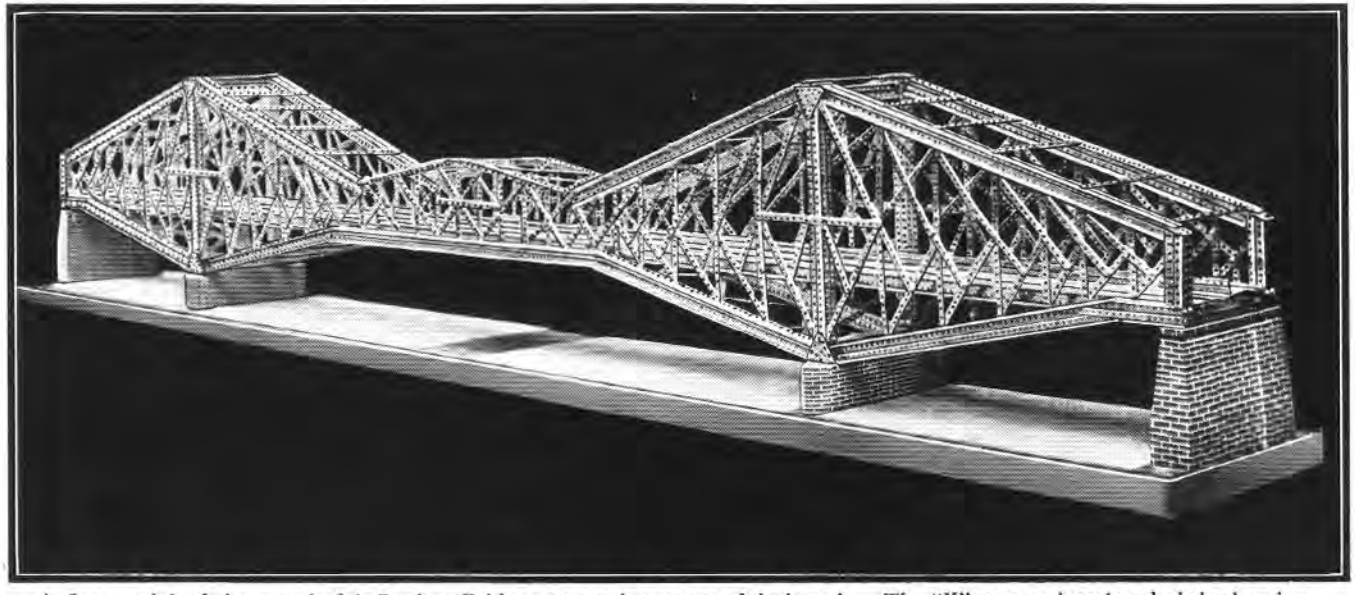
MECCANO
BOOK OF NEW MODELS

1/9

The Wonderful Quebec Bridge: A Fine Subject for Model-builders

OUR cover shows the giant bridge that crosses the St. Lawrence River at Quebec. Not only is this the largest cantilever bridge in the world, but also it has a history of tragedy that makes it unique among the bridges of modern times.

The first terrible disaster during the building of the bridge occurred on 29th August 1907. Shortly before work was due to cease for the day, the compression cords of the south anchor arm suddenly crumpled up. The entire cantilever rocked violently and collapsed with a fearful crash upon its pier, carrying with it eighty-six men who had been at work upon the erection at the time. In spite of all rescue efforts, only eleven men were saved.



A fine model of the wonderful Quebec Bridge, measuring over 15ft in length. The "K" pattern interlaced girder bracing used throughout the model is immensely strong, and was employed for the first time in the construction of the actual bridge, after every other system of girder bracing had been considered.

Of the 17,000 tons of steel contained in the structure, some 8,000 tons fell into the deep channel of the river, while the remainder lay astride the pier and along the bank—a gigantic mass of girders and plates 40ft. in height, twisted and distorted almost beyond belief. Thus in a few minutes was undone the labour of three years.

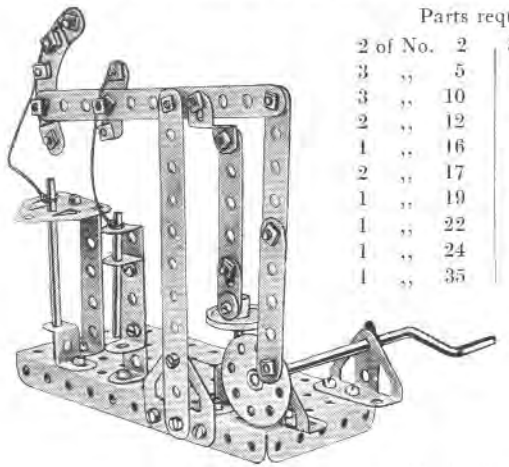
The Canadian Government now placed a contract for a new bridge. Construction started again, and all went well until September 1916, when everything was ready for hoisting into position the huge centre span that was to link up the two great shore cantilevers. This span had been built in the meantime at a point about 3½ miles down stream from the site of the bridge, and when all was ready it was conveyed on pontoons to the bridge site and manoeuvred into position beneath the gap between the cantilevers ready for being raised. It had been raised about 32ft. when suddenly there was a loud report and, almost before anyone realised what had happened, the great span had partially twisted over. With an appalling rumble and splash it disappeared into the river, bearing with it 90 men who had been engaged in the hoisting operations. Of these men 81, including the chief engineer, were saved.

The engineers were not beaten, however. Another centre span was built, and on 17th September 1917, it was safely hoisted into position. One month later the first train passed over the bridge.

Bridge-building is undoubtedly one of the most interesting branches of engineering for Meccano boys and the remarkable reproduction of the Quebec Bridge illustrated here is an excellent example of the adaptability of Meccano parts for this purpose. This fine model is 15ft. in length and carries two lines of Hornby track, which are separated, as in the actual bridge, by a strong steel partition constructed from Angle Girders and Flat Girders. The complete bridge is mounted on four wooden piers painted to represent brickwork. It will be noticed that K-pattern interlaced bracing, which has proved to be immensely strong, is used throughout.

A smaller and more simple reproduction of this famous bridge is illustrated and described on page 13 of this book.

Model No. 1. Watt's Beam Engine



Parts required :

2	of No.	2	31	of No.	37
3	,,	5	8	,,	37a
3	,,	10	2	,,	38
2	,,	12	1	,,	48
1	,,	16	2	,,	48a
2	,,	17	1	,,	52
1	,,	19	1	,,	90a
1	,,	22	2	,,	125
1	,,	24	2	,,	126
1	,,	35	2	,,	126a

The cylinder consists of a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip to which a Flat Trunnion is bolted. A $3\frac{1}{2}''$ Axle forming the piston rod is passed through the Trunnion and through a $\frac{1}{2}''$ Reversed Angle Bracket bolted to the base, and a length of cord is attached to its upper end and tied to a $2\frac{1}{2}''$ Curved Strip on the end of the beam.

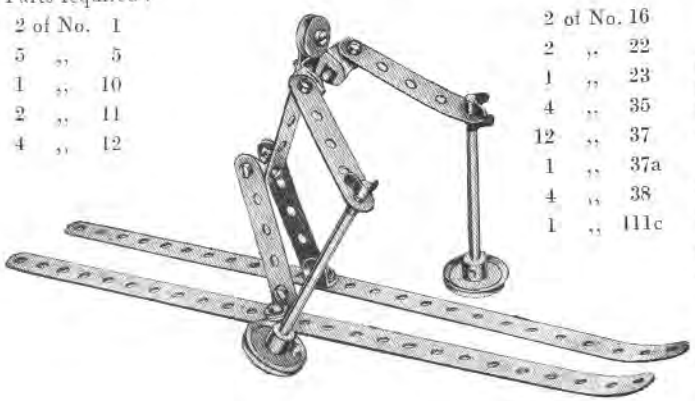
The "valve chest" comprises a $2\frac{1}{2}'' \times \frac{1}{2}''$ and a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip, in which slides a 2" Rod that is connected to the two Flat Brackets on the beam by a length of cord.

The "pump" is operated by a $2\frac{1}{2}''$ Strip extended by a Flat Bracket and pivoted to a $\frac{1}{2}''$ Reversed Angle Bracket that is secured rigidly to the beam. The Flat Bracket is held to the boss of a 1" Pulley by a bolt screwed into the set-screw hole of the latter. This bolt also grips a short Rod that works up and down in a Double Bent Strip attached to the base.

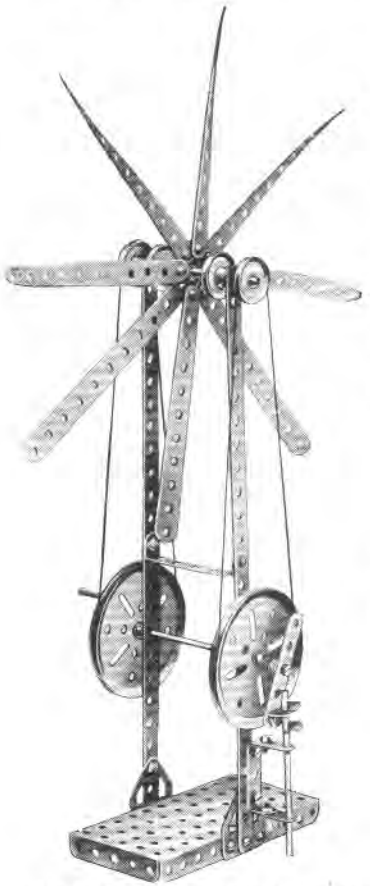
Model No. 2. Ski-ing Champion

Parts required :

2	of No.	1	2	of No.	16
5	,,	5	2	,,	22
1	,,	10	1	,,	23
2	,,	11	4	,,	35
4	,,	12	12	,,	37
			1	,,	37a
			4	,,	38
			1	,,	111c



Model No. 3. Windmill Pump



Parts required :

2	of No.	1	1	,,	48a
8	,,	2	1	,,	52
1	,,	5	3	,,	111c
2	,,	10	2	,,	126a
1	,,	12			
2	,,	16			
2	,,	19b			
1	,,	19s			
4	,,	22			
1	,,	24			
2	,,	35			
19	,,	37			
4	,,	37a			
8	,,	38			
1	,,	48			

A $3\frac{1}{2}''$ Rod is journalled in the upper ends of two $12\frac{1}{2}''$ Strips. This Rod carries four 1" Pulleys and a Bush Wheel, to which eight $5\frac{1}{2}''$ Strips are bolted to form vanes. The ends of these Strips may be twisted slightly to obtain greater realism.

A Crank Handle journalled as shown carries two 3" Pulleys that are connected by endless lengths of cord to two of the 1" Pulleys on the Rod carrying the "sails." To one of the 3" Pulleys a $2\frac{1}{2}''$ Strip is attached pivotally by a $\frac{3}{8}''$ Bolt passed through its centre hole, and secured rigidly by two nuts.

The pump consists of a $3\frac{1}{2}''$ Axle Rod passed through two Flat Brackets that are secured by their elongated holes to a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. Two Spring clips on the Rod secure it to an Angle Bracket attached pivotally to the end of the $2\frac{1}{2}''$ Strip.

Model No. 4. Swing

Parts required :

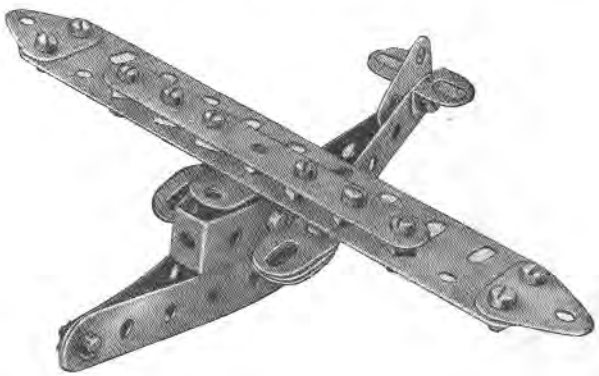
2	of No.	2
2	,,	5
2	,,	12
1	,,	16
2	,,	22a
2	,,	35
9	,,	37
1	,,	52
2	,,	126

Two Trunnions are bolted together to form the seat, which is suspended by two short lengths of cord from a $3\frac{1}{2}''$ Rod journalled in the holes at the upper ends of the vertical members. The latter are held rigid by $2\frac{1}{2}''$ Strips attached to the base by Angle Brackets.

Model No. 5. DO. X. Flying Boat

Parts required :

1	of No.	3	13	of No.	37	1	of No.	102
9	,,	10	18	,,	37a	1	,,	103
2	,,	11	3	,,	77	6	,,	111c
4	,,	12	2	,,	80			



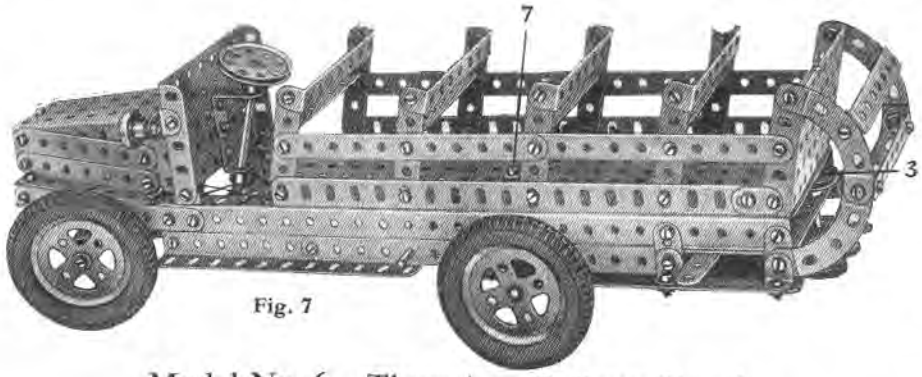


Fig. 7

Model No. 6. Three Arm Railway Signal

Soon after the introduction of railways over one hundred years ago it became obvious that some reliable method of controlling the ever increasing traffic was necessary. The difficulty was solved by means of a system of hand operated signals, placed at convenient points along the permanent way. Since its introduction, the system has steadily improved and has been adapted to control trains safely over the intricate network of metals at busy junctions. A large number of different types of signals are now in use and most of these, from time to time, have formed subjects for Meccano models.

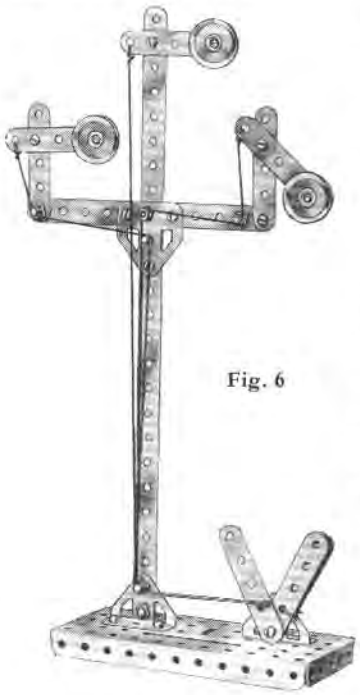


Fig. 6

The railway junction signal shown in Fig. 6 is specially designed for controlling a three-way point, the tallest arm being for the main track, while the two lower arms control the branch lines. Models of this type can be incorporated in a Hornby layout quite successfully when correct model signals are not available. It will be seen that the base of the gantry consists of a 5½" × 2½" Flanged Plate to which two Trunnions are secured. A 12½" Strip is bolted to one Trunnion, and a horizontal 5½" Strip, carrying a 2½" Strip at each end, is secured to the 12½" Strip by means of a Flat Trunnion. The signal arms, which consist of 2½" Strips carrying Pulleys, are pivoted to the uprights by lock-nutted bolts. (S.M.262).

A piece of Meccano cord is attached to each signal arm, and is then passed round the shanks of the bolts and finally tied to the 2½" Strips that form the operating levers. These are pivoted on a ⅜" Bolt that is secured by two nuts to the second Trunnion mounted on the base. The three levers are spaced apart by Washers.

Parts required :

1 of No. 1	15 of No. 37	6 of No. 111c
1 ,, 2	9 ,, 37a	2 ,, 126
8 ,, 5	2 ,, 38	1 ,, 126a
3 ,, 22	1 ,, 52	

Model No. 7. Charabanc

Parts required :

1 of No. 1	4 of No. 9	4 of No. 20a	4 of No. 38	4 of No. 90a
1 ,, 1b	12 ,, 10	1 ,, 21	1 ,, 40	7" ,, 94
4 ,, 2	21 ,, 12	4 ,, 22	1 ,, 48a	1 ,, 96
2 ,, 2a	2 ,, 12a	1 ,, 23	6 ,, 48b	1 ,, 96a
12 ,, 3	1 ,, 15	1 ,, 26	2 ,, 52a	3 ,, 111
1 ,, 5	1 ,, 15a	1 ,, 27a	2 ,, 53	3 ,, 111c
5 ,, 6a	1 ,, 16	2 ,, 29	1 ,, 54	4 ,, 142a
2 ,, 8	1 ,, 16a	112 ,, 37	9 ,, 59	1 ,, 160
2 ,, 8a	1 ,, 17	11 ,, 37a	2 ,, 77	Clockwork Motor

Motor vehicles are always popular subjects for model-building, and consequently the clockwork-driven Charabanc shown in Fig. 7 should be of interest to many model-builders.

The chassis of the model is built up from 12½" Angle Girders, which are extended at the front by 4½" Strips held together by a 2½" × ½" Double Angle Strip.

The Clockwork Motor is secured to the sides of the chassis by means of two 5½" Angle Girders 8 (see Fig. 7a) and the ½" Pinion on the Motor driving shaft engages with a 57-teeth Gear on the Rod 1. Two 1" Pulleys 2 and 3 are secured to each extremity of this Rod, and are connected by cord to two Pulleys on the Rod 4. The jockey Pulley 5, over which one side of the cord passes, is mounted on the Motor side-plate by a Flat Bracket and a ½" × ½" Angle Bracket. The Rod 6, which guides the cord to and from the Pulley 3, is journalled at one end in the side of the chassis, and at the other is a Collar secured to the floor by a Bolt 7 (see Fig. 7).

The model is steered by means of a cord passed four times round the lower end of the steering column and connected to each end of the 3½" × ½" Double Angle Strip 9. The Double Angle Strip is pivoted at its centre hole to a 1½" Strip secured to the front of the bonnet or "radiator" by a 1" × 1" Angle Bracket.

The bonnet is formed from a Sector Plate and 3½" Strips secured at the front by means of a 1½" Flat Girder, and at the rear to a 3½" × 2½" Flanged Plate. A 1" × 1" and a ½" × ½" Angle Bracket bolted to the Plate form bearings for the steering column.

Two 5½" × 3½" Flat Plates are secured to the side Girders of the chassis and 9½" Angle Girders are bolted in position with their elongated holes uppermost. These Girders form supports for the seats, each of which consists of two 2½" Strips connected together by 3½" × ½" Double Angle Strips.

A Flanged Plate forms the back of the rear seat, and to this Curved Strips are attached; a Double Angle Strip is bolted between the Curved Strips, and a 2½" Strip is also secured in position by Angle Brackets. To complete the body-work, 5½" Strips are bolted to the 2½" Strips of the seats to form sides. A 5½" Angle Girder forms the running board, and is held in place by a Flat Bracket and 7½" Strip.

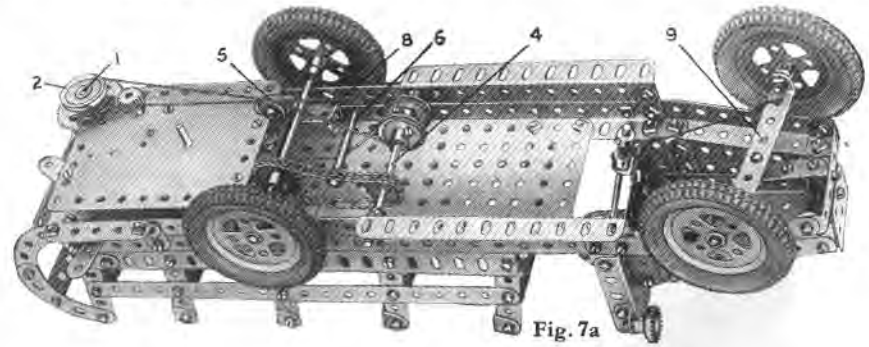


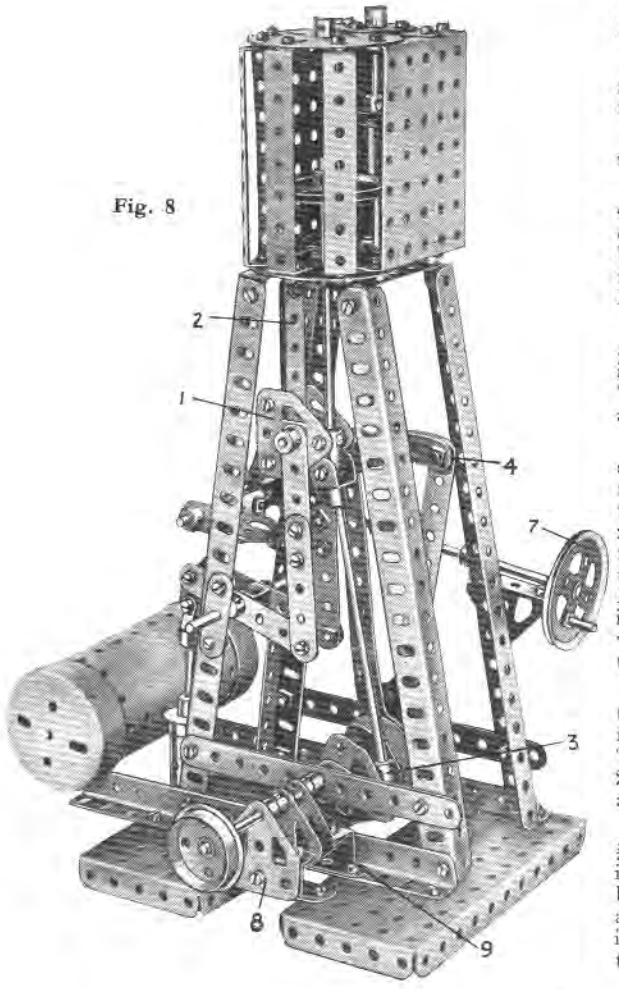
Fig. 7a

Model No. 8. Single Cylinder Marine Engine

The model shown in Figs. 8 and 8a is excellent for demonstration purposes. It is modelled on a well-known type of marine engine, and incorporates an adaptation of George Stephenson's famous locomotive valve gear, suitably modified to meet the requirements of the vertically placed cylinder.

The construction of the cylinder block, cylinder supports and bed of the engine will be clear from Figs. 8 and 8a and only the mechanical features require explanation.

Fig. 8



The crosshead 1 consists of two Flat Trunnions secured together by two Double Brackets, which are free to slide between two 4½" Strips 2 forming the crosshead guides. The Strips 2 are attached at their upper extremities to a ½"×½" Angle Bracket on the bottom cylinder cover, and at their lower extremities to a ½"×½" Angle Bracket that is mounted on a Trunnion. The Strips are spaced apart by a Washer on each of the retaining bolts. A Coupling is secured rigidly to the apex of the crosshead by bolts inserted in its upper transverse tapped bore. This Coupling is secured also to the piston rod, and is attached pivotally to the connecting rod by a Fork Piece that rides on two bolts inserted in its lower transverse tapped bore.

The crankshaft is built up from two Rods on the inner ends of which Cranks are secured very rigidly. The crank pin is a ¾" Bolt, which is fixed securely by nuts in the end holes of the Cranks, and in Flat Trunnions that form the balance weights. The "big end" (a Coupling 3) is free to turn on the crank pin between the Cranks, and is attached to the lower end of the connecting rod.

The valve gear is actuated by two Eccentrics that are mounted upon the crankshaft in such a manner that their "throws" are opposite, and each Eccentric is connected by a 4½" Strip to one end of an "expansion link" 4. This link consists of two 2½" large radius Curved Strips bolted together at each end by a ¾" Bolt and three nuts. On one of these Strips slides a "die block" 5, and the other is connected pivotally to a crank arm 6 by a 2½" Strip. The die block is an Eye Piece, which is attached to the lower end of the valve spindle by a ½" Reversed Angle Bracket and an End Bearing. The crank 6 is mounted on the "weigh shaft" 6a, to one end of which is secured a 1½" Pulley carrying a "spider" (removed from a Swivel Bearing), in which works a Screwed Rod. This rod is rotated by turning the Wheel 7, so actuating the crank 6 and moving the expansion link in the die block.

The "thrust block" 8 consists of two Trunnions and one Flat Trunnion. The two former are bolted down to four Double Brackets 9, Washers spacing each Trunnion from the Double Brackets; while 1½" Strips keep the Trunnions apart. The lower portions of the Double Brackets are clamped between pairs of 2½" Strips bolted to the bed plate to keep the thrust block in position, and the Flat Trunnion is secured in place by a ½"×½" Angle Bracket.

The circulating pump is represented by a Sleeve Piece 10 fitted with a ¾" Flanged Wheel, through which the pump plunger passes. The pump is retained in position by being pushed on to a Chimney Adaptor that is bolted to the base plate, and it is worked off the crosshead through a lever and links. The Boiler secured behind the pump represents the condenser, in which, in actual practice, the steam is condensed ready for re-pumping to the boiler.

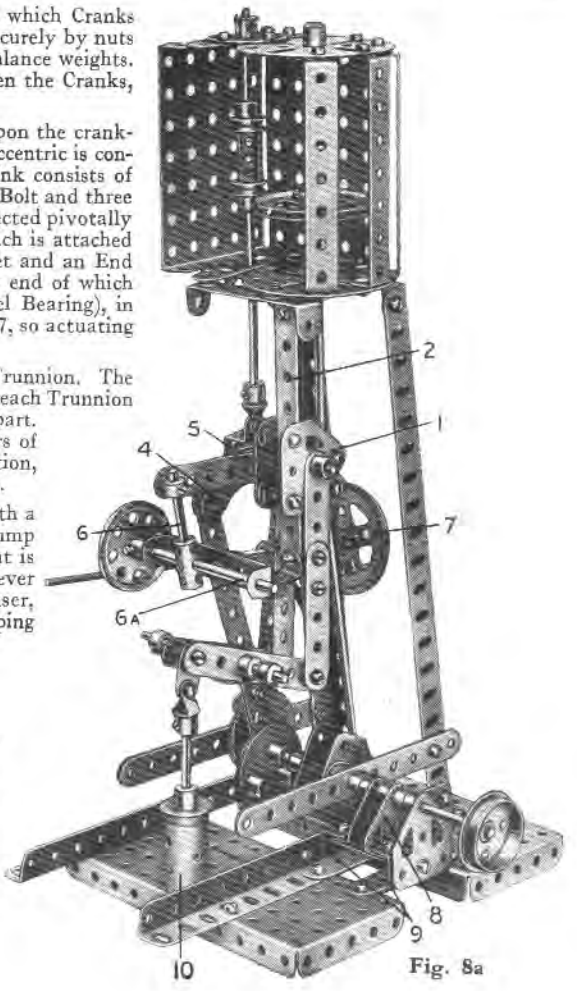
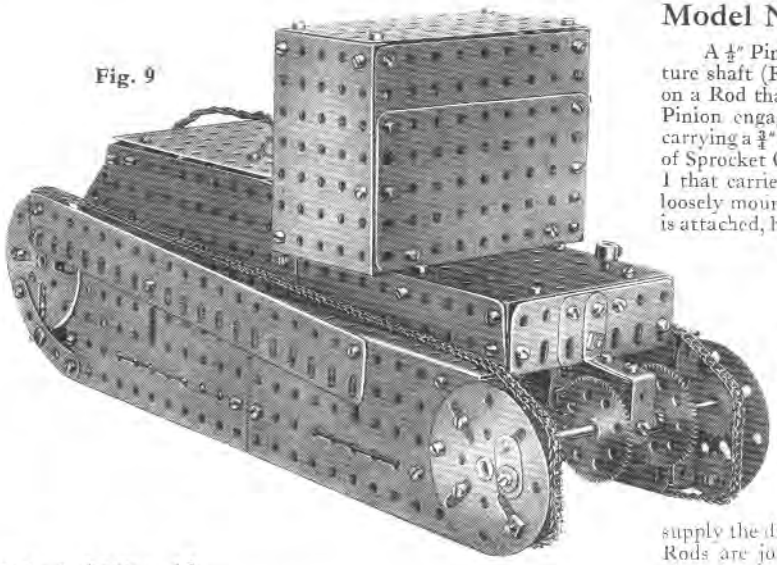


Fig. 8a

Parts required:

4 of No. 2	7 of No. 11	2 of No. 20a	1 of No. 48	1 of No. 80a	5 of No. 126a
4 „ 2a	5 „ 12	1 „ 20b	3 „ 48a	2 „ 90	1 „ 162
1 „ 3	1 „ 14	1 „ 21	3 „ 48b	2 „ 109	1 „ 163
2 „ 4	2 „ 15	1 „ 23	1 „ 50a	2 „ 111	1 „ 164
10 „ 5	4 „ 16	1 „ 23a	2 „ 52	6 „ 111c	1 „ 165
4 „ 6a	1 „ 16a	2 „ 24	3 „ 53	1 „ 115	1 „ 166
4 „ 8a	1 „ 17	86 „ 37	15 „ 59	1 „ 116	
2 „ 8b	2 „ 18a	18 „ 37a	2 „ 62	1 „ 125	
1 „ 10	1 „ 20	24 „ 38	4 „ 63	4 „ 126	

Fig. 9



Model No. 9. Military Tank

A ½" Pinion on the Electric Motor armature shaft (Fig. 9a) engages a 57-teeth Gear on a Rod that carries also a ¾" Pinion. This Pinion engages a 50-teeth Gear on a Rod carrying a ¾" Sprocket, which drives by means of Sprocket Chain a 1½" Sprocket on the Rod 1 that carries also two ½" Pinions. A Collar loosely mounted between two further Collars is attached, by means of a bolt passed through its tapped bore, to a 1½" Strip secured to the Bell Crank 2. A second Collar attached to the other arm of the Bell Crank grips a short Rod passing through the 3½"×2½" Flanged Plate. By moving this Rod the Rod 1 is caused to slide in its bearings, thus bringing either or both of the ½" Pinions into engagement with two 57-teeth Gears secured on short Rods carrying 1" Sprockets, which supply the drive to the driving Chains. These Rods are journalled in a Coupling, held in place by a 1"×1" Angle Bracket 3. This arrangement can be seen quite clearly in Fig. 9.

The 5½" Angle Girders 4 (Fig. 9a) are attached by means of Angle Brackets to the 5½"×2½" Flanged Plates, and form guides for the driving Chains. Further guides consisting of Angle Brackets are fitted to the leading edges of the Plates at each side of the model.

Parts required :

1	of No.	6a	5	of No.	53
6	,,	9	4	,,	53a
1	,,	9a	9	,,	59
2	,,	9b	2	,,	62b
3	,,	9d	1	,,	63
2	,,	10	2	,,	70
14	,,	12	2	,,	90
2	,,	12a	40"	,,	94
2	,,	15a	2	,,	95
4	,,	16a	1	,,	95a
1	,,	18a	2	,,	96
1	,,	25	4	,,	96a
3	,,	26	2	,,	103a
1	,,	27	2	,,	103f
3	,,	27a	4	,,	109
120	,,	37	7	,,	111
12	,,	37a	4	,,	125
20	,,	38	1	,,	128
2	,,	48b	Electric Motor.		
4	,,	52			
3	,,	52a			

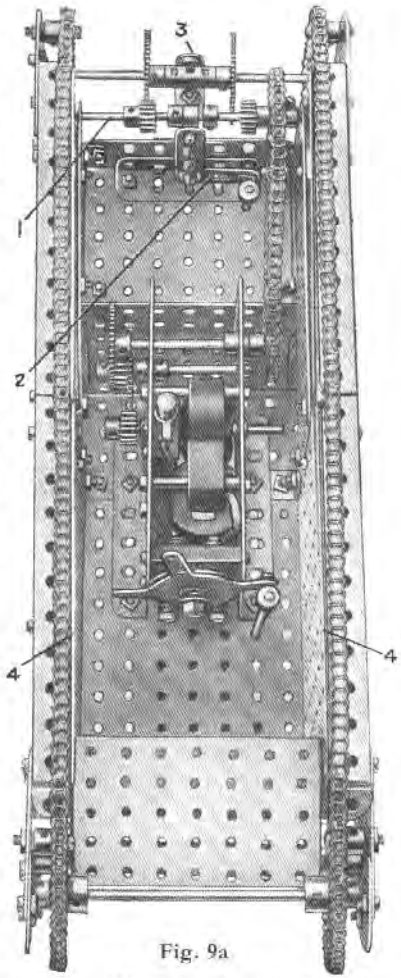


Fig. 9a

Model No. 10. Useful Ratchet Screwdriver

Parts required :

2	of No.	12	2	of No.	37a
1	,,	17	4	,,	48a
2	,,	24	1	,,	58
1	,,	36b	1	,,	63
10	,,	37	1	,,	148

Fig. 10

The Ratchet Screwdriver illustrated in Fig. 10 will be found very useful in Meccano model-building.

