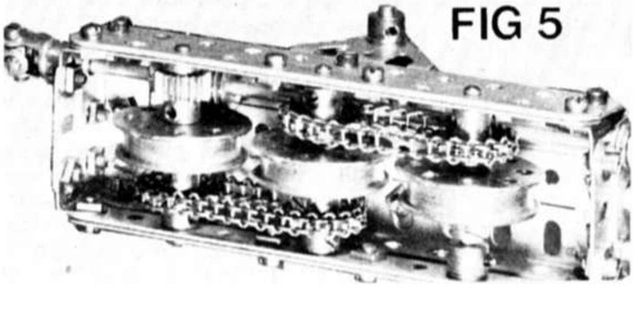
Sprocket drives retain the advantage of gears in providing fixed ratios. In the rig of Fig. 3 a 1 : 1 ratio is shown. This ratio would be the same if both wheels are the same size so why not use the smallest Sprocket Wheels at each end? These would be ¾ in. dia. and there would be no objection to this so long as heavy drive is not required where slipping could well occur. The larger Sprockets reduce the slip possibilities on heavier drives.

A word of warning here on gear ratios via Meccano Sprocket Wheels: count the teeth! A 1½ in. Sprocket Wheel driving a 3 in. Sprocket Wheel gives a reduction ratio of 2 : 1, as expected, but a 1 in. Sprocket driving a 3 in . Sprocket does *not* give a 3 : 1 ratio as might be expected. This is because the teeth ratio is 18 for the 1 in. Sprocket and 56 for the 3 in. Sprocket which is not a 3 : 1 arrangement. The ¾ in. Sprocket, 14 teeth, does give proper ratios with the 1½ in. Sprocket, 28 teeth (2 : 1) and with the 3 in. Sprocket, 56 teeth (4 : 1). The rig in Fig. 3 will demonstrate all this by attaching the range of Sprockets mentioned and will provide good practice in handling Sprocket Chain.

There are occasions, as has been mentioned earlier in the series, when a chain drive is deliberately attached with a slack loop and Fig. 4 shows such an application to the travelling bogey of a dragline subject to unsteady levels when running over undulating track. For clarity, this particular bogey is shown mounted upside down so that the drive arrangements are clear.

Fig. 5 shows just how compact a Meccano Chain drive can be. This shows a travelling bogey from a dockside crane in which all wheels are driven. For this purpose, ¾ in. Sprocket Wheels are adequate, the drive being spread over a total of 12 wheels when the crane is in motion. This is a case where the spacing for all wheels is identical and the lengths of Chain can be trimmed to the same length and preferably fitted to the small Sprocket Wheels *before* sliding them in place on their Axle Rods. This avoids a common, but not good practice of forcing the Chain on with the wheels in position which invariably stretches the Chain and stretched chain can be disastrous on such short runs. Whether or not one closes the final link in the Chain is a matter of personal choice. The link should be closed on an exhibition or demonstration model, of course, but the open end is frequently left in case early adjustments are required. The Chain will still give a satisfactory drive, even if the last link does not have its loops fully closed.

Finally, a word on storing Sprocket Chain: drop it into the bottom of your cabinet in a heap and you are asking for trouble! You can expect a tangled, dirty mess on trying to retrieve it later. Either wind it on to a stiff card or wooden reel and put it into a plastic bag (a dry one, or your Chain will rust—*don't* blow into the bag to open it!), or hang your Chain in selected lengths from hooks inside your Meccano storage cupboard if you are lucky enough to have one. Be very sparing on oil with Sprocket Chain. The slightest overdose will guarantee a chain looking like a hairy caterpillar in no time! Look after your Sprocket Chain and it will serve you well.



Another bogey, this time from a crane, which demonstrates compactness of sprocket drive.

