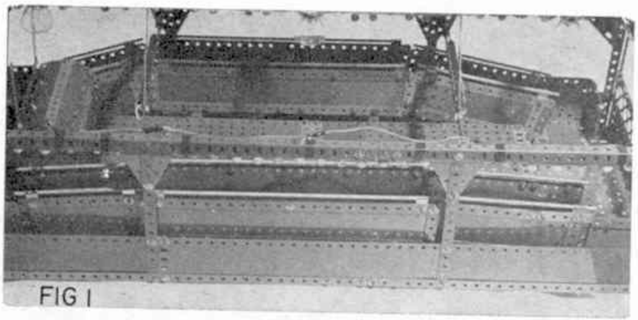


Fig. 1. A simple two-stage " Cake-walk ". Each platform is in three sections with slide bearings at each end and two hinged " breaks " on the walks.

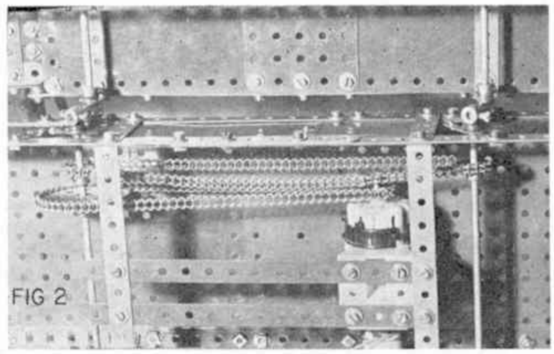


Fig. 2. The simple chain drive to the cranks under each oscillating platform in the " Cake-walk ". The crank rods extend to both platforms, but the Couplings forming the crank webs are off-set at either end.

MECCANO CONSTRUCTORS GUIDE by B. N. Love

Part 9: Fairground Machinery

HAMPSTEAD HEATH ON A BANK HOLIDAY, or any similar location, draws tremendous crowds to the traditional Fair which travels all over the countryside. The Public, as a whole, are fascinated if not spellbound by the huge fairground machines in motion and are always ready to place themselves at the mercy of these mechanical monsters to have their insides shaken unmercifully. Some excellent fairground models have been published in Meccano Magazine from time to time, with comprehensive descriptions of the special mechanisms required to produce the compound motions of such exciting machines as the " Octopus " or the " Satellite " and the fairground is a rich source for other Meccano modelling ideas. Mechanisms abound from the simplest oscillating or rotary motions to the complex compound motions, so that the enthusiast can work his way through the available fairground " rides " according to the parts at his disposal.

A great favourite of our forebears, young and old alike, was the " Cake-walk "—a pair of reciprocating platforms which were negotiated by the " walkers " with many a hysterical shriek from Victorian sporting ladies who ventured upon it. Its popularity survives to this day and is a simple subject to model in Meccano. Fig. 1 shows the general arrangement of the " walks " which are raised platforms, side by side, driven from below by a reciprocating mechanism that rocks the two sides of the Cake-walk in opposite directions—just to make the " walkers " ever more giddy as both walks

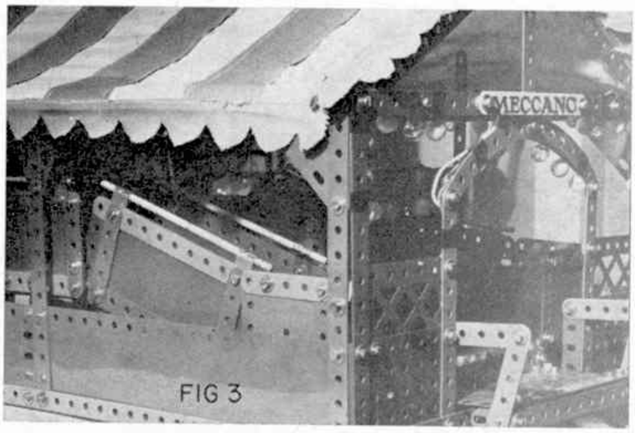


Fig. 3. A gay striped canopy and attractive entrance give added realism to fairground models. Note the " break " in the first cake-walk platform which occurs just before the attachment of the cranks from below.

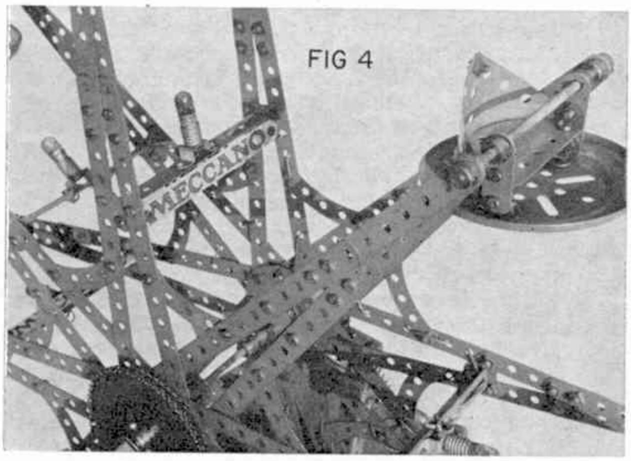


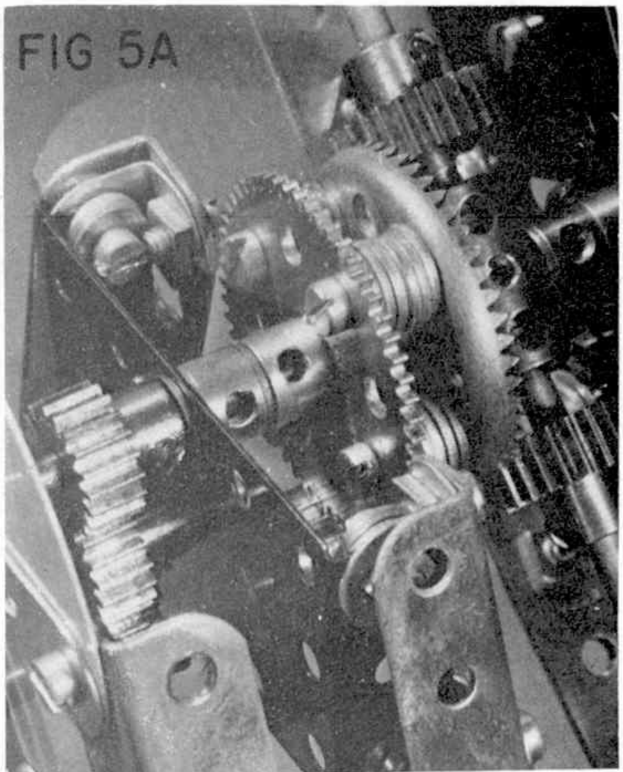
Fig. 4. A simple arrangement for the arms and passenger cars of an open Ferris Wheel.

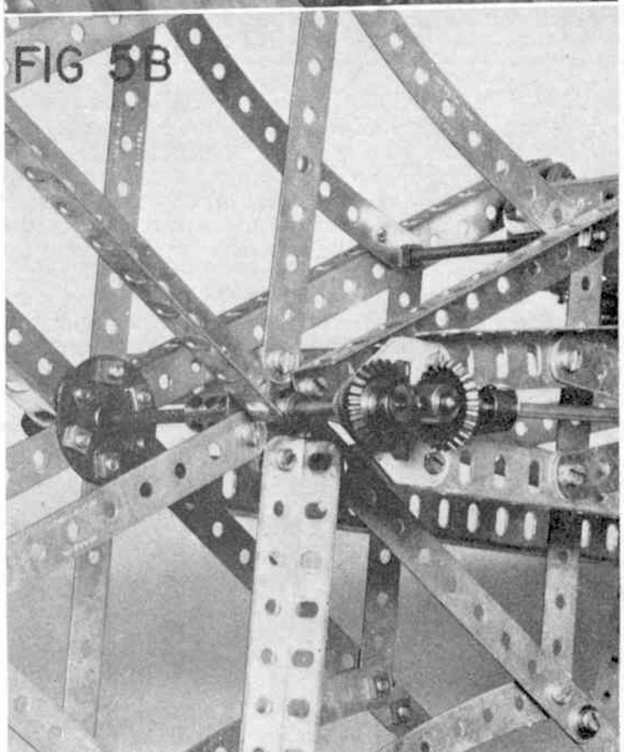
need to be negotiated before the exit platform is reached. Fig. 2 shows the simple arrangement of the mechanism which is driven through chain-drive and cranks by a 3-12 volt D.C. Motor with 6-ratio Gear Box. Although simple in principle, the Cake-walk is an attractive model and, when fitted with lights, a gay canopy of striped material, entrance steps and a pay-box, it has all the realistic flair of the genuine article.

The Showman's aim is to thrill and delight his customers or to exploit their human weaknesses for financial gain—according to one's point of view, but his machinery has remained basically simple for more than a hundred years. The simple Ferris Wheel is always well patronised, being an ideal 'stomach displacer' as the passengers ride through a great arc on its periphery, and this is another simple machine to model in Meccano. Various lengths of Perforated Strips, from 7½ in. upwards, are the most usual components for the wheel spokes, Face Plates forming central hubs to which the radial spokes are attached. A separation by 4½ in. Double Angle Strips would give satisfactory porportions to a wheel of about 20 in. diameter and this will accommodate eight passenger cars, or "cupolas", quite nicely. Fig. 4 shows one of the many variations of passenger cars suitable for Ferris Wheels, but these can be made in a variety of ways with some thought given to exploiting the more interesting shapes which present themselves in the range of Meccano parts.

An interesting development of the Ferris Wheel is the replacement of the main wheel with a rotating boom which carries a separate and smaller Ferris Wheel at each end. By arranging drives both to the boom and the wheels and selecting appropriate gear relationships, some very interesting geometrical paths are traced out by the unfortunate fairground devotee as he is hurled through equilateral triangles and other uncomfortable loci in a vertical plane, much akin to to those provided by the "Whip" at ground level. Fig. 5 shows a simple epicyclic gear mounted at the boom centre of such a contra-rotating "Double Ferris Wheel" which passes on the drive to the outer wheels in one of the geometrical paths outlined above. The 1½ in. Contrate Wheel is bolted to the 57-teeth Gear Wheel, both of which are free to revolve on the main central shaft, this shaft not only turning the main boom, but also passing motion to the Contrate Wheel via the ½ in. Pinion train shown. The 25-teeth Pinions meshing with the Contrate Wheel pass on the motion to the two separate wheels in the correct phase to give the desired locus of travel for each passenger car.

Very strong Ferris Wheels of large diameters can be built from standard Meccano parts if the enthusiast is in a position to command a large collection of parts. Axle Rods joined by Couplings provide spokes which can build up a 6 ft. diameter wheel of elegant proportions. By using hub cheeks made of 3 in. Sprocket Wheels, to which 3½ in. Gear Rings are bolted in spaced pairs, a 32-spoke hub is quite easily constructed. The Axle Rods forming wheel spokes are fitted with Strip Couplings which are, in turn, fastened by Meccano Hinges to the peripheral holes of the Gear Ring. This hinge arrangement allows all of the spokes to be doubled up by using two hinges at one hub anchoring point and allowing for one spoke to go straight out to the rim of the Ferris wheel, or to be slightly angled to give a 'dished' construction, while the inside spoke from the same hinge root goes across at a greater angle to meet the wheel rim on the far side. This gives very strong bracing to the wheel and is the method employed on demonstration models





Upper: Fig. 5a. A simple, but effective epicyclic drive for contra-rotating Double Ferris Wheels.

Lower: Fig. 5b. The Bevel drive to the individual wheels on the rotating boom of a Double Ferris Wheel. This drive is taken from the ¾ in. Pinions shown in Fig. 5a.

Fig. 6. Giant Ferris Wheels of 6 ft. diameter and more can be built by liberal use of Rods and Couplings. Heavy hub sections are constructed from 3 in. Sprocket Wheels and 3½ in. Gear Rings. Note the built-up central shaft reinforced with long Screwed Rods which runs in " square " bearings as described in the text.