No difficulty should be experienced in constructing the stock of the tool, but care should be taken to tighten up the bolts securely. The blade is obtained by removing the blade from a Meccano Special Screwdriver (part No. 36b).

In the built-up screwdriver a Rachet Wheel is secured to the blade as shown in the illustration, and two ½"×½" Angle Brackets, lock-nutted to the Bush Wheel, engage with the Rachet on opposite sides of its diameter. Two pieces of Spring Cord are attached to the Angle Brackets and to the Bush Wheel in order to keep the Brackets in constant engagement with the Rachet Wheel, so that they act as pawls.

When desired the blade can be locked to the handle, by gripping the blade and 2" Rod attached to it by means of set-screws inserted in the bosses of the two Bush Wheels.

Model No. 11. Submarine

Parts required :

4	of No.	1	3	of No.	22	2	of No.	38
5	,,	10	1	,,	24	1	,,	48
2	,,	11	2	,,	35	1	,,	48a
8	,,	12	28	,,	37	2	,,	125
2	,,	17	2	,,	37a	2	,,	126

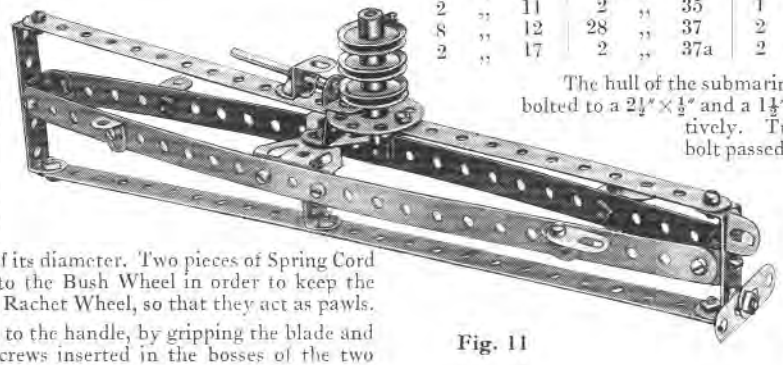
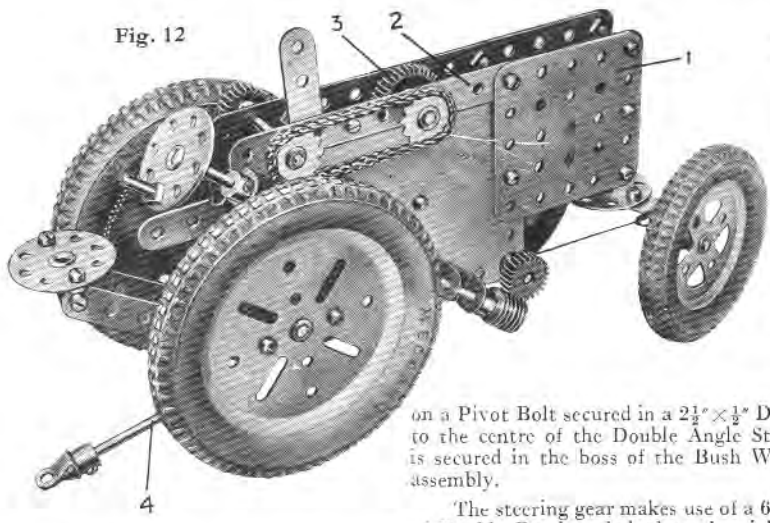


Fig. 11

The hull of the submarine is composed of four 12½" Strips the ends of which are bolted to a 2½"×½" and a 1½"×½" Double Angle Strip at the prow and stern respectively. Trunnions are bolted to the side 12½" Strips, and a bolt passed through their inner extremities secures a ½" Reversed Angle Bracket and an Angle Bracket. The former is attached to the upper 12½" Strip, while the Angle Bracket is connected by means of a Flat Bracket and a further Angle Bracket to the lower Strip.

The "propeller" is formed from two Flat Brackets mounted on a Bolt. To complete the model it is only necessary to attach the "stabiliser fins" and "depth rudders" to the sides of the hull, these consisting of Angle Brackets and Flat Brackets.

Fig. 12



Model No. 12.
Powerful Clockwork Tractor

Fig. 12a clearly demonstrates the remarkable hauling powers of this ingenious model Tractor.

The Clockwork Motor used in the Tractor performs the dual function of chassis and power unit, and a $5\frac{1}{2}$" Strip 2 and a $2\frac{1}{2}$"×$2\frac{1}{2}$" Flat Plate 1 should be bolted to each Motor side plate as shown in Fig. 12. The Plates 1 are held at the correct distance apart by means of two Double Brackets. The centre holes of these Brackets form journals for a 2" Rod about which the front road axle pivots. Each road wheel consists of a 2" Pulley fitted with a Dunlop Tyre, and is mounted on a Pivot Bolt secured in a $2\frac{1}{2}$"×$\frac{1}{2}$" Double Angle Strip. A Bush Wheel is bolted to the centre of the Double Angle Strip and the 2" Rod previously mentioned is secured in the boss of the Bush Wheel, thus completing the front road axle assembly.

The steering gear makes use of a $6\frac{1}{2}$" Axle Rod mounted in journals consisting of Double Brackets bolted to the right-hand side plate of the Motor. A Bush Wheel fitted with a Threaded Pin is mounted on the upper end of this Rod, and a Worm is secured to its lower end. The Worm meshes with a $\frac{3}{4}$" Pinion that is mounted on a 1" Rod journalled in the Motor side plates. A length of cord should be wound round the Rod and the ends tied to the extremities of the $2\frac{1}{2}$" Double Angle Strip forming the front axle.

The gear mechanism is constructed as follows. A 1" Gear Wheel 3 is mounted on a 1" Axle Rod journalled in the Motor side plates in such a manner that it meshes with the primary gear wheel of the Motor. A $\frac{3}{4}$" Sprocket Wheel is also mounted on the shaft of the 1" Gear, and this Sprocket is coupled, by means of Sprocket Chain, to a further $\frac{3}{4}$" Sprocket mounted on another 1" Rod. A $\frac{3}{4}$" Pinion fastened on the second 1" Rod engages with the teeth of a $3\frac{1}{2}$" Gear secured to the rear road axle. The $3\frac{1}{2}$" Gear should be locked securely to its axle by means of two set-screws, and the 3" Pulley forming one of the road wheels should be fastened rigidly to the Gear by two $\frac{3}{4}$" Bolts. A Bush Wheel should be locked by two set-screws to the other end of the axle, and the second 3" Pulley, in addition to being secured by its set-screws, should be attached rigidly to it by two further $\frac{3}{4}$" Bolts.

The drawbar 4 consists of a $3\frac{1}{2}$" Axle Rod fitted with an End Bearing at one end and secured rigidly in a Coupling at the other. A 1" Axle Rod is passed through the transverse bore of this Coupling, the Rod being journalled in the bottom row of holes in the side plates of the Motor and held in place by means of Collars.

The trailer shown in Fig. 12a is constructed from a number of Angle Girders, which provide a rigid frame that will safely support the weight of even the most robust Meccano boy.

Fig. 12a

Parts required :

2	of No. 2	2	of No. 19b	1	of No. 48a	2	of No. 142a
2	,, 3	2	,, 20a	9	,, 59	2	,, 142b
4	,, 11	5	,, 24	1	,, 63	2	,, 147b
4	,, 12	2	,, 25	2	,, 72	1	,, 166
1	,, 14	1	,, 27b	2	,, 77	Clockwork Motor	
1	,, 15a	1	,, 31	9*	,, 94		
1	,, 16	1	,, 32	2	,, 96a		
1	,, 16a	30	,, 37	6	,, 111		
4	,, 18a	12	,, 38	1	,, 115		

Model No. 13. A Novel Meccano Pistol

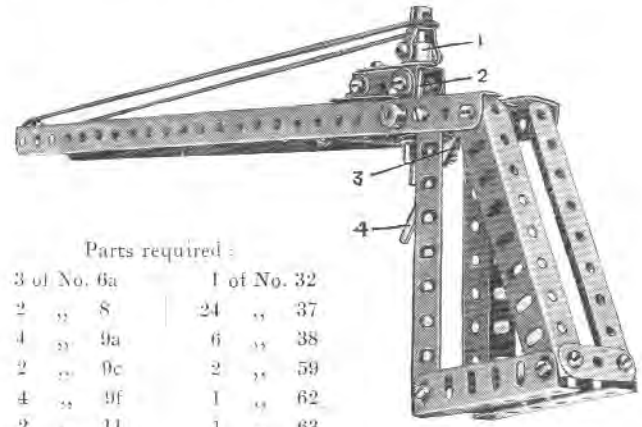


Fig. 13

Parts required :

3	of No. 6a	1	of No. 32		
2	,, 8	24	,, 37		
4	,, 9a	6	,, 38		
2	,, 9c	2	,, 59		
4	,, 9f	1	,, 62		
2	,, 11	1	,, 63		
1	,, 16a	1	,, 77		
1	,, 17	20*	,, 94		
1	,, 26	1	,, 116a		

The novel feature in the Meccano Pistol illustrated in Fig. 13 lies in the fact that instead of Collars or Washers being employed as missiles, a length of Spring Cord or an elastic band is used. The pistol is thus quite suitable for the younger Meccano boys for, although it shoots accurately over considerable distances, it cannot cause serious damage. The actual construction of the model should not prove difficult if the illustration be examined carefully. It will be seen that the handle is composed of four $4\frac{1}{2}$" Angle Girders secured to the rear end of the "barrel" of the pistol, and that the barrel consists of two $12\frac{1}{2}$" Angle Girders. The front ends of the latter are secured to a 1" Triangular Plate.

The release mechanism is constructed as follows. A Small Fork Piece is mounted pivotally on bolts inserted in the grub-screw holes of a Crank 1, which is attached to the pistol by Double Brackets and $1\frac{1}{2}$" Angle Girders. A Rod 2, sliding in the boss of the Crank, carries on its lower end a Worm, while its upper end enters the boss of the small Fork Piece. The Worm engages with a $\frac{1}{2}$" Pinion on a short transverse Rod that is journalled in the $12\frac{1}{2}$" Angle Girders, and to which the trigger 4 is attached by means of a Coupling 3.

Spring Cord is stretched between the 1" Triangular Plate and the boss of the Small Fork Piece, so that when the trigger is pushed the Rod 2 moves downward out of contact with the boss of the Small Fork Piece, which then falls forward and releases the "missile."

Model No. 14. Railway Breakdown Crane

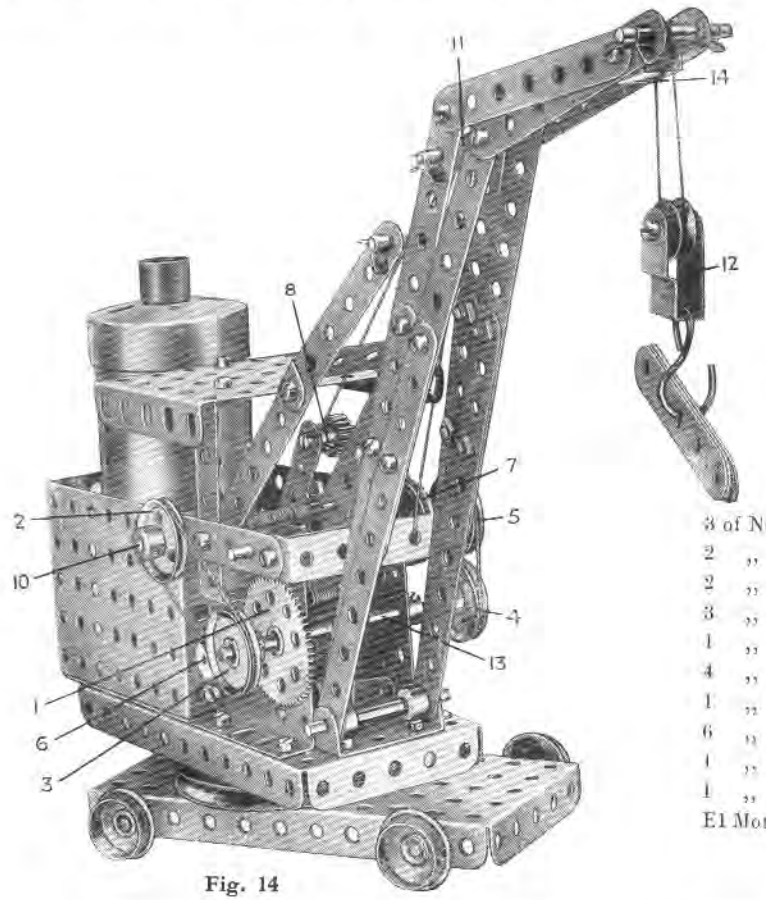


Fig. 14

Parts required:	
10 of	No. 2
6 ,,	3
7 ,,	5
1 ,,	11
1 ,,	12
1 ,,	15a
4 ,,	16
2 ,,	17
3 ,,	18a
1 ,,	19b
4 ,,	20b
4 ,,	22
2 ,,	22a
1 ,,	23
2 ,,	26
1 ,,	27a
9 ,,	35
48 ,,	37
7 ,,	37a
12 ,,	38
2 ,,	40
1 ,,	44
2 ,,	48
3 of	No. 48a
2 ,,	48b
2 ,,	52
3 ,,	53
1 ,,	57
4 ,,	59
1 ,,	111
6 ,,	111c
1 ,,	162
1 ,,	164
E1 Motor.	

In this country railway mishaps are rare, thanks to the highly efficient systems of the railway companies, and the skill and care of their staffs. Now and again an accident does occur, however, and it is then that the ever-ready breakdown crane has to be requisitioned to restore normal working conditions.

Many modern breakdown cranes are capable of lifting loads of from 35 tons to 60 tons. They are specially constructed to travel with ordinary railway rolling stock, and although they are usually hauled by a locomotive, they are also equipped with self-propelling gear.

The Meccano model Breakdown Crane shown in Figs. 14 and 14a, although not following exactly the design of the actual appliance, will nevertheless prove an interesting model to build and operate.

The model incorporates several novel features. It is driven by an E1 Electric Motor, and hoisting and luffing movements are provided. The hoisting and luffing shafts are coupled to the Motor through Pulley friction clutches, and either motion can be brought into action merely by operating a simple hand brake. The travelling base of the Crane consists of a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate, and two $3\frac{1}{2}"$ Axle Rods carrying $\frac{3}{4}"$ Flanged Wheels are journalled in it. A 3" diam. Pulley Wheel is secured to the centre of the Plate by means of $\frac{3}{8}"$ Bolts, and a 2" Axle Rod is placed in the boss of the Pulley. The base of the swivelling superstructure consists of a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate, and this rotates upon the rim of the 3" Pulley, the 2" Rod forming the pivot.

The luffing and hoisting motions of the Crane are built up as follows. The small pinion on the armature shaft of the Electric Motor engages with the 57-teeth Gear 1 (see Figs. 14 and 14a), and imparts the drive to the 1" fast Pulleys 3 and 4 on the $3\frac{1}{2}"$ Rod 13. The 1" Pulley 3 is connected by means of a length of cord to the 1" Pulley 2, which is clamped between two Collars on the hoisting shaft 10. This shaft carries also two $5\frac{1}{2}"$ Strips joined together by a $1\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip as shown, and a 1" fast Pulley (see Fig. 14a) that forms a brake drum. A length of cord is passed round this Pulley and attached at one end to the frame of the Crane, and at the other end to a pivoted lever carrying the $\frac{1}{2}"$ Pinion 9. When the cord is slack round the groove in the Pulley, the friction caused by the Collars pressing against the 1" loose Pulley 2 is sufficient to enable loads to be lifted; but on tightening the cord by depressing the brake lever, the Pulley 2 slips, thus disengaging the hoisting shaft.

The luffing motion is operated by a mechanism similar to that used for hoisting, the drive being taken from the Pulley 4 to the 1" loose Pulley 5 mounted on the luffing shaft. A length of cord is secured to the lever 8 and passes round the 1" fast Pulley 7. By operating the lever, the luffing shaft can be engaged or disengaged as desired. The hoisting cord is first attached to the Rod 10, then passed over the Rod at the jib head and carried down to the $\frac{1}{2}"$ loose Pulley in the block 12. It is finally secured to the Double Bracket 14, which is bolted between the Strips forming the jib head.

The luffing cord is passed over the Rod 11 and round the $1\frac{1}{2}"$ Rod that is carried in the $5\frac{1}{2}"$ Strips mentioned previously. It is then passed back round the Rod 11, round the $1\frac{1}{2}"$ Rod a second time, again over the Rod 11, and finally secured to a $2\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip on the frame. The luffing cords are spaced apart on the Rod 11 by means of Washers.

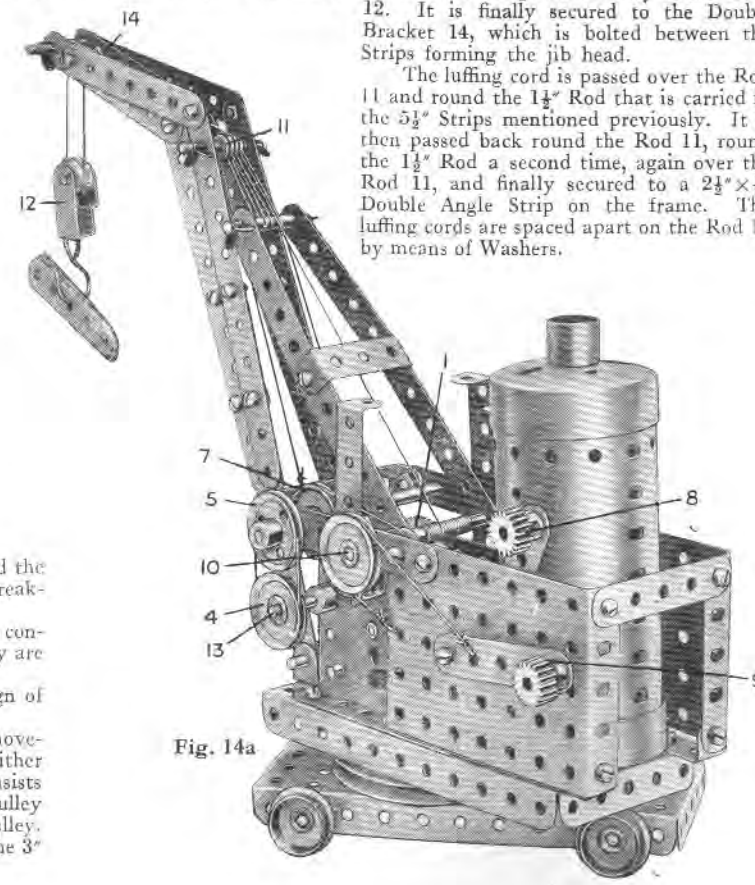


Fig. 14a

Model No. 15. Steam Tug Boat

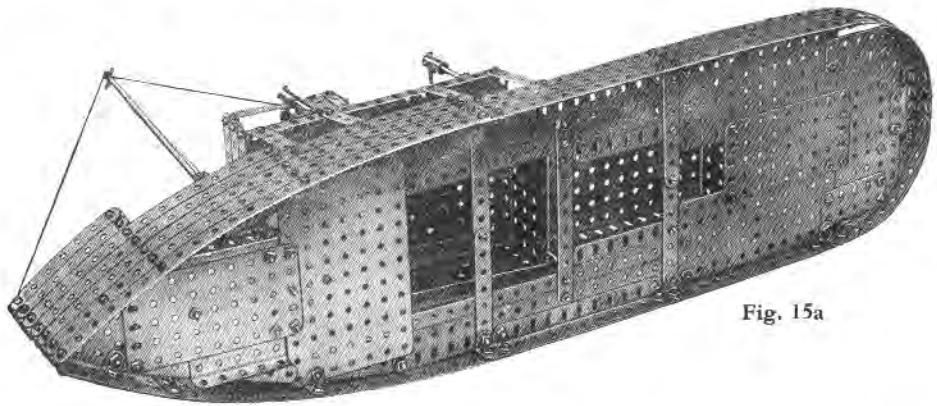


Fig. 15a

Parts required :

14	of No.	1	4	of No.	9f	314	of No.	37	6	of No.	63
2	,,	1a	10	,,	10	5	,,	38	2	,,	70
5	,,	1b	26	,,	12	1	,,	40	2	,,	72
24	,,	2	4	,,	12a	2	,,	48	1	,,	76
4	,,	2a	1	,,	13	6	,,	48b	2	,,	90
15	,,	3	1	,,	15	2	,,	52	1	,,	102
12	,,	4	1	,,	15a	4	,,	52a	2	,,	103a
17	,,	5	4	,,	17	2	,,	53	2	,,	103f
3	,,	6	4	,,	18a	4	,,	53a	1	,,	103h
12	,,	6a	1	,,	18b	6	,,	59	5	,,	111a
2	,,	8b	1	,,	22a	2	,,	62	1	,,	162b
8	,,	9	3	,,	35	2	,,	62b	1	,,	165
6	,,	9d									

The Steam Tug, in spite of its comparatively small size, has a history longer than that of most other types of steamships. The first definitely recorded occasion on which a steam-propelled vessel was used for towing dates back to August, 1816, when a Thames vessel named the "*Majestic*" towed a sailing ship of considerable size from Deptford to Woolwich under extremely bad weather conditions. Up to comparatively recent years tug-boats were mainly concerned with the handling of sailing ships which, as a general rule, required their services on entering harbour. At some ports, such as Liverpool, it was possible, when wind and tide were favourable, for a sailing vessel to be brought into port under sail without the assistance of a tug ; but many ports, such as London, could not be entered by large sailing vessels without assistance.

The sailing ship has gone, and the majority of steamships are able to enter and leave port under their own power, and in some cases to enter dock without assistance. The tug is still required, however, to assist in the task of berthing and docking liners and other steamships that are too large to be manœuvred through dock entrances under their own steam. At every busy port, therefore, is stationed a small fleet of sea-going tugs, which are always in readiness to steam at high speed, in fair weather or foul, to meet an incoming liner and tow her through intricate channels into harbour, and either bring her alongside a landing stage or guide her into dock.

As a rule two tugs take charge of strong manilla hawsers at the bows, while one or more act as an additional rudder by hitching on astern with engines reversed to maintain a "grip" on the tow. With the liner's engines at "stand by" or "dead slow" the small craft are in full control of her movements.

The Meccano model Tug shown in Fig. 15 is a close reproduction of one of these powerful little vessels.

The hull of the model should be assembled first. Each side comprises seven 12½", one 7½", and two 3½" Strips connected by means of transverse Strips. At the bows, the sides are secured together by three Angle Brackets, Strips being employed for spacing them apart amidships. A view of the underside of the model appears in Fig. 15a, and from this the arrangement of the spacing members can be seen clearly. The stern consists of 5½" Strips curved and joined together by 2½" Strips.

Each side of the superstructure consists of a 5½"×2½" Flanged Plate and a 2½"×2½" Flat Plate bolted end to end with a 7½" Strip secured along the bottom. A 4½"×2½" Flat Plate is bolted across the end flanges of the 5½"×2½" Flanged Plates at the rear end, and a 3½"×2½" Flanged Plate and two 3½"×½" Double Angle Strips are secured at the forward end of the superstructure.

The funnel is formed from ten 5½" Strips bolted to a Boiler (part No. 162b) which is compressed so that the edges overlap three holes. It is secured to the deck of the superstructure by a 1"×1" Angle Bracket and two ½"×½" Angle Brackets. The steam whistle is formed by a Coupling held to the funnel by a bolt screwed into its centre tapped hole. The steam pipe is represented by a Rod secured in the Coupling and passed through a hole in the deck of the superstructure.

The mast consists of an 11½" Rod extended at its lower end by a 4½" Rod held in a Coupling. The latter is secured by means of a bolt passed through the 5½" Angle Girder of the bridge and inserted in its lower tapped hole, while the 4½" Rod enters a hole in the deck. A ½" Bolt that carries a 1" loose Pulley and a "spider" (from a Swivel Bearing) fitted with four ½" Bolts to represent the "Wheel" is screwed into the Coupling.

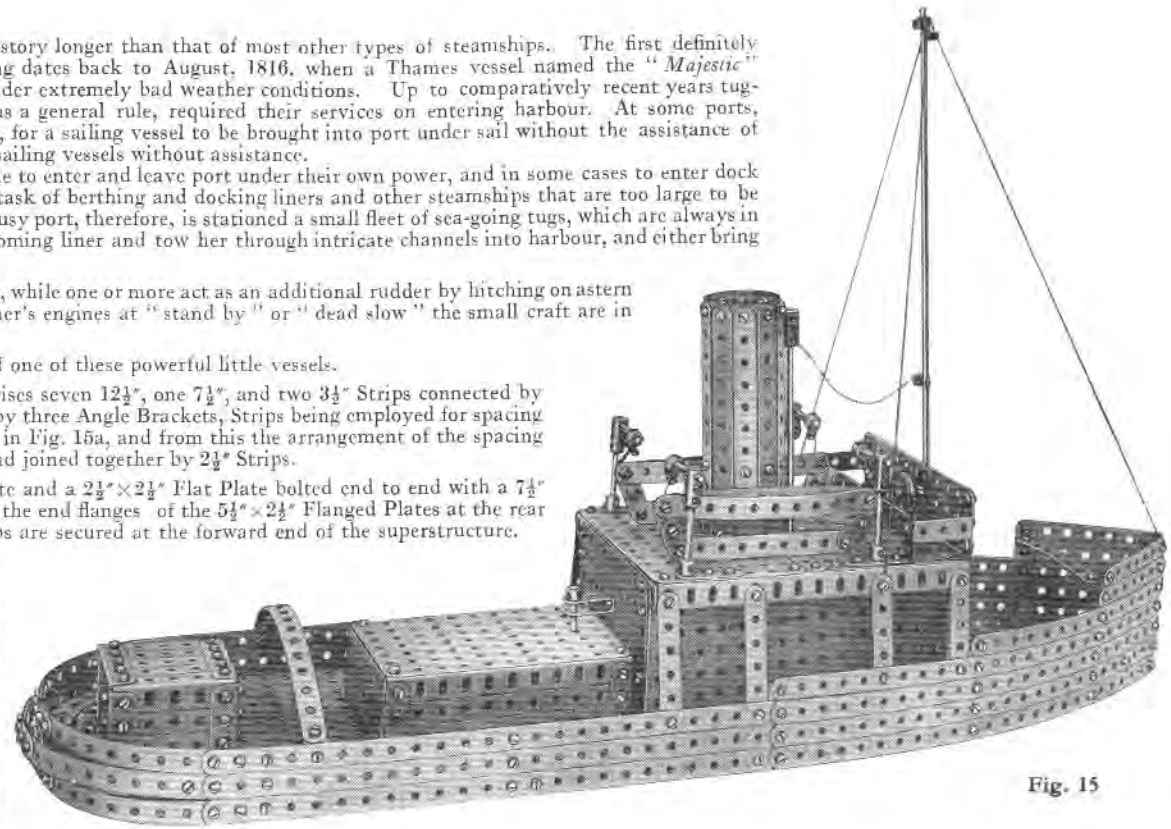


Fig. 15

Model No. 16. Mechanical Man

Although the remarkable Meccano model robot illustrated in Fig. 16 is not capable of working out Square Roots or Compound Interest, it will nevertheless walk forward in a remarkably realistic manner, merely by pressing one of the 1" Pulley Wheels that represent this weird individual's "ears."

The body consists of four $5\frac{1}{2}" \times 3\frac{1}{2}"$ Flat Plates joined together by means of $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates 1 and $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plates 2. The $5\frac{1}{2}"$ Angle Girders forming the arms have attached to them Boiler Ends, inside which are 2" Pulleys; and the "fists" so formed are attached to the arms by means of $2\frac{1}{2}"$ Rods 3 and Collars 4. The complete arms are attached by $\frac{3}{4}"$ Bolts to the shoulders, and an Angle Bracket and a $\frac{1}{2}"$ Bolt 5 are used to secure each elbow to the body.

The $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates forming the head are bolted to the top ends of the $12\frac{1}{2}"$ Girders 6, Fig. 16b. These Girders run from the top of the head to a point halfway down the body, and also support the Electric Motor, which is attached by means of the $2\frac{1}{2}"$ Flat Girders 7.

A 57-teeth Gear and a $\frac{1}{2}"$ Pinion connect the armature spindle to the $2\frac{1}{2}"$ Rod 8 on which is fixed a Worm 9. This engages with a $\frac{1}{2}"$ Pinion 12 on the Rod 10, the latter also carrying two loose Couplings 11 and 11a. The Pinion 12 engages with a $\frac{3}{4}"$ Contrate 13 on a $1\frac{1}{2}"$ Rod journalled in the side plate of the Motor and in the lower loose Coupling 11. This Rod also carries a $\frac{1}{2}"$ Pinion, which engages with the 57-teeth Gear 14 that is mounted on a $1\frac{1}{2}"$ Rod journalled in the Motor side plate and in the top loose Coupling 11a. The latter $1\frac{1}{2}"$ Rod is connected to the crankshaft 15 by Sprocket Chain.

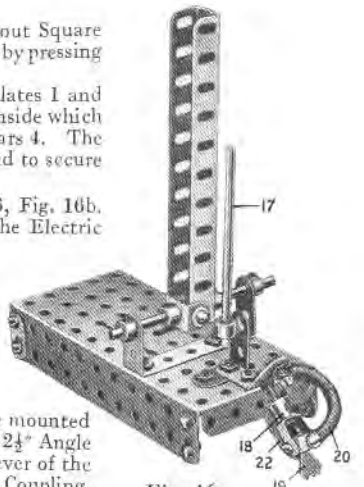


Fig. 16a

The crankshaft carries two Bush Wheels 21 that are fitted with $\frac{3}{4}"$ Bolts on which are mounted loose Pulleys 16. These Pulleys are spaced by Washers so as to slide between the two $12\frac{1}{2}"$ Angle Girders forming each leg. A short Rod engaging with one of the holes in the reversing lever of the Electric Motor is fixed to the Rod holding the 1" Pulleys forming the "cars," by means of a Coupling, and held in place by two Collars. By pressing either of the Pulleys the Motor can thus be started or stopped.

The Motor unit and transmission gear complete may now be fixed in place by bolting the two $12\frac{1}{2}"$ Angle Girders flush with the back of the body and with both the flanges of the Motor side plates to the front. Two $\frac{1}{2}"$ Bolts 23 spaced by Washers are used to secure the latter.

The feet are each constructed as follows. A $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate is raised on $5\frac{1}{2}"$ Strips as shown in Fig. 16a, and a $2\frac{1}{2}" \times 1"$ Double Angle Strip bolted to the top of the Plate carries a $3\frac{1}{2}"$ Rod. Two $5\frac{1}{2}"$ Angle Girders connected together by a Double Bracket are held in place on this Rod by Collars. Two $1" \times 1"$ Angle Brackets are bolted to the rear end of the foot as shown. One carries a $3\frac{1}{2}"$ Rod 17, while a Swivel Bearing 18 attached to the other by a $\frac{3}{4}"$ Bolt carries a Centre Fork 19, which is held against the ground by the Spring 20. A Flat Bracket 22 attached as shown to the "spider" and boss of the Swivel Bearing, prevents excessive movement of the Centre Fork.

The $12\frac{1}{2}"$ Angle Girders forming the upper parts of the legs are bolted to the $5\frac{1}{2}"$ Angle Girders of the feet, and the complete legs are pivoted by bolts and lock-nuts immediately below the $\frac{3}{4}"$ Bolts holding the arms. The $3\frac{1}{2}"$ Rod 17 is connected to an $11\frac{1}{2}"$ Rod 20 by means of a Coupling, the whole being pivoted one inch to the rear of the leg pivot as follows. A bolt is passed through the Plate 1 and into the set-screw hole of a Collar on the Rod 20, and the bolt is screwed home until the Collar is fast on the Rod, leaving the bolt free to turn in the Plate.