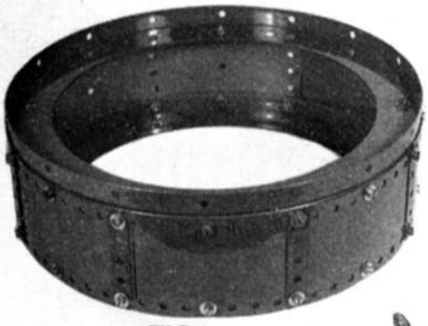


FIG.1

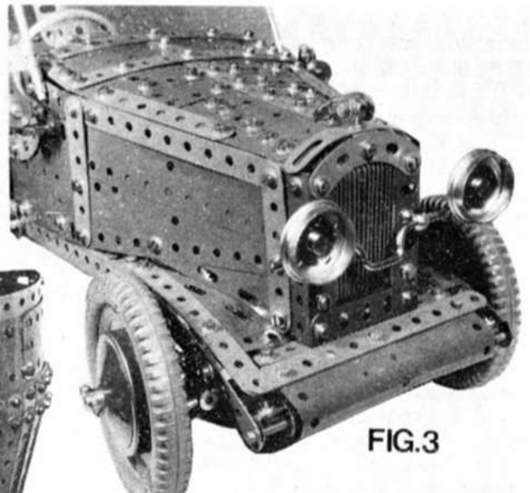


FIG.3

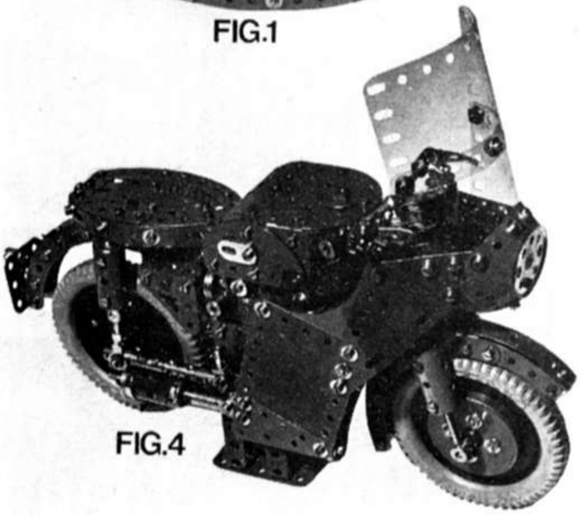


FIG.4

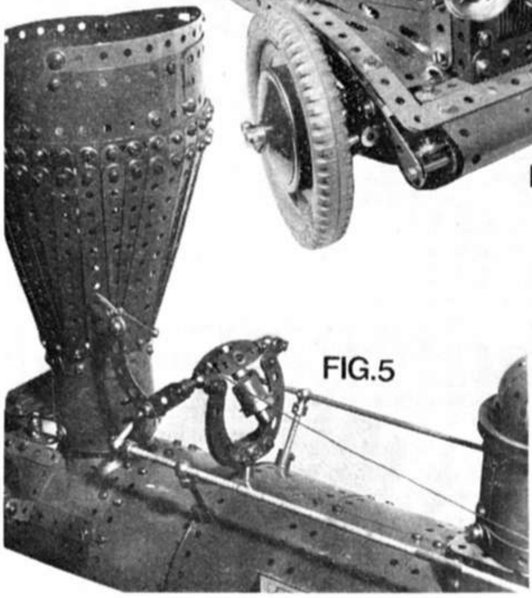


FIG.5

MECCANO PARTS AND HOW TO USE THEM

Part 9

By B. N. Love

Fig. 1. Flexible Plates provide a rigid curved wall which supports Flanged Rings to make a very strong drum for a roller bearing. Fig. 3. An example of excellent contour moulding on the front bodywork of a vintage sports car. Fig. 4. A modern motor-cycle in Meccano parts with its entire streamlined fairing moulded in Flexible Plates. Fig. 5. Model locomotives are particularly suitable subjects for using flexible plates in boiler and chimney modelling.

BASIC construction and motion having been introduced, we may now consider the use of Curved and Flexible Plates to give shape and form in a finished model. Fortunately, the Meccano system has a large range of these parts so that prototype models can be quite readily made to simulate the original in general appearance with considerable fidelity. Flexible and Curved Plates are made in a thinner gauge of sheet steel than that used for the standard rigid plates and this enables the modeller to mould them to the appropriate contour.