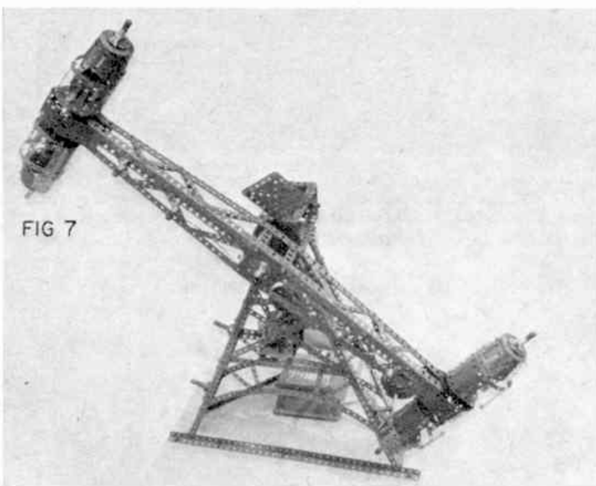


Fig. 7. Whirling " Torpedoes " make a fascinating display model with revolving aerocars driven through simple gearing.

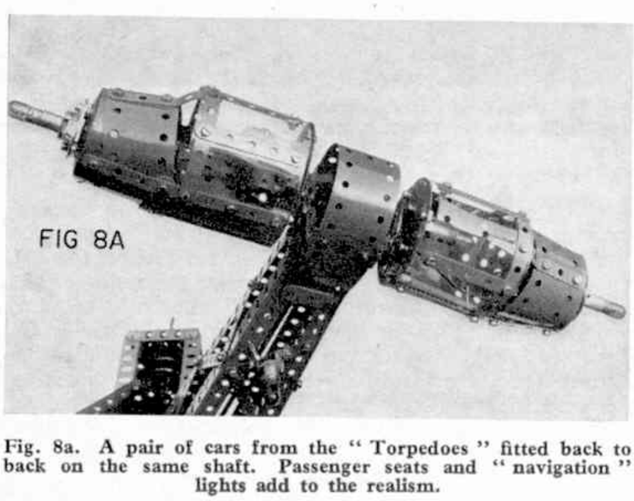


Fig. 8a. A pair of cars from the " Torpedoes " fitted back to back on the same shaft. Passenger seats and " navigation " lights add to the realism.

which have to run for long periods in exhibitions. Fig. 6 shows a portion of such a wheel.

As a diversion from the contra-rotating Double Ferris Wheel, the rotating boom has been put to good use in an even more fiendish piece of machinery in the shape of the " Torpedoes ". This makes a fascinating Meccano model and requires quite simple gearing. The general arrangement of the passenger cars is shown at the boom end in Fig. 8a. Apart from rotation of the main boom, each passenger car revolves on its own axis, thus imparting a helix, or screw-form locus in a circular orbit to the passenger. This type of machinery can have the boom supported between large ' A ' frames but the overhang, or cantilever form shown is quite common and is often designed in this manner so that the vertical plane in which the boom rotates can also be given a tilting motion just to add to the thrills.

While the section of the model illustrated in Fig. 9 is confined to vertical plane rotation, the cantilever or over-hung central shaft must be of substantial proportions. It is, in fact, made from long Screwed Rods and Wheel Discs, the Rods themselves passing right through a large bearing at the front of the model. This means that the shaft on which the boom is carried is almost the diameter of a Wheel Disc—some 1½ in. diameter, although its construction is in cage form. The important part is the front end bearing which really carries all the weight of the rotating structure. This is simply a square box made from 1 × 1 in. Angle Brackets mounted in a framework of short Angle Girders with Nuts and Bolts selectively placed in the corners of the assembly, where they will not foul the large-diameter compound axle. By placing several thicknesses of Wheel Discs together on the Screwed Rods at this point, a large rolling surface is rotating inside of a ' square ' bearing—unorthodox, but quite strong and efficient at low speed, so long as the bearing is packed with grease. Motor car grease is quite suitable, but oil must be avoided. Long Screwed Rods pass right through the eight holes available in the 3 in. Sprockets and into a thick sandwich of 8-hole Wheel Discs at each end of the main axle assembly. A ' square ' bearing is mounted at the top of each massive ' A ' frame and the support given is quite adequate for the heavy wheel revolving at the low speed of a fairground model.

In the case of the cage shaft used for the overhanging boom of the " Torpedoes ", only one of these ' square ' bearings is used, i.e. at the front, where the main weight is carried. Running through the centre of the cage shaft is a fixed Axle Rod secured in a Bush Wheel bolted to a 2½ in. square Plate at the rear of the model. This allows a pair of 8-hole Wheel Discs at the rear end of the cage shaft to rotate on a " dead " centre and at the same time to be held in place literally by a pair of Collars, thus positioning the other Wheel Discs at the other end of the cage in the correct lateral position inside the front ' square ' bearing. The fixed centre Axle Rod runs right through into the centre structure of the rotating boom where it holds a fixed 1½ in. Contrate Wheel. A pair of ½ in. Pinions run round the fixed Contrate Wheel in epicyclic motion to pass on rotation to the aerocars or torpedoes through the long Axle Rods in the arms of the boom. Final drive to the cars is by Pinion and small Contrate Wheel, as shown in Fig. 8b.

Traditionally, the central feature of all fairgrounds for more than a hundred years is the Roundabout, Carousel or Gallopers and these machines offer an excellent subject for Meccano Modelling. Fig. 10

shows just one of the hundreds of examples of which the Meccano system is capable and the model illustrated is built as far as possible on the lines of basic prototypes. Meccano models have appeared from time to time employing a heavy base turntable and this is basically wrong as the showman could never transport such a heavy turntable across country. Instead, for the early types of travelling fairs, a pivot truck formed the centre of a set of gallopers. The truck carried the steam engine, to drive the " ride ", as well as the smoke stack and the central " mast ", or pivot, on which a heavy crown wheel and bevel gearing was mounted. The truck wheels and frame were heavily shored and wedged with timber to give a stable centre pivot and the sections of the roundabout were suspended from 'spider' arms rigged to a stout centre mast through which the exhaust gases from the steam engine were vented.

Although modern gallopers are fitted with electric motors and electrically-driven " steam " organs, traditionally they still follow the centre truck design. Fig. 11 illustrates the heart of a Meccano roundabout capable of driving 24 gallopers. The centre support is an octagonal pillar made from Ange Girders and Flexible Plates on which a Circular Girder is mounted. A simple ring roller race made from Curved Strips carries eight ½ in. Pulleys, over which a second Circular Girder runs on a self-centring path. This second Circular Girder is reinforced with short Strips and Flexible Plates to form an octagonal 'skirt' which revolves outside the central octagonal pillar. Bolted to the top Circular Girder are eight 1 × 1 in. Angle Brackets carrying free-running ½ in. Pinions on Short Threaded Pins fixed in their horizontal lugs, the vertical lugs providing a thrust bearing for ¾ in. Contrate Wheels in direct mesh with the Pinions. As the roller race carrying the ½ in. Pulleys is " hollow ", a 3½ in. Gear Ring may be secured rigidly at the top of the central pillar by a series of Reversed Angle Brackets.

The object now is to get the whole superstructure revolving about the fixed gear ring so that the eight ½ in. Pinions will run round the ring and pass on their motion to the Contrate Wheels. Both in the large-scale machine and the Meccano model, the superstructure has very considerable inertia, i.e. resistance to motion when in the stopped position, and, as the drive must be transmitted from the centre of the roundabout, considerable torque must be supplied. This asks a great deal from a Meccano-size Axle Rod, but the hollow centre bearing lends itself to the 'cage' axle design already described. If a single Axle Rod is used for the central drive, adequate means must be provided for securing driving gears etc. to the Rod. It must also be suitably geared by providing a large Gear Wheel of 2½ in. or 3½ in. diameter at its lower end and this should be reinforced with a Sprocket Wheel with a large boss to give a total of four Set Screws gripping the Axle, the Sprocket Wheel being bolted directly to the large Gear Wheel. At the upper end of the central Axle Rod, two Face Plates are provided, careful fitting of which is very important. The lower Face Plate carries eight ½ in. Angle Brackets to form inner bearings for the 3 in. Axle Rods carrying the Contrate Wheels, and the height of this Face Plate is adjusted to give a slight tilt to the 3 in. Rods for easing the meshing between Contrates, Pinions and Gear Ring. It is then locked into place with two Set Screws. The upper Face Plate carries eight 7½ in. Perforated Strips (only four shown in Fig. 11 for clarity) which are slightly " sprung " by long Bolts

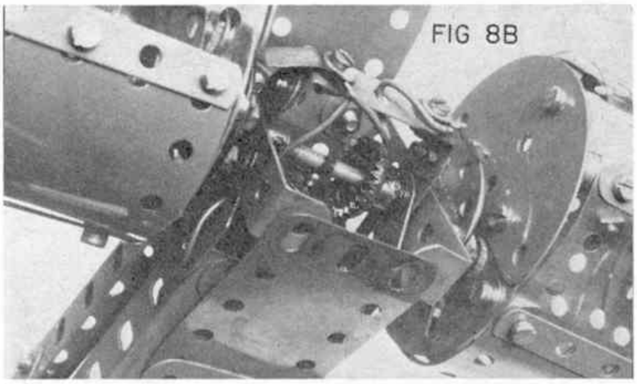


Fig. 8b. Close up view of the Contrate Wheel between the Torpedo's passenger cars with flexible cover plate removed. This gear receives a drive from a ½ in. Pinion fitted to a long Axle Rod running to a 1½ in. Contrate locked to a stationary Rod at the centre of the rotating boom.

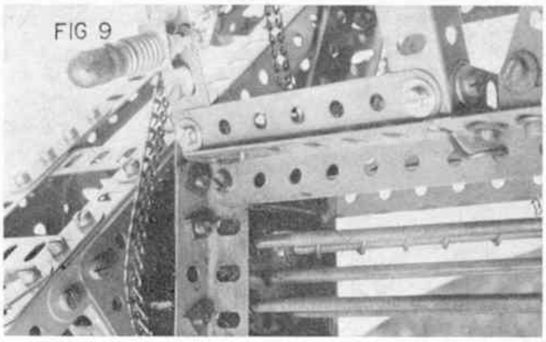


Fig. 9. The 'cage' shaft built from Screwed Rods and stacked Wheel Discs which supports the overhanging rotating boom for the " Torpedoes " in the 'square' bearing mentioned in the text.

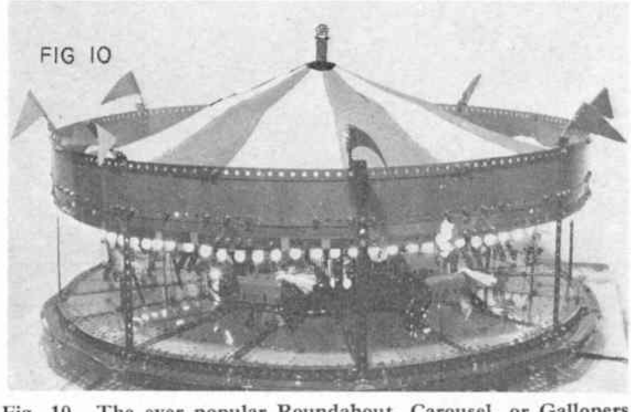


Fig. 10. The ever popular Roundabout, Carousel, or Gallopers —a challenging Meccano subject. Canopy, flags and chimney details again add to the realism.

at their extremities to support the rotating superstructure. However, as these suspension arms pass out through gaps *between* the Contrate Gears, the top Face Plate must be staggered between the holes of the lower Face Plate and must also be locked to it to form a solid hub. This is done by means of four ½ in. Reversed Angle Brackets. We now have four Set Screws (or long Grub Screws) available for securing the hub to the Axle Rod. By this method, standard parts provide all the grip required without the necessity of filing flats on Axle Rods.