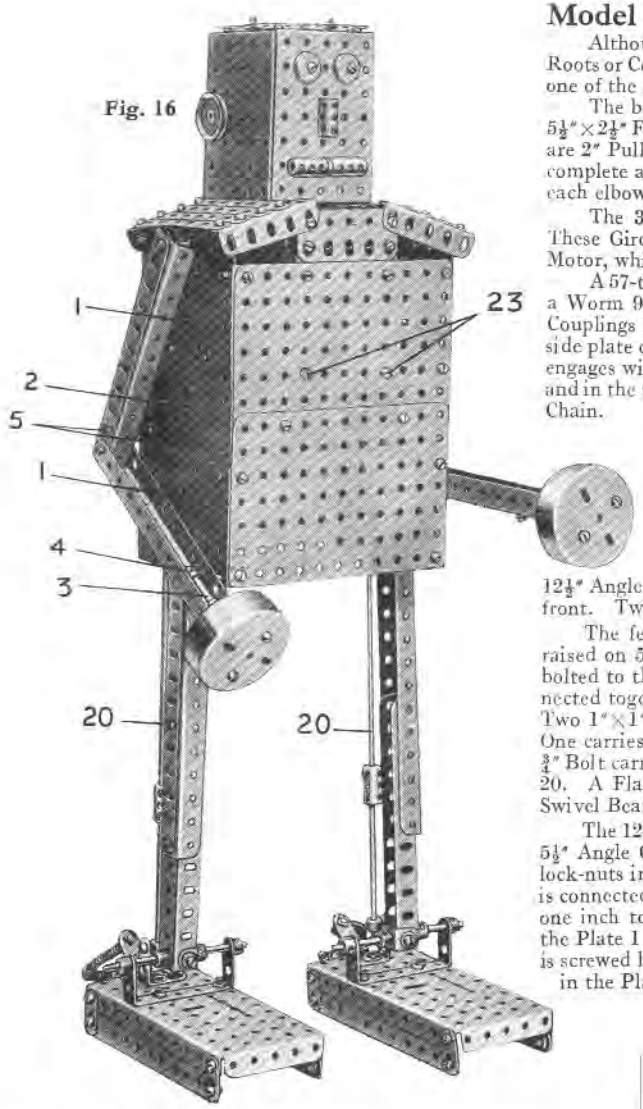


Fig. 16

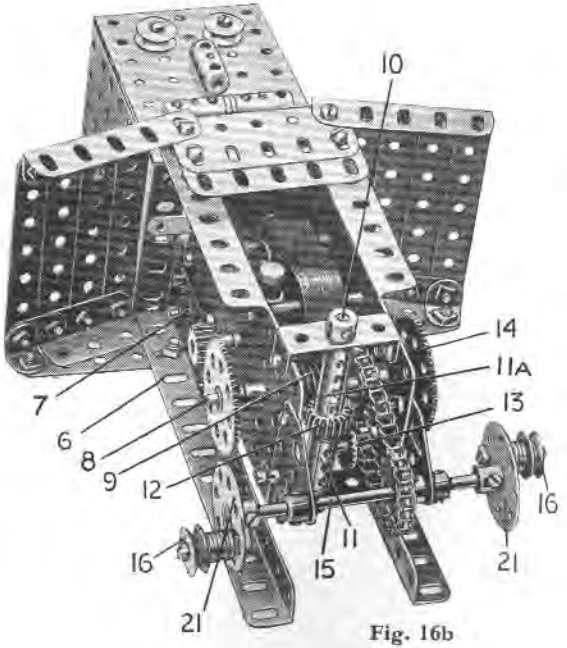


Fig. 16b

Parts required:

28	of No.	2	12	of No.	10	2	of No.	16b	2	of No.	24
10	,,	3	2	,,	11	1	,,	17	3	,,	26
4	,,	8	3	,,	12	2	,,	18b	2	,,	27a
2	,,	8b	4	,,	12a	2	,,	20	1	,,	29
12	,,	9	2	,,	13	4	,,	20a	1	,,	32
3	,,	9d	5	,,	16	2	,,	22	114	,,	37
2	,,	9f	3	,,	16a	4	,,	23	15	,,	37a
									31	,,	38
									2	,,	43
									2	,,	46
									1	,,	48

2	of No.	52	1	of No.	96a			
4	,,	52a	2	,,	103f			
7	,,	53	8	,,	111			
1	,,	53a	4	,,	111a			
23	,,	59	6	,,	111c			
8	,,	63	2	,,	126a			
2	,,	65	2	,,	162a			
2	,,	70	2	,,	165			
1	,,	72	Electric Motor.					
6	,,	94						
1	,,	96						

Model No. 17. Motor Lorry

Parts required:

8	of No.	2	1	of No.	18a
1	,,	3	4	,,	19b
10	,,	5	2	,,	22
6	,,	10	1	,,	24
1	,,	15	12	,,	35
1	,,	15a	49	,,	37
2	,,	16	3	,,	38
			1	,,	45
			4	,,	48a
			1	,,	52
			1	,,	54
			2	,,	62
			2	,,	111c
			2	,,	126a
			Clockwork Motor		

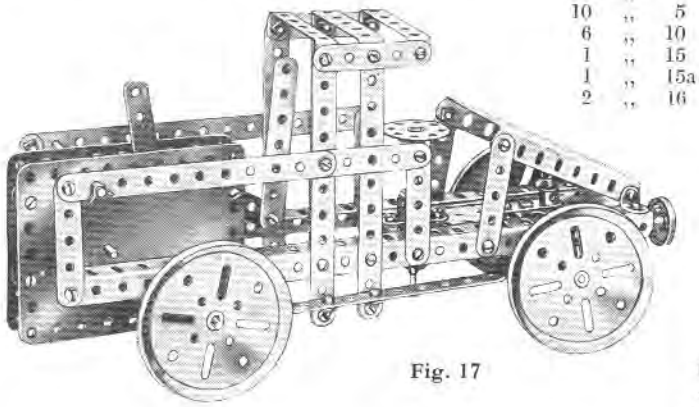


Fig. 17

Two 12½" Angle Girders are bolted to the side flanges of a 5½" × 2½" Flanged Plate, and to these are bolted 2½" Strips to support a Sector Plate that forms the "bonnet," the front end of this Plate being secured to the chassis frame by Angle Brackets.

The lorry is steered by means of a Bush Wheel on the end of a 3½" Rod journalled in a Double Bent Strip bolted to the 5½"×2½" Flanged Plate. Cord is wound round the lower end of the Rod and tied to each end of the Double Angle Strip carrying the front road wheels.

The rear wheels are mounted on a 3½" Rod, journalled in Flat Trunnions and passed through the holes in the sides of the Clockwork Motor in which the standard Motor spindle is normally journalled, the special Motor Pinion being secured on the 3½" Rod by its grub-screw.

Model No. 18. Mechanical Gong

Parts required:

1	of No.	2	1	of No.	12	2	of No.	38
1	,,	3	1	,,	19	1	,,	52
3	,,	5	1	,,	24	1	,,	54
4	,,	10	2	,,	35	2	,,	126a
			16	,,	37			

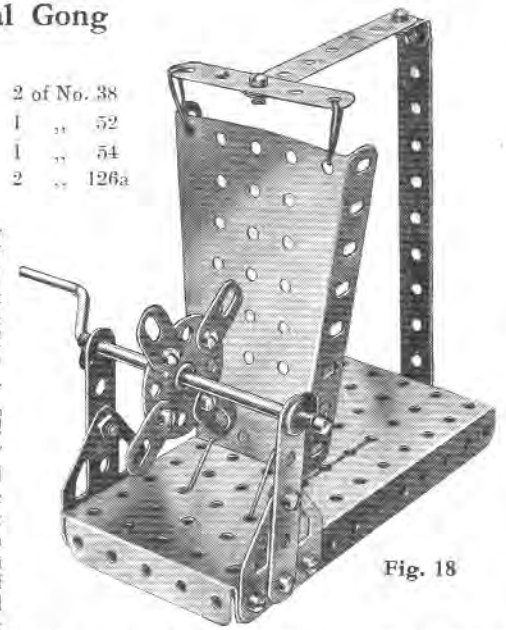


Fig. 18

This model has been called a "dinner gong," but although it is capable of emitting a certain amount of sound when the handle is turned rapidly, we doubt whether it would provide adequate warning to intending diners, especially if any of these were Meccano boys deeply engrossed in building a new model. Connect the spindle to a Clockwork Motor, however, and a really terrific din will result!

In order to build the model, a 5½" Strip should be bolted in a vertical position to a 5½"×2½" Flanged Plate forming the base. This Strip carries at its upper end an Angle Bracket to which a 3½" Strip is secured, a 2½" Strip in turn being bolted at right angles to the end of the 3½" Strip. A Sector Plate is suspended from the latter Strip by means of two short pieces of string or elastic, and is attached to the base by similar means. The operating handle is journalled in two 2½" Strips held by means of Flat Trunnions to the 5½"×2½" Flanged Plate, and carries a Bush Wheel to which four Flat Brackets are bolted. As the handle is turned, the Flat Brackets strike the Sector Plate, thus causing a ringing sound.

Model No. 19. Auto-Giro Aeroplane

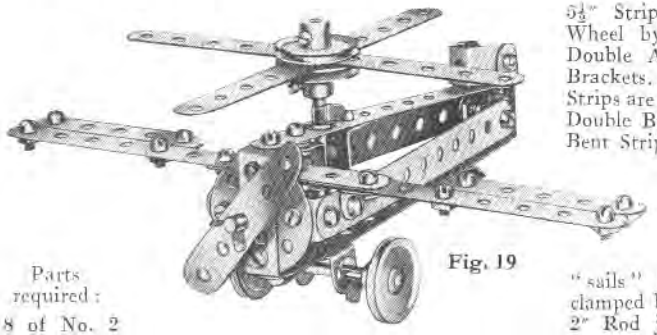


Fig. 19

Parts required:

8	of No.	2	4	of No.	22	5	of No.	38
3	,,	5	1	,,	24	1	,,	44
5	,,	10	5	,,	35	1	,,	48
2	,,	11	31	,,	37	2	,,	125
8	,,	12						
2	,,	17						

The fuselage consists of four 5½" Strips secured to a Bush Wheel by means of a 1½"×½" Double Angle Strip and Angle Brackets. The other ends of the Strips are connected by Angle and Double Brackets, and a Cranked Bent Strip forming the tail fin is held in place by similar means.

The wings are built up from Strips, and the revolving "sails" from two 5½" Strips clamped between 1" Pulleys on a 2" Rod journalled in a Double Bent Strip, and in the upper Strip of the "fuselage." The propeller is fitted on a 1½" Rod held in the Bush Wheel forming the front portion of the fuselage.

Model No. 20. A Simple Catapult

An Angle Bracket is secured to one of the Sector Plates forming the base, and a 2½" Strip is attached pivotally to it. The upper end of the Strip rests against the Flanged Plate, and by adjusting the Strip, the angle between the base and the Plate can be varied.

A 2½"×½" Double Angle Strip is mounted pivotally between two Trunnions bolted to the Flanged Plate; and a 3½" Rod passed through the centre hole in the Double Angle Strip is held in place by two 1" Pulleys. This Rod also carries a 2½" Strip 4, which is connected to the Flanged Plate by a length of Spring Cord. To work the model a small pellet should be placed on the Spring Clip attached to the Rod 2, and the latter then depressed and released.

Parts required:

8	of No.	5	1	of No.	52
1	,,	12	2	,,	54
2	,,	16	2	,,	111c
2	,,	22	2	,,	126
3	,,	35	2	,,	126a
24	,,	37	Piece of Spring Cord or Elastic.		
7	,,	37a			
2	,,	48a			

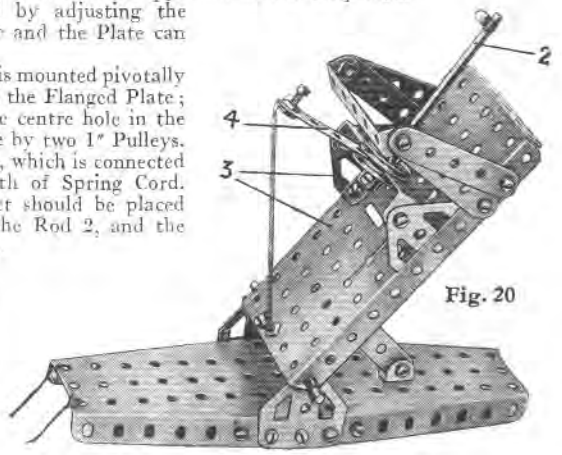
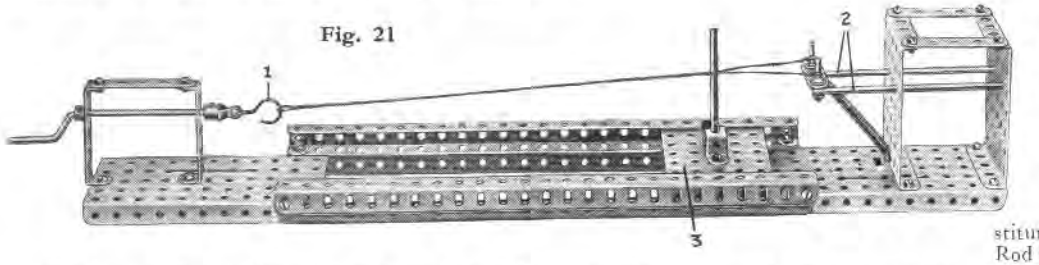


Fig. 20

Model No. 21. Flex-Twisting Machine

Fig. 21



The base of the machine consists of two 5½"×2½" Flanged Plates connected together by a pair of 12½" Angle Girders, and a second pair of Angle Girders are attached by means of Angle Brackets so as to form channels in which the 3½"×2½" Flanged Plate 3 may slide. Two 3½"×2½" Flanged Plates are bolted in an upright position to one of the 5½"×2½" Flanged Plates, and two 4½" Rods 2 are placed as shown so that they can slide longitudinally. A Collar is mounted on the end of each of the Rods 2 and a 1½" Strip held in place between the Collars by means of Threaded Pins, which are secured in the threaded bores of the Collars. A Crank Handle fitted with an End Bearing and Hook 1 is journalled in two Double Angle Strips.

Parts required:

3	of No. 5	1	of No. 16	1	of No. 43	1	of No. 57
1	,, 6a	1	,, 19s	1	,, 45	3	,, 59
4	,, 8	2	,, 35	2	,, 48a	2	,, 115
4	,, 12	32	,, 37	2	,, 52	1	,, 166
2	,, 15a	2	,, 38	3	,, 53		

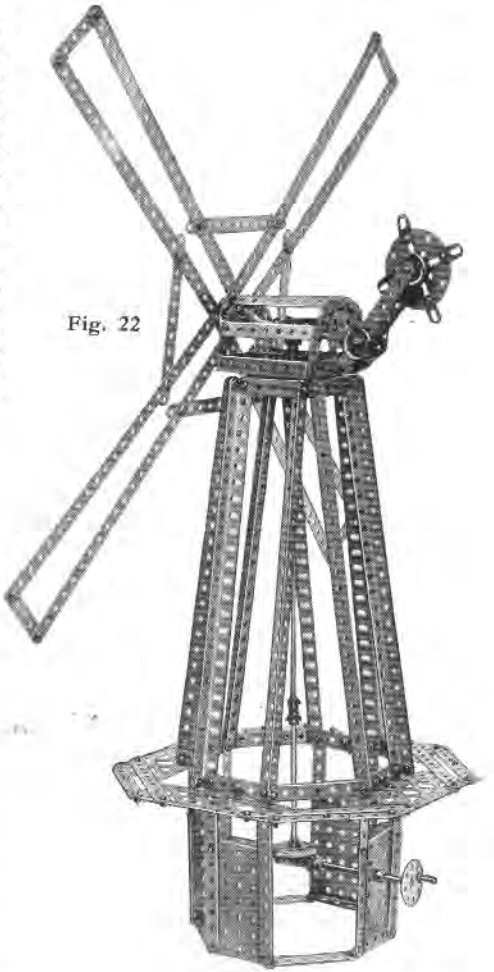
Model No. 22. Windmill

The octagonal base of the mill comprises four 3½"×2½" Flanged Plates to which 5½" Strips are secured. The upper ends of each pair of Strips are attached to 12½" Angle Girders spaced by a 2½" Strip. Four 2½"×½" Double Angle Strips are fitted between the four pairs of Girders so formed, but the ends of the Strips should be slightly bent outward. At the upper ends the Angle Girders are held together by 2½" Strips and Angle Brackets, a 3" Pulley being attached, boss downward, to the Strips by means of Angle Brackets. A second Pulley is attached to the superstructure by 1½" Strips spaced from the Pulley by Collars, and secured by Angle Brackets to the 2½" Strips of the frame. The two Wheels are placed together to form a substitute for a roller bearing, and a 11½" Rod is passed through their bosses.

A Rod journalled in the Plates forming the base of the model carries a handwheel and a ½" Pinion. A Coupling, remaining idle on the Rod but held in place by Collars, forms a journal for the rod passing up the centre of the model. A Contrate Wheel is fitted at the base of the Rod, and at its upper extremity a ½" Pinion is secured, to mesh with a ¾" Contrate on the Rod carrying the sails. Journals for this Rod are formed by a Flat Bracket and Flat Trunnion.

Two 4½" Strips are attached to a Double Bracket of the superstructure to form journals for a short Rod carrying the fantail. A 1" Pulley on this shaft is connected by a belt of cord to the lower 3" Pulley attached to the frame, so that as the cap of the mill revolves the fantail is caused to rotate.

Fig. 22



Parts required:

8	of No. 1	2	of No. 26				
16	,, 2	1	,, 28				
2	,, 2a	1	,, 29				
6	,, 3	2	,, 35				
4	,, 4	126	,, 37				
16	,, 5	6	,, 37a				
2	,, 6a	10	,, 38				
8	,, 8	4	,, 48a				
5	,, 10	6	,, 48b				
1	,, 11	4	,, 53				
12	,, 12	9	,, 59				
1	,, 13	2	,, 63				
1	,, 13a	4	,, 90				
2	,, 15a	2	,, 90a				
2	,, 18a	4	,, 100				
2	,, 19b	1	,, 109				
1	,, 22	6	,, 111c				
2	,, 22a	1	,, 115				
2	,, 24	1	,, 126a				

Model No. 23. Novel Meccano Calendar

The Meccano calendar shown in Fig. 23 should form a very acceptable present, for it is both useful and ornamental. The construction of the model is fairly apparent from the illustration, and we do not propose to go into details of the casing, since this is best modified to suit individual requirements.

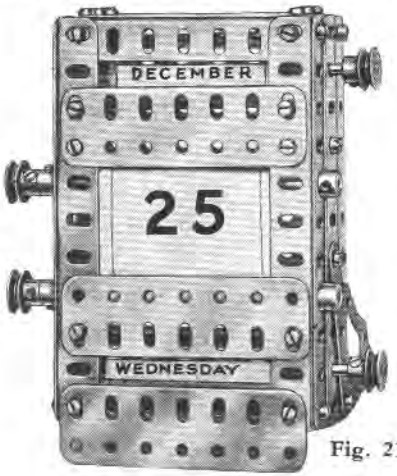


Fig. 23

The names of the months are neatly written out on a piece of paper of such a length that it wraps exactly once round a Wood Roller, which may be turned when it is desired to change the month, by rotating the ½" fast Pulley at the top right-hand corner. The numbers of the days are inscribed on a large strip of paper that may be wound off or on two Rods; the Pulleys for manipulating these are to be seen on the left. Another Wood Roller is provided on which the days of the week are written. These should be carefully printed with Indian ink on a piece of cartridge paper of the correct length and width.

Parts required:

2	of No. 2	32	of No. 37
4	,, 9	1	,, 52a
4	,, 9b	4	,, 59
4	,, 9f	4	,, 103d
4	,, 15a	2	,, 106
4	,, 23a	2	,, 108

Model No. 24. Power-Driven Flyboats

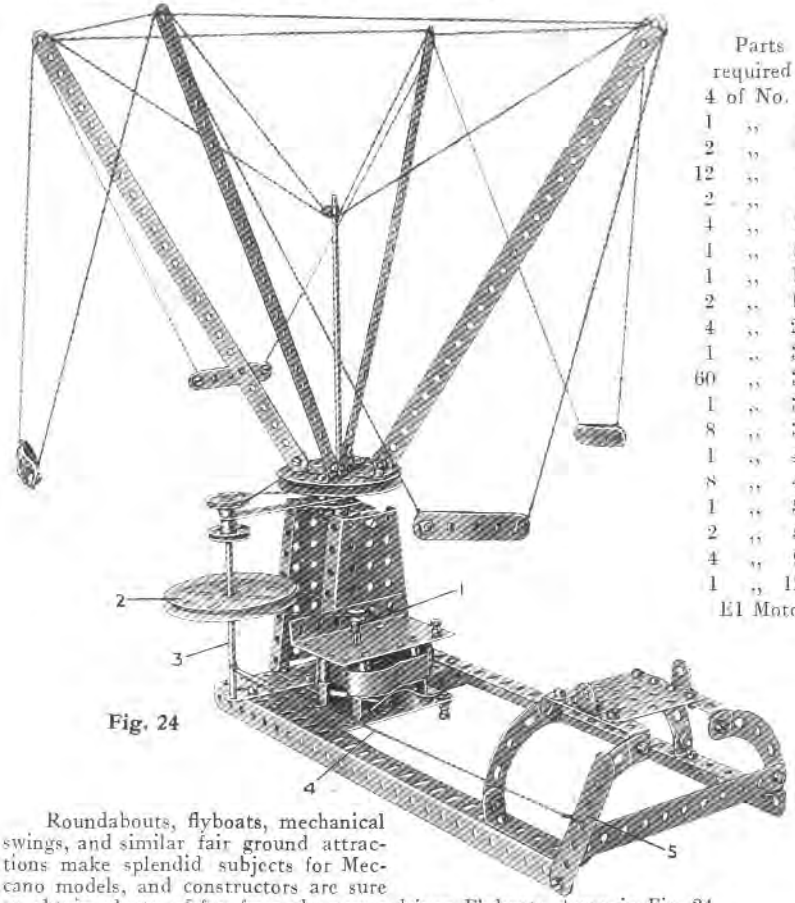


Fig. 24

Parts required:

4	of No.	1
1	,,	2
2	,,	3
12	,,	5
2	,,	8
4	,,	12
1	,,	13
1	,,	15
2	,,	19b
4	,,	22
1	,,	35
60	,,	37
1	,,	37a
8	,,	38
1	,,	40
8	,,	48a
1	,,	52
2	,,	54
4	,,	90a
1	,,	126a

E1 Motor.

Roundabouts, flyboats, mechanical swings, and similar fair ground attractions make splendid subjects for Meccano models, and constructors are sure to obtain plenty of fun from the power-driven Flyboats shown in Fig. 24.

The rotating structure consists of an 11½" Rod carrying a 3" diam. Pulley Wheel, to which four 12½" Strips are secured by Angle Brackets.

The rotating portion is journalled in a 2½" × ½" Double Angle Strip, which is secured between two Sector Plates, and the 5½" × 2½" Flanged Plate forming part of the base frame.

The drive from the Motor is taken to the 5½" Axle Rod 3, by means of an endless length of cord passed round the 3" Pulley 2 and the Pulley mounted on the armature shaft of the Motor. A crossed belt, passed round the 1" Pulley on the shaft 3, and also round the groove in the 3" Pulley on the rotating structure, completes the drive. A brake for controlling the speed of the model is fitted to the shaft 3. This consists of a length of cord secured to the base frame and passed twice round the Axle 3. The cord is finally tied to the pivoted Strip 5. On moving the lever 5 the cord can be drawn tight round the axle 3, when the drive between the Pulleys 1 and 2 will slip and full power will not be transmitted to the revolving structure.

Model No. 25. Parasol Type Monoplane

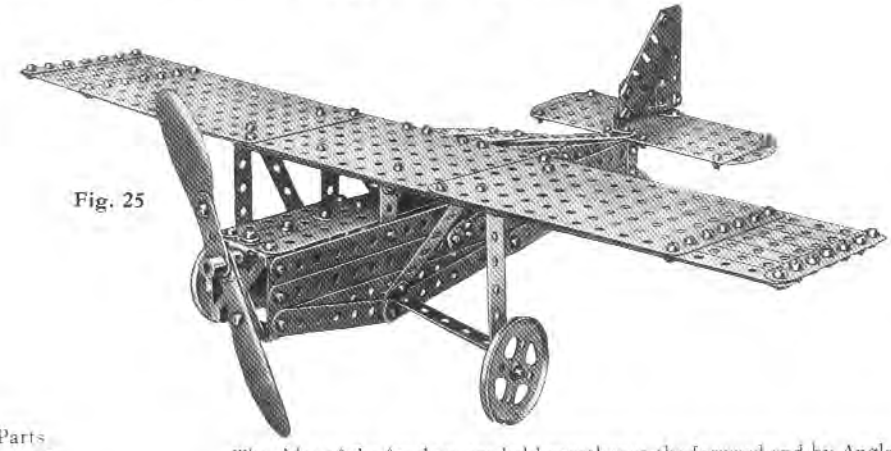


Fig. 25

Parts required:

6	of No.	1
2	,,	1b
6	,,	2
4	,,	2a
12	,,	3
6	,,	4
17	,,	5
2	,,	6
5	,,	6a
6	,,	10
2	,,	11
11	,,	12
2	,,	12a
1	,,	16a
2	,,	20a
106	,,	37
6	,,	37a
8	,,	38
2	,,	41
1	,,	48
2	,,	48a
3	,,	52a
1	,,	59
2	,,	62
1	,,	70
2	,,	90a
3	,,	103f
2	,,	111
2	,,	111c
2	,,	126

The sides of the fuselage are held together at the forward end by Angle Brackets and Trunnions, and at the rear by 1" × 1" Angle Brackets bolted to the 4½" × 2½" Flat Plate forming the tail plane.

The main plane consists of three 5½" × 3½" Flat Plates bolted together and strengthened by two 12½" Strips overlapped and secured to the leading edge of the plane. The wings are extended by means of 2½" Strips, which are held rigid by 3½" Strips bolted across their ends.

Curved Strips are secured across the ends of the 5½" × 2½" Flat Plate forming the tail plane, and the "fin," which consists of three Flat Girders is secured to the tail plane by Angle Brackets.

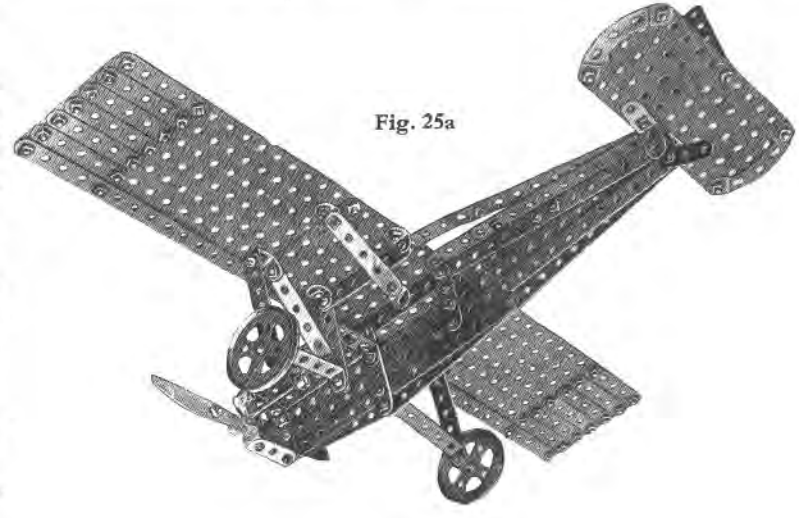


Fig. 25a

Model No. 26. Field Gun

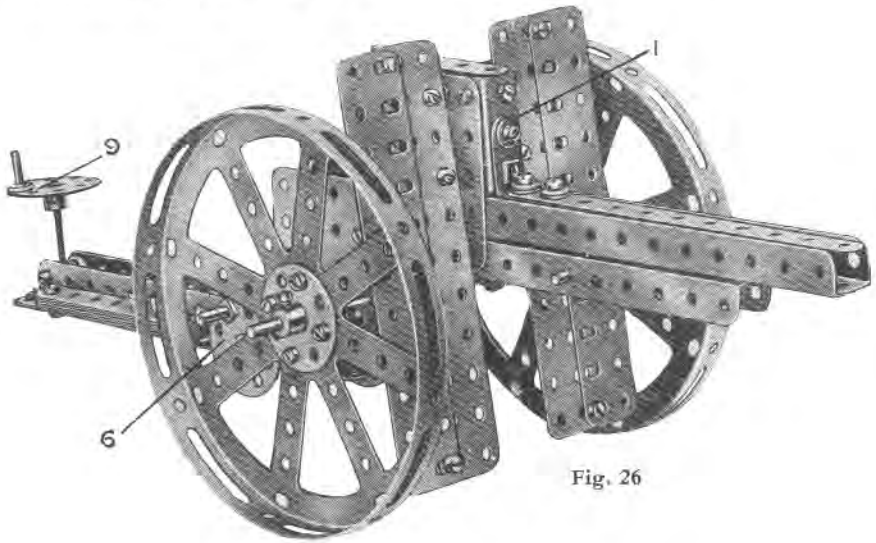


Fig. 26

Here is an interesting model that incorporates an ingenious "quick firing" or "repeater" action, by means of which twelve Meccano Steel Balls, which form the "shells," can be fired in succession at one loading. This repeater action should make the model particularly interesting to those Meccano enthusiasts who like to construct models that are more or less automatic in action.

The construction of the model, which is quite simple, should be commenced by assembling the gun barrel and magazine chamber. This is shown removed from the undercarriage and partly dismantled for the sake of clearness in Fig. 26a.

Each side of the magazine chamber is built up from two 2½"×2½" Flat Plates with corners overlapping. The two upper plates have two 1½" Angle Girders 10 and one Channel Bearing 1 (see Fig. 26a) bolted to them; and the bottom plates are joined together by a Double Bracket. The barrel of the gun is built up from two 7½" Angle Girders, secured together to form a channel section girder by two bolts at the "breech" end. The end bolt also holds a Double Bracket in place inside the barrel, and the dummy recoil chamber, which consists of two 5½" Angle Girders 11, is secured in position underneath the barrel by the second bolt.

A 2" Axle Rod, forming the discharge plunger, is arranged to slide in the two holes of the Double Bracket that is secured inside the gun barrel; and a Small Fork Piece 3, carrying a ⅜" Bolt, is fastened on the end of the Axle Rod. A second 2" Rod 4, working freely in the jaws of the Small Fork Piece, is secured to a Coupling that is pivoted on the Rod 12. This arrangement is shown clearly in Fig. 26a.

The firing mechanism operates in the following manner. On turning the Bush Wheel 6 (see Figs. 26 and 26a), which is secured to the Rod 6a, the Bush Wheel 5 is rotated slowly through the reduction gearing 13, which consists of a ½" Pinion and a 57-teeth Gear Wheel. The Bush Wheel 5 carries in one of its radial holes a ⅜" Bolt that strikes the lower portion of the Rod 4 and pulls back the small Fork Piece 3, which is attached to the plunger, against the action of the Springs 15. The plunger is now clear of the space between the 2" Strip 2, that forms the floor of the "magazine," and the end of the Channel Bearing 1. This movement allows a single Steel Ball to fall from the magazine chamber into the barrel directly in front of the end of the 2" Rod forming the plunger. On continuing the movement of the hand wheel 6, the Bolt secured to the Bush Wheel 5 slips off the end of the Rod 4, and allows the plunger to strike the "shell" and so shoot it from the gun.

The 6½" Axle Rod that carries the road wheels is journalled in the end holes of the 3" Strips 8, and "axle covers" are provided by bolting a 1½" Angle Girder on each side of the magazine chamber to the ½"×½" Angle Brackets 14. To provide the crews of real guns with protection from machine gun and rifle fire, shields of heavy gauge steel are usually provided; and these are represented in the model by two pairs of 5½" Flat Girders overlapped and bolted together, and secured to the sides of the magazine chamber by means of the Angle Brackets 7.

The trailing girder is built up from two 7½" Angle Giredrs joined together at the outer end by means of a 1½" Strip, and secured at the inner end to the lower holes of the plates forming the magazine chamber. The elevating apparatus consists of a 2" Threaded Rod, surmounted by a hand wheel 9 consisting of a Bush Wheel fitted with a Threaded Pin, the Rod working in a Threaded Boss secured to the 7½" Angle Girders by Bolts fitted with Washers for spacing purposes.

It will be seen from Fig. 26 that several 3½" Strips are bolted to each side of the trailing girder in order to balance the weight of the gun barrel and magazine. When the gun is completely assembled, a 5½" Strip should be placed in position along the top of the barrel and secured to the Channel Bearing 1, Fig. 26, by means of a 1"×1" Angle Bracket.

With this model before him, and a suitable target to shoot at, a Meccano boy has a splendid source of entertainment that will make the hours slip by in marvellous fashion.