Two basic methods of forming these plates arise from the degree of curvature required. If a shallow curve is all that is required, then the Flexible Plate may be attached to the framework of the model starting at the centre of the Plate or perhaps at one end and then, by simply laying the Plate round the framework and securing it at several points, the required curvature is achieved with no damage to the plate. When the model is taken to pieces, the Flexible Plate may be used again for bending to a different shape. Fig. 1 shows this first application, a very simple one in which the same size of Flexible Plate is overlapped round Flanged Rings to form a very strong drum shape to support a built-up roller bearing. In this case, 4½ in. × 2½ in. Flexible Plates, Part No. 193c, are used, each one overlapping its neighbour by one slotted hole which is, in turn, covered by a 2½ in. Perforated Strip. This adds rigidity and neatness but the strength of the drum wall comes from the curvature of the Plates. The construction shown will support the weight of a man standing upon it. In Fig. 2, an even shallower curve is used to form the fairing at the rear of a model vintage car. As well as the rectangular Flexible Plates in the system, Triangular Plates of similar thin gauge metal are available and two of these are shown in the illustration bolted to 2½ in. Square Flexible Plates as an extension of the fairing over the spare wheel platform. In this case the slight curvature required is applied by Perforated Strips above and below the Flexible Plates.

Once the limit of elasticity in a Flexible Plate has been exceeded, it will take up a permanent bend or "set" and such bending is deliberately introduced in a standard part, No. 199 known as a Curved Plate, U-Section. Two of these are illustrated in Fig. 3 which shows the frontal bodywork of the vintage car. Being bent to U-shape form, they make a splendid streamlined nosing between the chassis irons below the radiator. Further use of the Flexible Plate is also evident in the illustration where 5½ in. × 1½ in. Flexible Plates and 3½ in. × 1½ in. Triangular Flexible Plates are combined to mould the bonnet contours with great realism. The upper portion of the bonnet shows a method for utilising several small Flexible Plates and Perforated Strips to produce a taper effect with increasing curvature towards the radiator end. Careful thought, intelligent selection of parts and patient construction can achieve very high standards of neatness and realism.

Fig. 4 shows a splendid example of this in which the entire body fairing of a model motor-cycle is formed from Flexible Plates. One of the special Flexible Plates is known as a Corner Gusset, Part No. 201, or a Flexible Gusset Plate. Two applications of this occur in the motor-cycle model although they are not immediately apparent. One pair is used to form the join in the rider's leg guards at knee height and another pair, bent and joined together by two overlapping holes, trap a 1½ in. Pulley Wheel by its flange or groove to form a neatly moulded headlamp. On a small model like this, very little manipulation is required because only small plates and shallow bends are required. As an addition to the Flexible Plates, Meccano Ltd., introduced Transparent and opaque Plastic Flexible Plates at the end of the 1960's. Two of these are shown in Fig. 4 where a pair of 2½ in. × 2½ in. Transparent Plastic Plates form the windshield. Curvature is given by locking the lower end of the windshield inside the headlamp support fairing. It is true that the upper plate will attempt to flatten itself out but this simply produces an overall conical curvature which enhances the shape of the windshield.

Where long Flexible Plates and perfectly circular bending is required, two methods of achieving this are available. Many of the circular parts already in the system such as Circular Girders, Hub Discs etc. may be used as formers around which long plates may be bolted step by step. A sample of this construction is shown in Fig. 5 where parts of a locomotive boiler are formed from 12½ in. × 2½ in. Strip Plates. When the length of a Flexible Plate is 7½ in. or longer, it is known as a Strip Plate and is made of slightly thicker gauge steel than the other Flexible Plates. This gives them longitudinal thickness with less tendency to twist under load. It also means that they require more effort to bend them.

The advanced constructor who has a sufficient range of parts at his disposal might well consider making a bending machine to produce his curves. An excellent design for this appears on Page 157 of the March 1969 Meccano Magazine where full building instructions for a Plate bender built entirely from Meccano parts are given. Such a bender is capable of producing very smooth and accurate curvature in Meccano Flexible and Strip Plates, the Plates emerging as cylinders with a "set" curvature in them. Readers will have seen Meccano demonstration models in the windows of toy dealers and will have noticed the uniform curvature achieved in many of these standard models developed at Liverpool. One might think that an expensive forming machine is used for these parts so it may come as a surprise to readers to know that a bending machine using Meccano parts and Wooden Rollers, included in the system, has served for many years in the Model Room at Binns Road and is still in daily use.