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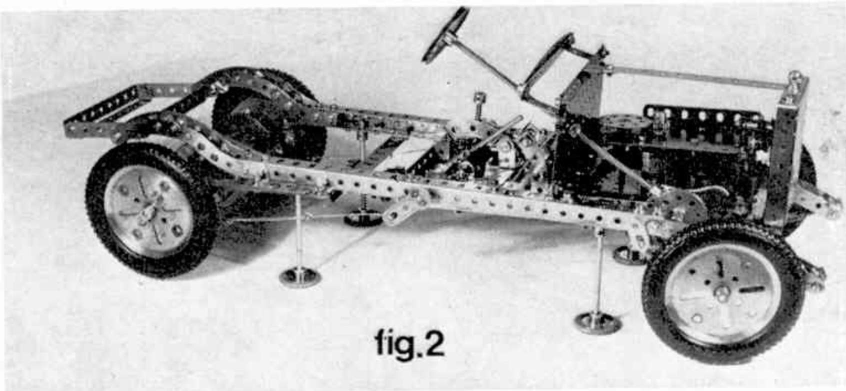


fig.2

Meccano Constructors Guide

by B. N. Love

Reconstruction of original Meccano Motor Chassis which demonstrates basic car mechanics.

PART 10 – VEHICLE MECHANICS

ANY LAD OPENING his Meccano Outfit for the first time will be confronted with a range of parts so suggestive of vehicles that some form of car or lorry will be among the very first of his creations.

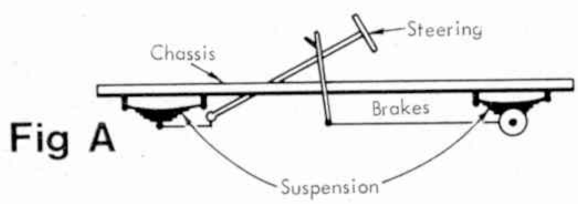


Fig A

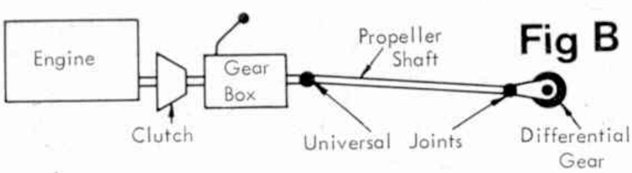


Fig B

This fever seldom leaves the life-long enthusiast who knows how well the system is suited for demonstrating vehicle mechanics. If we consider two aspects of this topic we might put them in these categories :
(a) Chassis, steering, brakes and suspension,
and (b) Transmission from engine to road wheels.

Although the bareness of the diagrams make them more akin to a 1916 Motor omnibus than a 1970 family saloon, the essentials have altered little in the past fifty years. In other words, we need basically, four wheels attached to a frame and a method of propelling the vehicle smoothly and a means for setting it in motion and bringing it to rest while being able to make it follow a non linear path. Considering the chassis before the transmission is literally putting the cart before the horse so we might consider the latter first. Thanks to the Powerdrive motor with its built-in gear box we can install an engine in a Meccano model in a comparatively small space and then proceed to give it realism by building detail around it. At one time the constructor was obliged to use a long sideplate motor which can be seen installed in the original Meccano Motor Chassis, a rebuild of which appears in Fig. 2. Despite the limitation in parts of the period from which this model originates, the basic movements of the motor mechanisms are all reproduced in this model. Fig. 3 shows what can be done in the way of disguising the Powerdrive motor of modern manufacture by enclosing it in an engine 'block' constructed of Plates, Strips and accessory parts to simulate a heavy duty deisel unit. Fuel lines are easily assembled from connecting wire covered in transparent plastic insulation while standard parts provide generator, breather, dipstick and well, starter motor and cooling fan. A clutch housing is provided by a Boiler End, four 1 in. × ½ in. Angle Brackets and an 8-hole disc to form the Bell moulding, while particular care has been taken in making the thrust race which is engaged by the clutch dogs to disengage the clutch plate. The two ¾ in. Washers sandwiching a 'spider' Collar (Part No. 140Y) which carries four Washers on short Set Screws forms probably the smallest Meccano Roller Bearing. It is very efficient in action.

This particular clutch is somewhat unorthodox in that the Bell housing revolves as a whole, the clutch plate being a 1 in. Pulley with Motor Tyre fixed to the engine shaft. When the clutch pedal is depressed, the Bell housing moves forward bodily, the Boiler End component thus losing contact with the Motor Tyre carried inside it. The clutch shaft is fitted with a Small electrical Bush Wheel at its rear end to engage with a sliding coupling to the gearbox and its forward

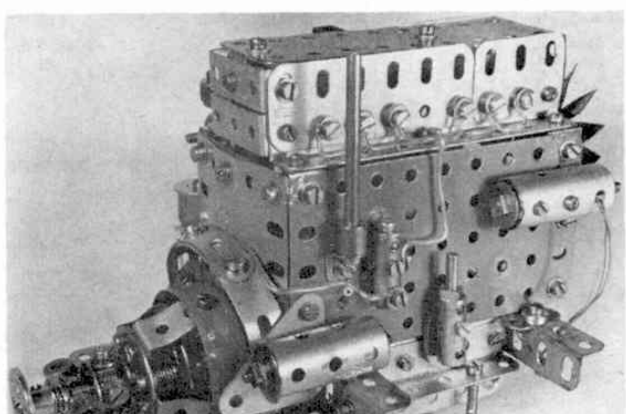
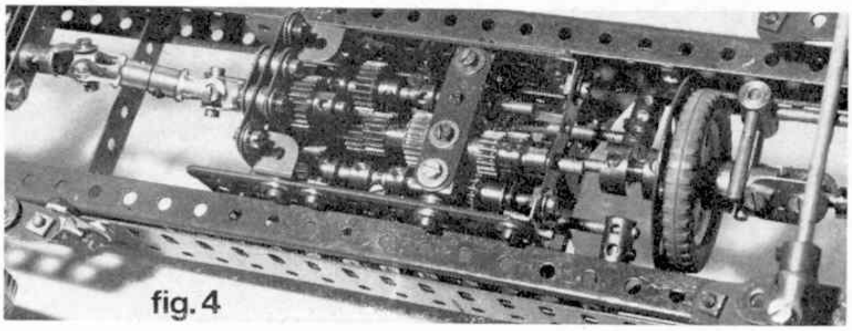


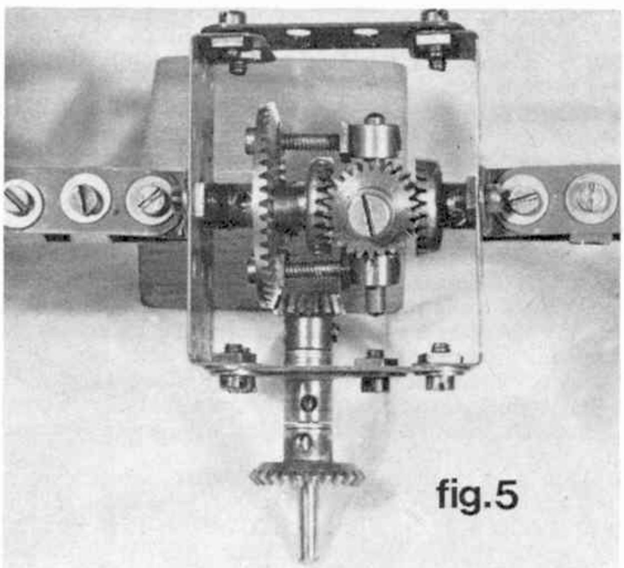
fig.3

Built up engine block housing Powerdrive Unit.



Simple clutch unit on lorry chassis. Note all-Pinion gear-box and universal coupling at rear.

end carries the spring pressure 8-hole disc and Bush Wheel, a portion of this shaft being journalled in the clutch housing in alignment with the engine shaft. The inner 8-hole disc is spaced from its Bush Wheel by a lock-nut on each of the compression spring bolts and

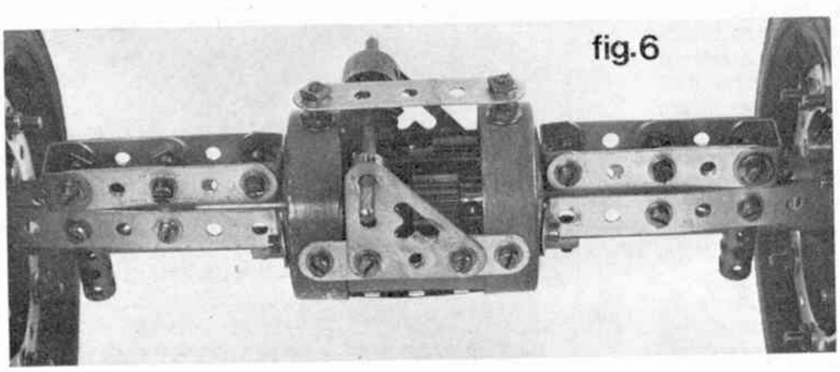


Simple differential gear employing Bevel, Contrate and Pinion Gears.

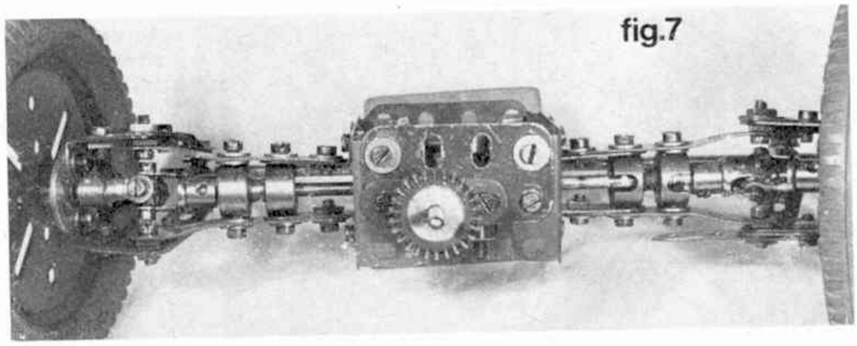
thus forms a free centre for the tip of the engine shaft to enter for alignment. A pressure pad of greased washers may be inserted between this inner disc and the boss of the 1 in. Pulley with Tyre for clutch idling with motor running.

A simpler but perfectly effective clutch unit is shown in Fig. 4. In this case, the clutch plate is a Faceplate connected to the gearbox shaft by a Socket Coupling and Collar. This provides a hollow bearing through the centre of the Faceplate boss so that the engine shaft can be journalled inside it. The clutch friction disc is a Motor Tyre on a 1½ in. Pulley journalled in a second Socket Coupling which is free to slide on the engine shaft. It is obliged to revolve with the engine shaft by the drive from a pair of Fishplates lock-nutted to the other end of the Socket Coupling as shown in the illustration. The slotted holes of the Fishplates slide on the shanks of Set Screws fixed tightly in a Collar on the engine shaft. A clutch fork is made from two 1½ in. Axle Rods in a Coupling attached to the clutch pedal by link rods. This fork will pull the 1½ in. Pulley with Tyre away from the Faceplate when the clutch pedal is pressed to disengage.

Fig. 4 also shows a compact gearbox based on a non-standard spacing employing ½ in. and ¾ in. Pinions. Twin lay-shafts are employed in this arrangement because of the limited selection of Pinion sizes. The central shaft is split at the centre in a common bearing and three forward speeds plus one reverse are available. Readers are referred to M.M. for April 1969, page 192, for a further explanation of a similar gearbox. The non standard spacing of ½ in. and ¾ in. Pinions in mesh is achieved by using Flat Girders in the construction of the gearbox casing, exploiting the slotted holes to obtain the critical spacing required. Notice that at the output of the gearbox, a universal joint is provided. Fig. 1 shows the normal positions for these joints which are required to make allowance for the difference in level between the rear axle of the vehicle and its gearbox. This difference in level is both a design feature and a consequence of axle movement when the vehicle is travelling. A universal joint is capable of making a junction between the ends of two shafts in such a way that rotation is maintained even when the shafts are at a small angle to one another—drive being available for an angle up to 45 deg. but with decreasing efficiency as the angle increases.



Heavy-duty rear axle unit with spur gear differential.