Parts required:

1 of No. 2	2 of No. 9	2 of No. 18b	2 of No. 43	6 of No. 111c
24 „ 3	4 „ 9f	5 „ 24	9 „ 59	1 „ 114
2 „ 4	2 „ 11	1 „ 26	1 „ 63	2 „ 115
1 „ 5	9 „ 12	1 „ 27a	1 „ 64	1 „ 116a
1 „ 6	1 „ 12a	52 „ 37	4 „ 72	2 „ 118
1 „ 6a	1 „ 14	4 „ 37a	1 „ 81	1 „ 160
4 „ 8b	4 „ 17	20 „ 38	4 „ 103	

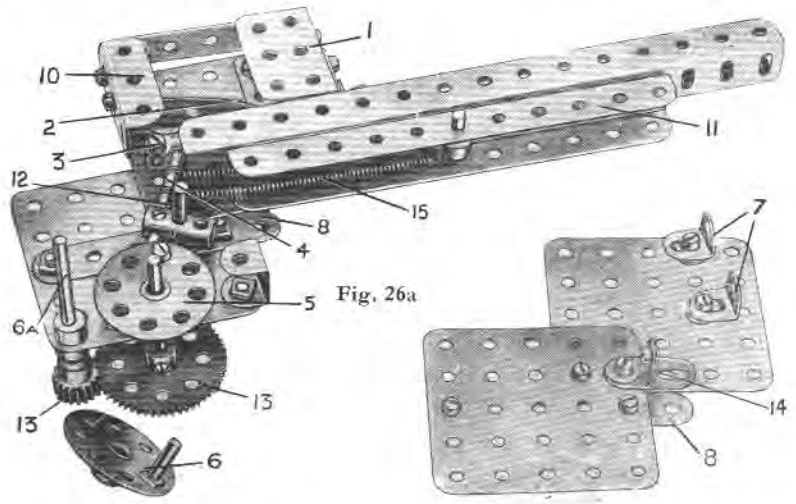
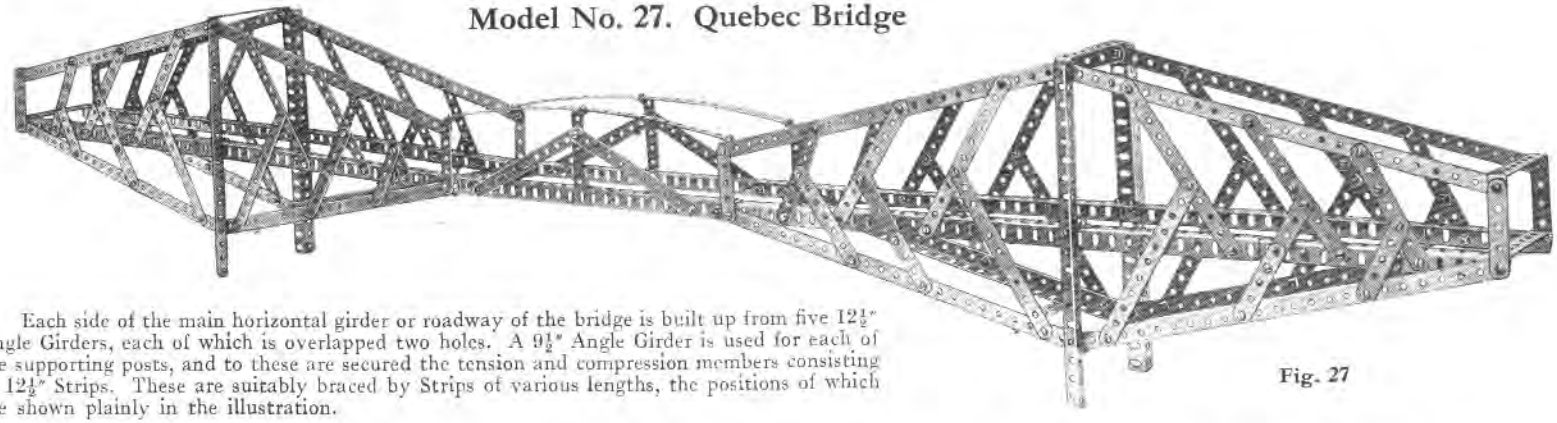


Fig. 26a

Model No. 27. Quebec Bridge

Parts required:

14	of No.	1
20	,,	2
4	,,	2a
10	,,	3
5	,,	4
28	,,	5
4	,,	6
4	,,	6a
14	,,	8
4	,,	8a
4	,,	10
4	,,	12
169	,,	37
3	,,	37a
2	,,	48a
6	,,	48b
3	,,	111c



Each side of the main horizontal girder or roadway of the bridge is built up from five 12½" Angle Girders, each of which is overlapped two holes. A 9½" Angle Girder is used for each of the supporting posts, and to these are secured the tension and compression members consisting of 12½" Strips. These are suitably braced by Strips of various lengths, the positions of which are shown plainly in the illustration.

Fig. 27

Model No. 28. Dirt-Track Rider

The details of the motor cycle should be clear from Fig. 28. The Strips at the head of the frame are attached to a Coupling by Bolts inserted in the tapped bores and carrying Washers for spacing purposes. The Bolts grip a 1½" Rod, on each end of which three Washers are placed. Flat Brackets attached by Angle Brackets to the front forks are passed over the ends of the Rods. The girder connecting the motor cyclist to the motor unit is bolted by means of Angle Brackets to the inner fork of the cycle. The end of the girder is passed over the main driving axle carrying a 3½" Gear. A Screwed Rod, fitted as shown between the two, causes the driving arm and Gear to rotate as one unit. The drive from the No. E1 Motor is transmitted to a 57-teeth Gear on the shaft of which a Worm is fitted to engage the 3½" Gear Wheel, the Rod of which is journalled in two 4½"×½" Double Angle Strips supported in Architraves. The Motor is held rigidly in position by a 3½" Strip secured between the upper Double Angle Strip.

The base of the power unit should be screwed down to the floor or a large base-board before setting the model in operation.

The wires from the Motor should be laid close to the ground so that they will not interfere with the progress of the cycle.

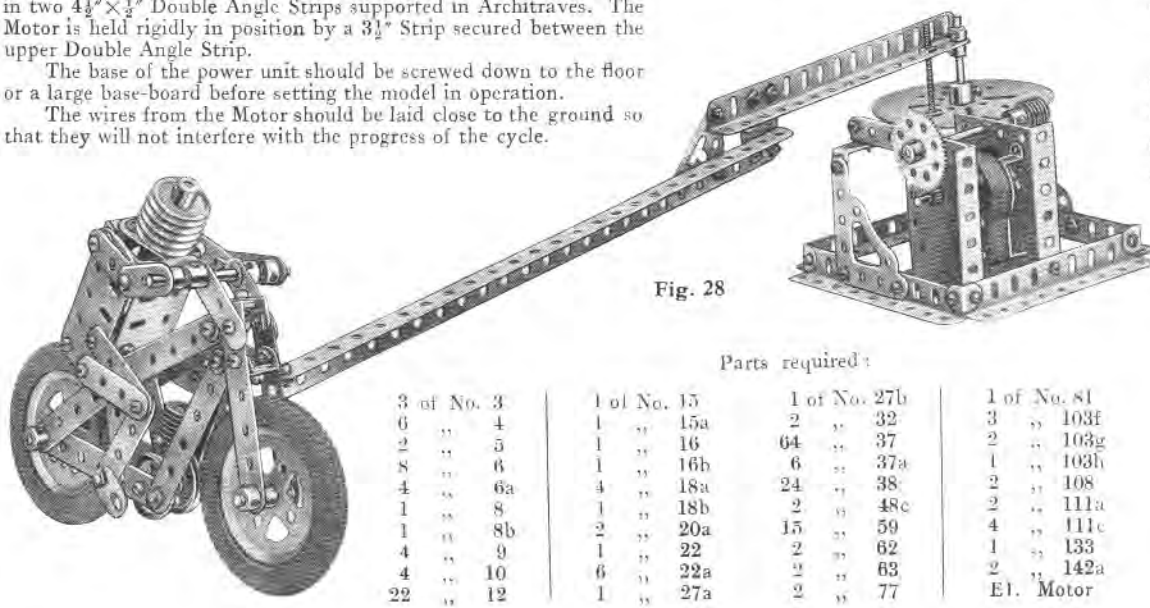


Fig. 28

Parts required:

3	of No.	3	1	of No.	15	1	of No.	27b	1	of No.	81
6	,,	4	1	,,	15a	2	,,	32	3	,,	103f
2	,,	5	1	,,	16	64	,,	37	2	,,	103g
8	,,	6	1	,,	16b	6	,,	37a	1	,,	103h
4	,,	6a	4	,,	18a	24	,,	38	2	,,	108
1	,,	8	1	,,	18b	2	,,	48c	2	,,	111a
1	,,	8b	2	,,	20a	15	,,	59	4	,,	111c
4	,,	9	1	,,	22	2	,,	62	1	,,	133
4	,,	10	6	,,	22a	2	,,	63	2	,,	142a
22	,,	12	1	,,	27a	2	,,	77	E1.	Motor	

Model No. 29. Saw Bench

The top of the bench consists of a 5½"×2½" Flanged Plate. The No. E1 Electric Motor incorporated in the model forms a support for one end of the Plate, the other end of which is supported on 3" Angle Girders, a 2½" Girder being secured across their lower ends by means of bolts inserted in the elongated holes. Two 5½" Strips are fitted as shown to add strength to the structure, and Angle Brackets may be added to the Motor flanges so that the model may be screwed to a baseboard.

A ¾" Sprocket on the armature shaft of the Motor transmits the drive to a 1½" Sprocket on a 3½" Axle Rod carrying a Circular Saw. A 1½" Angle Girder forms a guide for the timber, and may be adjusted in the transverse slotted hole of the Plate.

Parts required:

2	of No.	2
2	,,	9c
1	,,	9d
1	,,	9f
4	,,	12
1	,,	16
15	,,	37
7"	,,	94
1	,,	95a
1	,,	96a
1	,,	159
E1.	Motor	

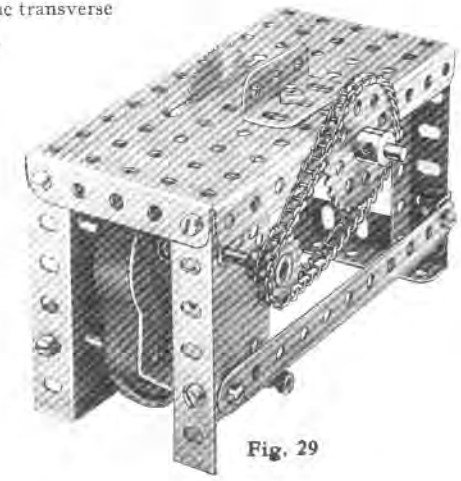


Fig. 29

Model No. 30. Automatic Penny-in-the-Slot Machine

The operating mechanism is shown in Fig. 30c removed. Four 12½" Angle Girders are spaced apart by 2½"×½" Double Angle Strips and 2½" Strips to form a receptacle for match boxes. It will be seen that the bolts are arranged so that they do not interfere in any way with the downward movement of the boxes. The 9½" Strip bolted between the rear pair of Girders is clamped between two 2½" Strips (see Fig. 30b) near its lower end.

The drawer and guides on which it slides are shown in Fig. 30a. The bolts 2, which hold the 2½" Strips to the 1½"×½" Double Angle Strips of the slide, should be passed through the vertical 12½" Angle Girders, one hole above their lower extremities. The Angle Brackets 3 form guides for the 5½"×½" Double Angle Strips of the drawer. The Rack Strip 4 is secured to a 1"×1" Angle Bracket and to a 3½" Strip that is fixed by an Angle Bracket to the Flat Girders that form the front of the drawer.

A ¾" Pinion 5 (Figs. 30b and 30c) is mounted on a Pivot Bolt and gripped in place by a ½" Bolt 6. When the drawer is moved in or out, the Rack Strip engaging with the Pinion causes the latter to rotate. Normally, with the drawer closed the Bolt 6 should be almost touching an Angle Bracket 7 (Fig. 30b) that is secured to a Crank on the end of a 4½" Axle Rod, which also carries a second Crank to which the Flat Bracket 8 is fixed by a ¾" Bolt. The Cranks are arranged so that when the ¾" Bolt strikes the vertical Angle Girder, the Angle Bracket 7 just clears the teeth of the Pinion 5.

A 4½" Strip is bolted to a Double Arm Crank fixed on the other extremity of the 4½" Rod, and carries two 2½" Strips which act as a balance weight. The weight is adjusted correctly by means of a Bolt and Washers. The Flat Bracket 9 is spaced from the 4½" Strip by two Washers and a ⅜" Bolt 10 carrying four Washers is bolted in the fourth hole from the end of the Strip so that the falling coin may rest on the Strip.

The coin chute consists of two pairs of 9½" Angle Girders bolted, one inside the other, so that a space rather thicker than a penny is left between them (see Fig. 30). A 7½" Angle Girder is attached to each of the compound Girders, and the latter are held at the correct distance apart by means of two 2½" Flat Girders. The top end of the chute is partly filled in with a Flat Bracket secured in position by means of two ½"×½" Angle Brackets. This form of construction provides a slot down which a penny can slide freely and so reach the actuating mechanism.

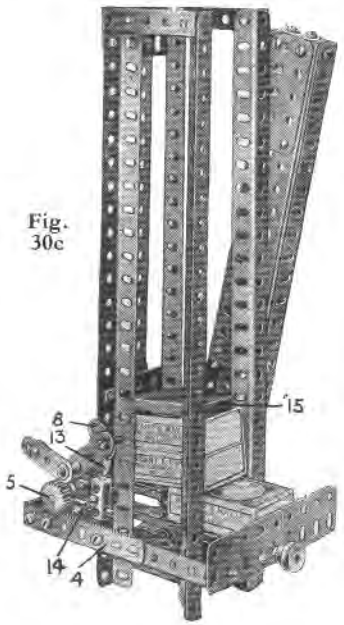


Fig. 30c

The chute is secured in place by a 1" Triangular Plate bolted to the upper transverse 5½" Angle Girder at the front of the outer casing of the model, and also by the ½" Reversed Angle Bracket shown in Fig. 30b.

The operation of the mechanism is as follows. The penny is placed in the chute and falls between the Flat Bracket 9 (Fig. 30b) and the 4½" Strip. The Washers on the Bolt 10 serve as a "stop" for a penny. The weight of the penny raises the Crank carrying the Angle Bracket 7, but only sufficiently to allow the Bolt 6 to pass unimpeded, for the Centre Fork 13 engages the Flat Bracket 8 and prevents further movement of the Crank. The Centre Fork is held in a Coupling loosely attached to the model by a ¾" Bolt passed through its centre transverse hole, and secured by two nuts to an Angle Bracket. The Rod 14 held in the lower transverse hole of the Coupling is forced upward by the Bolt 6 when the drawer is pulled out, and thus forces the Centre Fork 13 out of engagement with the Flat Bracket. The penny is then free to drop off the end of the lever. The weight of the Rod 14 then returns the Centre Fork to its normal position, and as the drawer is pushed back the Bolt 6 raises the Angle Bracket 7, which should be arranged obliquely. When the drawer is pushed right in, the next box of matches should fall into position in the drawer, and the weight 15 (see Fig. 30c), consisting of a piece of lead, is provided to assist the downward movement of the boxes in the vertical guides.

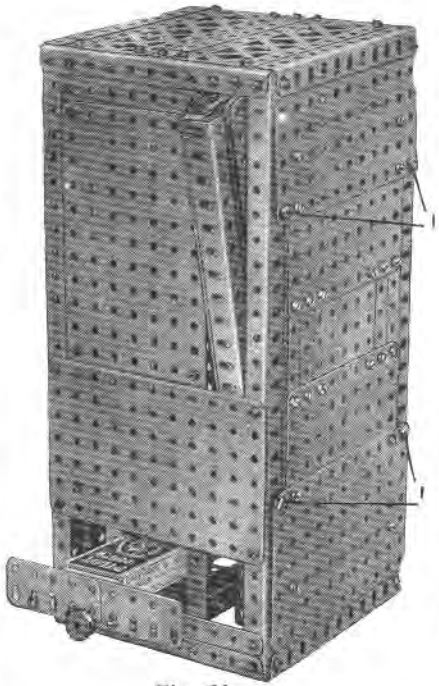


Fig. 30

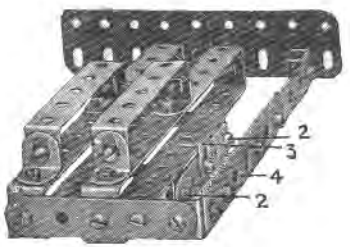


Fig. 30a

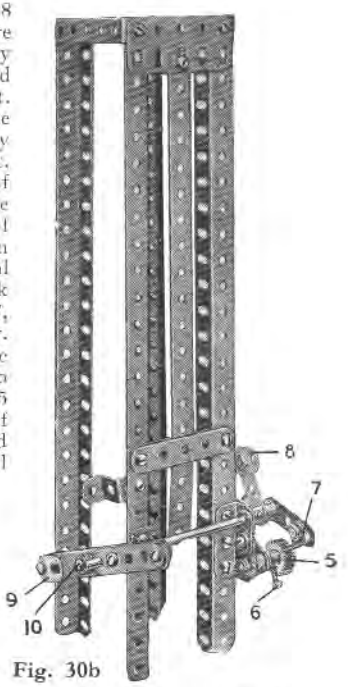


Fig. 30b

Ten small-size match boxes should now be inserted in the "magazine," and the right-hand side plate secured in position by means of four nuts 1 (see Fig. 30). The model is then ready for operation.

It will be noted that the model does not incorporate a container for the coins after they have fallen off the weighted arm. We do not think this omission will present much difficulty, however, as model-builders should find it quite a simple matter to devise a "strong box" in which their wealth may rest in perfect safety.

Parts required:

1 of No. 1		4 of No. 10		4 of No. 48a		2 of No. 77	
1 ,,	1a	12 ,,	12	4 ,,	48d	2 ,,	100
5 ,,	2	1 ,,	12a	4 ,,	52a	5 ,,	103f
1 ,,	2a	1 ,,	15a	4 ,,	53a	1 ,,	110
2 ,,	3	1 ,,	18b	1 ,,	59	1 ,,	111
11 ,,	5	1 ,,	23a	2 ,,	62	2 ,,	111a
8 ,,	8	1 ,,	26	1 ,,	62b	2 ,,	111c
8 ,,	8a	170 ,,	37	1 ,,	63	1 ,,	125
2 ,,	8b	13 ,,	37a	1 ,,	65	1 ,,	147b
8 ,,	9	16 ,,	38	6 ,,	70		
1 ,,	9f	2 ,,	48	2 ,,	72		

Model No. 31. Portable Lamp with Automatic Switch

Parts required :

2 of No. 2a		2 of No. 24		1 of No. 53	
4 ,, 9		30 ,, 37		1 ,, 106	
2 ,, 12		5 ,, 48b		4 ,, 136	
2 ,, 17		4 ,, 52a		1 ,, 137	

When the lamp shown in Fig. 31 is picked up the bulb is illuminated ; but as soon as it is put down again the light goes out.

The automatic switch device comprises a 2½" Rod 3 (Fig. 31a), journalled in one of the 3½"×½" Double Angle Strips forming part of the base, and also in a ½"×½" Angle Bracket bolted to one of the side plates. A second Angle Bracket 2 is attached to and insulated from the 3½"×2½" Flanged Plate in the base by a 6 B.A. Nut and Bolt, equipped with an Insulating Bush and Washer. A short length of wire is attached to this 6 B.A. Bolt to form a connection with one of the terminals of the Accumulator that supplies the current for the lamp. A Compression Spring is placed on the Rod 1 between the Angle Bracket and a Collar.

Fig. 31

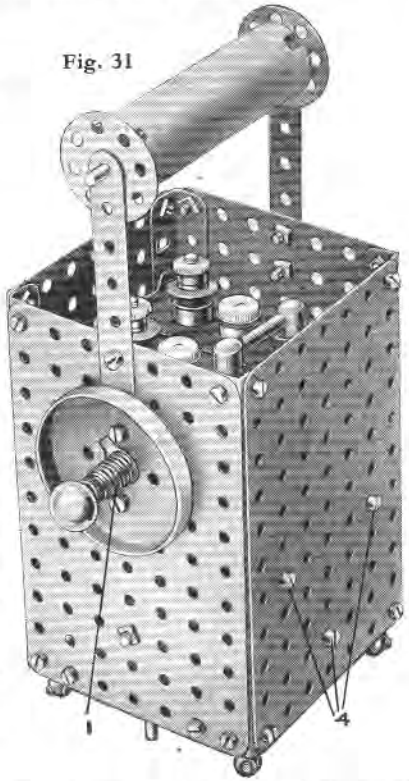
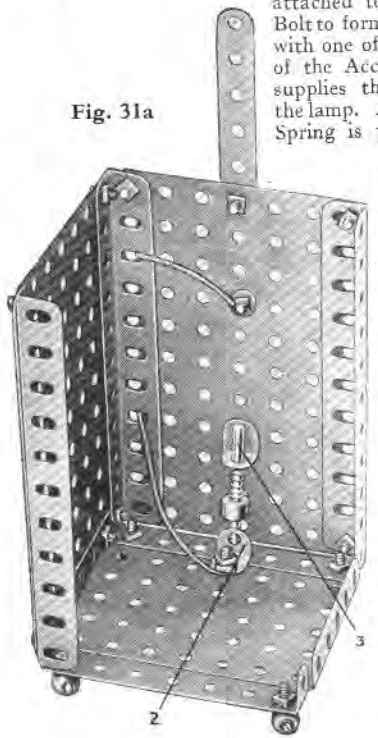


Fig. 31a



A 6 B.A. Bolt is inserted in the hole in the base of the Lamp Holder 1 (Fig. 31) so that its head is inside the latter. The shank of the Bolt is then passed through a hole in the 5½"×3½" Flat Plate, and an Insulating Bush is placed upon it. A 6 B.A. Nut, with a short length of wire clamped beneath it, retains the Lamp Holder in position ; and this wire is connected to the second terminal of the Accumulator. The latter is retained in position by three 3½"×½" Double Angle Strips, which are secured to the side Plates by the Bolts 4.

The Compression Spring normally holds the Collar in contact with the Angle Bracket 2, thus completing the circuit. As soon as the lamp is put down, the portion of the Rod 1 that projects beneath the base is forced upward out of contact with the Angle Bracket 2, thus interrupting the flow of current to the lamp.

The model is designed for use with a small 4-volt accumulator, but the Meccano 6-volt Accumulator may be used if the body of the lamp is made sufficiently large to accommodate it.

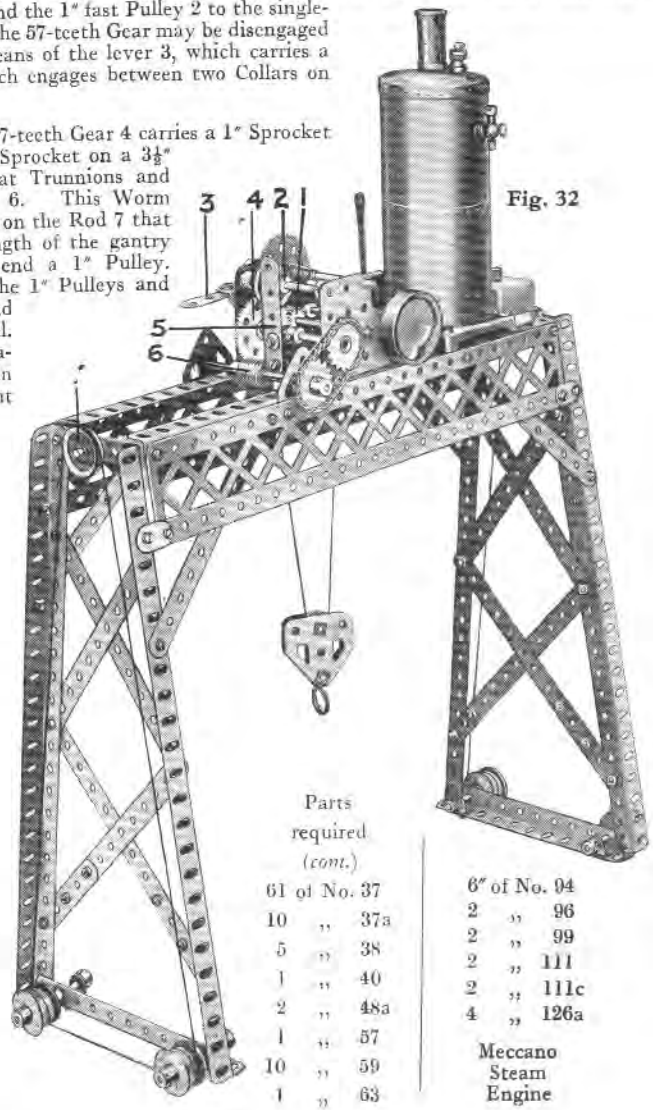
Model No. 32. Steam-driven Gantry Crane

The end frames of the gantry each consist of two 12½" Angle Girders bolted at the base to a 5½" Angle Girder and at their upper ends to a 2½" Strip ; and the resulting structures are braced with Strips as shown. Two horizontal 12½" Girders are bolted between the end frames and a Braced Girder is secured to each.

The Meccano Steam Engine is then bolted in position and the Gears are assembled as follows. A ½" Pinion 1 meshes with a 57-teeth Gear on the hoist shaft, the cord from which passes round the 1" fast Pulley 2 to the single-sheave pulley block. The 57-teeth Gear may be disengaged from its Pinion by means of the lever 3, which carries a bolt the shank of which engages between two Collars on the hoisting spindle.

The shaft of the 57-teeth Gear 4 carries a 1" Sprocket that drives a further Sprocket on a 3½" Rod journalled in Flat Trunnions and carrying the Worm 6. This Worm engages with a Pinion on the Rod 7 that extends the whole length of the gantry and carries at each end a 1" Pulley. Cord is passed over the 1" Pulleys and then wound once round each travelling wheel. The travelling mechanism can be set in operation by movement of the lever 5.

Fig. 32



Parts required :

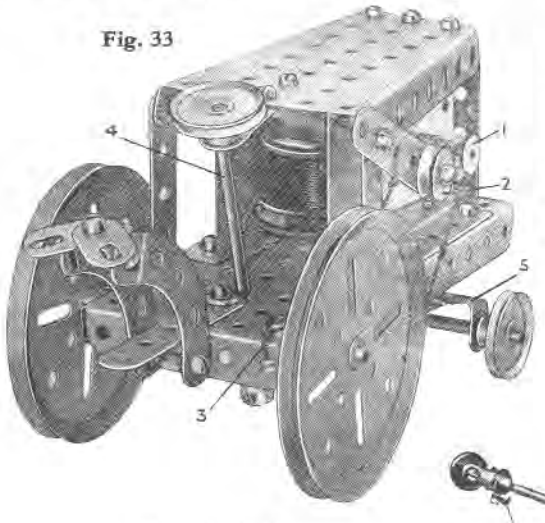
12 of No. 2		6 of No. 37		6" of No. 94	
6 ,, 5		10 ,, 37a		2 ,, 96	
6 ,, 8		5 ,, 38		2 ,, 99	
2 ,, 9		1 ,, 40		2 ,, 111	
4 ,, 10		2 ,, 48a		2 ,, 111c	
6 ,, 12		1 ,, 57		4 ,, 126a	
1 ,, 13		10 ,, 59			
2 ,, 15a		1 ,, 63			
4 ,, 16					
4 ,, 17					
8 ,, 20b					
3 ,, 22					
1 ,, 23					
2 ,, 26					
2 ,, 27a					
1 ,, 32					
1 ,, 35					

Parts required (*cont.*)

Meccano Steam Engine

Model No. 33. Farm Tractor

Fig. 33



Parts required :

8 of No. 5	1 of No. 24	1 of No. 52
2 ,, 10	2 ,, 35	1 ,, 54
2 ,, 11	30 ,, 37	1 ,, 59
3 ,, 12	4 ,, 37a	2 ,, 90a
3 ,, 16	2 ,, 38	2 ,, 111c
2 ,, 19b	1 ,, 40	E1 Electric
4 ,, 22	1 ,, 48a	Motor
1 ,, 23		

The frame of the model consists of a $5\frac{1}{2}$"×$2\frac{1}{2}$" Flanged Plate on which the Motor is mounted. The front axle assembly consists of a $2\frac{1}{2}$"×$\frac{1}{2}$" Double Angle Strip 5 in which a $3\frac{1}{2}$" Axle fitted with two 1" Pulleys is secured.

A length of cord is attached to one end of the pivoted Double Angle Strip 5, passed twice round the Axle Rod 4 that forms the steering column, and finally tied to the other end of the Strip. A Collar and Spring Clip are secured to the lower end of the Rod in order to keep the cord in position.

An endless length of cord is passed round the small Pulley 1 on the armature shaft, and also round the groove in the 3" Pulley forming one of the rear road wheels. This cord should be quite slack, so that normally there is little friction between the cord and the Pulleys. A $2\frac{1}{2}$" Strip, fitted with a $\frac{1}{2}$" Pulley Wheel 2, is pivoted on a $\frac{3}{8}$" Bolt secured to the side of the tractor. A length of cord is tied to the Strip, and the end is then passed through holes in the base plate and finally tied to the Washer 3. By lifting the Washer, the Pulley 2 will press on the transmission cord, and the friction between the cord and the Pulleys will thus be increased so that power can be transmitted from the Motor to the road wheels.

Model No. 34. Electric Tramcar

Parts required :

9 of No. 1	4 of No. 17	3 of No. 52a
2 ,, 1b	2 ,, 18a	13 ,, 59
12 ,, 2	4 ,, 20	4 ,, 63
2 ,, 2a	4 ,, 20a	2 ,, 77
7 ,, 3	2 ,, 20b	4 ,, 90a
2 ,, 4	4 ,, 22	8" ,, 94
18 ,, 5	1 ,, 23	4 ,, 99
4 ,, 6	169 ,, 37	4 ,, 100
6 ,, 6a	6 ,, 37a	4 ,, 103f
4 ,, 8	24 ,, 38	3 ,, 111
4 ,, 8a	1 ,, 40	6 ,, 111c
12 ,, 10	1 ,, 43	2 ,, 115
4 ,, 11	2 ,, 45	1 ,, 116
20 ,, 12	2 ,, 48	1 ,, 116a
1 ,, 13	2 ,, 48a	2 ,, 126
3 ,, 16a	4 ,, 48b	1 ,, 147b

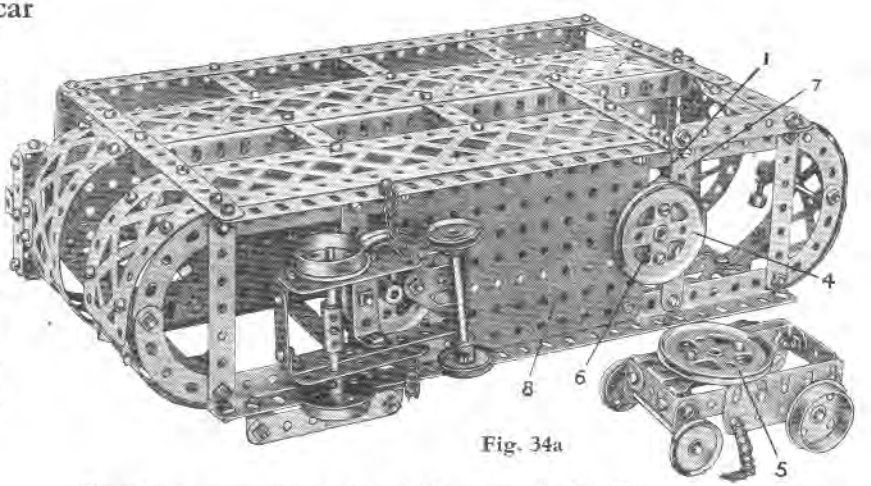


Fig. 34a

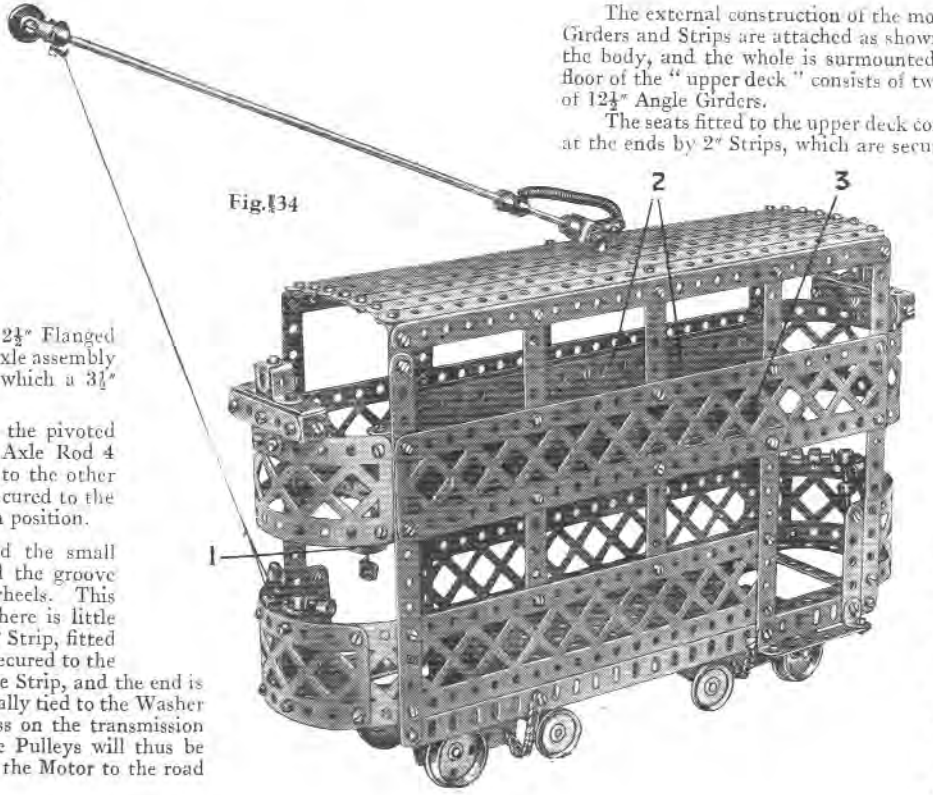


Fig. 34

The external construction of the model is shown clearly in Figs. 34 and 34a. Braced Girders and Strips are attached as shown to the sides and ends of the base frame to form the body, and the whole is surmounted by seven $12\frac{1}{2}$" Strips that form the roof. The floor of the "upper deck" consists of two $5\frac{1}{2}$"×$3\frac{1}{2}$" Flat Plates held to the sides by means of $12\frac{1}{2}$" Angle Girders.