Of particular interest is the "balloon" chimney stack on the locomotive in Fig. 5 which combines Perforated Strips with Flexible Plates to create the awkward shape of the old American wood burning locomotive chimney. A further locomotive is shown in Fig. 6 which illustrates a combination of Flexible Plates and the cylinders which are already available in the Meccano system, namely, the Boiler, Part No. 162, and the Chimney Adapter, Part No. 164, used with the Sleeve Piece, Part No. 163. These combine with the standard range of Flexible Plates to provide the realistic body contours of a twin boilered monorail steam locomotive, an unusual subject modelled with a high standard of realism and detail. The reader should note that where a Flexible Plate has slotted holes, these are overlaid with Strips or secured by Nuts and Bolts carrying Washers on both sides of the Flexible Plate. The slotted holes provide an excellent range of adjustment but the use of Washers gives a neater and stronger join between plates. In cases where Flexible Plates have been "set" for a special shape by the modeller, it is generally better to keep these for later models rather than attempt to straighten them out. This latter practice often leads to buckling or noticeable distortion.

Fig. 2. Body mouldings of vehicles can be readily modelled using Flexible Plates on a Perforated Strip framework. Fig. 6. An unusual subject in the form of a twin boiler monorail locomotive shows an excellent combination of Flexible Plates and some standard cylindrical parts in the Meccano system.

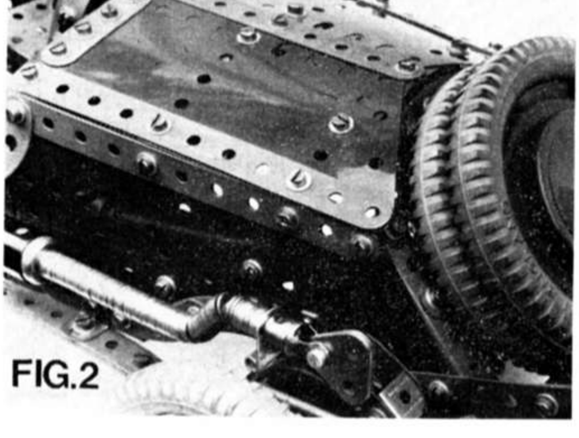


FIG.2

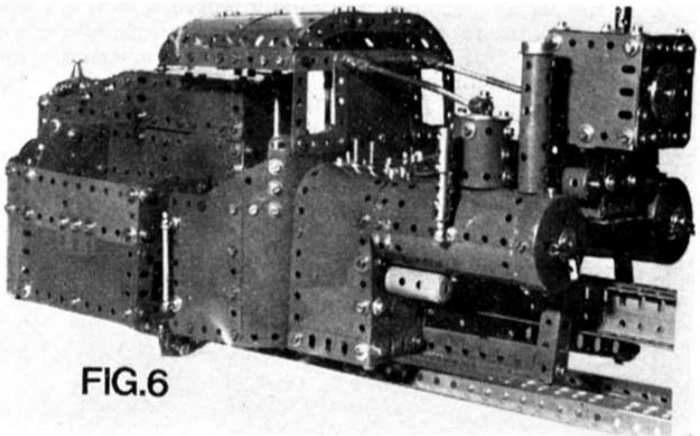
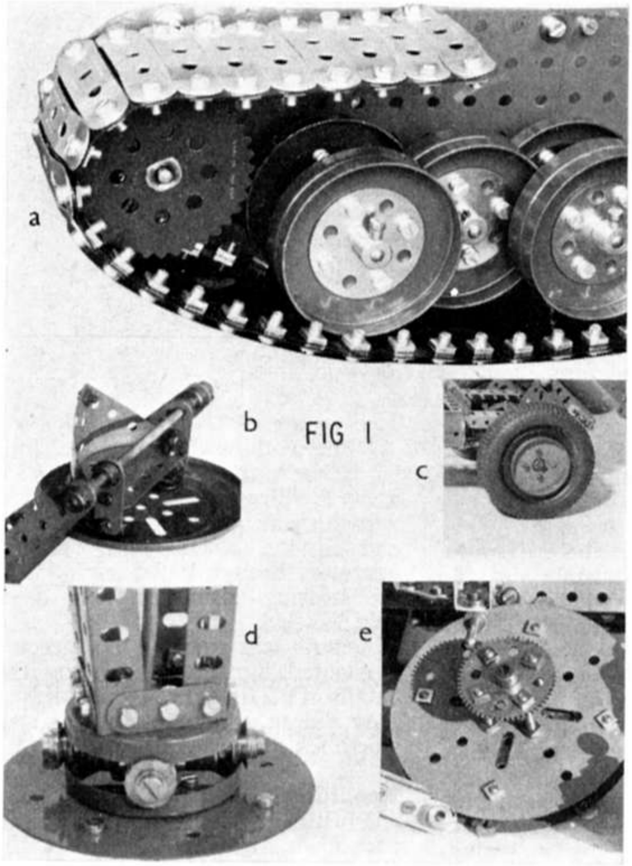