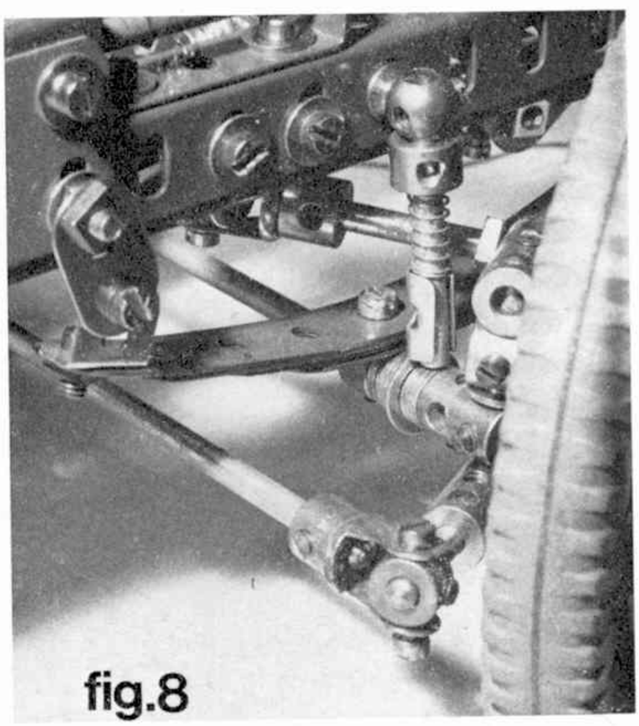


Demonstration front axle drive with flexible joints to road wheels. Note use of Socket Couplings as axle bearings.

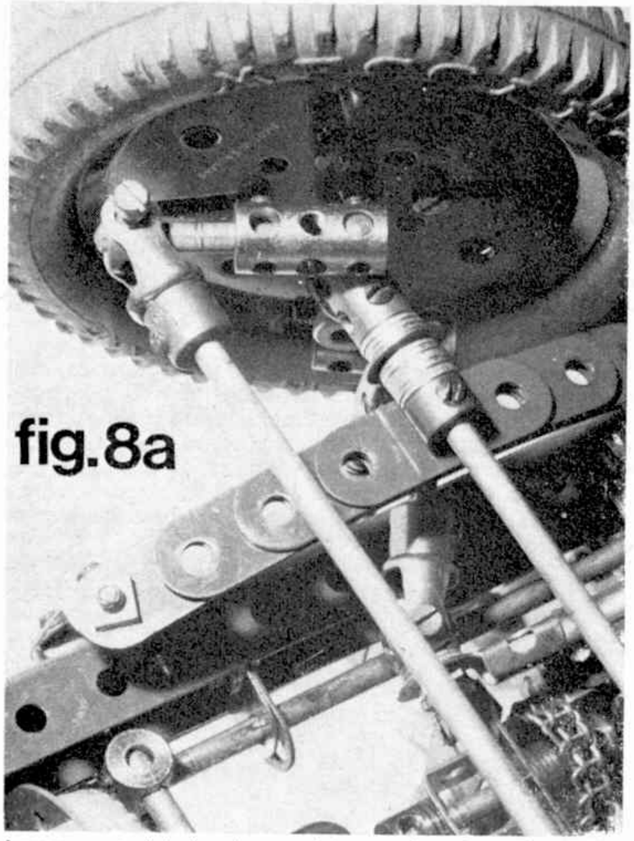
At this stage the transmission from the engine is still running in a line from front to rear and must be turned through 90 deg. if the rear axle is to turn. This could be achieved very simply by using a Pinion and Contrate gear to obtain the necessary right-angle drive as demonstrated in the early chapters of the Constructors' Guide and for very simple models this is a satisfactory way of doing the job. However, when a vehicle changes direction it tends to follow a curved path, as tyre marks in snow or mud will immediately show. This running over curved paths causes the rear wheels to run at different speeds depending on the sharpness of the turn and its direction left or right. Therefore, to permit the rear wheels to turn at different speeds, a differential drive is required and a simple form of this is shown in Fig. 5. Many such differentials have been illustrated in M.M. over its 50 years and more of publication and the gear illustrated in Fig. 5 is a neat combination of bevels, contrates and pinions. A Coupling forms the heart of the differential and receives the inner ends of the 'half-shafts' running to each road wheel, in either end of its lateral bore. The central transverse bore of the Coupling holds a $1\frac{1}{2}$ in. Axle Rod which in turn is bolted to the large Bevel Gear by $\frac{3}{4}$ in. Bolts lock-nutted on Collars as shown. The two 'planetary' 50-teeth Pinions are carried round in 'orbit' by the Pivot Bolts which tie them to the central tapped holes of the Coupling. The two 50-teeth Contrate Gears receive the drive from the Pinions and pass it on to their respective road wheels. If the vehicle is travelling in a straight line on a flat surface, both rear wheels will revolve at the same speed and the orbiting planet Pinions will be carried round by the large Bevel Gear, known as the 'crown' wheel, but the Pinions will not revolve on their Pivot Bolts. If, on turning a corner, one rear wheel is turning faster than the other, the planet Pinions will commence to turn on their bolts and in so doing will pass on a 'differential' motion to the two half-shafts comprising the rear axle. An appreciation of this is far more easily demonstrated by making up the mechanism than by attempting to describe its working in print.

An important feature in mounting differential gearboxes on rear axles is to ensure that they are rigidly attached to axle tubes which are in turn secured to the springs of the vehicle. Fig. 6 shows a rugged construction of a differential gear case suitable for a heavy duty model lorry. Boiler Ends provide strong journal plates for the axle tubes and half-shafts which run out from the differential. By a suitable selection of Double Angle Strips, Double Brackets, etc., the reinforced rear axle assembly shown will carry considerable torque and is designed to receive hub reduction gear at its extremities. Under these conditions, a model would be reaching a very advanced state. The actual differential shown is known as a spur differential because spur or Pinion gears are used. The principles do not change, however, long and short faced Pinions being employed to obtain the necessary meshing arrangements. In this particular instance, a Helical 'crown' wheel is employed to turn the differential carrier and this allows a top meshing Helical to pass the drive 'over the top' making it a simple matter to engage the drive to a second differential if twin rear axles are employed.

Fig. 7 shows a drive arrangement for a front axle where the road wheels are required to steer. Under prototype conditions a special flexible joint is required to pass on a steady drive to the front wheels at all angles of steering. The geometry of the simple universal joint shown in Fig. 7 falls short of this requirement, a special slot and ball joint being required. This can be partially simulated in the Meccano system by engaging a Handrail Coupling, fitted with a Keyway Bolt, in the open end of a Socket Coupling. This does not give a true ball joint through 360 deg. of drive however but the arrangement shown in the illustration is adequate for demonstration purposes. Note the use of Socket Couplings as rigid bearings in the axle tubes. Basic steering on non-driven front axles has been illustrated frequently in various Meccano articles and a further example is shown in Fig. 8. In



Steering gear fitted with simple coil spring shock absorber.



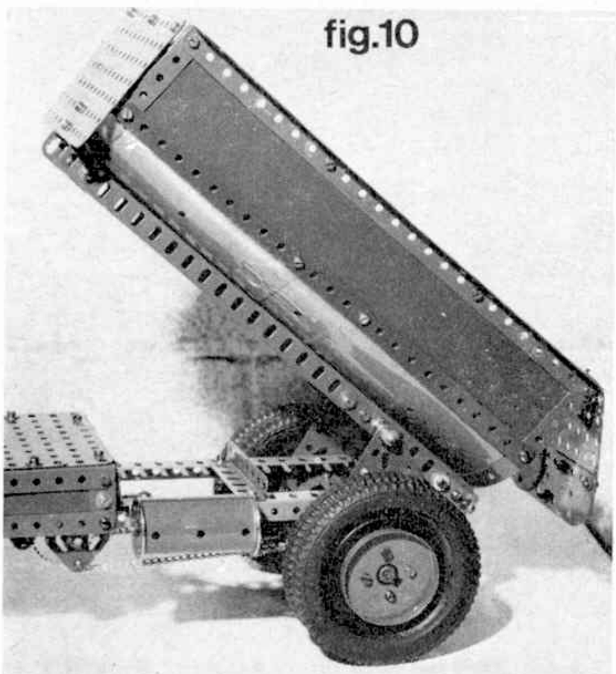
Arrangement of leaf springs and front axle rod securing collars to centre of springs.

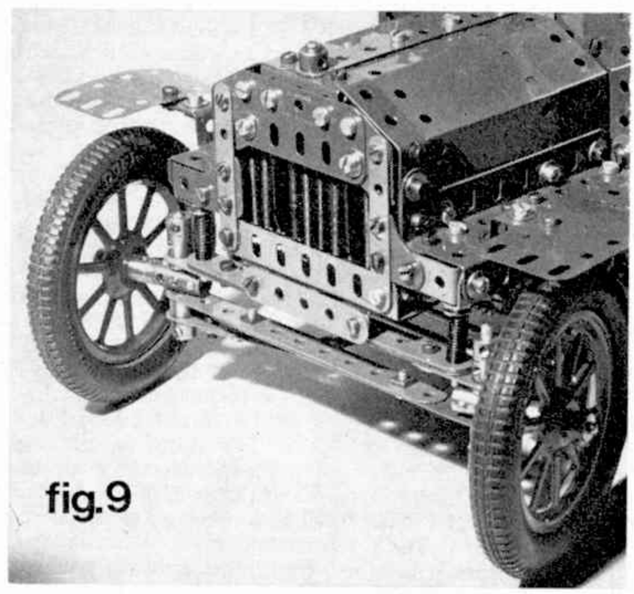
this case an Axle Rod is used for the main axle beam which is secured to the leaf springs by Collars. Short Couplings at each end serve as Kingpin journals and the track rods which link one wheel hub to the other are terminated in Swivel Bearings. An interesting feature in Fig. 8 is the provision of a coil spring shock absorber. A 1½ in. Axle Rod pivots in a Rod and Strip Connector on the main Axle and carries a Compression Spring held in place by a loose Collar. A handrail Support, lock-nutted to the chassis, allows the 1½ in. Axle Rod to ride up and down in its transverse bore to cushion the bumps from the main leaf springs.

A form of coil spring suspension is shown in Fig. 9 applied to a neat model of a veteran car. In this case the front axle beam is made of two or three thicknesses of Perforated Strips pivoted at the centre just below the bonnet. Cranks are bolted to each end of the beam to form journals for the Kingpins which are reinforced from below by a cross-strut made from further Perforated Strips. The chassis bearers on either side of the radiator are fitted with Long Threaded Pins pointing downwards, each fitted with two Compression Springs, the tips of the Pins penetrating the axle beam at which point the Compression Springs are trapped in place.

Vehicle features in general offer considerable scope to the Meccano modeller as the veteran car radiator details illustrate in Fig. 9. Coiled Tension Springs in this case give a very realistic appearance while the sharp bends in the Flexible Plates gives a really veteran look to the model.

Tipping section of heavy lorry for earth moving. Note curved shape under bodywork.





Simple front axle unit for veteran car employing central axle pivot and coil spring suspension.

Commercial vehicles are always popular and with so much motorway construction in progress, the tipper is a common sight these days. Nothing spoils the appearance of such a model as a tipper section which is badly designed or full of holes and the example shown in Fig. 10, although quite simple, makes a neat job of tipping. This is largely due to the use of overlapping flexible plates to give a curved under-belly to the tip unit with a minimum number of protruding bolt shanks to prevent smooth discharge of spoil. A further feature is the gravity tail board, hinged from the top edge and neatly curved at its lower edge to conform to the tip-body contours. Twin rear wheels are fitted to the vehicle and nicely finished with Wheel Flanges. The tipping motion, which is controlled from the driver's seat is via the motor gearbox and Sprocket Chain.

Meccano Constructors Guide

by B. N. Love

Part II

Further Vehicle Mechanisms

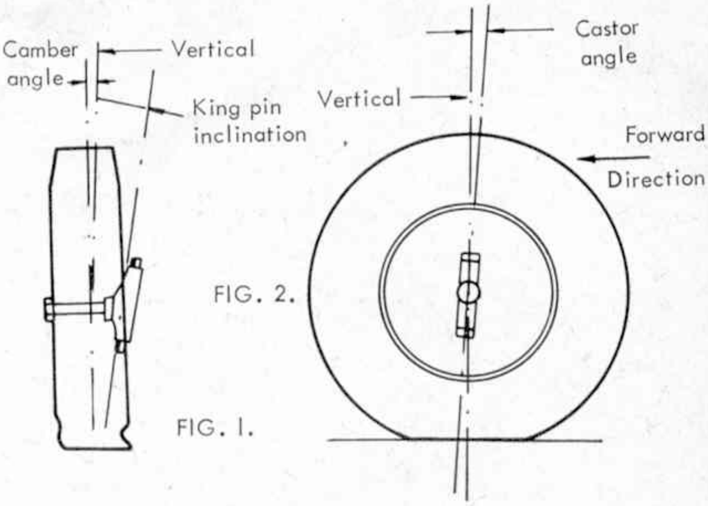


FIG. 1. FIG. 2.