The seats fitted to the upper deck consist of two sets of $5\frac{1}{2}$" Strips 2 connected together at the ends by 2" Strips, which are secured to the floor of the upper deck by means of two $9\frac{1}{2}$" Angle Girders 3 (see Fig. 34). The seats proper are $5\frac{1}{2}$" Strips similar to 2, but are joined together by Flat Brackets and secured to the backs by Angle Brackets.

The construction of the bogies can be followed from Fig. 34a. Each bogie consists of two $3\frac{1}{2}$"×$\frac{1}{2}$" Double Angle Strips, held apart by $1\frac{1}{2}$" Strips at one end and by Trunnions at the other. A $1\frac{1}{2}$"×$\frac{1}{2}$" Double Angle Strip is also bolted between the bogie frame, and a 2" Pulley 5 is secured to this and to the Trunnion by $\frac{3}{8}$" Bolts, three Washers being used for spacing purposes. The second Pulley 4 is connected to two $1\frac{1}{2}$" Strips 6 by means of $\frac{3}{8}$" Bolts spaced away from the Strips by means of three Washers placed on each bolt. The bogies pivot about $\frac{3}{4}$" Bolts passed through the bosses of the Pulleys 4 and nipped by the set-screws in the bosses of the Pulleys 5, which are secured to the bogies.

The bells are represented by $1\frac{1}{2}$" Flanged Wheels 1, fixed to the roof of the lower deck by means of Angle Brackets, and Collars attached to a Cord running through the bosses of both Wheels form the strikes. If the cord is drawn down at any point between the two Flanged Wheels, one or other of the Collars will be drawn up, thus striking the Wheel forming the bell or gong.

Model No. 35. Four Cylinder Electric Engine

Parts required:

5	of No.	2	1	of No.	20	Electrical parts:	
6	,,	6a	42	,,	37		
6	,,	9	18	,,	37a	4	of No. 301
6	,,	9f	14	,,	38	4	,, 302
6	,,	12	9	,,	59	2	,, 303
1	,,	17	8	,,	63	3	,, 304
5	,,	17a	9	,,	82	3	,, 305
3	,,	18b	4	,,	103	2	,, 306
			4	,,	172	2	,, 313

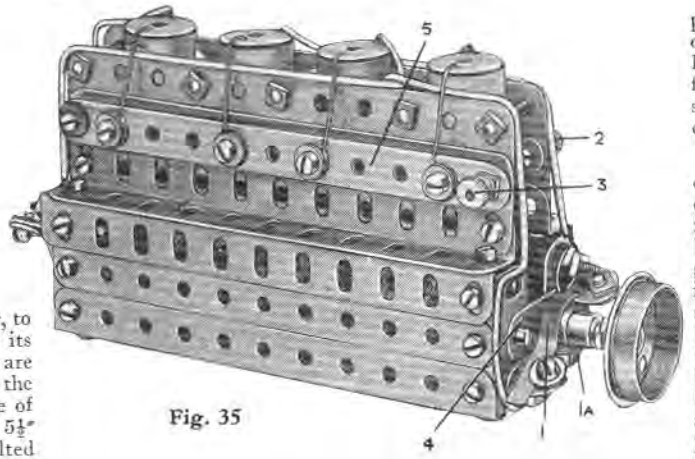


Fig. 35

The base of the crankcase consists of a 5½" Flat Girder, to the sides of which are bolted 5½" Angle Girders; and to its ends 1½" Angle Girders are fixed. Four 1½" Angle Girders are then secured in a vertical position to the four corners of the crankcase base. Each side portion of the crankcase (one of which is shown detached in Fig. 35a) is composed of two 5½" Flat Girders and two 5½" Angle Girders, the latter being bolted together so that their flanges form a Z.

The crankshaft is of the four-throw type, each crank consisting of two Couplings secured by their centre holes to the ends of short Rods 9 that form the straight portions of the crankshaft. The crankpins each consist of a 1" Screwed Rod that is secured by lock-nuts 10 in the transverse end tapped holes of each pair of Couplings, the upper extremities of the connecting rods being carried on Set-screws inserted in Collars on the ends of the piston rods. The crankshaft is journalled in 1½" Strips 4.

Each solenoid is wound with No. 26 gauge wire, and after being covered with paper to protect its windings, is clamped in position between the Flat Girders that form the top portion of the crankcase. The Flat Girders are drawn together by means of 1" Screwed Rods.

The next item for attention is the rotary switchgear. Two similar switches are required, one on each end of the crankshaft; and each takes the form of two brushes (Pendulum Connections, part No. 172) 1, 1a, which are bent carefully to the shapes shown so that they make contact alternately with a Set-screw inserted in a Collar on the crankshaft, as the latter rotates. The brushes are attached rigidly to ½"×½" Angle Brackets that are secured by 6 B.A. Bolts to the end of the crankcase, and are insulated from it by Insulating Bushes and Washers. A similar arrangement is followed at the other end of the crankshaft, and from Fig. 35a it will be seen that the brush 6 has been removed in order to show the Set-screw 7.

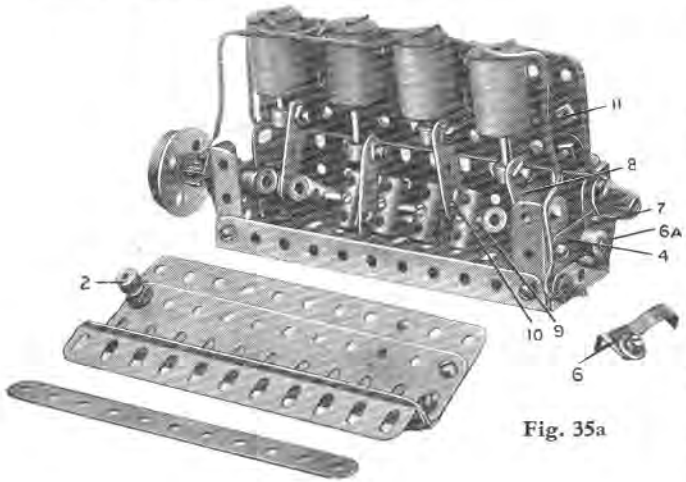


Fig. 35a

The brush 1 is connected by covered wire to the second solenoid, and the brush 1a to the third solenoid (counting from the right-hand end of the model in Fig. 35). The remaining two solenoids are connected to the brushes 6 and 6a. The other ends of the windings of the solenoids are all connected to a common "busbar" 5, which is composed of a 5½" Strip that is attached to, and insulated from, the Flat Girders by means of 6 B.A. Bolts and Insulated Bushes and Washers. A Terminal 3 is mounted on a shank of one of the 6 B.A. Bolts that serve to secure the busbar in place, and a second terminal 2 is secured in metallic contact with the frame of the model.

The path of the current is from the Accumulator to the terminal 3 on the busbar, and from there through the particular solenoid the switch of which happens to be making contact. The closing of the switch allows the current to pass through the frame of the model to the terminal 2 and to the other pole of the Accumulator, thus completing the circuit.

Model No. 36. Extending Fire Escape

Fig. 36 shows a model of an extensible fire escape, an important unit in the fire fighter's equipment. The running carriage of the escape consists of two 5½" Strips spaced apart by 2½"×½" Double Angle Strips. To the end Double Angle Strips of the frame, a Flat Trunnion and a 3½" Strip are bolted, the former serving as a leg for supporting the carriage, while the latter carries a ⅜" Bolt at each end to represent handles.

The fixed ladder is built up from two 12½" Angle Girders 4 connected together by 3½" Strips. The horizontal 5½" Strips of the carriage are bolted to the Girders, and the whole is held rigid by further 5½" Strips 7 secured to the carriage, and to the Girders 4 by Angle Brackets. Two ½"×½" Reversed Angle Brackets 5 form guides for the movable ladder, which may be extended by operating the Crank Handle 2. A length of cord is attached to the shaft of the Handle and passes over a ½" Pulley 1 mounted on a ⅜" Bolt that is fixed by means of two nuts to an Angle Bracket on the ladder. The cord is tied finally to the 2½" Strip that forms the base of the movable ladder. A 1" Pulley 3 mounted on the Crank Handle serves as a brake drum, around which a length of cord is passed and tied to a 3" Strip carrying the ¾" Flanged Wheel 6, which acts as a weight. The 3" Strip is pivoted on a ⅜" Bolt attached to one of the Strips 7.

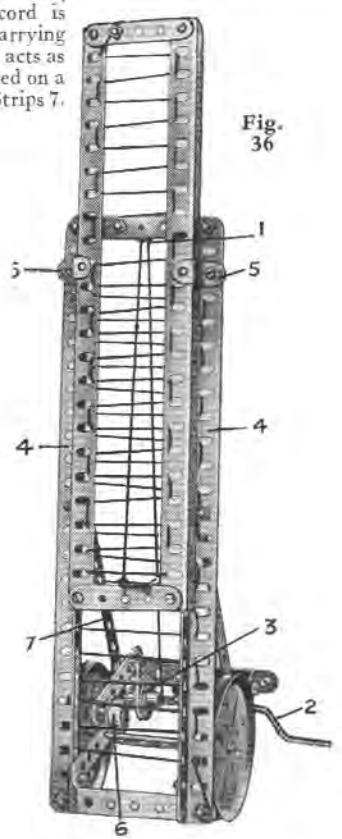


Fig. 36

Parts required:

4	of No.	2
3	,,	3
1	,,	4
2	,,	5
4	,,	8
3	,,	12
1	,,	16
1	,,	19s
2	,,	19b
1	,,	20b
1	,,	22
1	,,	23
26	,,	37
6	,,	37a
5	,,	38
2	,,	40
2	,,	48a
3	,,	59
5	,,	111c
2	,,	125
1	,,	126a

Model No. 37. Omnibus

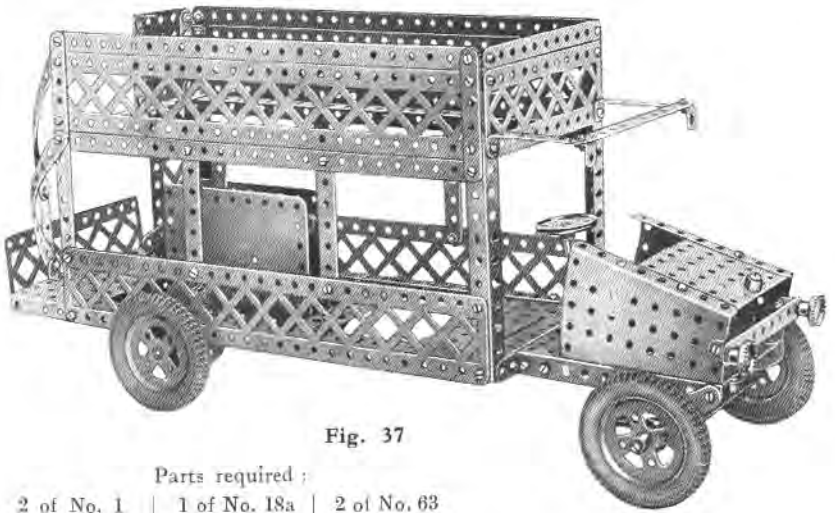


Fig. 37

Parts required :

2	of No.	1	1	of No.	18a	2	of No.	63
9	,,	2	4	,,	20a	2	,,	90a
1	,,	2a	1	,,	21	1	,,	98
4	,,	3	1	,,	26	4	,,	99
4	,,	4	1	,,	27a	3	,,	100
2	,,	5	2	,,	29	3	,,	111
4	,,	8	98	,,	37	3	,,	111c
4	,,	9	4	,,	37a	1	,,	116a
3	,,	10	3	,,	38	1	,,	125
14	,,	12	3	,,	48a	2	,,	126a
2	,,	12a	2	,,	52	4	,,	142a
1	,,	14	3	,,	53	1	,,	147b
1	,,	15a	2	,,	54	2	,,	165
2	,,	16	5	,,	59	Clockwork		
1	,,	17	1	,,	62	Motor		

The front wheels are journalled on $\frac{3}{4}$" Bolts secured in Couplings that pivot on bolts lock-nutted to the end holes of the front axle (Fig. 37a). The track rod is connected by Swivel Bearings to the Rods 1, 2, which are secured in the inner transverse holes of the Coupling. Connection is made as shown with a Crank 3 on the bottom end of the steering column, and the Rod 2.

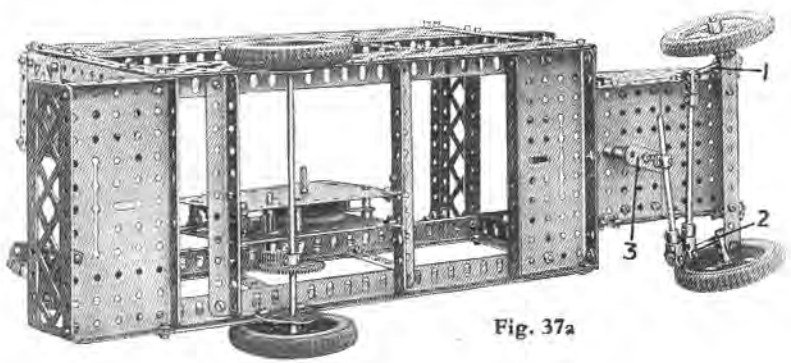


Fig. 37a

Model No. 38. Coal Tipper

Parts required :

10	of No.	2	6	of No.	38
2	,,	3	1	,,	40
6	,,	4	1	,,	43
9	,,	5	1	,,	46
4	,,	8	3	,,	48a
4	,,	9	2	,,	52
21	,,	12	1	,,	53
3	,,	14	1	,,	54
3	,,	15	9	,,	59
1	,,	19s	30"	,,	94
1	,,	22	1	,,	95
3	,,	22a	1	,,	96a
1	,,	26	2	,,	100
2	,,	27a	2	,,	111
12	,,	35	1	,,	115
85	,,	37	2	,,	126
9	,,	37a			

Speed in handling is the controlling factor of economy in all problems of modern transport.

Many ingenious mechanical devices have been invented within recent years specially intended for speeding up the handling of various kinds of merchandise, and one of the most interesting of these is the mechanical Coal Tipper, a Meccano miniature of which is illustrated in Fig. 38.

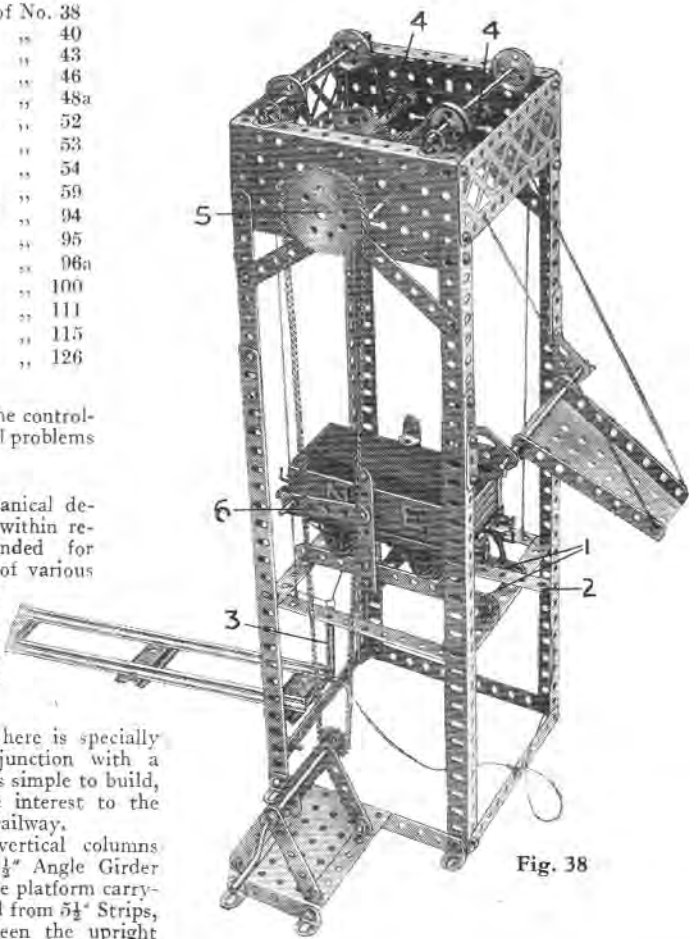


Fig. 38

The model described here is specially designed for use in conjunction with a Hornby Train layout. It is simple to build, and will add considerable interest to the working of any miniature railway.

Each of the main vertical columns consists of a $12\frac{1}{2}$" and a $5\frac{1}{2}$" Angle Girder overlapped three holes. The platform carrying the truck is constructed from $5\frac{1}{2}$" Strips, and it slides freely between the upright members. Four cords of equal length attached to each corner of the platform are taken over Pulleys at the top of the structure and are wound to each of the Rods 4, and their Gears mesh with a $\frac{1}{2}$" Pinion on a Rod 5. This, as will be seen, is driven by means of Sprocket Chain and a Crank Handle.

The truck rests on a pair of rails consisting of $5\frac{1}{2}$" Strips, which are pivoted at their front ends on $\frac{1}{2}$"×$\frac{1}{2}$" Angle Brackets. A Strip 2 is secured to a transverse Strip fixed across the rails, and a length of cord is tied to its end, so that when the platform reaches a certain height the truck is tipped. A Spring 3 is attached to a length of cord in order to keep the platform in a horizontal plane when the truck tips.

To keep the truck in place on the rails, a pivoted strip 6, with a $\frac{1}{2}$"×$\frac{1}{2}$" Angle Bracket on its end, can be swung round so that the Angle Bracket engages with the back of the truck ; while further $\frac{1}{2}$"×$\frac{1}{2}$" Angle Brackets on the top of the vertical Strips are arranged to engage with the top edges of the truck.

Model No. 39. Telpher Span

Modern electric overhead runways, or telphers as they are generally called, have been developed to provide transport in circumstances where the amount of traffic is not sufficient to justify the use of a specially-prepared track along the ground. Telphers are used also when the nature of the ground is such as to make the construction of a railway or roadway almost impossible. Overhead transport is comparatively cheap to install and work, and among other advantages it does not interfere in any way with operations that are in progress on the ground below. As a rule telpher lines are comparatively short, but of course their length may be arranged to suit requirements. For instance, in an important marble quarry in Italy there is a telpher line nearly one mile in length, capable of raising loads of 20 tons from the bottom of the quarry to a point 3,420 ft. above, where the marble is stored ready for use.

Telpher lines are capable of dealing with very heavy loads and they are quite economical in use. All that is required to drive them is an electric motor, and this is only used for starting the trolley on its journey, and for dealing with unbalanced loads, as it is usual for the descending load to weigh heavier than the material going up.

Although the Meccano Telpher Span does not follow the construction of an actual telpher very closely, the main working features are the same, the telpher carriage being balanced by a lift situated behind the main tower. The constructional details of the main tower and lower terminal need no description as Fig. 39 shows the main points quite clearly.

A Worm Wheel on the armature spindle of the Electric Motor engages a ½" Pinion that is secured, together with a second ½" Pinion, on a vertical 2" Rod. This Rod is journalled in a Channel Bearing that is secured to the Motor side plates. The second ½" Pinion engages a 1½" Contrate Wheel that is carried on the hoisting drum, the latter being formed by a 2½" Rod journalled in the end holes of the Motor side plates. The lift and telpher hoisting rope, which is continuous, is wound round the hoisting drum three times, and is then connected to the lift and telpher in the following manner.

One side of the cord is passed over 1" and ½" loose Pulleys at the top of the tower, then over a 1" fast Pulley attached to the cage, and is finally attached to a Flat Bracket that is carried on the same Rod as the ½" Pulley. The other side of the cord is passed over a second 1" loose Pulley at the top of the tower, and from there to a 2½"×½" Double Angle Strip on the telpher.

In order to prevent the telpher car and lift cage from being raised and lowered beyond the required distance a limit switch is provided, which is constructed in the following manner. An End Bearing, pivotally attached to one side of the Electric Motor switch, is connected by means of a crank mechanism built up from two Couplings, to a vertical connecting Strip attached to a Coupling mounted on a 3½" Rod at the top of the tower. This Rod also carries a Crank that is lifted, when the lift cage nears the top of the tower, by means of a Double Bracket carried on a Double Bent Strip secured to the roof of the cage. This action moves the Motor switch into the "off" position, thus stopping the cage and telpher car.

A similar operation is carried out when the cage reaches the bottom of the tower, except of course that the Motor switch is moved in the opposite direction.

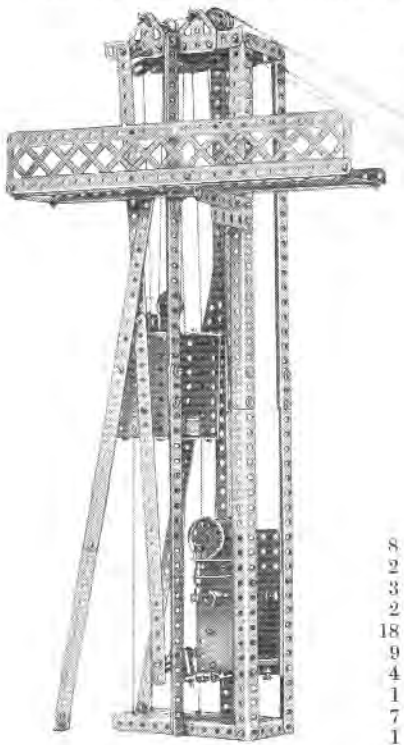
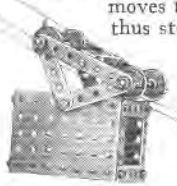


Fig. 39



Parts required:

8	of No.	1
2	,,	2
3	,,	3
2	,,	4
18	,,	5
9	,,	8
4	,,	9
1	,,	11
7	,,	12
1	,,	15a
5	,,	16
2	,,	18a
2	,,	20
4	,,	22
3	of No.	22a
1	,,	23
2	,,	26
1	,,	28
1	,,	32
4	,,	35
126	,,	37
6	,,	37a
24	,,	38
1	,,	40
1	,,	44
	,,	45
5	of No.	48a
2	,,	52
5	,,	53
10	,,	59
2	,,	62
3	,,	63
1	,,	98
1	,,	99
2	,,	103f
4	,,	111c
1	of No.	115
4	,,	126a
1	,,	160
1	,,	162a
1	,,	165
1	,,	166
	Electric Motor	

Model No. 40. Land Yacht

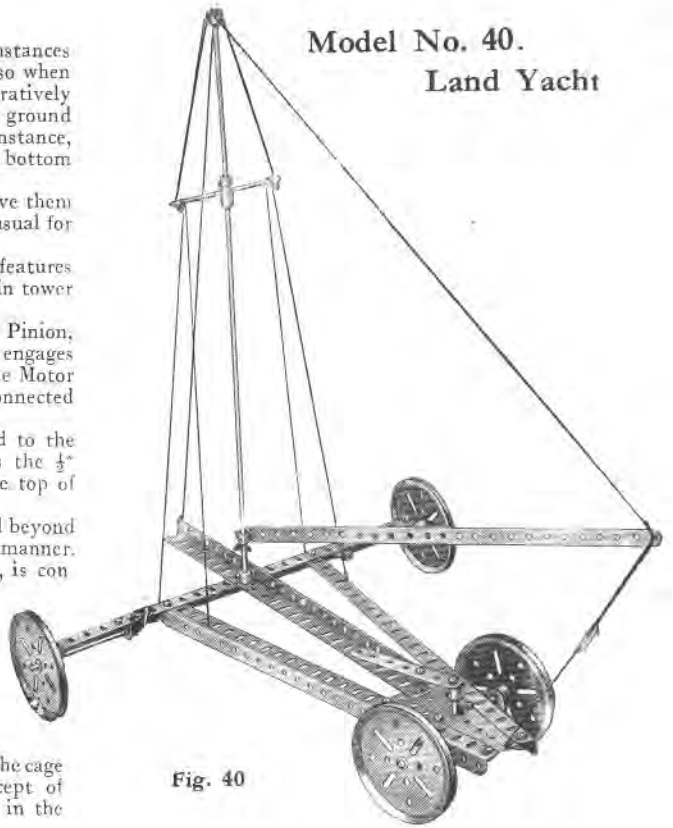


Fig. 40

Parts required:

1	of No.	1
1	,,	3
4	,,	8
1	,,	10
1	,,	13
3	,,	15
1	,,	16
1	of No.	17
4	,,	19b
1	,,	24
5	,,	35
19	,,	37
1	,,	37a
1	,,	45
1	of No.	48a
1	,,	54
4	,,	59
2	,,	62
1	,,	63
2	,,	111c

The rear wheels are mounted on ⅜" Bolts journalled in the upturned ends of a 3½"×½" Double Angle Strip. A Bush Wheel is bolted to the centre of the Double Angle Strip, and a 2" Rod is secured in its boss. The Rod passes up through a Double Bent Strip bolted to the underside of the Sector Plate, and a Crank is secured to its upper end. A 3½" Strip bolted to the Crank forms the "tiller."

The boom is pivotally secured to the mast by a bolt screwed into a Collar that is held in position by Spring Clips.

NEW MECCANO MODELS

Model No. 41. Doxford Type Internal Combustion Engine

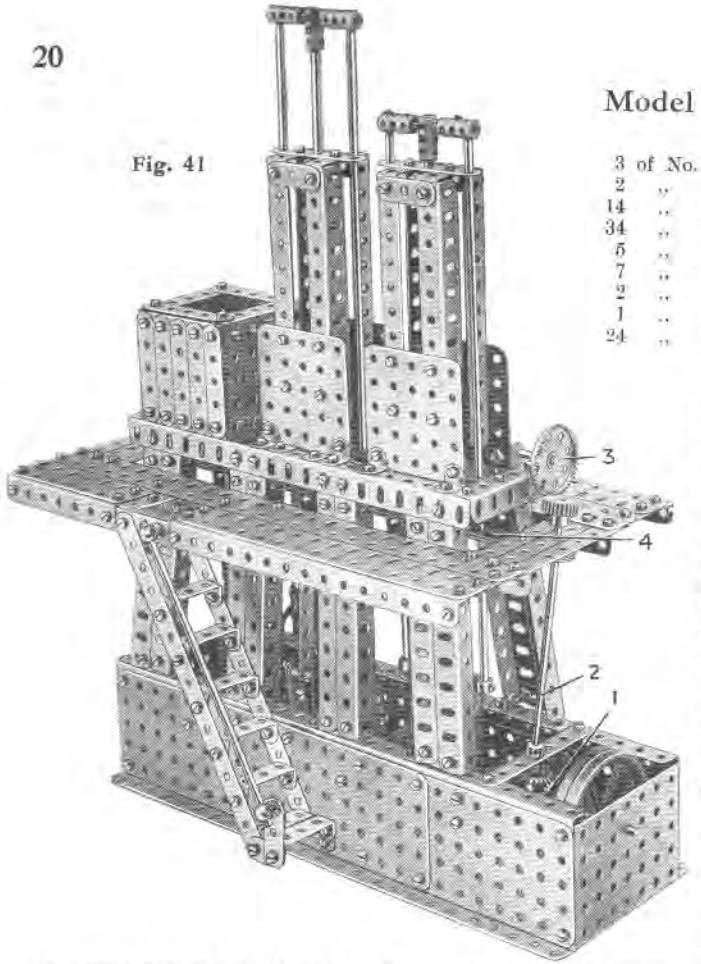


Fig. 41

Parts required:

3	of No. 1	1	of No. 9b	1	of No. 18a	234	of No. 37	16	of No. 62	2	of No. 103k
2	,, 1b	6	,, 9d	7	,, 18b	10	,, 37a	9	,, 63	4	,, 111a
14	,, 2a	9	,, 10	1	,, 20a	6	,, 38	2	,, 64	11	,, 111c
34	,, 5	20	,, 12	4	,, 22	12	,, 48	4	,, 70	1	,, 125
5	,, 6a	4	,, 13	2	,, 24	4	,, 48a	2	,, 72	1	,, 132
7	,, 8	2	,, 14	1	,, 25	4	,, 48b	1	,, 80b	2	,, 136
2	,, 8a	3	,, 15	1	,, 28	2	,, 53	4	,, 103b	1	,, 147b
1	,, 8b	5	,, 15a	2	,, 30	11	,, 59	2	,, 103d	3	,, 166
24	,, 9	1	,, 16								

Internal-combustion engines are divided into two groups, the high-speed petrol engines, which are used mostly in small craft and racing boats; and the slow running Diesel Engines, which are capable of propelling large ocean liners. In the Diesel engine, air is compressed in the cylinder until the temperature rises to about 1000 degrees Fahrenheit. Crude oil is then injected into the cylinder, where it instantly ignites and thus moves the piston in exactly the same manner as expansive steam in the cylinder of a steam engine.

One of the latest engines working on the Diesel principle is the Doxford engine, which is fitted with two pistons working in each cylinder, three cranks being used for each set of pistons and connecting rods. An extra crank is provided for the scavenging piston whose job it is to force a blast of air through the cylinders and thus remove any products of combustion remaining in the cylinder after each power stroke.

The model shown in Fig. 41 is an accurate reproduction of this type of engine, all the movements of the prototype being faithfully reproduced. Each side of the engine bedplate consists of two 12½" Angle Girders and three 5½"×2½" Flat Plates, which are bolted together as shown in Fig. 41. When completed the two sides are joined together by two 3½"×2½" Flanged Plates. The 3½"×½" Double Angle Strips, which form the bearings for the crankshaft, may now be fitted. The side standards, 5½" Angle Girders, are secured at the top, to two 9½" Angle Girders joined together by 2½" Angle Girders. The 9½" Angle Girders form a base to support the cylinders.

The construction of the combustion cylinders will be seen clearly from the two illustrations and the scavenging cylinder is built up from a number of 2½" Strips and 2½"×½" Double Angle Strips.

The Crankshaft is built up from sixteen Cranks and four 2½" Strips, in the following manner. Two Cranks 9 are bolted together as shown in Fig. 41a to form one crank web, and to this is attached, by means of a 1" Rod, a second web 10 constructed in a similar manner to the first, except that a 2½" Strip is used for lengthening purposes. These two webs are connected by a 1" Rod to two webs 11 of similar dimensions. A 3½" Strip is slipped on to each of the 1" Rods joining two webs together. A second set of three cranks is now to be built up and when completed should be journalled together with the first set, in the 3½"×½" Double Angle Strips mentioned previously. A scavenger crank 8 is fitted to the end of the crankshaft and is connected by a 3½" Strip to a piston Rod 15 to which a 2" Pulley is secured inside the cylinder to form a piston. The other end of the crankshaft carries a Flywheel and a 1" Bevel 1 that meshes with a second 1" Bevel on a Rod 2, which carries also a ¾" Pinion driving a 1½" Contrate 3 on the cam-shaft.

Each of the upper piston rods carrying the piston heads 13, 1" Pulleys, is connected by Couplings in the manner shown to two 11½" Rods 14 which, in turn, connect with the cranks and connecting rods 12. These Rods slide in 2½" Strips placed across the tops of the cylinders, and also in two 12½" Strips 4 which are bolted to a raised platform secured round the engine in the position shown. The lower pistons and piston rods are connected to their respective connecting rods by means of End Bearings.

The valve regulating gear may now be constructed. A Bush Wheel 5, pivotally mounted on a Pivot Bolt secured to a Flat Trunnion on the bed-plate, is connected to a Coupling 6 by two Threaded Bosses and a 4½" Threaded Rod. This Coupling is mounted on a 4½" Rod, together with a second Coupling that is connected by a 2" Strip to the Coupling 7, which operates the valve regulating rod.