FIG.6



Meccano Parts and how to use them

Part 10
Rigid Circular Parts

By B. N. Love

Fig. 1a. Wheel Flanges form neat running gear for model tank tracks.
Fig. 1b. The flanged disc of the Ball Thrust Bearing serves as part of a passenger car on a fairground ride.
Fig. 1c. Footstep ring on a lorry wheel provided by a Wheel Flange.
Fig. 1d. Two Wheel Flanges form a strong thrust roller bearing with ½ in. Pulleys.
Fig. 1e. The 4 in. Circular Plate used as a power sprocket on a Crawler Tractor.

AS the modeller develops his skill and increases his stocks of Meccano parts, he will come across the various rigid circular pieces in the system. Washers and Wheel Discs come into this category at the small diameter end of the range and the 9½ in. Flanged Ring, which is illustrated in Part 9 of this series, is the largest circular part in the standard list of parts. The smallest of the flanged discs is Part No. 137, Wheel Flange, which is designed to fit over a Face Plate with sufficient clearance to pass over the boss and Set Screw of the Face Plate to simulate a railway wheel. In fact, the clearance hole in the centre of the Wheel Flange is of ½ in. diameter, so it will also fit over the bosses of the larger Sprocket Wheels and the 3½ in. Gear Wheel. Fig. 1c shows a simple application of this part where it is serving as a footstep ring on a lorry wheel. The Wheel Flange can be used as a built-up wheel by bolting it to a Bush Wheel as shown in Fig. 1a, either single or twin flanges being used to provide running gear for a wide-form tank-track reminiscent of the famous German Panther and Tiger tanks. In Fig. 1d we see a further use of this part where it forms a thrust roller bearing with ½ in. Pulleys capable of supporting a large revolving crane superstructure or fairground model. Having a large clearance hole at its centre, the Wheel Flange permits cable entry up through a rotating mast to feed electric motors and lights in control cabins at the top. When bolted to a 4 in. diameter Circular Plate as shown, a strong base is provided and as the Circular Plate is also designed with a ½ in. diameter centre hole, cable entry is obtained through both components illustrated in Fig. 1d. Standard Meccano Sprocket Wheels are available up to 3 in. diameter but this does not limit the dedicated constructor. A special built-up "sprocket" wheel is shown in Fig. 1e and although it has only eight teeth, it is capable of driving the tracks of a model bulldozer of very generous proportions. In this case, two 4 in. diameter Circular Plates, Part No. 146a, are fitted with Narrow Strips sandwiched between them, suitably spaced by Washers. The tips of the Narrow Strips protrude ½ in. all round to engage driving dogs in the form of Angle Brackets bolted to the bulldozer crawler tracks. Slotted holes in the 4 in. plates can be clearly seen, and this permits the attachment of assemblies requiring latitude in spacing. Part No. 146 is a larger edition of Circular Plate No. 146a being 6 in. diameter but it is made in a gauge of steel about twice as thick as the 4 in. version. It, too, has a ½ in. centre hole and is suitable for making the base plates of turntables etc.

One of the "special-purpose" Meccano parts is the 4 in. diameter Ball Thrust Bearing which has useful sub-assemblies. One of these is the flanged disc illustrated in Fig. 1b where it is simply used as an ornamental dished base for a passenger cupola on a fairground ride. However, when these flanged discs are paired up, they become versatile wheels as Figs 2 and 3 illustrate. Fig. 2 shows a neat model of an Experimental Steam Carriage for which a solid single front wheel was required of appropriate scale. This was achieved by mounting two of the flanged discs, Part No. 168a, on Bush Wheels and placing them face-to-face on a short Axle Rod held in a forked steering arm. A second use for a pair of these flanged discs is shown in Fig. 3 where they form a neatly proportioned flywheel on a model Showman's Engine. However, this time the discs are not set face-to-face but are both mounted on the flywheel shaft with their flanges facing inwards. This gives the most suitable rim surface for maintaining a belt drive to the dynamo at the front of the model, but the