EFFICIENT STEERING ON MODERN high-speed vehicles demands careful attention to 'Steering Geometry' in the design stages to ensure minimum tyre wear, good road holding and cornering properties and the least driver fatigue. The parallel arm steering common to most vehicles has been demonstrated in Meccano parts on many occasions but the combination of those features required for accurate reproduction is not easily achieved with the standard parts at the disposal of the Constructor if he is to keep his models within reasonable scale size, viz a viz prototypes.

Fig. 1 shows what is known as Camber Angle on a front wheel in which the centre line vertically through the tyre is set at an angle to the King Pin. The first advantage of this is that the centre point of contact of the tyre section on the ground will coincide with the turning axis of the King Pin, or nearly so, which means that the wheel is steered, in the stationary position, almost on a single spot instead of through a wide arc which would produce steering 'drag' and driver fatigue. At the same time, tyre wear is reduced as the geometry involved reduces 'scrubbing' of the tyre tread.

Fig. 2 shows another important aspect of front wheel mounting known as Castor Angle. A glance at a four-wheeled porter's trolley on a railway station will quickly show that all four wheels are castored, i.e. fitted in forks with a pronounced trailing effect. This ensures that an initial push or pull on the trolley will align the wheel directions to that of the line of effort. The slight tilt to rear of the King Pin shown in Fig. 2 is sufficient to provide castor action in the steering geometry so that, after cornering, the car will tend to straighten up, the steerig wheel returning to central position without effort on the part of the driver.

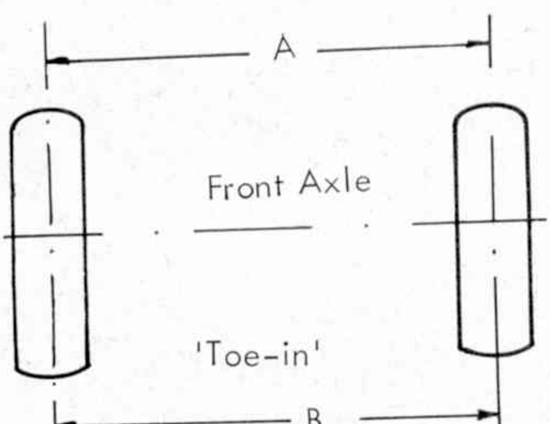


FIG. 3. Dimension A is less than B

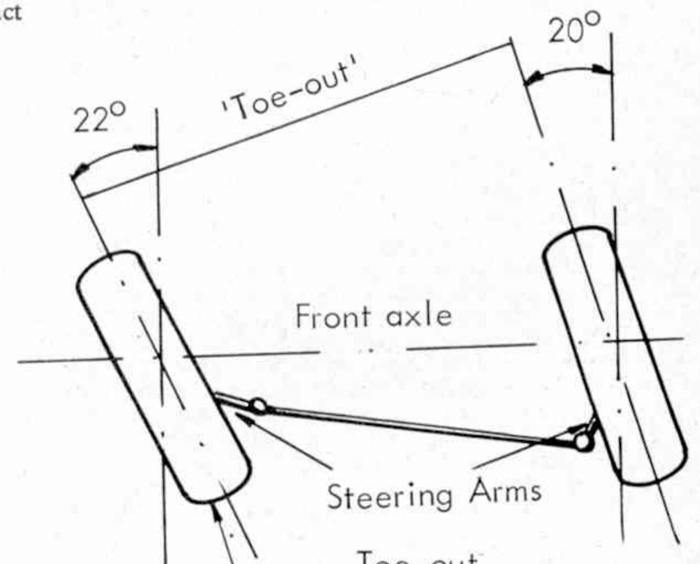


FIG. 4. Wheels turn through different angles when cornering.

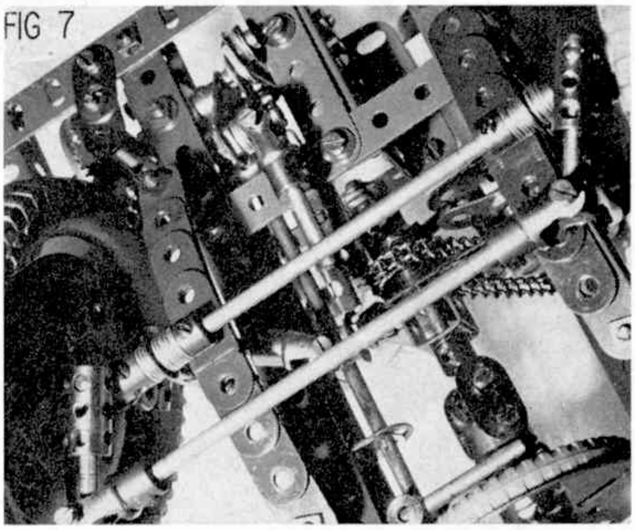


FIG 7

Steering linkage comprising track-rod, steering arm, drag link and drop arm.

It is sometimes mistakenly thought that this self centring of the steering wheel is caused by splaying open the front wheels slightly to produce the same effect. On the contrary, in the stationary position, the front wheels of a vehicle have a very slight inclination towards each other rather than being splayed apart. This feature is known as 'toe-in' and, although such an adjustment is measured in fractions of an inch, it is sufficient to provide a counter against the tendency of the front wheels to splay apart under normal travelling conditions and thus prevents unwanted strains on the steering mechanisms and links.

It may be confusing at this stage to point out that once the steering wheel is turned, the front wheels will immediately start to 'toe-out'. Fig. 3 shows the 'toe-in' alignment and Fig. 4 shows the 'toe-out' condition when cornering. It will be noticed from Fig. 4 that the inside wheel, when cornering, is turned through a sharper angle than that of the outside wheel. The reason for this is that the front wheels of a car will complete two turning circles in a full turn, one circle being inside the other. Fig. 5 illustrates this and shows why the wheel describing the smaller circle requires a greater angle of turn. This is achieved by setting the steering arms of the front wheels at a pre-determined angle, as shown in Fig. 4.

Meccano steering hub capable of 'castor' angle adjustment.

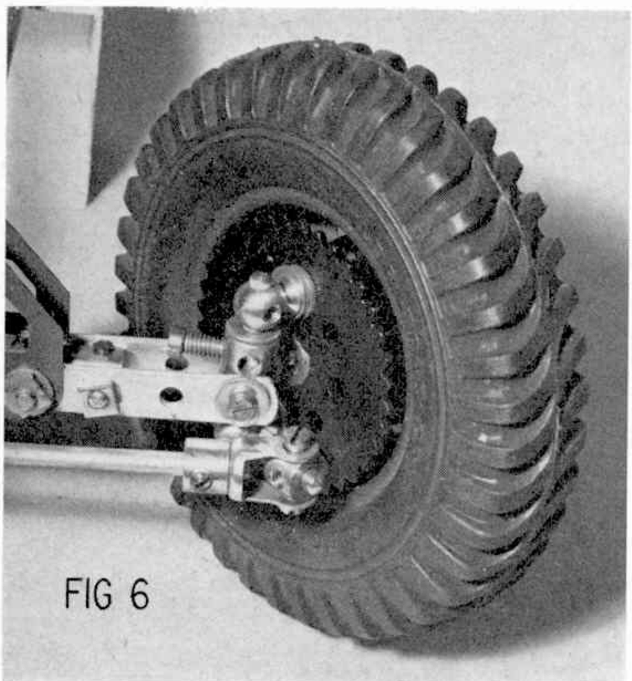


FIG 6

Fig. 6 shows a method of making a steering hub in Meccano parts. The hub flange is a 2 in. dia. Sprocket Wheel fitted with a pair of Handrail Supports. These carry a $1\frac{1}{2}$ in. Axle Rod to act as the King Pin which is journalled in a Short Coupling attached to the extreme end of the axle. By packing out the top Handrail Support with Electrical Brass Washers, camber angle can be achieved. The $1\frac{1}{2}$ in. Axle Rod must be free to pivot in the Short Coupling which is secured to double thickness Narrow Strips by Set Screws packed with a Washer to prevent the shank of the Set Screw from binding with the Axle Rod forming the King Pin. The lower Handrail Support is fitted with a short Threaded Pin in its tapped hole and the shank

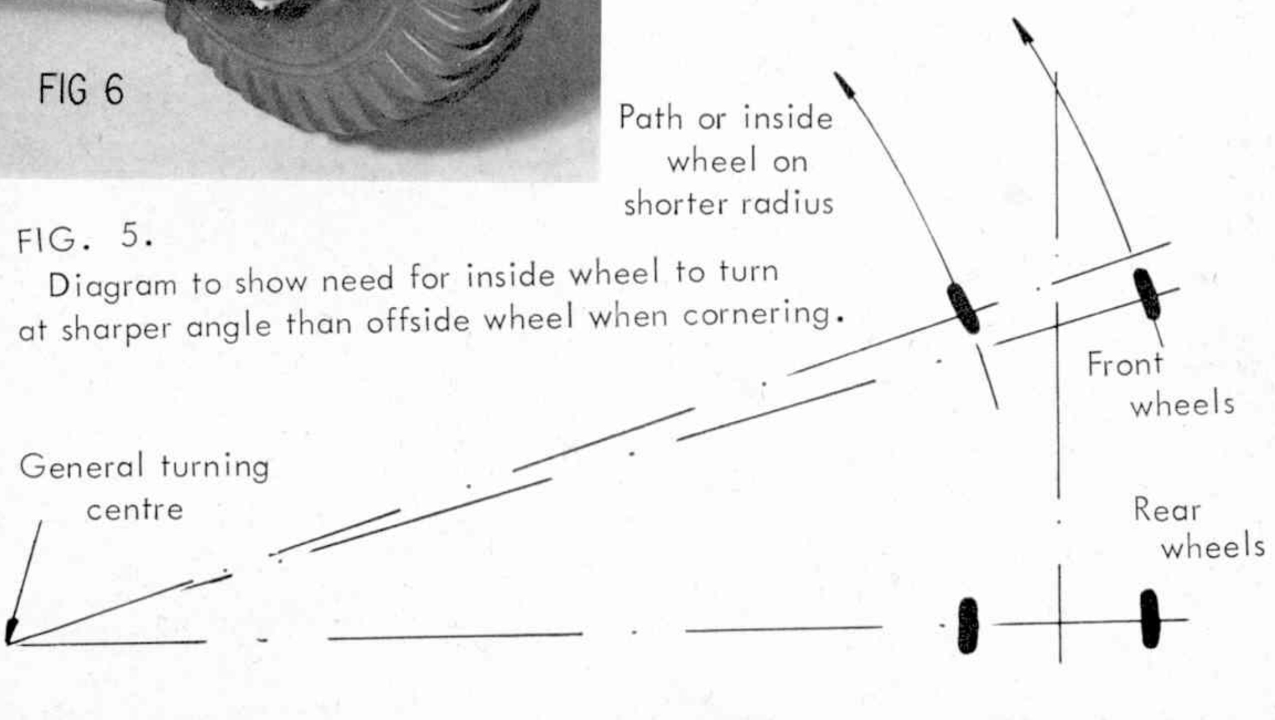
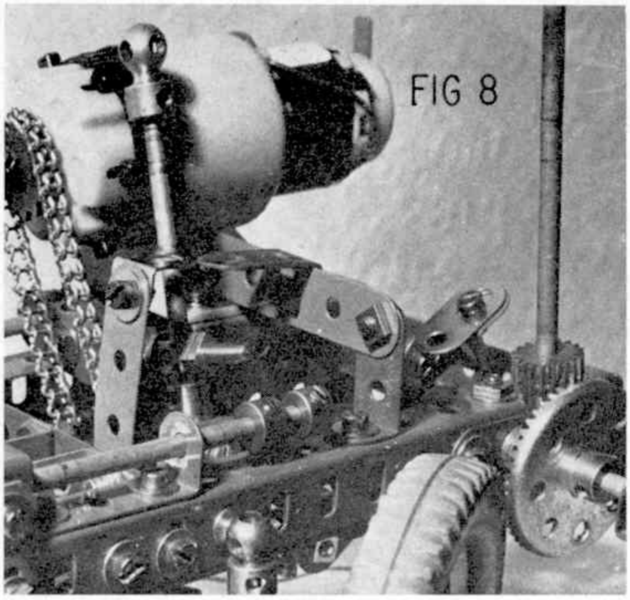


FIG. 5.
Diagram to show need for inside wheel to turn at sharper angle than offside wheel when cornering.