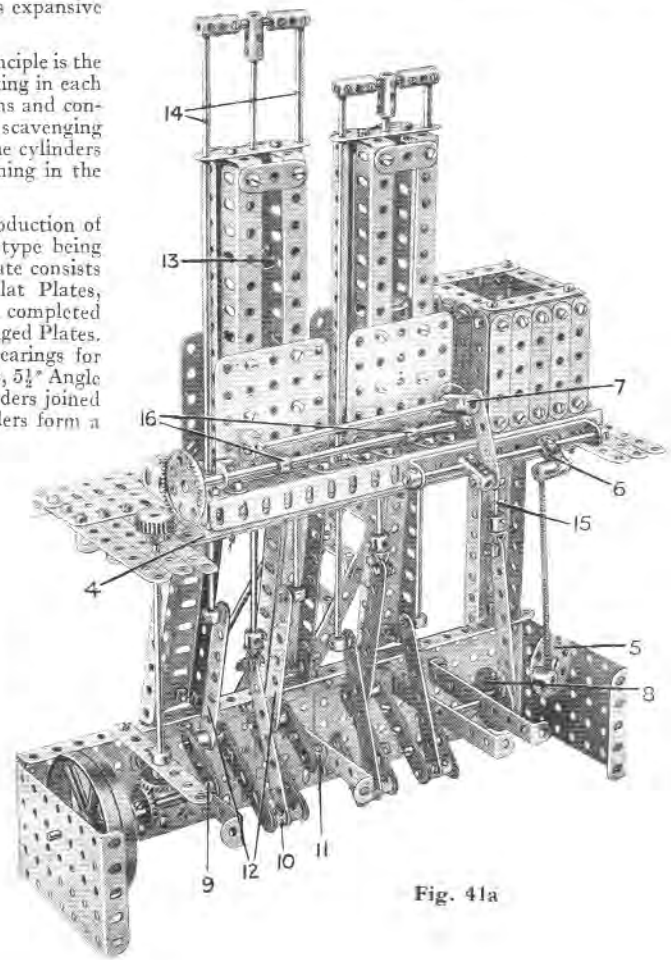


Fig. 41a

Model No. 42. Rolling Lift Bridge

Parts required:

4 of No.	1	18 of No.	9	1 of No.	22a	4 of No.	52a	1 of No.	103h
6	,, 1a	2	,, 9a	3	,, 26	2	,, 53	1	,, 111a
10	,, 1b	2	,, 9b	2	,, 27a	4	,, 53a	6	,, 111c
28	,, 2	6	,, 9d	1	,, 29	9	,, 59	4	,, 126
4	,, 2a	4	,, 9f	1	,, 32	6	,, 70	Electric Motor	
24	,, 3	3	,, 10	314	,, 37	2	,, 72		
2	,, 4	24	,, 12	6	,, 37a	14	,, 94		
12	,, 5	4	,, 12a	6	,, 38	2	,, 96		
2	,, 6	1	,, 13a	2	,, 40	2	,, 98		
3	,, 6a	1	,, 15a	1	,, 44	4	,, 99		
16	,, 8	2	,, 16a	1	,, 48	2	,, 100		
8	,, 8a	1	,, 16b	7	,, 52				
2	,, 8b	1	,, 17						

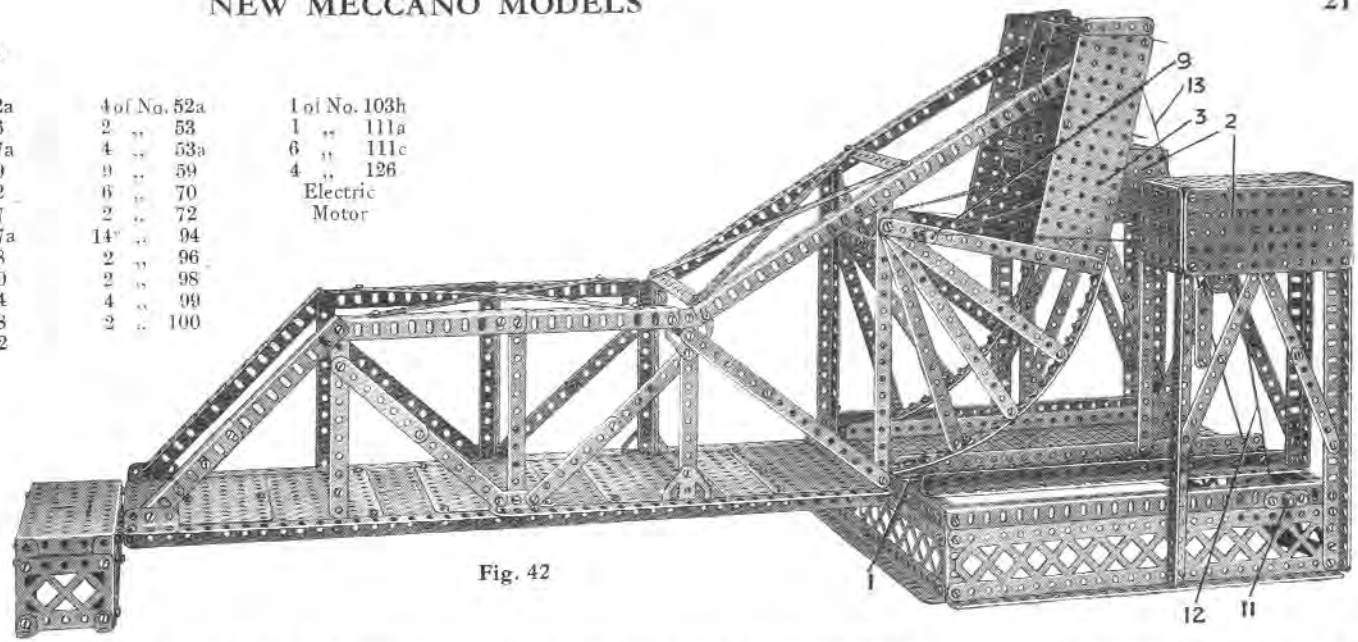


Fig. 42

Bridge construction is a very fascinating branch of civil engineering, and forms a splendid subject for the interest of Meccano model-builders. All types of bridges have been reproduced in Meccano at one time or another, ranging from a tiny Roman stone bridge to a giant model of the wonderful Quebec Bridge.

The model Rolling Lift Bridge shown in Fig. 42 is an excellent reproduction of a type of bridge built by the Horsley Bridge and Engineering Co. Ltd. The prototype is used for spanning narrow but navigable canals where it is impracticable to install the usual permanent road bridge. The Meccano model embodies all the working principles of the original structure, and all the parts necessary for its construction are found in a No. 6 Outfit.

A square section structure is first built from a number of 12½" Angle Girders and 12½" Braced Girders to form the base of the model, and across the centre of this is then bolted the roadway which, as will be seen from the illustration, is built up from twenty-three 5½" Strips laid edge to edge. Each side of the roadway is supported between a 12½" Strip and a 12½" Angle Girder, and a second 12½" Strip 1 is bolted over the upper face of the Angle Girder to form a bearing surface for the bridge. A nut and bolt is placed in every hole of the side of the roadway as shown in Fig. 42, to form a rack that prevents the bridge from sliding when in operation. The necessity for these bolts will be realised when the model is complete. Each of the control cabins 2 are carried on two 9½" Angle Girders, a 7½" Strip and a 7½" Angle Girder, the four supports being suitably braced with 3½" and 4½" Strips as shown in the illustration.

The next operation is the construction of the bridge, which is quite a simple matter and needs no description. Care must be taken, however, to see that the curved portion at the rear has no irregularities in its outline.

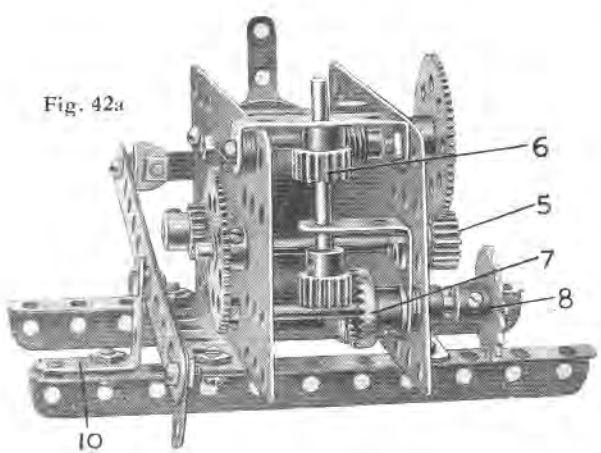
The model is operated by an Electric Motor bolted to two 5½" Angle Girders secured by ½"×½" Angle Brackets to the bridge between the 4½"×2½" Flat Plates 3. The mechanism is as follows. A ½" Pinion on the Motor armature shaft engages with a 57-teeth Gear that is secured on the same rod as the ½" Pinion 5. This Pinion meshes with a second 57-teeth Gear that, in turn, rotates a Worm in engagement with the ½" Pinion 6. A second ½" Pinion secured on the same Axle Rod as Pinion 6 meshes with a ¾" Contrate 7, which is secured to the Axle Rod of a 1" Sprocket 8. A length of Sprocket Chain is used to connect the Sprocket 8 to a second 1" Sprocket on the 8½" Rod 9 (Fig. 42) and to this Rod is attached the operating cords of the bridge. The inner ends of the cords are attached to ¾" Bolts on the control towers 2.

Automatically operated limit switches are fitted to the model in order to prevent overwinding of the bridge, and are arranged in the following manner. A 5½" Strip, pivotally attached to a 1"×1" Angle Bracket 10, is secured at one end to an arm of the Motor switch (see Fig. 42a), and its other end carries a Flat Bracket. This latter, when the bridge is in a raised position, strikes the base of the roadway and moves the Motor switch into a neutral or "off" position.

The second limit switch is operated when the bridge is in its lowered position. It consists of a piece of cord 13 attached at one end to the Motor switch, on the opposite arm to the 5½" Strip previously mentioned; and at the other end to a Collar secured on the 3" Axle Rod 11. A second Collar on this Axle Rod carries one end of a length of cord 12, which is passed over a 1" loose Pulley and weighted at its free end by means of six 2½" Strips. Care must be taken to see that when the cord 13 is fully extended, and has pulled the Motor switch into the "off" position, the cord 12 is wound on to the Axle Rod 11, and the weight is in the position shown in Fig. 42.

The small platform at the end of the bridge is constructed in the following manner. A 5½"×2½" Flanged Plate is supported by four 2½" Angle Girders, one at each corner, and Braced Girders of suitable lengths are bolted between these to form the sides. A 5½" Angle Girder is bolted on one of the long sides of the platform, and this supports the bridge when it is in a lowered position. Four ½"×½" Angle Brackets are used for screwing the stand to a suitable base.

Fig. 42a



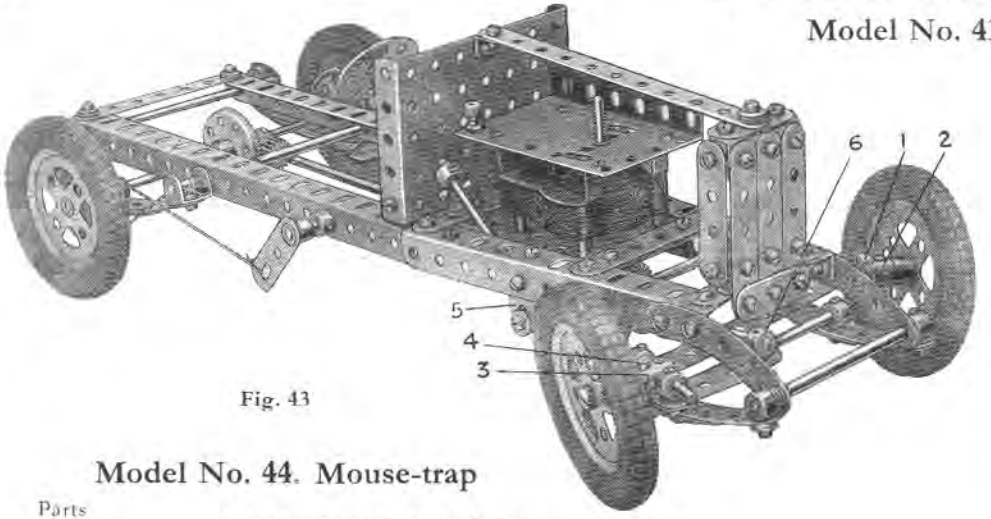


Fig. 43

Model No. 44. Mouse-trap

Parts required:

2	of No.	5
2	,,	6a
1	,,	11
1	,,	16
1	,,	18b
11	,,	37
5	,,	37a
4	,,	38
2	,,	43
1	,,	46
1	,,	48
1	,,	52
1	,,	59
1	,,	63
1	,,	102
2	,,	111
1	,,	111c

A 2½" × ½" Double Angle Strip is secured across the centre of a 5½" × 2½" Flanged Plate, and a 2½" Strip is pivotally attached to each end by means of a ½" bolt and two nuts. The 2½" Strips are connected together by a 2½" × 1" Double Angle Strip. A Double Bracket secured to the Plate forms a journal for a sliding 3½" Rod carrying at one end a Collar and at the other end a Coupling, in the end transverse hole of which a 1" Rod is held. This Rod forms a "catch" and engages the centre hole of the 2½" × 1" Double Angle Strip, and the Collar at the other end of the Rod is engaged by a 1½" Strip pivoted by its centre hole on a ½" Bolt passed through a single bent Strip. A second 1½" Strip carries a hook made from a length of wire, on which the bait is placed.

Immediately a mouse touches the bait, the movement is transmitted through the 1½" Strips to the sliding Rod, which, in turn, releases the catch, thus allowing the Springs shown in Fig. 44 to pull the 2½" Strips over sharply so that the mouse is trapped between the Double Angle Strip and the base plate.

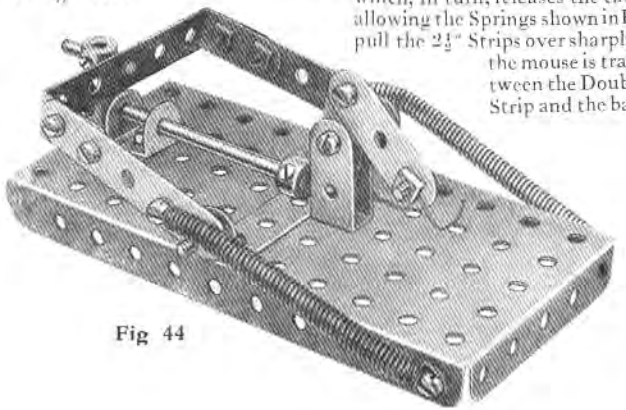


Fig 44

Model No. 43. Motor Car Chassis

The E1 Electric Motor is secured to the chassis by bolting it to a 3" Strip near the radiator, and clamping it to a 3½" Strip situated under the dashboard. A Worm on the armature spindle on the underside of the Motor meshes with a ½" Pinion on the 2½" Rod 11. This Rod is journalled at one end in a Double Bracket secured to a 1" × ½" Angle Bracket 8, and at the other end is carried in the top hole of a 1" × 1" Angle Bracket bolted to two 3½" Strips. The Rod 11 also carries a universal coupling, built up from a Swivel Bearing and a Small Fork Piece, and connected by means of a 5" Rod to a ½" Pinion and 1½" Contrate driving the back axle. A 1½" Pulley, and a 2" Pulley fitted with a Dunlop Tyre, are secured at one end of the back axle, and the other end carries similar Pulleys, but they are not secured on the Rod, connection between them being made by a Threaded Pin 15. This method of construction allows the car to turn a corner without the aid of a differential. The 1½" Pulleys serve as brake drums, the brakes consisting of short lengths of cord, passed round the Pulleys and tied to Cranks secured on a 4½" Rod that is journalled in the sides of the chassis. This Rod carries also the brake lever.

Each of the front springs consists of a 1½", 2½", and 3½" Strip, which are secured together in the centre by a bolt screwed into the threaded hole of a Collar carried on the front axle. One end of each complete spring is bolted to a Collar and the other end is attached to the frame by the shackles shown in Fig. 43a. The rear springs are built in a similar manner, but an extra 4½" Strip is used in each.

A ¾" Contrate 14 on the steering column engages a ½" Pinion carrying a Threaded Pin 13. The Pinion is carried on a Pivot Bolt locknutted in one of the threaded holes of the Collar 12. The Threaded Pin 13 carries a Swivel Bearing that is connected by a short Rod to a Collar 6, which is secured to a 2" Strip coupled by means of a Collar to a Coupling 3. The Coupling carries one of the front wheels and is pivotally mounted on a ¾" Bolt secured in one of the threaded holes of a Collar carried on the front axle.

The Collar 4 (Fig. 43) is connected by a 4½" Strip, to a second Collar 10 carried on a ¾" Bolt secured to a Coupling supporting the second front wheel. The Collar 9 supports a ¾" Bolt on which the Coupling carrying the front wheel pivots.

Parts required:

1	of No.	2	8	of No.	35	2	of No.	90
3	,,	2a	63	,,	37	3	,,	111
6	,,	3	12	,,	37a	2	,,	111c
1	,,	4	24	,,	38	2	,,	115
8	,,	5	1	,,	40	1	,,	116a
3	,,	6	1	,,	48b	4	,,	142a
6	,,	6a	1	,,	53	3	,,	147b
2	,,	8a	19	,,	59	2	,,	165
2	,,	9	2	,,	62	E1 Motor		
12	,,	10	4	,,	63			
7	,,	11						
12	,,	12						
1	,,	12a						
1	,,	14						
4	,,	15						
3	,,	15a						
1	,,	16						
1	,,	16a						
1	,,	16b						
2	,,	18a						
4	,,	20a						
2	,,	21						
1	,,	24						
3	,,	26						
1	,,	28						
1	,,	29						
1	,,	32						

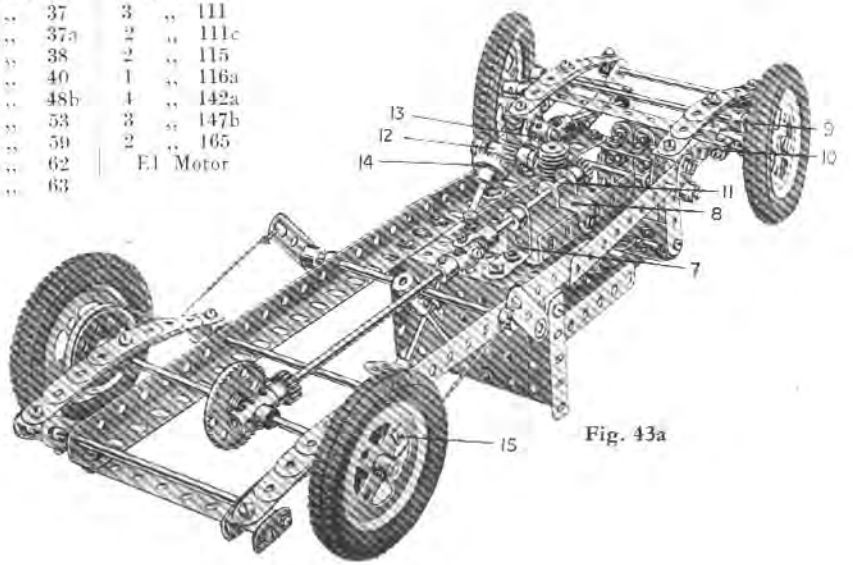


Fig. 43a

Model No. 45. Novel Momentum Tractor

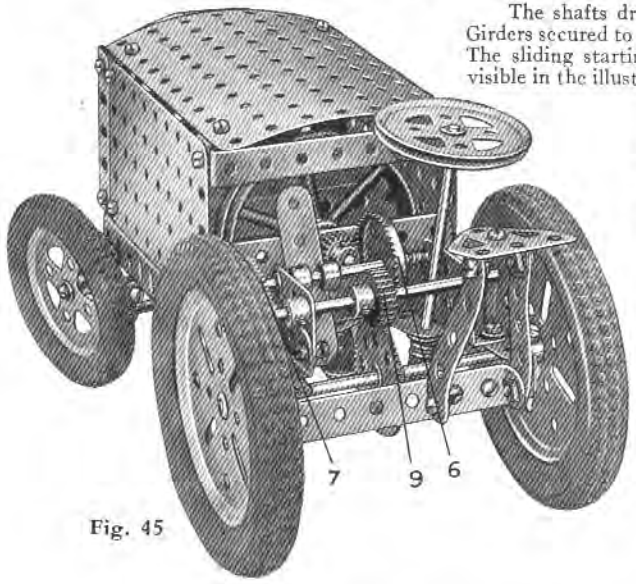


Fig. 45

The shafts driving the Flywheel 2 are carried in 3½" Flat Girders secured to the frame of the Tractor by 3½" Angle Girders. The sliding starting-handle shaft carries a 57-teeth Gear, not visible in the illustration, which meshes with a ½" Pinion secured to a sliding Rod carrying a 57-teeth Gear 1 (Fig. 45a), held out of mesh with a ½" Pinion on the flywheel shaft by a Compression Spring and Crank 5.

A second ½" Pinion, secured on the flywheel shaft, engages with a 1½" Contrate 6, which may be disengaged, when desired, by a pivotally mounted 2½" Strip and bolt shown in Fig. 45. A ½" Pinion, on the same Rod as the Contrate, drives a 57-teeth Gear on the back axle, through a 57-teeth Gear 7 and ¾" Pinion 9.

The steering column is connected to a Collar carried on a ¾" Bolt, lock-nutted in one hole of a "spider" taken from a Swivel Bearing, which is pivotally attached to a Coupling 3. The "spider" also carries one front wheel, and a second ¾" Bolt 4 which is connected to a ¾" Bolt and "spider" on the opposite side of the tractor.

A Flat Trunnion forming the driver's seat is bolted, by means of two ½"×½" Angle Brackets, to two 2½" strips secured to the frame of the model by two 1"×½" Angle Brackets.

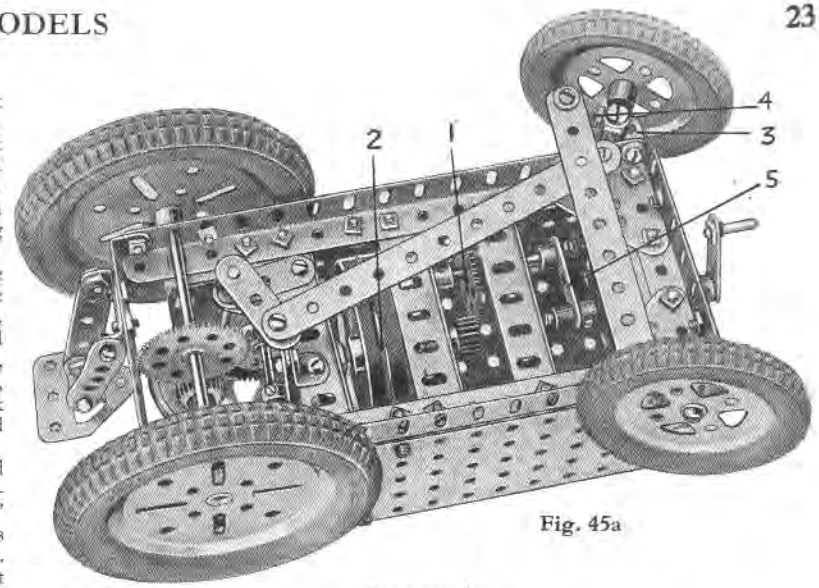


Fig. 45a

Parts required :

1	of No.	2	1	of No.	15a	4	of No.	37a	2	of No.	103h
1	,,	2a	2	,,	16	14	,,	38	3	,,	111
1	,,	3	1	,,	16a	2	,,	48b	2	,,	111a
3	,,	5	3	,,	16b	1	,,	52a	2	,,	115
6	,,	6a	2	,,	19b	2	,,	53a	1	,,	120b
2	,,	8b	3	,,	20a	14	,,	59	1	,,	126a
5	,,	9b	1	,,	25	3	,,	62	1	,,	132
2	,,	9d	4	,,	26	2	,,	63	2	,,	133
2	,,	9f	4	,,	27a	1	,,	72	2	,,	142a
1	,,	11	1	,,	28	4	,,	103d	2	,,	142b
3	,,	12b	78	,,	37	2	,,	103f	2	,,	147b

Model No. 46. Mortar Mixer

Parts required :

4	of No.	4	1	of No.	18a	1	of No.	29	2	of No.	63
2	,,	5	2	,,	18b	8	,,	37	1	,,	96a
2	,,	12	4	,,	20b	2	,,	48b	1	,,	137
1	,,	15a	1	,,	23	4	,,	59	2	,,	164
2	,,	16a	1	,,	25	1	,,	62b	1	,,	171

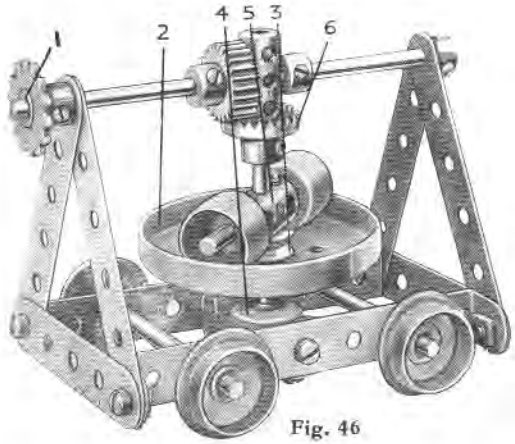


Fig. 46

The road wheels are carried on 2½" Rods journalled in two 3½"×½" Double Angle Strips, which are secured together at their ends by means of 2½" Strips. The Rod carrying the ¾" Sprocket 1 is journalled in the top holes of two 3" Strips bolted to the 3½"×½" Double Angle Strips carrying the road wheels.

The Wheel Flange 2 is clamped between a ½" fast Pulley 3 and a Socket Coupling 4, the boss of the Pulley being secured in the Socket Coupling. The lower end of the Socket Coupling fits over the boss of a Double Arm Crank that is secured by means of two ½"×½" Angle Brackets to the frame of the model.

The Rod, carrying the Coupling 5 and Contrate 6, is journalled in a Coupling at its upper end, and in the ½" fast Pulley 3 at its lower end.

Model No. 47. Variable Reaction Condenser

The small variable condenser shown in Fig. 47 works quite well if care is taken to see that the two sets of Rack Segments forming the Plates, are not touching each other.

The Rack Segments 1, clamped on a ¾" Bolt, are spaced by means of nuts, and are secured rigidly to two 1"×1" Angle Brackets insulated from the base. The second set of Rack Segments 2 are secured on a 3½" Threaded Rod similarly to 1, and are journalled in the 1"×1" Angle Brackets 3. A 1" fast Pulley fitted with a 1" Dunlop Tyre is used for working the moving vanes.

Parts required :

4	of No.	12a	Electrical					
1	,,	22	Parts :					
10	,,	37a	8	of No.	302			
1	,,	53	8	,,	303			
3	,,	59	8	,,	304			
1	,,	80a	8	,,	305			
1	,,	111a						
7	,,	129						
1	,,	142c						

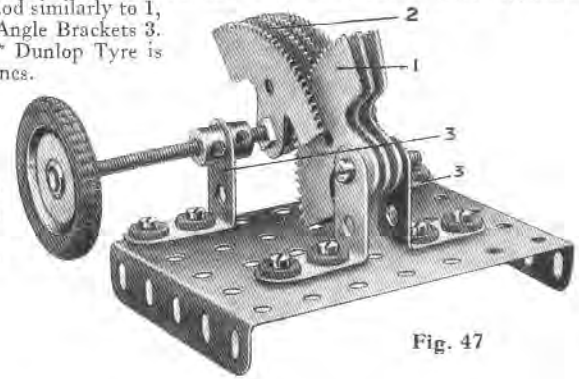


Fig. 47

Model No. 48. A Telegraph Recorder

Parts required:

2	of	No.	3	30	of	No.	37	2	of No. 108
3	,,		6a	2	,,		37a	2	,, 109
2	,,		8b	4	,,		38	2	,, 133
1	,,		12	1	,,		48	2	,, 142c
1	,,		16a	9	,,		59	2	,, 161
1	,,		16b	1	,,		63		Electric
2	,,		17	2	,,		77		Motor
4	,,		18a	1"	,,		94		
2	,,		22						
2	,,		24						
3	,,		26						
2	,,		32						

Electrical parts:

2	of	No.	301
2	,,		302
2	,,		303
2	,,		304
2	,,		305
2	,,		306
2	,,		308
1	,,		313

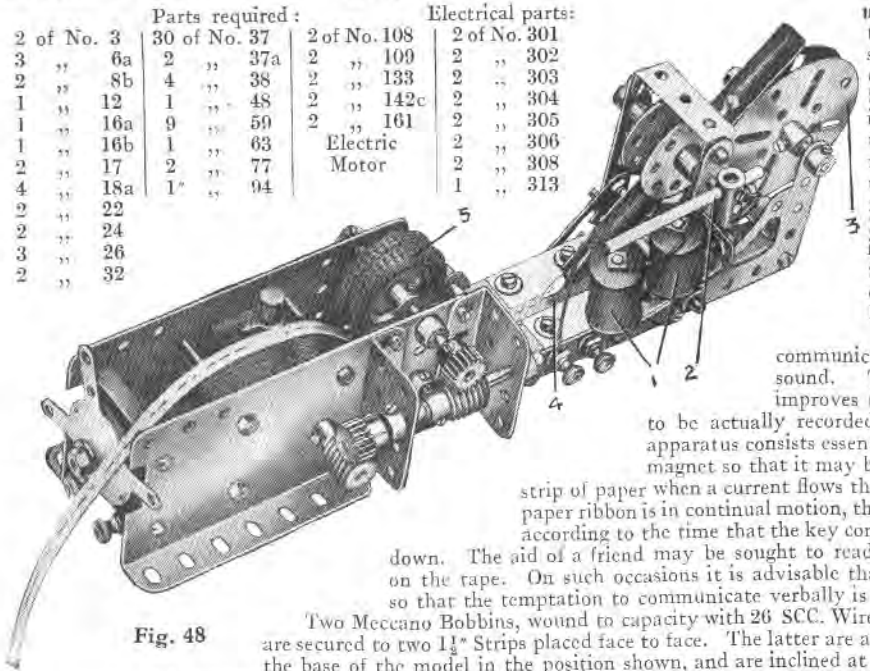


Fig. 48

Messages sent by telegraph in the ordinary way are transmitted by means of the Morse Code, in which the letters of the alphabet are represented by combinations of dots and dashes printed on a paper ribbon, or by corresponding sounds. The code is not difficult to learn, and a little time spent in studying it will be well repaid by the hours of enjoyment that may be obtained in transmitting and receiving messages to and from friends by means of model apparatus. An ideal installation for this purpose is the Meccano Buzzer and Key, described fully in the "M.M." for February, 1928.

With the buzzer apparatus, communication is of course made entirely by sound. The instrument shown in Fig. 48 improves upon this, as it enables the messages to be actually recorded in printed dots and dashes. The apparatus consists essentially of a pen actuated by an electric magnet so that it may be made to press lightly on a travelling strip of paper when a current flows through the coils of the magnet. As the paper ribbon is in continual motion, the pen makes long or short impressions according to the time that the key controlling the energising current is held down. The aid of a friend may be sought to read the messages as they come through on the tape. On such occasions it is advisable that the partners be in separate rooms so that the temptation to communicate verbally is removed.

Two Meccano Bobbins, wound to capacity with 26 SCC. Wire, are mounted on Pole Pieces, which are secured to two 1½" Strips placed face to face. The latter are attached by a ½" × ½" Angle Bracket to the base of the model in the position shown, and are inclined at a slight angle to the horizontal. The end of the winding of one magnet is connected to the commencement of the winding of the other, and the two remaining ends are secured to terminals, one of which is insulated from the frame by Insulating Bushes and Washers.

The pen is clamped rigidly between two Bush Wheels on a Rod, which is journalled in two vertical Strips and carries a Coupling in which is secured a short Rod 2. The latter projects over, and a short distance above, the pole faces of the magnets. A short piece of Spring Cord, attached to the Coupling and to the frame, serves to maintain the pen normally raised, so that it is only by the attraction of the magnet that the pen is brought into contact with the moving tape.

The tape (a paper streamer will do excellently) is wound off the drum 3 by being pulled through a pair of rollers at the other end of the device. The top roller 5 consists of a pair of 1" fast Pulleys shod with 1" Dunlop Tyres and secured to a Rod that is driven by the Electric Motor. The second roller consists of a ½" Pinion, and it is immediately below the upper roller so that it makes light contact with the tyres.

The tape passes over a smooth piece of cardboard where the nib of the pen makes contact; and it also runs under two guides. These take the form of Rods, one of which is journalled in the bottom holes of the vertical Strips carrying the pen rod, and the other is mounted in Flat Brackets attached to the Motor end of the base. Care should be taken to see that when the Rod 2 is attracted by the magnets, the pen rests only lightly on the tape.

It will be found a great advantage to incorporate a Resistance Controller in the Motor circuit, so that the speed of the tape may be varied to suit the speed at which the message is transmitted, for this is liable to considerable variation with beginners.

The Morse Code

A	·—	J	·———	S	···
B	—···	K	—·—	T	—
C	—·—·	L	·—··	U	··—
D	—··	M	——	V	···—
E	·	N	—·	W	·——
F	··—·	O	———	X	—··—
G	——·	P	·——·	Y	—·——
H	····	Q	——·—	Z	——··
I	··	R	·—·		

Model No. 49. Novel Electric Engine

An interesting example of the use of the Meccano solenoid is provided by the tiny vertical engine illustrated in Fig. 49. This engine, although only 4" in height, runs at a considerable speed, and when in operation closely resembles a steam engine.

The construction of the model should be commenced by winding a Meccano Bobbin to capacity with No. 26 SCC. Wire. The completed solenoid may be covered with brown paper to protect the windings and to enhance its appearance. It is retained in position by 1½" Flat Girders, which are attached by bolts to 3½" Strips forming the vertical members of the engine. Each Flat Girder is spaced away from the 3½" Strip by two 1½" Strips, and the lower ends of the 3½" Strips are secured to ½" × ½" Angle Brackets 4. The top ends of the Strips are joined together by Double Brackets. The bolts securing the Angle Brackets 4 to the 3½" × 2½" Flanged Plate forming the base plate of the model, also serve to retain in place a Channel Bearing, which forms the bearing for the crankshaft.

The crankshaft consists of a short Rod, to one end of which a Coupling is attached, while on the other end the flywheel is mounted. The Coupling is connected pivotally by a 1½" Strip to the plunger sliding in the core of the solenoid. One end of this Strip is mounted loosely on a set-screw inserted in the grub-screw hole of a Collar on the plunger (a 1½" Rod); and the other end is carried on a bolt held in the Coupling. The flywheel is a 2" Pulley that fits inside a Wheel Flange, the two being bolted together to obtain additional weight.

A short length of springy brass strip 1 or Pendulum Connection (part No. 172) is attached to a Terminal 2, and is adjusted so that its free end makes contact with the grub-screw of a Collar that is secured to the crankshaft. Contact must take place on the commencement of the upward stroke of the plunger. One end of the solenoid is connected to the frame of the model, and the other to the insulated Terminal 3. Terminal 2 is also insulated.

Parts required:

2	of	No.	3
5	,,		6a
1	,,		9b
2	,,		11
1	,,		18a
1	,,		18b
1	,,		20a
11	,,		37
1	,,		37a
6	,,		38
1	,,		53
2	,,		59
1	,,		63
2	,,		103h
3	,,		111c
1	,,		137
1	,,		160
1	,,		172

Electrical parts:

1	of	No.	301
1	,,		302
1	,,		303
1	,,		304
1	,,		305
2	,,		306
1	,,		313

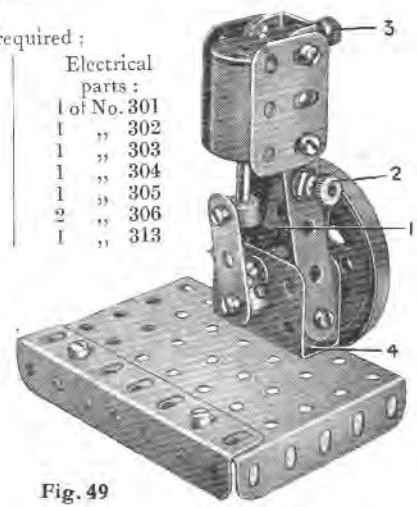


Fig. 49

The Meccano movements shown on this and the following seven pages have been selected from the "Suggestions Section" of various issues of the "Meccano Magazine." They are shown here because each movement is adaptable to a large number of models, and each should suggest to the keen Meccano boy quite a number of new models. The self-adjusting winch illustrated below, for example, could be adapted to many Meccano Cranes, and similar models employing hoisting mechanisms.

No. 1. Centrifugal Governor

Meccano enthusiasts who possess a gramophone will be aware of the great importance of running the turntable at the correct speed. The speed of the motor actuating the turntable is controlled by a simple form of centrifugal governor, and model-builders who wish to construct such a device will find the example shown in Fig. 1 highly satisfactory. This mechanism has been designed as a result of a competition announced in the "*Meccano Magazine*" in which model-builders were asked to send in their conceptions of the neatest and most efficient governor. Many ingenious entries were received, and we have combined all their best points in the device shown in Fig. 1.

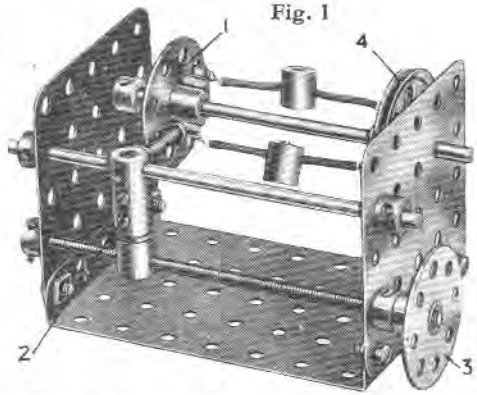


Fig. 1

The thin spring strips to which the "bobs" are attached in the actual device are represented by short lengths of Spring Cord carrying Threaded Bosses that are secured in place on the Spring Cord by grub-screws, inserted in the ends of the Bosses and screwed home. One end of each length of Spring Cord is secured to bolts inserted in the set-screw holes of a 1½" Pulley 4, fixed to a 4½" Rod; and the other end is attached in a similar manner to a Bush Wheel 1. The latter must be free to slide on the Rod, and therefore the bolts in its boss should not be allowed to touch the 4½" Rod.

As the speed of the governor Rod increases, the bobs fly out under the influence of centrifugal force and so cause the Bush Wheel to move along the Rod until it comes into contact with the head of a ¾" Bolt, which thus imparts a braking effect and prevents any further increase in speed. If for any reason the speed drops, the bobs tend to collapse inward, and so move the Bush Wheel away from the ¾" Bolt. The braking effect thus being eased, the device again picks up speed. These effects take place almost instantaneously, so that the result is a steady rate of rotation.

The speed that the governor is expected to maintain may be varied by turning the Bush Wheel 3, which is attached to a Screwed Rod. On this Rod is mounted a Threaded Boss attached to a Coupling 2, which carries the ¾" Bolt and slides on a guide rod.

An improvement in the performance of the governor would result if the head of the ¾" Bolt were fitted with a small felt pad. This would allow for smoother running of the model.

The felt may be wound round the Bolt and secured by a piece of cord. An alternative method is to fit two Washers on the shank of the Bolt and clamp the felt between them with a nut.

Model-builders who are particularly interested in speed-governing devices are advised to study the Meccano book of "*Standard Mechanisms*," which contains descriptions and illustrations of several devices suitable for incorporation in Meccano models. This book also describes a remarkable form of governor that is designed specially to control the speed of the Meccano Electric Motor. This item will be found under S.M. 113, "Speed Governor for Electric Motor."

No. 2. A Novel Overflow Indicating Device

The device shown in Fig. 2 is for use with a running water aquarium. With an aquarium of this type there is always a danger of the water over-flowing owing to the accidental clogging of the outlet pipe. The device is hung inverted, that is with the blotting paper downward, on the inside of one side of the aquarium, at a pre-determined height, so that immediately the water reaches the danger level it comes into contact with the strip of blotting paper 1.

The simplest way of fitting the device to the aquarium is to bolt a long Strip to one Flange of the Plate. The end of the Strip should then be bent so as to form a clip to grip the edge of the side. One end of the strip of paper is clamped between a Flat Bracket and a ½"×½" Angle Bracket, while its other end is attached similarly to a 1"×1" Angle Bracket 2. This Angle Bracket has bolted to it a Double Bracket, which is mounted freely on a Short Rod that is held in Angle Brackets on the base plate. A 6 B.A. Bolt and Terminal 3 is secured to the Angle Bracket 2 and is insulated from it by means of an Insulating Bush and Washer. A second 6 B.A. Bolt 4 is secured in metallic contact with the Plate, and in such a position that it is vertically below the Bolt 3. A terminal is secured to the Plate in the position indicated, and this is also in metallic contact with the Plate.

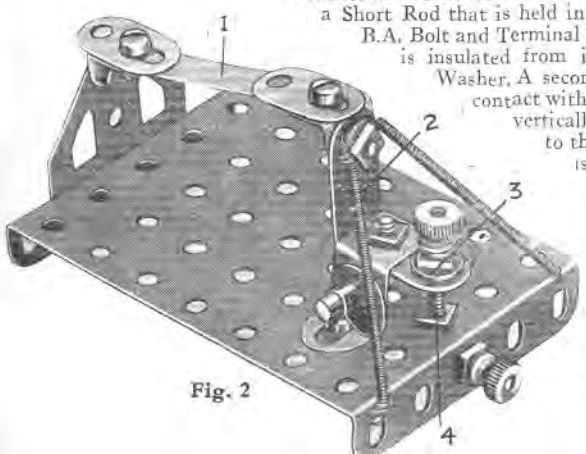


Fig. 2

When water touches the blotting paper, the paper softens and breaks under the tension of two lengths of Spring Cord. The bolthead then makes contact with the Bolt 4, thus completing the circuit and ringing a bell or other alarm mechanism.

The indicator is placed in series with the battery and the bell, so that the current flows across its contacts on the way to the bell.

No. 3. A Self Adjusting Winch

The most notable feature of the device shown in Fig. 3 lies in the fact that it accommodates itself to variations in the weight of the load, so that a heavy load may be hoisted just as easily as a much lighter one. This is accomplished entirely automatically by the employment of an expanding barrel round which the winding cord is wound.

It will be seen from Fig. 3 that the mechanism consists essentially of an expanding barrel built up from two 2½" Strips, which are mounted on Pivot Bolts inserted in the tapped holes of Collars secured on the winding shaft.

When the winch is engaged in hoisting a light load the barrel is fully expanded, but when lifting a heavier load it contracts. In this manner a gain is brought about in the mechanical advantage of the machine, which means that a heavy load may be hoisted with comparative ease.

The device may be incorporated in cranes instead of a gear box, a Pawl engaging a Ratchet on the hoisting shaft being used for a safety clutch.

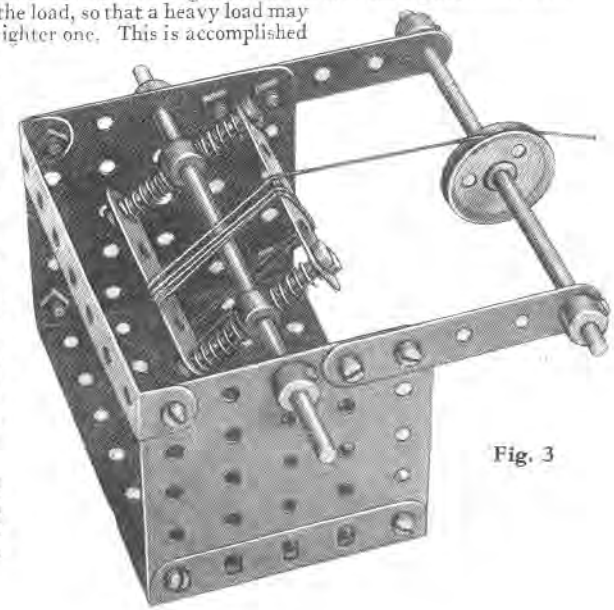


Fig. 3

No. 4. Demonstration Model of a Single Plate Clutch

From a very early stage in the history of the motor car, clutches of one type or another have been standard fittings to all models. It was found at the outset by the pioneers of motoring that a gear box was necessary in order to obtain full efficiency from the engine, and also to enable the engine to do its work under varying conditions. In order to facilitate a change from one gear ratio to another, some means had to be provided for disengaging the motive power for a short time while the operation was effected. This was accomplished by means of a clutch. Like every other part of a motor car, the clutch has undergone considerable improvement during recent years and the leather-faced clutches formerly used have been replaced by more efficient devices in which metal plates are employed. Modern clutches may have one or more plates that are pressed forcibly into contact with each other in order to transmit the movement of the engine; but the present model is one of a typical single-plate clutch that is very interesting to build and operate, and is specially useful for demonstration purposes.

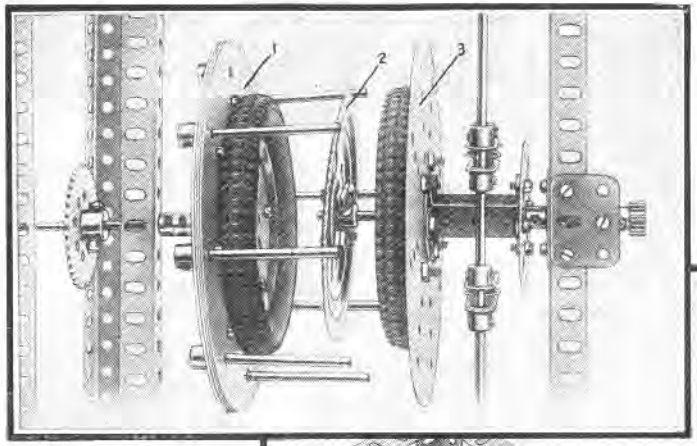


Fig. 4a

A suitable framework should first be built on which to mount the clutch unit. The constructional details of this should be easy to follow from Fig. 4. The clutch unit itself embodies several important parts, the main ones being the flywheel 1, the floating plate 2, and the withdrawal plate 3. These are shown, in Fig. 4a, separated from each other in order to make matters clearer. The flywheel is built up from five 6in. diam. Circular Plates, fitted with a 3" Pulley provided with a Dunlop Tyre, which represents the "Ferodo" disc of the actual clutch. The flywheel is secured rigidly to the crankshaft, which is a Meccano Rod driven by an Electric Motor through a Sprocket Chain drive. It should be noted that the 3in. Pulley must be bolted very tightly to the flywheel in order to provide a space in which the floating plate 2 can move freely when necessary.

The floating plate consists of the geared portion of a Ball Race (part No. 168b), attached by means of ⅜" Bolts to a Bush Wheel in such a manner that it is free to slide longitudinally through a short distance. The Bush Wheel is secured to the secondary or driven shaft, the tip of which runs freely in the boss of the 3" Pulley Wheel that is bolted to the flywheel.

The withdrawal plate 3 consists of a 6" diam. Circular Plate, to the centre of which a Face Plate is attached by means of 1½" Double Angle Strips, so that both rotate freely upon the Rod as a single unit. A second 3" Pulley Wheel, fitted with a Dunlop Tyre, is bolted on to the plate, and forms a second "Ferodo" disc.

The flywheel and the withdrawal plate revolve as one. They are connected, as shown, by 2" Rods fixed to the flywheel by means of Cranks and passed through corresponding holes of the withdrawal plate. Compression Springs on the rods serving to keep the plate normally hard up against the driving member of the clutch. The Springs are retained in place by Collars.

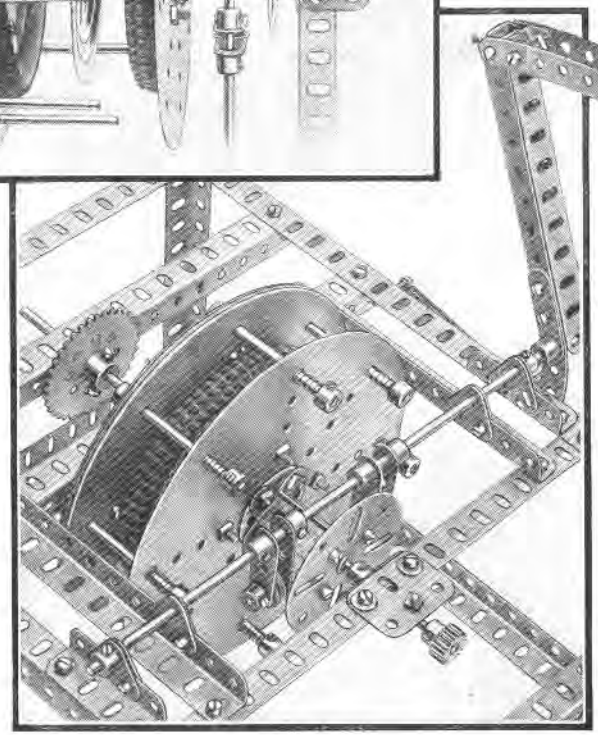


Fig. 4

The withdrawal mechanism should now receive attention. An efficient clutch pedal is made from 5½" Angle Girders and Curved Strips, together with two 2½" Flat Girders, as shown in the illustration. The pedal is fixed rigidly to one end of a 11½" Axle Rod that is journalled in four bearings formed by several pairs of 1in. Triangular Plates. The withdrawal forks are secured very rigidly by double grub-screws to the same Rod, and each consists of a pair of Cranks fitted with a roller formed of a ½" loose Pulley. The Pulleys are mounted on Threaded Pins secured to the Cranks, and they are spaced centrally by Washers. When the pedal is depressed, the forks press against the edge of the Face Plate and bring the withdrawal plate out of contact with the floating plate, thus freeing the latter from the drive.

It should be noted that to limit the movement of the clutch pedal this member is extended below the 11½" Rod by means of a 2½" large radius Curved Strip, which is restricted in its movement by Threaded Pins secured to the framework. A Spring, which is attached to the lower end of the 2½" Curved Strip and to a ¾" Bolt affixed to the frame-work, assists the clutch pedal to return to its normal position after operation. Owing to the fact that the withdrawal mechanism is subject to very great strain in operation, it is advisable to use two grub-screws in each of the Cranks.

Model-builders will realise, of course, that this model cannot be incorporated in a Meccano Chassis on account of its large dimensions, and it is therefore, only suitable as a demonstration model for showing the working principles of a single plate clutch.

Those who are keenly interested in constructing realistic models of motor cars should therefore endeavour to design a small compact form of this clutch, as its use in a model car will add considerably to the interest and pleasure of working the model.

It may be mentioned here that other interesting parts of a motor car transmission reproduced in Meccano, namely the gear box and the differential, are fully described and illustrated in a Special Instruction Leaflet that deals with the construction of the Meccano Motor Chassis. This Leaflet is No. 1 of a series describing the construction of Meccano Super Models, and it may be obtained from any Meccano dealer, or direct from Meccano Ltd., Old Swan, Liverpool, price 3d., plus postage.

Another interesting part of a modern motor car is the Bendix Pinion, which is designed to disconnect automatically the starting motor from the crankshaft of the engine immediately the latter starts. This remarkable mechanism was described and illustrated in the 1930 "*Book of New Models*," and model-builders will find it a splendid subject for a Meccano model.

No. 5. Novel Four Movement Gear Box

This is a type of gear box so designed that it may be put together by the merest tyro in Meccano engineering, and when completed it will function efficiently.

The principle on which the gear box is designed is as follows: A pinion is arranged so that on operation of the "selector" lever it may be moved bodily round another pinion secured to the driving shaft, in the same way as the "planet wheel" travels round the "sun wheel" in epicyclic mechanism (see Standard Mechanism No. 279). The four separate shafts that are to be driven are arranged radially about the driving shaft, and carry gear wheels that mesh with the planet wheel when the latter is brought into direct line with a particular gear wheel and the sun wheel. Thus the planet wheel forms a connecting link by means of which any one of the four driven shafts can be linked up as desired with the driving shaft, an arrangement giving great scope for experiment.

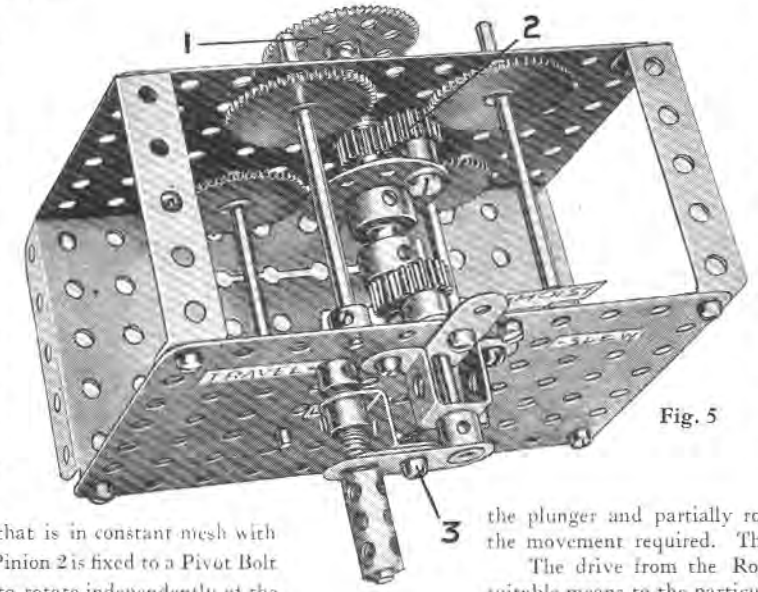


Fig. 5

The sun wheel on the driving shaft is a ½" Pinion that is in constant mesh with a second ½" Pinion 2 (Fig. 5) forming the planet wheel. Pinion 2 is fixed to a Pivot Bolt that is carried in a Bush Wheel, and the latter is free to rotate independently of the driving shaft on which it is mounted. On turning the Bush Wheel the Pinion 2 may be brought into mesh at will with the 50-teeth Gears on the driven shafts.

The Bush Wheel is connected by a Socket Coupling to a ½" Pinion that is loose on the driving shaft, and is engaged with a similar Pinion secured on the end of a short Rod carrying at its outer extremity a Crank 3. As will be seen, the Rod is mounted in the 5½" × 3½" Flat Plate that forms the side of the gear box. The end of the Crank is provided with a spring-loaded plunger that may be inserted, on rotation of the Crank, in certain holes in the Plate. These holes are plainly marked in the illustration with the desired gear positions. The plunger is a short Rod free to slide in a Reversed Angle Bracket and a Flat Bracket that are bolted to the Crank, while a Compression Spring serves to keep the end of the plunger in the holes in the Plate. To change gear, it is only necessary to pull out the plunger and partially rotate the Crank until it is opposite the hole labelled with the movement required. The plunger is then released.

The drive from the Rods carrying the 50-teeth Gears may be conveyed by any suitable means to the particular movement it is intended to operate.

No. 6. Overload Release for Electric Motor

Every electrical circuit should be equipped with safety devices to protect the apparatus from damage that might arise from the passing of a heavier current than that for which the circuit is designed. In the case of electric motors it is customary to provide protection by means of a device known as an "over-load release."

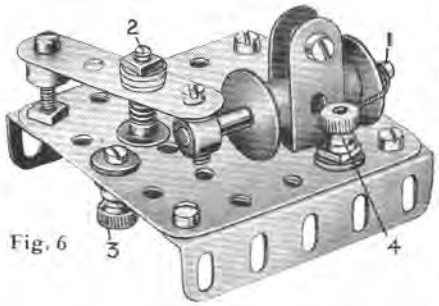


Fig. 6

Fig. 6 shows a Meccano overload release mechanism. As will be seen from the illustration, a solenoid (consisting of two layers of Meccano 26 SCC Wire wound on a Bobbin) is clamped in position on the base plate of the apparatus. The Rod 1 slides in the bore of the solenoid and is connected pivotally to a switch arm carrying the contact 2. The latter is part of a Spring Buffer (part No. 120a) and it normally makes contact with a 6 B.A. Bolt that is insulated from the Plate by insulating Bushes and Washers, and carries on its shank a terminal 3. One end of the solenoid winding is attached to the insulated terminal 4; the other end is connected to the base plate.

To connect the device in circuit with a 6-volt Motor and Accumulator, either of the two wires attached to the Accumulator should be connected to one of the terminals of the overload release, and the remaining terminal of the latter to the Motor. Hence the current is caused to flow through the turns of the solenoid and through the contacts of the overload release on its way to the Motor, and when the current rises above a certain value the plunger 1 is drawn into the interior of the solenoid, thus moving the switch arm and breaking the circuit.

No. 7. Anti-Friction Bearing

Ball bearings and roller bearings play a great part in the economical running of machinery, for they reduce very greatly the friction of bearings and thus make available the energy that otherwise would be lost through friction, in addition to cutting down wear and tear to an absolute minimum.

In actual engineering practice, and also in Meccano engineering, there are various types of both ball and roller bearings. Most of these are familiar to model-builders, but the type shown in Fig. 7 is rather unusual. It should prove interesting to most Meccano boys, for it reduces friction to a surprising degree as compared with ordinary plain bearings and is therefore specially suitable for delicate mechanisms.

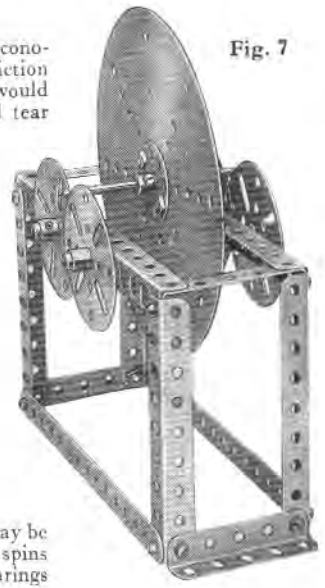


Fig. 7

The axle carrying the flywheel, a Circular Plate, runs on the circumferences of four Face Plates, which are journalled loosely on Pivot Bolts. The pair of Face Plates on each side are arranged so that their inner edges overlap one another. To this end the Pivot Bolts are mounted 2ins. apart. It should be noted that this device can be used only when the load on the axle is exerting pressure in a downward direction as a load acting sideways or upward would cause the spindle to leave its bearings.

Proof of the efficiency of this type of anti-friction bearing may be obtained by comparing the length of time that the flywheel spins when running in bearings of the ordinary description and in bearings of the form described here.

No. 8. Demonstration Model of Variable-Pitch Propeller

Variable pitch propellers have recently come into use for aircraft. The amount of work demanded of an aeroplane engine varies with the height at which the machine is flying, and in order to maintain constant engine speed with an ordinary propeller the pilot can adjust the throttle according to the altitude. An alternative to this is to use an airscrew with a variable pitch.

Fig. 8 illustrates an exceptionally interesting Meccano model of one of these ingenious devices. The novel feature of the model is the provision whereby the blades may be angled while they are rotating.

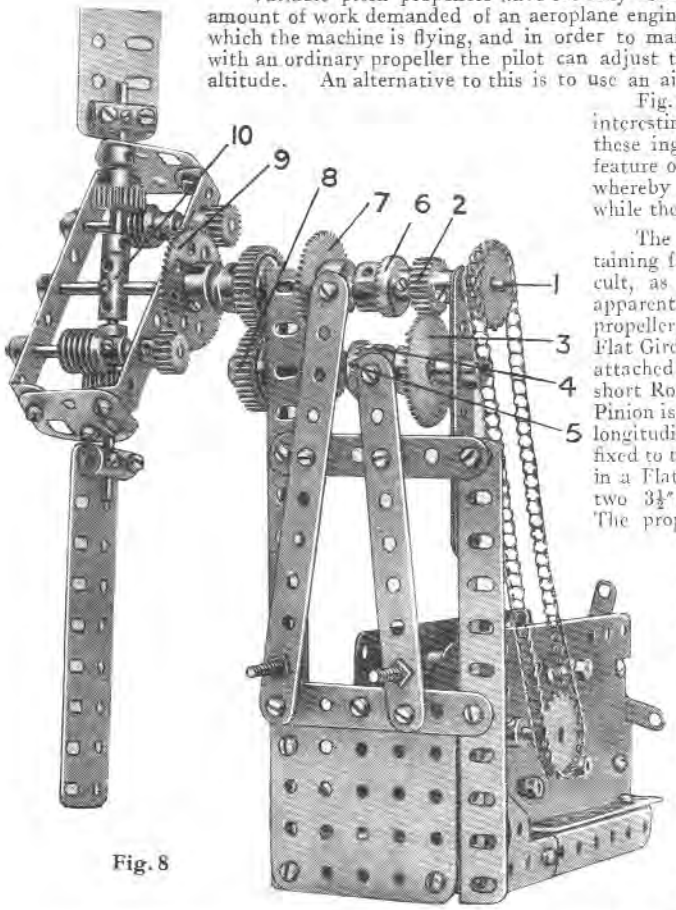


Fig. 8

The building of the main containing frame should not prove difficult, as its construction is clearly apparent from the illustration. The propeller blades each consist of a 5½" Flat Girder, the lower end of which is attached by means of a Coupling to a short Rod. This Rod, to which a ¾" Pinion is secured, is journalled in the longitudinal bore of a Coupling 10 fixed to the propeller shaft 1, and also in a Flat Trunnion that is bolted to two 3½"×½" Double Angle Strips. The propeller shaft passes through the centre holes of the Double Angle Strips, which serve also as bearings for two short Rods, on each of which is a Worm and a ½" Pinion. The Worms mesh with ¾" Pinions on the Rods carrying the blades, and both the ½" Pinions mesh with a 57-teeth Gear 9, which is loose on the propeller shaft and is connected to a loose 1" Gear by a Socket Coupling.

A unit comprising a 50-teeth Gear 7 and a Socket Coupling runs loosely on the propeller shaft, and a ¾" Contrate 6 and a ¾" Pinion 2 are fixed securely on the shaft. A movement of a lever results in the Socket Coupling coming into contact with the Contrate Wheel, which forms a clutch thus causing the unit to turn with the shaft. A similar arrangement is followed with regard to the layshaft, a 50-teeth Gear 3 of the latter unit meshing with the ¾" Pinion, while the ¾" Pinion on the layshaft meshes with the Gear 7. A 1" Gear 8 fixed on the end of the layshaft meshes with that attached to the 57-teeth Gear 9.

The device works in the following manner. When the clutch on the propeller shaft is engaged by moving the appropriate handle, the Gear 7 revolves at the same speed as the shaft, thus actuating the ¾" Pinion and the 1" Gear of the layshaft. This angles both blades through the medium of the unit 9 and the Worm gearing contained in the boss of the propeller. When it is desired to angle the blades in the reverse direction, the clutch previously operated is withdrawn and the other then engaged.

No. 9. A Practical Meccano Time Switch

Most readers will have noted the fact that many of the large stores keep their window displays illuminated after the place is closed to the general public and the staff has left. Possibly some of them have been under the misapprehension that the lights continue burning until the staff returns on the following morning. This is not the case, however. The lights are switched off by a night watchman, or by a time switch. Such a device consists of a clock connected by some means to the electric light switch, so that at a predetermined time the switch is actuated by the mechanism of the clock and the lights are extinguished.

A remarkably simple time-switch of this nature is shown in Fig. 9. It consists essentially of an ordinary alarm clock operating a simple form of trigger mechanism, which is constructed entirely from standard Meccano parts and connected to the switch by a length of Sprocket Chain.

Two 7½" Angle Girders 1 are secured to the 5½"×2½" Flanged Plate forming the base of the device, additional rigidity being gained by the use of Architraves. The member 2, which slides on the flanges of the Girders 1, consists of two 3½" Flat Girders, which are placed face to face and spaced apart by Washers on the securing bolts. Two tension Springs (part No. 43) are attached to the sliding member 2 and also to a 3½" Strip that is bolted between the Girders 1. The ends of the Springs are attached to the sliding frame by means of ⅜" Bolts.

A Rod 5, journalled in 1½" Strips that are bolted to the 7½" Angle Girders, has secured to it two Couplings carrying the Rods 3. The Couplings are spaced on the Rod 5 so that the Rods 3 may pass freely through the slotted holes of two ½"×½" Angle Brackets that are secured to the sliding frame 2. The Rod 5 is slidable transversely in its bearings, however, and in setting the mechanism it is moved slightly to one side and the frame 2 is raised so that the Rods 3 do not coincide with the holes in the Angle Brackets, but instead keep the frame 2 raised by pressing against the Brackets, as indicated in the illustration.

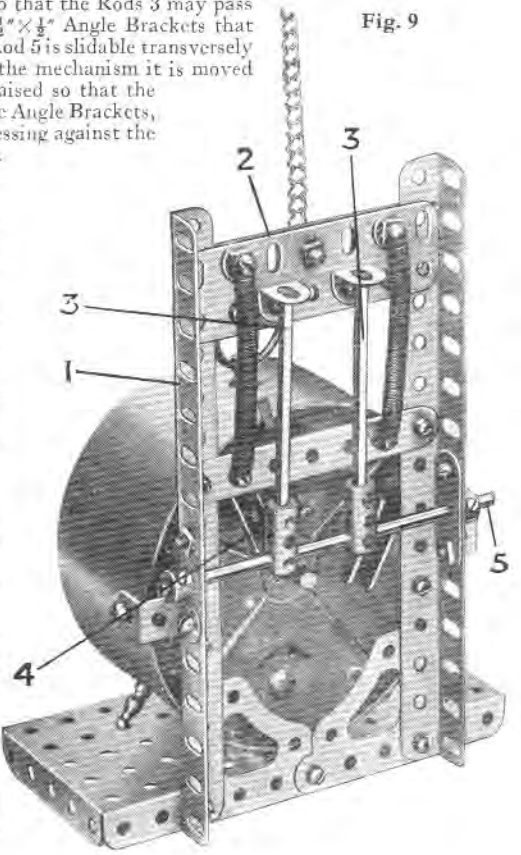
The left-hand Coupling has a ½" Bolt inserted in its transverse bore for the purpose of engaging with the alarm key 4 of the clock. Ordinary flat keys may be used in place of the U-section keys shown in the illustration.