Forward-mounted steering column suitable for model buses, etc.

the Crank arms are pivotted on lock-nutted bolts attached to the brake lever in such a way that a forward movement of the brake lever drives the Crank bosses outwards to bind against the inside of the Wheel Flange. These bosses are sprung inwards for return motion by a short Rubber Driving Band linking them together.

More positive braking action can be achieved by making brake shoes from several thicknesses of Pawls without bosses, Part No. 147c. If these are locked on to a short Screwed Rod pivotting in the boss of a Threaded Crank attached to the wheel hub, a strong braking effect may be transmitted to the Pawls by an external lever. It is even possible to make fibre brake shoes by using 1½ in. Insulating Perforated Strips bolted together or pivotted in stacks on Pivot Bolts inside the brake drums.

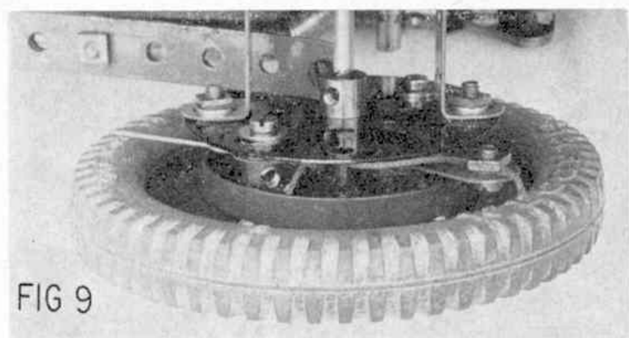
Simple brake cables may be formed from Loom Healds, Part No. 101, as shown in Fig. 9a and these are strong enough to provide considerable braking effort. A flexible brake cable can be made up from Meccano Spring Cord, Part No. 58, and for demonstration purposes, Electrical Tinned Copper Wire may be used running down the centre of the Spring Cord which would be anchored in Collars at either end of the brake line. Copper wire stretches quite easily how-

of the pin forms the steering arm to which the track rod is attached by a swivel Bearing. This arrangement gives a wide angle turning 'lock' and compact swivel joints. The angle of the Short Coupling forming the King Pin journal may be adjusted as follows: Fig. 6 shows a long-shank Bolt screwed into the upper tapped hole of the Coupling to indicate its alignment. By replacing this Bolt with a Screwed Rod and securing the inner end of the Rod near the axle centre by means of a Threaded Boss, Coupling, etc., a small degree of 'positive' or 'negative' tilt can be set on the King Pin and locked by nuts to a rigid setting. The spinning wheel hub carrying the tyre is simply a Boiler End fitted internally and/or externally with Bush Wheels to centre it, the tyre being a neat push fit on to the Boiler End.

A further system of track rod connection is shown in Fig. 7 where Couplings are employed at the lower end of the King Pins. These may be set at an appropriate angle for 'toe-out' (see Fig. 4) to give the correct turning geometry. In this arrangement, the steering arm linked to the steering column is carried at the top of the King Pin on the off-side of the chassis and runs between the elliptical springs and chassis member above. The steering arm is fitted with a drag link making use of Collars, Rod and Strip Connectors and Swivel Bearings to join up with a Crank acting as the drop arm from the steering gear. A further view of the steering column gearing is shown in Fig. 8 where it is seen mounted almost at the front of the chassis, typical of modern bus steering, the 19-teeth Pinion giving a reduction drive to the drop arm. The 19-teeth Pinion can be replaced by a 15-teeth or even a 13-teeth Pinion from the Meccano Clockwork Motor if a lower reduction is required between the steering column and the Contrate Wheel which operates the drop arm Crank.

Braking systems can be incorporated in Meccano vehicles by utilising Wheel Flanges or Boiler Ends as brake drums. Fig. 9 shows a simple internal expanding brake in which the bosses of two Cranks slide outwards in the slots of a Faceplate attached to the rear springs. A 2½ in. Perforated Strip forms the brake lever and

Simple internal expanding brake suitable for demonstration purposes.



Hand brake lever suitable for operating vehicle brakes employing wire Loom Healds as brake cables. The Crank transmits identical braking effort to the far side of the chassis.

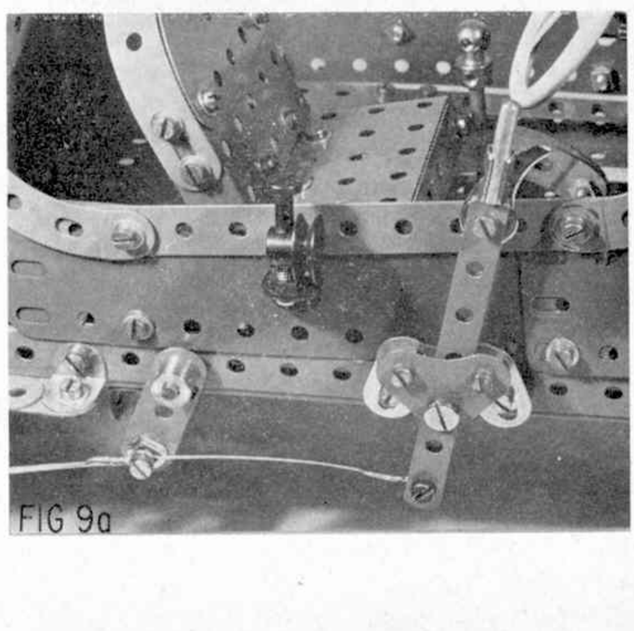
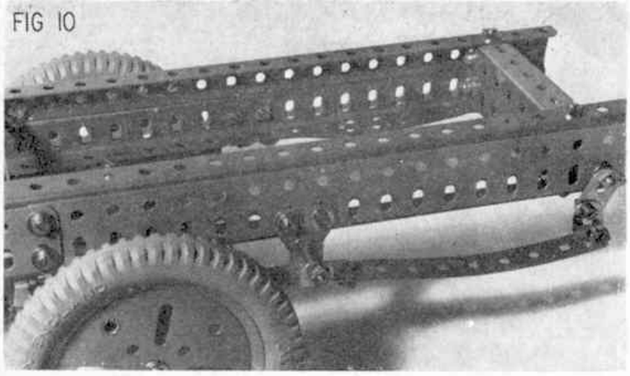


FIG 10



Lorry models should be provided with substantial chassis members as shown in the illustration.

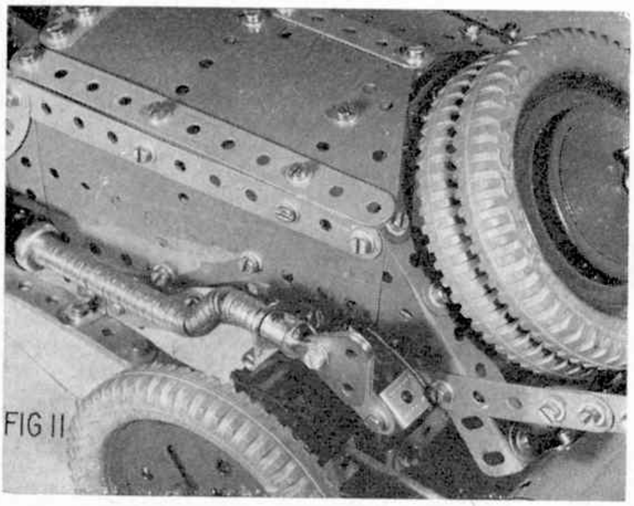


FIG 11

'Tail-end' modelling of an early type sports car. Note twin spare wheels and tapered faring at rear of luggage boot.

ever and steel wire is preferable—that used in stringed instruments being ideal for the purpose.

Chassis construction for commercial vehicles should be rugged as in the prototypes and Fig. 10 shows one made up in channel girders with skeleton arrangement of leaf springs to indicate wheel spacing at the rear of a heavy duty lorry. Once the wheel arrangement is satisfactory, the leaf springs may be reinforced with additional Perforated Strips or built up from Narrow Strips to give a more pleasing scale.

If leaf springs are employed in Meccano models, they should be compatible with the size of the vehicle as far as possible and care should be taken to support the springs at their ends by well-designed shackles which will keep them aligned but will also permit them to bend under load. Our roads are well used by large vehicles and the observant constructor will note how the springs vary according to size and class of vehicle, many of the heavy commercial vehicles having their springs exposed below a fairly open structure of the chassis.

One type of popular spring which works well in Meccano vehicles is the cantilever spring. This is an 'upside down' spring which has its forward end and its centre secured to the chassis and its trailing end is attached to the rear axle as shown in Fig. 11.

Considerable detail can be modelled into Meccano motor cars and lorries, by the careful selection and use of parts. Fig. 11 shows a neat construction of a heavy 'sporty' type exhaust system using a large number of Washers on Axle Rods and Crank Handles, a 'fishtail' being supplied by three 1 in. Triangular Plates locked in an End Bearing.

Figs. 12a and 12b show how fairings can be moulded from triangular and rectangular Flexible Plates and how a badge bar with large headlamps can set off a stylish radiator. Constructors who favour the Bentley/Bugatti/Aston Martin vintage models will appreciate the difficulties in modelling details. Fig. 12b shows an unorthodox use of Tension Springs in providing flexible feed-out pipes from the exhaust manifold to the main exhaust line. The E15R Motor used in the model shown has base flanges with slotted holes. The small twisted loops at the ends of standard Tension Springs, as supplied, lock into the slots with a simple twist and no other form of securing is required.

Next month's article will deal with Electrical Parts in the Meccano System and this will conclude the Constructors' Guide Series.

An example of 'vintage' bodywork on a veteran chassis utilising Flexible Plates to model body contours and various parts in unorthodox applications.

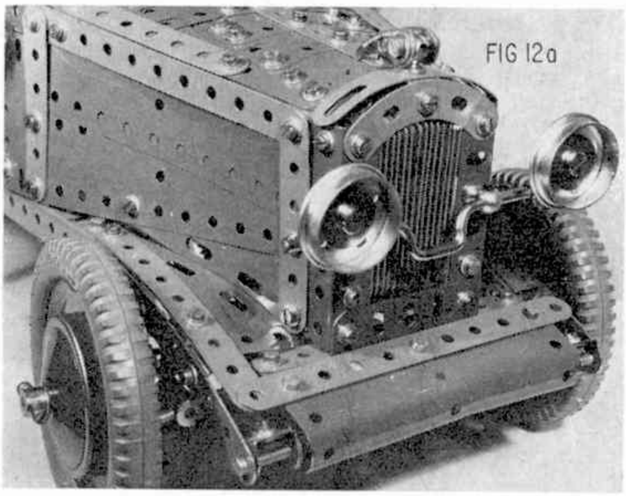
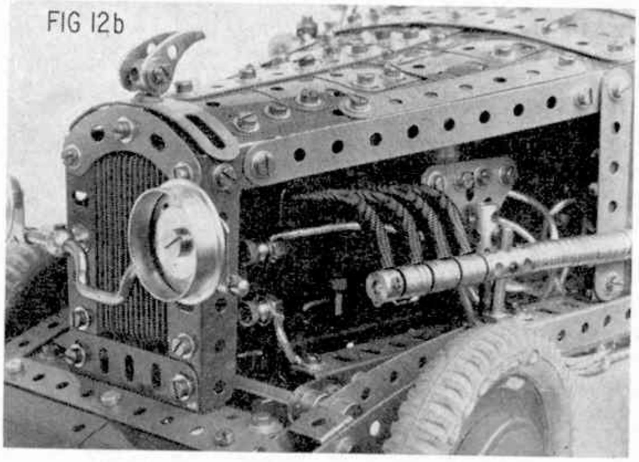


FIG 12a

'Open-sided' exhaust details making good use of Meccano Tension Springs in an unusual manner.

FIG 12b



MECCANO CONSTRUCTORS GUIDE

by B. N. Love **Part 12**

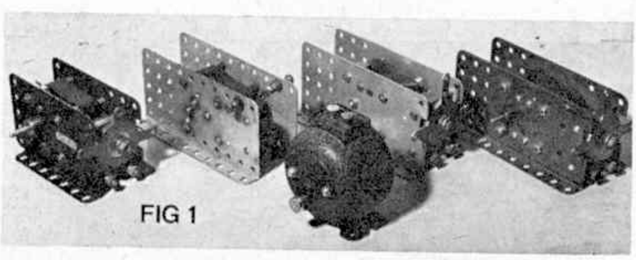
ELECTRICAL CIRCUITS FOR MOTORS AND LIGHTS

SO MANY TYPES of electric motor have been available to the Meccano enthusiast over the years that he may well be confused at times as to what is required in the way of power supplies and, as the number of transformers and controllers is equally profuse, a short explanation of general requirements may help to clarify the matter. Essentially, two types of Meccano motor are available to the constructor, one being known as a " universal " type and the other as a D.C. type. For a period of some 40 years or more, Meccano Ltd. produced the first type in large quantities and in several patterns, a selection of which are shown in Fig. 1. These are all known as ' side plate ' motors with the exception of the spherical enclosed motor which is affectionately known as a ' cricket ball " type.

All these motors are of the " Universal " type, which means that they may be very conveniently run, *via a suitable transformer*, from Alternating Current (A.C.) as supplied to houses in most parts of the world, or from Direct Current (D.C.) as supplied by a battery or transformer/rectifier.

Alternating Current is constantly changing direction 50 times per second in most European countries and 60 times per second in the U.S.A. Since an A.C. motor consists basically of an electro-magnetic armature driven by repulsion and attraction from an electro-magnetic set of field coils, the change of direction of current, being the same at any instant of time for both the armature and the field coils, means that the magnetic relationship between the two parts of the motor is constant, in terms of direction of rotation. D.C. motors for model driving, on the other hand, commonly have permanent magnet yokes acting in place of field coils, which means that the field of such a motor is not reversible. If such a motor had an armature supplied with alternating current it would try to start and reverse 50 times per second which would result in a complete cancellation of rotation—not to mention a probable burned-out armature! The D.C. motor has several advantages however, since it is only necessary to supply current to the armature.

With modern development of nickel alloy permanent magnets, motor fields can be very dense and very compact with long life characteristics—a failing in early D.C. motors for model driving. Hence, a battery, fitted with a switch which will change over the feed wire contacts will operate a D.C. motor in either direction and has the great advantage of portability making the model independent of trailing power supply leads.



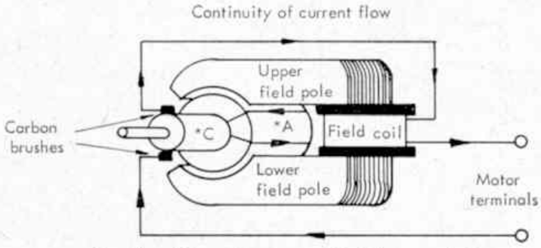


Fig. 2 General arrangement of Meccano 'universal' electric motor showing 'series' wound arrangement for Field coil and armature. *C - commutator *A - armature

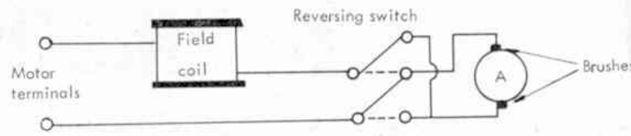


Fig. 2 b. Reverse switching arrangement common to Meccano 6 volt, 15 volt and 20 volt 'universal' (A.C. / D.C.) motors.

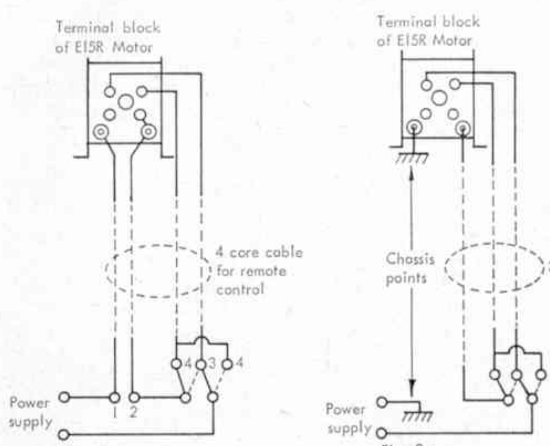


Fig. 3 Fig. 3a

Alternate methods of wiring the E15R and similar Meccano 'universal' motors for reversing by remote control. Fig. 3 - 4 core system. Fig 3a - 3 core system with one lead 'earthed' to chassis model. A Double Pole, Double Throw change-over switch is required for the remote reversing.

Early Meccano motors were intended to be operated from lead-acid accumulators as their current demands and low efficiency made dry battery operation unsatisfactory and very expensive. Four-volt motors were quite common in the early 20's to suit the accumulator but low voltage means high current consumption for the power required. By the late 20's the voltage rating had been increased to 6 volts and attempts made to drive Meccano motors from house mains. Few districts in U.K. were on A.C. supplies and one Meccano motor was manufactured to run from 110 volts, this being supplied from the then 220 volt D.C. domestic supply by dropping 110 volts or more through a household carbon filament lamp and a rheostat or variable resistor, the whole arrangement bordering on the semi-lethal! With the widespread change-over to domestic A.C. supplies, Meccano Ltd. produced an excellent range of transformers so that their popular 6 volt universal motors could be run either from a 6 volt accumulator for those enthusiasts living in houses without mains electricity, or from the mains where an A.C. installation was provided.

One puzzling feature of operating the A.C. motor is that changing round the transformer leads to the motor has no effect on its direction of rotation. On the other hand, a D.C. motor will immediately reverse if the battery leads are reversed. The explanation is as follows. In the case of the D.C. motor with a permanent magnet field, a change of direction of current through its armature will cause a change of magnetic polarity. Since the field cannot change, being a permanent magnet, the armature will turn in the opposite direction on having its current reversed. In the case of the 'universal' motor, reversing the battery leads or transformer leads simply reverses the magnetic polarity in both the armature and the field and we are back to square one, still going in the same direction.

In order to reverse a universal motor (A.C./D.C.) we must maintain the winding sense in the field coils but change over the polarity to the armature only, or vice versa. In the case of the current Meccano universal motor, the E15R (Electric, 15 volt, Reversing), one terminal is wired directly to the field coil and the other to a change-over switch. Current flow may then be considered to be through the field coil and then through the armature, the armature being reversible by means of the change-over switch to put it into opposite 'phase' to that of the filed coils and hence cause reverse of motion. The arrangement of wiring described is known as 'series' winding which means that the field and armature are in series, like two fairy lights on a string of tree lights at Christmas, which means that the current is the same in both parts of the motor from the D.C. point of view, and they 'share' the total voltage, commonly 6, 15 or 20 volts in the general range of Meccano electric motors. They do not necessarily have exactly half the voltage in each part of the motor, A.C. circuit theory not being quite so straightforward where electrical quantities, combining resistance and inductance, are involved.

Fig. 2 shows the general arrangement of the Meccano universal motors, a non-reversing type being illustrated. This demonstrates the series winding, direction of flow round the windings being illustrated for a D.C. input of appropriate polarity. Fig. 2(b) shows the switching arrangements built into the reversing motors manufactured by Meccano Ltd. over the past 50 years or more. This arrangement also highlights a disadvantage of the universal motor. In order to reverse its direction it is necessary to operate a mechanical reversing switch on the site of the motor so that it is not directly suitable for remote control. Long mechanical linkages could be fitted but this would be clumsy and seldom satisfactory. A D.C. motor, such as the Power Drive Unit with 6 speed Gearbox, the Junior Power Drive or the now-discontinued Emebo motor can readily be controlled remotely simply by fitting long leads to the battery or power unit and reversing the leads at the source of power by a simple change-over switch. However, there is a way of controlling the E15R motor and similar universal motors, remotely, by using four leads to a remote change-over switch, but this requires direct wiring to the motor terminal block after removing the fitted reversing lever and modifying the internal connections. Advanced modellers and those well acquainted with motor wiring may tackle such a modification, details of which are shown in Fig. 3.

Lead 1 goes straight to the motor terminal which is already connected to the field coil. The other field connection is made to the second motor terminal, internal modification being carried out as required. Finally, the brush leads in the motor are connected to the top two studs of the switch block after removing the reverse lever. The remote switch requires terminals and contacts as shown in Fig. 3 and a simple switch of this kind can be made from electrical parts in the Meccano system. Failing this, a radio-type switch, known as a D.P.D.T. (double-pole, double-throw switch) will do the trick.

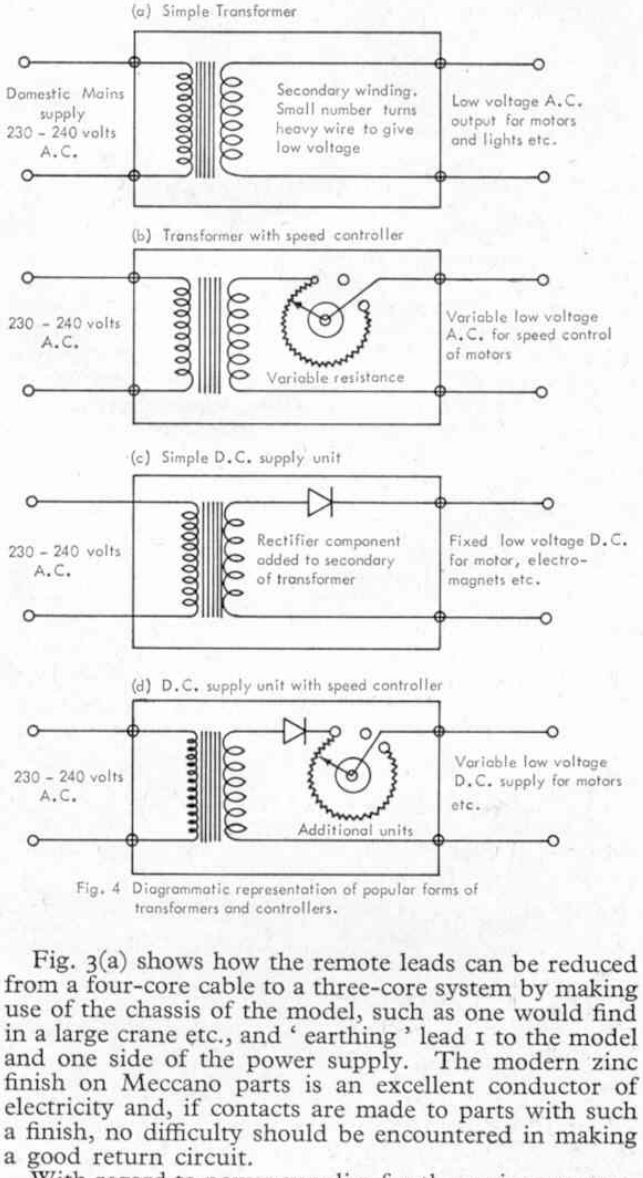


Fig. 4 Diagrammatic representation of popular forms of transformers and controllers.

Fig. 3(a) shows how the remote leads can be reduced from a four-core cable to a three-core system by making use of the chassis of the model, such as one would find in a large crane etc., and 'earthing' lead 1 to the model and one side of the power supply. The modern zinc finish on Meccano parts is an excellent conductor of electricity and, if contacts are made to parts with such a finish, no difficulty should be encountered in making a good return circuit.

With regard to power supplies for the various motors, while a 6 volt or 12 volt dry battery is quite suitable for the modern Meccano D.C. Power Drive motors, the majority of constructors will make use of mains supplies suitably reduced by means of transformers etc. A look at Fig. 4 will show the four basic types, in simplified form, which the Meccano builder is likely to come in contact with. Generally speaking, the

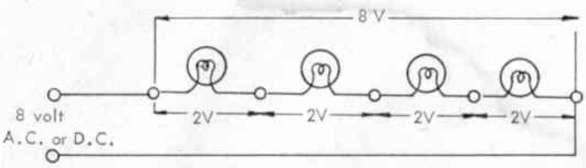


Fig. 5(a) A simple series circuit in which four 2 volt lamps are lit by a supply of 8 volts A.C. or D.C. Removal of one lamp will extinguish all lights.

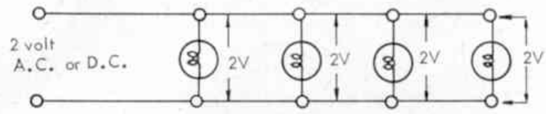


Fig. 5 (b) A simple parallel circuit in which four 2 volt lamps are lit by a supply of 2 volts A.C. or D.C. Removing any lamp will not extinguish the others.

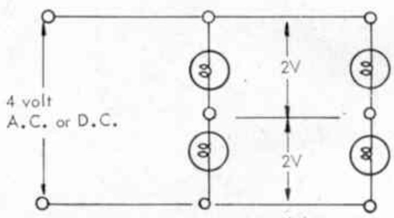


Fig. 5(c) Combined series/parallel circuit in which four 2 volt lamps are lit from a 4 volt A.C. or D.C. supply. Removal of one lamp will not extinguish the other two left in series across the 4 volt supply.

universal motors run at their best on full voltage, speed reduction being obtained by appropriate gearing. A simple transformer is required in this case, see Fig. 4(a). Essentially, a coil of many hundreds of turns of wire is wound round a metal core of soft iron and then, after layers of insulation are added, a second coil of wire, in thicker gauge, with a small number of turns is wound over the first. The long coil is known as the 'primary' and this receives the full 230 or 240 volts from the house mains. The smaller coil of thicker wire

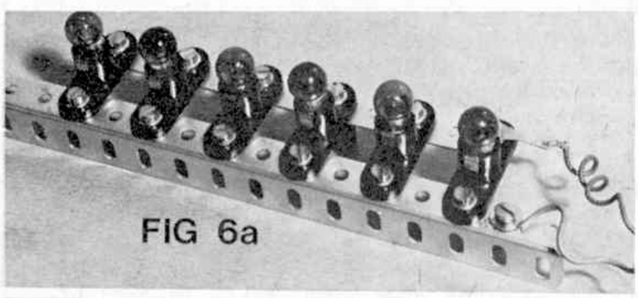


FIG 6a

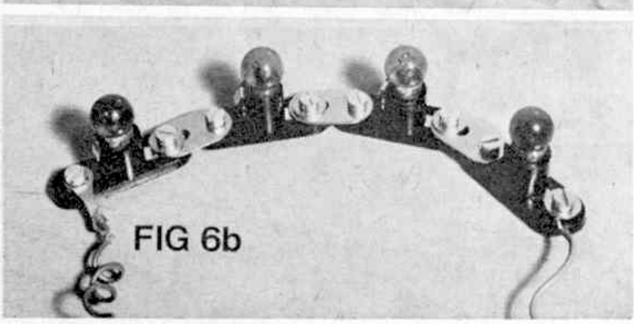


FIG 6b

is called the 'secondary' and this provides the reduced voltage to the universal motor. Some transformers are fitted with speed controllers as shown in Fig. 4(b), the controller in this case being a variable resistance connected in the secondary circuit. Such a transformer is commonly used for operating 6 volt or 20 volt A.C. trains but its speed regulation properties are not particularly good.

If D.C. apparatus is to be powered, an additional item is required in the secondary side of the transformer to permit the A.C. current to flow in one direction only, thus converting it to D.C. This item is called a 'rectifier' and is shown diagrammatically in Fig. 4(c).

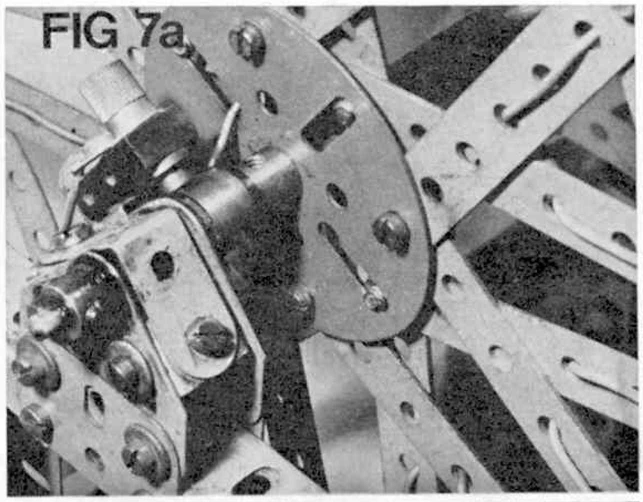


FIG 7a

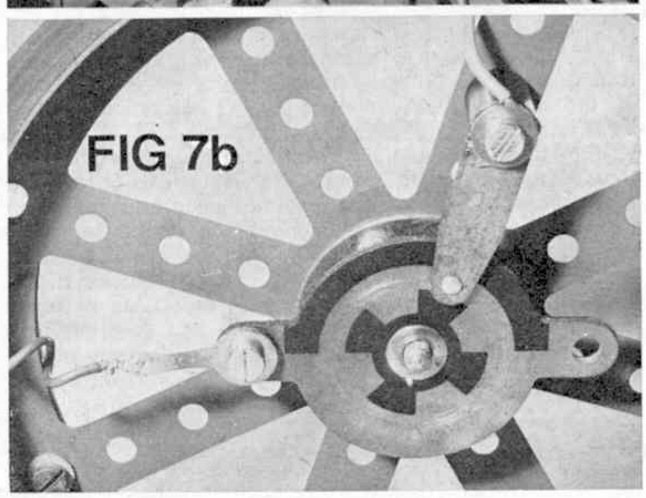


FIG 7b

When combined with a variable resistance, Fig. 4(d), the unit becomes a D.C. controller and is popularly used with small-gauge railways etc., because of its simple reversing qualities. The last refinement of the D.C. controller is to incorporate a change-over switch with the variable resistance, thus allowing motors, locomotives, etc., to be reversed from the controller.

Although the modern Meccano D.C. Power Drive motors are adequately powered by dry batteries, they may also be powered by mains-operated D.C. control units such as are used for model railways. A word of warning is required here, however. As the two Power Drive motors are primarily designed for battery operation they are not suppressed against radio and T.V. interference. If they are used with mains-driven controllers, they become highly effective (and illegal) interference transmitters! Suppressor circuits can be added and advice from a local radio dealer could be helpful in this respect.

Apart from motion, nothing adds more to the realism of a model, whether working or static, than a good display of coloured lights. Thanks to Meccano Electrical Parts, the modeller can decorate his structures to great effect. Three basic forms of circuit wiring are available to the constructor and these are illustrated in Fig. 5. The first is series wiring, all lamps strung out like fairy lights, current passing through each lamp in turn. This arrangement would be suitable for a string of six 2 volt lamps if a 12 volt transformer was used, as the voltages of the lamps, in series, are added for the total.

The second arrangement is a straightforward parallel circuit in which the lampholders are arranged like the rungs of a ladder and each lamp receives the full voltage of the supply available. The coloured lamps supplied by Meccano are for 12 volt working but each lamp draws only .04 amps. This means that no less than 100 Meccano 12 volt lamps could be illuminated by a 12 volt transformer rated at 4 amps. 'Popular' 12 volt transformers have a current rating of 1-2 amps so that 25 to 50 lamps could be driven from such transformers. The Electrical Part Lamp Holder has an all-insulated casing, but its securing holes are also contact bushes for wiring. A number of such Lamp Holders can be virtually built up like a ladder as shown in Fig. 6, no wiring being required between Holders as all current is carried by the Perforated Strips. Standard Bolts, (3/8 in. preferred) fit the holes but there must always be a gap in the metal contacting the two holes of any one Lamp Holder, as the brass bushes in the Lamp Holders are not insulated. They can, of course, be mounted on any part of the surface of the Fibre Insulated Plates, the simple rule being to make sure that there is no metal connection across the two holes of the holder as this would give a short circuit, no light and possibly a burnt-out transformer.

Very little wiring is required with the Lamp Holders, thanks to the versatility of the Electrical Parts, and Fishplates or frameworks provide neat and adequate current paths as shown in Fig. 6(a). It must always be borne in mind that low-voltage supplies are to be used with these parts. In theory, 20 Lamp Holders fitted with Meccano 12 volt Lamps could be strung in series across 240 volt house mains, but, in this case, all bare screws and tags on the lamp holders would be a potential lethal danger!

FIG 9

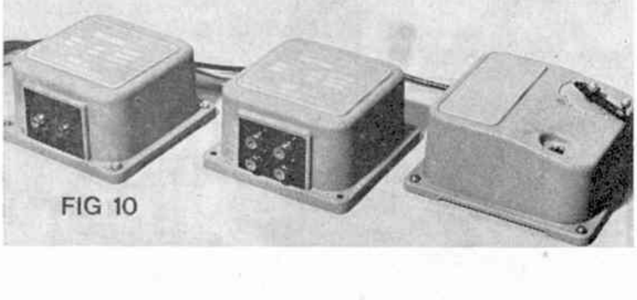


FIG 10

Finally, we may add further interest to illuminating models by arranging for lights to rotate with the superstructure of Big Wheels, Roundabouts and similar models. Fig. 7(a) shows how current is passed from the 'A' frames of a Ferris Wheel to the wheel itself by means of a carbon brush holder attached to the 'A' frame which contacts a simple copper ring commutator mounted on, but insulated from, the main spindle. The Electrical Part Flat Commutator is shown in Fig. 7(b) with a short Wiper Arm located to wipe on its surface. This Commutator has three tracks which give 180°, 360° and four equally-spaced intervals of 45°, respectively, and it may be used for intermittent contact as required.

As well as supplying current for lights to rotating structures, the Commutator will also carry the current required for any of the Meccano Electric Motors. Wiring should be carried out in plastic insulated cable, trimmed carefully to retain all strands, connections being made securely below a Washer or by means of a soldered tag where the constructor has facilities for soldering. Bare metal-to-metal contacts must be maintained and, if the framework of a model is employed for the 'earth' return path, it will serve both for A.C. and D.C. circuits, as shown in Fig. 8.

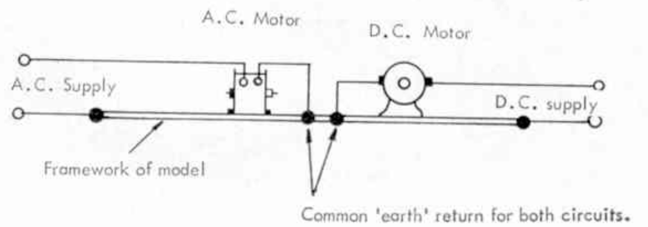


Fig. 8 If the chassis of a model is used for the return path wiring for motor or lights a common earth point may be used for both circuits as shown above, despite the apparent 'mixture' of A.C. and D.C. supply. The motors may still be reversed by their reversing levers but separate earth leads will be needed if multiple remote control is required.

As this is the closing chapter of the series, the writer would like to thank all those enthusiasts who have written so many encouraging letters to him during the course of the publication of the Constructors' Guide.

In particular he would like to thank those members of the Midlands Meccano Guild who have provided some of the material used in the various chapters and for their permission to take photographs in certain cases.

Because of the world wide interest shown, the Guild is now preparing an International Register of Meccano Constructors (over 18 years old). Any enthusiast actively engaged in model building in Meccano is invited to apply for entry on to the Register. This may be done by sending a stamped addressed envelope (International Reply Coupon for overseas constructors) to B. N. LOVE, Hon. Sec. Midlands Meccano Guild, 61, Southam Road, Hall Green, Birmingham, 28.