When the alarm is released the key rotates in an anti-clockwise direction and strikes the ½" Bolt, thus forcing the Rod 5 to the right and causing the ends of the Rods 3 to move into the slotted holes of the ½"×½" Angle Brackets. The sliding member will then be drawn down under the force of the Springs and the switch will be pulled off through the medium of a length of Sprocket Chain, which is attached to the member 2 and to the switch. It should be quite a simple matter to modify the construction of the device in order to adapt it to clocks of various types.

In most electric light and power switches of the tumbler pattern, the lever is raised in the "off" position. It is necessary, therefore, to either turn the switch upside down, or mount the Meccano model above it in an inverted position.

Another way of accomplishing the same result would be to pass the Sprocket Chain over a Sprocket Wheel placed above the switch before securing it to the latter, thus reversing the pull.

Fig. 9



Nos. 10 and 11. Two Useful Meccano Cams

A cam is a device for converting a rotary movement into an intermittent reciprocating movement, without the aid of links or gear wheels: In this function it resembles a crank, but unlike the latter, it cannot be used to change reciprocating into rotary motion. One of the commonest uses to which cams are put, and one that should be familiar to Meccano model-builders, is to be found in the operation of the valves of most motor car engines.

Cams are particularly useful for operating valve mechanisms, and in many types of engines, particularly internal combustion engines, the cam has now entirely superseded the eccentric for this purpose. Apart from their use for operating valve gears, however, cams fulfil many other equally useful purposes in general engineering, and they differ considerably in shape according to the duties they have to perform.

In effect a cam is merely a projection on a shaft, matters being so arranged that a lever, or the end of a slidable rod, rides up and down on the projection as the shaft rotates.

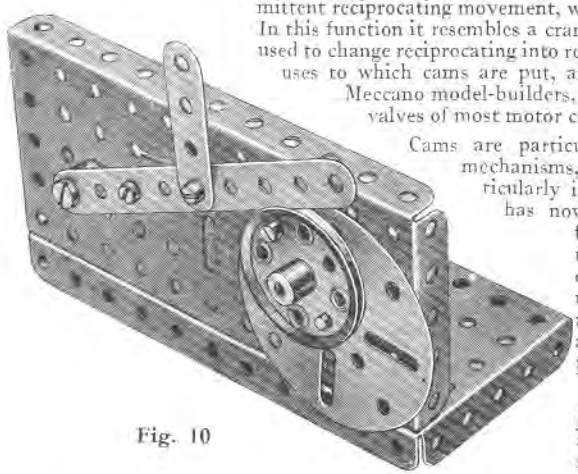


Fig. 10

Figs. 10 and 11 show two quite different and interesting types of Meccano cams. The former is designed for use where a regular reciprocating motion is required; and the latter is specially adapted to operate the picking motion in a Meccano Loom (see special Instruction Leaflet No. 16). We recommend all keen Meccano model-builders to try out for themselves its efficiency in place of the cam illustrated in the Leaflet.

The construction of the cam shown in Fig. 10 will be fairly obvious. A Face Plate has a 1½" Pulley secured to it in the manner shown, and a freely pivoted Strip rides in the groove of the Pulley. When the Face Plate is rotated, the Pulley performs an eccentric motion about the centre of rotation, and thus causes the pivoted Strip to rise and fall. The Strip may be connected by Rods or further Strips to the mechanism it is desired to operate, such as valve gear, pumps, etc.

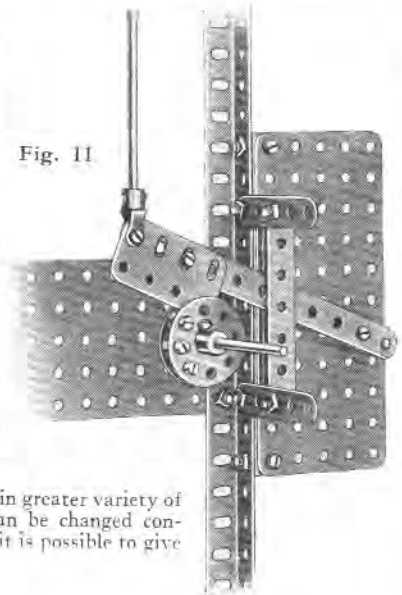


Fig. 11

The second cam, shown in Fig. 11, consists of two Bush Wheels that are spaced apart by three Collars and joined together by as many ⅜" Bolts, which are passed through the Collars. The rocker arm is a 5½" Strip, pivoted on a bolt at one end and secured at the other end to a 2½" Flat Girder, which bears on the Collars. A vertical Rod transmits the motion of the rocker arm to the "picking sticks" of the Loom.

Another model in which this cam would be useful is the Meccanograph. Some very intricate and fascinating results have been obtained with this model, and many novel cams have been devised in order to obtain greater variety of designs. The contour of the cam shown in Fig. 11 can be changed considerably by altering the position of its Collars, so that it is possible to give a wide range of movements to the pen of the model.

No. 12. Automatic Infinitely Variable Speed Gear

To effect a change of speed in the usual type of gear box it is necessary to slide certain gears into or out of mesh by means of a lever. This method has many disadvantages, and several ingenious devices have been invented in the attempt to replace it. Particular attention has been paid to motor car gear boxes, and there are now several mechanisms in existence that enable changes of speed to be carried out automatically or semi automatically.

Fig. 12 shows a Meccano example of such a mechanism. It embodies what is known as "friction disc" drive transmission.

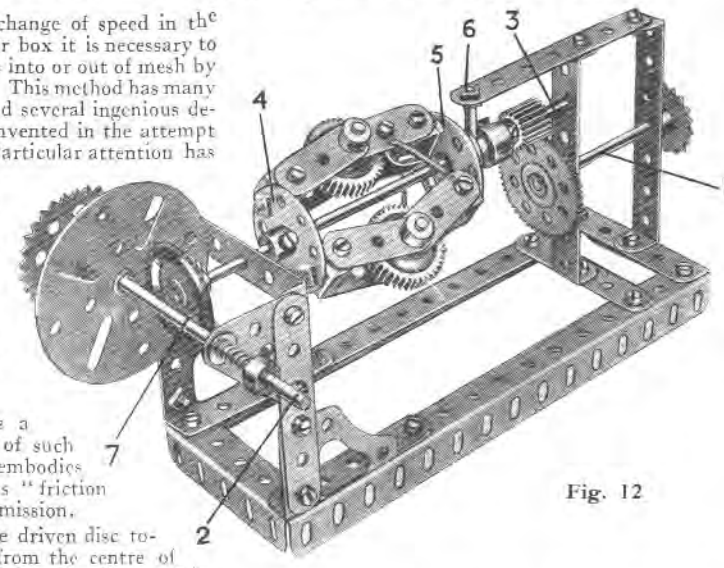


Fig. 12

By sliding the driven disc towards or away from the centre of rotation of the driving disc the speed is decreased or increased. For example, when the driven disc is pressing upon the driving disc at a point near the latter's circumference, the driven disc will rotate at maximum speed. If now the latter is advanced towards the centre of the driving disc, its speed must automatically decrease.

In the mechanism shown in Fig. 12 the change in speed is brought about automatically by a centrifugal governor, so that the speed ratio varies according to the resistance that is to be overcome.

The driving shaft 2, which is connected by any suitable means to the Motor, carries a Face Plate, and is journalled freely in two Corner Brackets that form part of the frame. A 6½" Rod is free to slide in its bearings, and is fitted with a 1" fast Pulley 7, which is fitted with a 1" Rubber Ring that engages with the surface of the Face Plate and is kept in close contact with it by a Compression Spring on the Rod 2.

The governor consists of two Bush Wheels 4 and 5, to each of which two Double Brackets are bolted rigidly. The links are attached pivotally to the Double Brackets by means of lock-nutted bolts (see Standard Mechanism No. 262), and are passed on to 1½" Rods, on which are mounted the 1" Gears forming the weights. Short lengths of Spring Cord, attached to the links as shown, tend to prevent the governor functioning at too low a speed, and also to return it to normal after operation.

The Bush Wheel 4 is secured to the Rod 3, but the Bush Wheel 5 is free upon it and is connected by a Socket Coupling to a ½" diam. ½" wide Pinion. A Threaded Pin 6, by engaging the groove of the Socket Coupling, prevents longitudinal movement of the Bush Wheel 5. The Pinion is in mesh with a 57-teeth Gear Wheel secured rigidly to the driven shaft 1.

Assuming the shaft 1 to be running free, the governor weights will fly out to their fullest extent owing to the centrifugal force that is developed by the speed of the rotating shaft 3. Since the Bush Wheel 5 cannot move longitudinally, the wheel 4 must do so, carrying with it Rod 3. The Pulley 7 is thus kept near the edge of the Face Plate, and a step-up ratio is obtained.

If the speed of the Rod 3 diminishes, the governor weights fall inward, thus moving the Rod 3 and pushing the 1" Pulley 7 nearer the centre of the Face Plate. As the resistance on the shaft 1 increases, so will the Pulley move nearer the centre of the Face Plate; thus compensating for the extra load by increasing automatically the reduction ratio between the shafts 2 and 3.

No. 13. Tandem Clockwork Motor Drive

Although the Meccano Clockwork Motors form excellent power units for most Meccano models, they suffer from the disadvantage that they periodically run down, thus necessitating a stoppage of the model they are driving while the spring is rewound. Those Meccano boys who are fortunate enough to possess two Clockwork Motors, or who are willing to invest in a second one, may overcome this drawback by employing the simple and interesting device shown in Fig. 13.

The idea consists principally in arranging the two Motors in such a manner that either may be connected at will to the driving shaft. With this arrangement one Motor may be wound up while the other is working the model. When the first Motor is exhausted the other is brought into gear merely by moving a hand lever, and while it drives the model the exhausted Motor may be rewound.

The mechanism is quite simple, and may be used with either the reversing or the new non-reversing Motors, but it is essential that both the Motors should be of the same type so as to ensure an even power output.

The Motors are bolted together in the manner shown, and to each of their driving spindles a 1½" Contrate Wheel 1, 2, is secured. A Rod 4 carries two ½" Pinions, which may be engaged with their respective Contrates on sliding the Rod by means of the lever 3. It is important to see that only one Pinion at a time is in mesh with its Contrate.

The Rod 4 is journalled in Couplings, one of which is mounted rigidly on the Motor side-plate by a long bolt inserted in its end and gripped by a grub screw, while the other is secured on the end of a Rod that is gripped in a Double Arm Crank bolted to the rear plate of the right-hand Motor.

Two Handrail Supports secured to the right-hand Motor, and a Trunnion on the left-hand one, form supports on which the device may be stood if it is desired to work in a horizontal position.

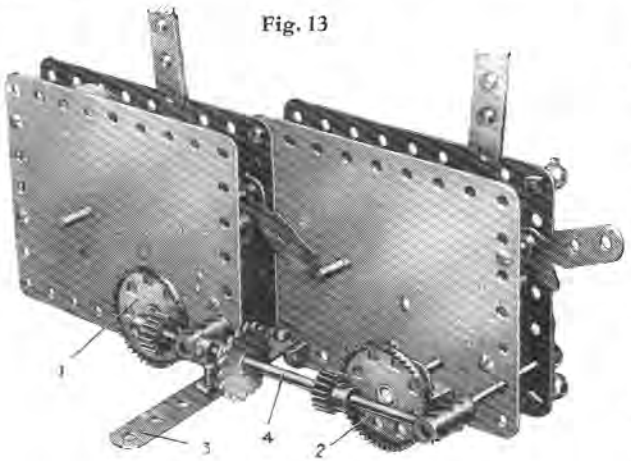


Fig. 13

No. 14. An Efficient Meccano Flicker Photometer

It is practically impossible to gauge by eye the intensity of even a weak source of light, but with the aid of an instrument known as a photometer the luminosity of almost any light can be accurately measured by comparison with a given standard.

The simplest form of this instrument is that known as the Bunsen, or "grease spot," photometer, which consists essentially of a screen of moderately opaque paper having in its centre a spot of grease. The light to be measured is directed upon one side of the screen and the standard light upon the other. The distances of the lights are then adjusted until the luminosity of the grease spot is exactly the same as that of the screen. This result being achieved, the distance of each light from the screen is squared, and the relative power of the two lights thus ascertained. For example, if a small electric bulb must be four times as far away from the spot as a light of one standard candle power in order to produce the balance of light, then it will have a candle power of 16.

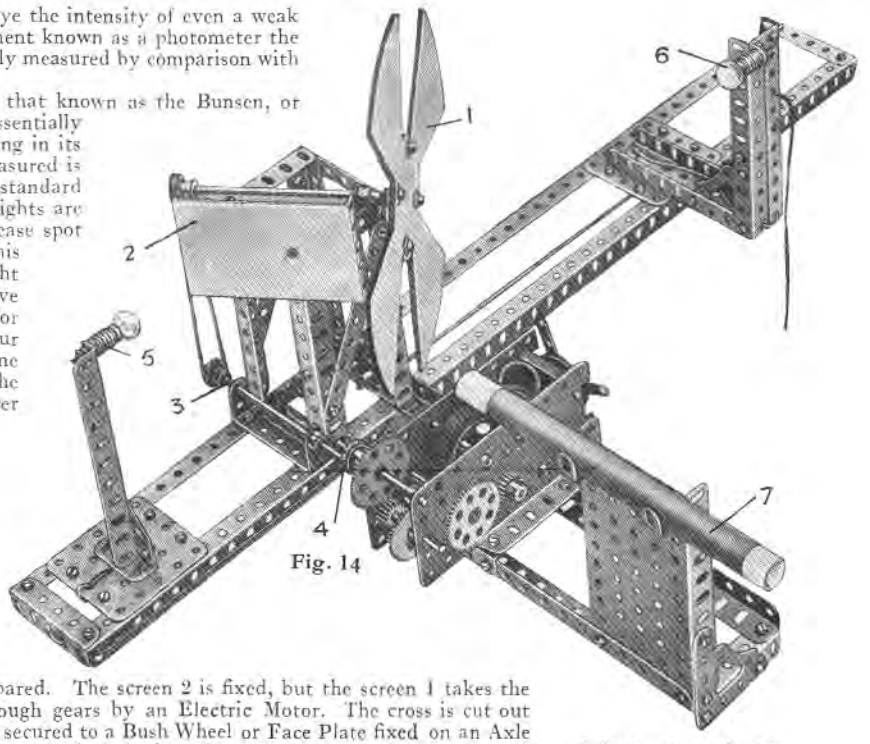


Fig. 14

Another form of photometer that can be used not only for very powerful lights, but for lights of varying colours, is the flicker photometer, and Fig. 14 shows a Meccano reproduction of one of these instruments. The Meccano model is simple to build and operate, and produces remarkably accurate results.

It will be seen that the apparatus consists essentially of two screens 1 and 2, that are illuminated by the lights to be compared. The screen 2 is fixed, but the screen 1 takes the form of a Maltese cross that is rotated through gears by an Electric Motor. The cross is cut out from a sheet of stout white cardboard, and is secured to a Bush Wheel or Face Plate fixed on an Axle Rod that is journalled in a 3½"×½" Double Angle Strip bolted to the top of a vertical frame, consisting of Girders braced with Strips. The Double Angle Strip is arranged to make an angle of 45 degrees with the longitudinal axis of the model.

The screen 2 consists of a 3½"×2½" Flanged Plate covered with a piece of cardboard of the same texture as that employed in the Maltese cross, and is secured in such a position that its face is at right angles to the cross. The latter is driven from a countershaft 3 by means of an endless belt formed from a length of Spring Cord. The countershaft is driven in turn by a Spring Cord belt that passes over a ½" fast Pulley on the countershaft and over a similar Pulley 4 on the Motor.

The eye-piece 7 is composed of a short length of ½" diameter brass tubing, and is coated inside with lamp black. If brass tubing is not easily obtainable, a substitute may be made by wrapping a piece of gummed paper round a "former" of the right size.

The 5½" Angle Girder carrying the Lamp 5 is secured to a 2½"×2½" Flat Plate, which slides upon the flanges of the 24½" Angle Girders forming the base of the apparatus. The Plate is retained in position by a similar Plate to which it is secured by bolts, Washers being placed on the shanks of the bolts so that the flanges of the Girders slide freely between the Plates. The lamp 6 is mounted similarly.

The insulated 6 B.A. Bolt of the Lamp 5 is connected by wire to the Lamp 6, and a continuation of this wire is taken to one terminal of a 6-volt Accumulator, which is attached also to one of the Motor terminals. The other terminals of the Motor and Accumulator are connected to the framework and two terminals are attached to it for this purpose.

The two screens are each at 45 degrees to the line of sight. Hence, as the Maltese cross rotates, the eye sees alternate patches of first one screen and then the other. When the screens are illuminated differently by their respective lamps, a flickering effect is seen, but if the distance of each lamp from its screen is adjusted until the flicker is absent, then the screens are illuminated to the same degree, and the ratio of the powers of the two lamps may be determined from the squares of their respective distances from the line of sight, as in the case of the grease spot photometer mentioned earlier.

No. 15. Novel Free Wheel Device

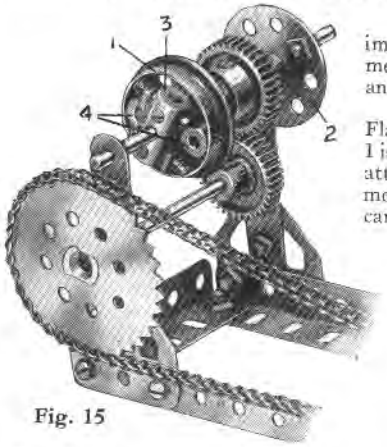


Fig. 15

In practice a device of the kind shown in Fig. 15 has important advantages over the ordinary ratchet and pawl mechanism, in that it is quicker and smoother in action and there is less wear and tear.

A Coupling 3 is secured to a Rod, which also has a Flanged Wheel 1 mounted freely on it. The Flanged Wheel 1 is spaced away from the Coupling by four Washers and is attached to a 1" Gear by a Socket Coupling. The 1" Gear meshes with a second similar Gear secured on a Rod that carries also a 2" Sprocket.

In each of the end transverse bores of the Coupling is secured a Threaded Pin in such a manner that the square shanks are on opposite sides and the flats of the shanks are turned at an angle to the longitudinal axis of the Coupling. Two Collars are free to "float" inside the Flanged Wheel. When the Coupling is turned in a certain direction the Collars will be found to jam between the flange of the wheel and the inclined edges of the Threaded Pin shanks, so locking the Flanged Wheel to the rotating Rod. When, on the other hand, the Coupling is turned in the reverse direction, the Collars ride idly and the Rod is free to rotate independently of the Flanged Wheel.

These advantages render it particularly suitable for use in, say, the Meccano model of the Constantinesco Torque Converter. In the existing model a pawl and ratchet device is employed, and under certain conditions of working the pawl may fail to make proper engagement with a new tooth of the Ratchet. With the apparatus described here, however, the slightest reverse movement of the Flanged Wheel locks the two parts of the free wheel together.

No. 16. Simple Car Steering Gear

The steering gear illustrated in Fig. 16 incorporates the correct Ackermann principle, by means of which the inner road wheel is turned always at a shaper angle than that of the outer wheel when the car travels in a curved line. Perhaps the most interesting feature of the mechanism, however, is the manner in which the movements of the steering wheel are transmitted to the stub-axles.

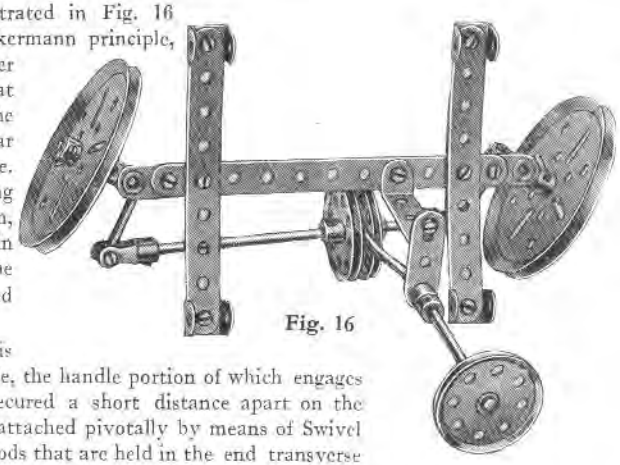


Fig. 16

The steering wheel is secured to a 3½" Crank Handle, the handle portion of which engages between two 1½" Pulleys secured a short distance apart on the "track rod." The latter is attached pivotally by means of Swivel Bearings to the ends of 1½" Rods that are held in the end transverse bores of two Couplings. The Couplings have Pivot Bolts passed loosely through their centre transverse bores, and these bolts are inserted in the bosses of Threaded Cranks on each end of the front axle. Lock nuts serve to retain the Pivot Bolts in place.

The road wheels, which are represented by 3" Pulleys, turn freely on 1" Rods held in the longitudinal bores of the Couplings, and they are retained in position by Collars.

No. 17. Tachometer or Speed Indicator

In practice it is often desired to ascertain the speed in revolutions per minute at which a rotating piece of machinery may be running, and to this end an instrument termed a tachometer, or to give it a more familiar title, a revolution indicator, is employed. Such a device finds a place on the instrument board of every aeroplane, as it is of the utmost importance to the pilot to know at any instant the revolutions the engine is making. Although some pilots can tell this by the note of the engine, the use of a tachometer is much to be preferred.

In the case of an alternator, that is, a dynamo that produces alternating current, it is necessary to know the revolutions per minute of the machine in order that the frequency may be ascertained. Knowing the speed, and also the number of field poles, it is a simple matter to work out the number of complete cycles of current that take place in one second, and thus arrive at the frequency.

The demonstration model tachometer shown in Fig. 17, while not following the lines of an actual instrument, nevertheless functions in a remarkably efficient manner. It may be calibrated and put to practical use.

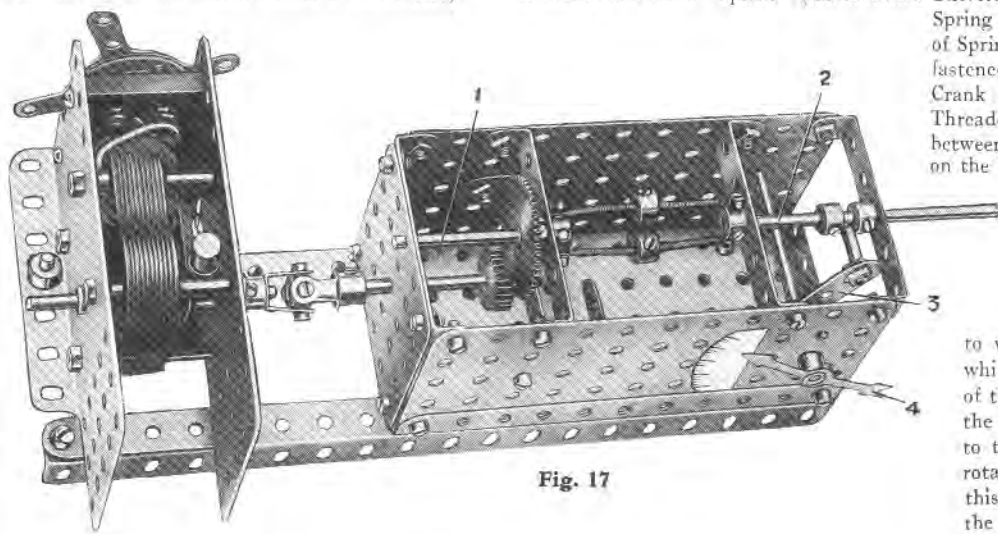


Fig. 17

The Rod 1 is driven from the Motor through a reduction gear having a ratio of 2 : 1, and carries at one end a "spider" (taken from a Universal Coupling) to which two short lengths of Spring Cord are attached by bolts. Each length of Spring Cord carries a Collar, and its other end is fastened to a second "spider" on a Rod 2. A Crank 3, secured to the Pointer shaft, has a Threaded Pin in its end hole that locates between two Collars secured a short distance apart on the Rod.

When the Rod 1 is rotated quickly the weights fly out, owing to centrifugal force, thus sliding the Rod 2 longitudinally in its bearings and moving the Pointer 4. The sliding movement of the Rod depends on the extent to which the governor weights are extended, which depends in turn on the speed of rotation of the Motor. It is an easy matter to calibrate the instrument by attaching a train of gears to the armature spindle so that the last gear rotates at a countable speed. The r.p.m. of this gear, multiplied by the gear ratio, will give the speed of the Motor under test.

No. 18. Governing Device for Steam Engines

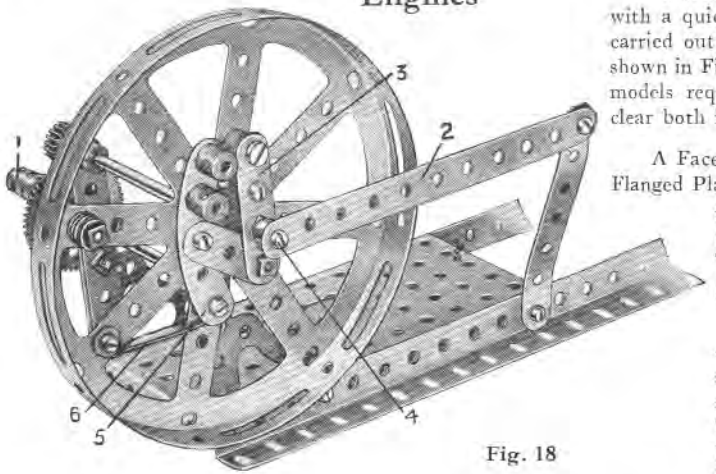


Fig. 18

Most devices that are fitted to steam engines to keep the speed constant under widely varying loads, take the form of a centrifugal governor. With the form of governor shown in Fig. 18, however, both the governor and the manner in which it controls the engine are different from usual practice.

The device consists essentially of a weighted arm 5, which is mounted "off centre" so that it is sensitive to changes in speed of the flywheel. It is connected by a 1½" Strip to a second pivoted Strip 3, which is attached to the slide valve rod 2 at the point 4. As the end of the weighted lever flies outward (due to an increase of centrifugal force when the speed is increased), the lever 3 is moved nearer the centre of the wheel, and so the radius of eccentricity of the point 4 is decreased. This means that the travel of the slide valve shortens, and therefore the point in the stroke of the piston at which the admission of steam is cut off occurs earlier. The reverse happens when the speed drops.

The curved Strip 5 is pivoted to a ⅜" Bolt, and spaced from the Hub Disc by Washers so that the heads of the retaining bolts of the Threaded Bosses forming the weights do not foul the Hub Disc. The Strip is prevented from flying out too freely by a length of Spring Cord 6, one end of which is secured to the Hub Disc and the other end to one of the bolts holding the Threaded Bosses. The Spring Cord is passed half-way round the pivot of the Strip 5 before being fixed in place. The Strip 3 is bolted to a Crank that is free to turn on a Pivot Bolt secured to the Hub Disc. The model may be set in motion by turning the handle 1.

The advantage of this form of governor over the more common type is that the steam is made to work in the most economical manner; for when the speed of the engine increases the cut-off takes place earlier in the piston stroke, and the piston completes its journey by the aid of the expansion of the steam. Thus as much as possible of the energy of the steam is extracted. With the usual centrifugal governor the live steam—which is at reduced pressure due to the throttling effect at the valve—follows the piston for the greater part of its stroke, with the result that the expansion of the steam is not utilised.

No. 19. New Quick-return Motion

In order to speed up production, planing and shaping machines are fitted with a quick-return motion enabling the return or non-cutting stroke to be carried out quicker than the cutting stroke. A model of this mechanism is shown in Fig. 19 and model-builders will find this device adaptable to numerous models requiring a rapid reverse motion. A very few words should make clear both its construction and operation.

A Face Plate is secured to a Rod that is journalled in vertical 5½"×2½" Flanged Plates, and an Eye Piece is attached to the Face Plate by passing a ⅜" Bolt through one of the holes in the latter, and securing the Bolt in the boss of the Eye Piece by the grub-screws. Two Washers are placed on the shank of the Bolt for spacing purposes.

A 5½" Strip is mounted pivotally on a ⅞" Bolt that is double-nutted to a Double Bent Strip, and the Eye Piece slides on the longer arm of the lever so formed, while the short arm carries a Rack Segment that engages with a 1" Gear. The latter is secured on a Rod that is journalled in the Flanged Plates and connected by any suitable means to the Model that it is intended to operate.

It will be realised that when the device is set in motion the 5½" Strip moves from side to side at a speed that varies according to the distance of the Eye Piece from the fulcrum of the Strip, and this causes the 1" Gear to rotate slowly in one direction and rapidly in the reverse.

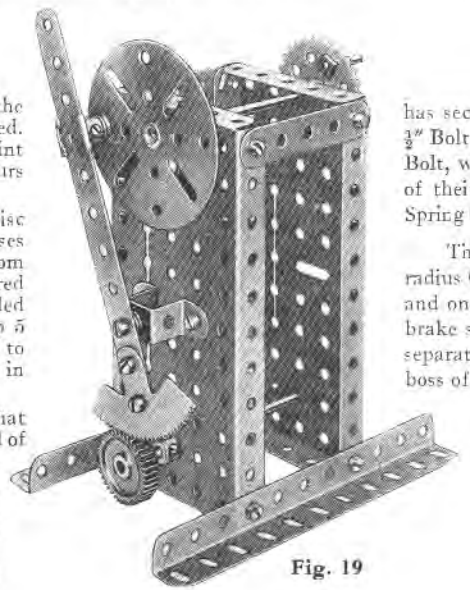


Fig. 19

No. 20. Front Wheel Brakes for Model Cars

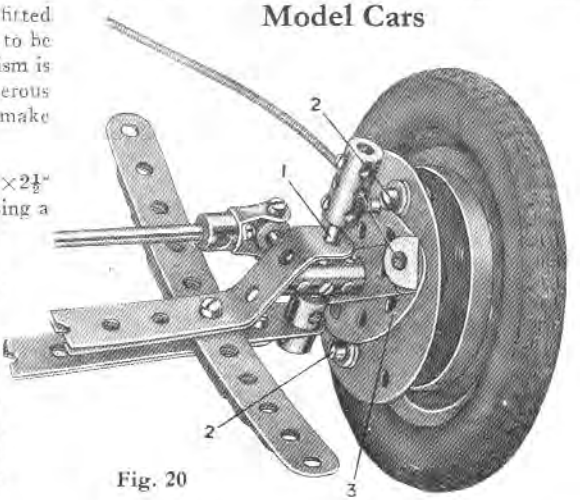


Fig. 20

In the design of front wheel brake mechanisms, it is a difficult matter to get the road wheels within a reasonable distance of the stub axle support. This is a matter of great importance and has been considered fully in the brake shown in Fig. 20.

The stub axle pivot 1, which is journalled freely in the two portions of the front axle, has mounted on it a Coupling, which carries the stub axle. This has secured rigidly to it a Face Plate in the exactly opposite slots of which ½" Bolts 2 are free to slide. Two Washers are placed under the heads of each Bolt, which are then inserted in the slots, and Collars are secured on the end of their shanks. The Collars form the brake shoes, and a short length of Spring Cord is attached to their set-screws to keep them in contact with the cam.

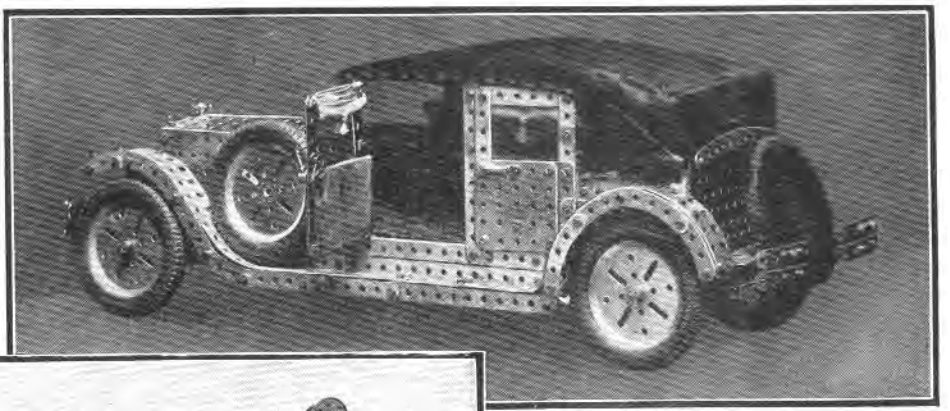
The ½" Bolts are actuated by a cam 3, which consists of two 2½" small radius Curved Strips bolted to a 2½" Strip. The latter pivots on the stub axle, and on operating the cam the Bolts 2 are forced outward, thus applying the brake shoes to the brake drum (a Wheel Flange). The road wheel is shown separated from the Face Plate, but actually it is spaced by a Washer from the boss of the Face Plate.

The cam is operated by Bowden wire control, the outer sheath consisting of Spring Cord through which is threaded a length of wire. One end of the Spring Cord is clamped to the chassis, while the other end lies in the transverse hole of a Coupling on the pivot 1, the top end of which projects into the transverse hole to prevent the passage of the Spring Cord while allowing the wire to pass freely.

A Chance to Win Prizes with Your Models

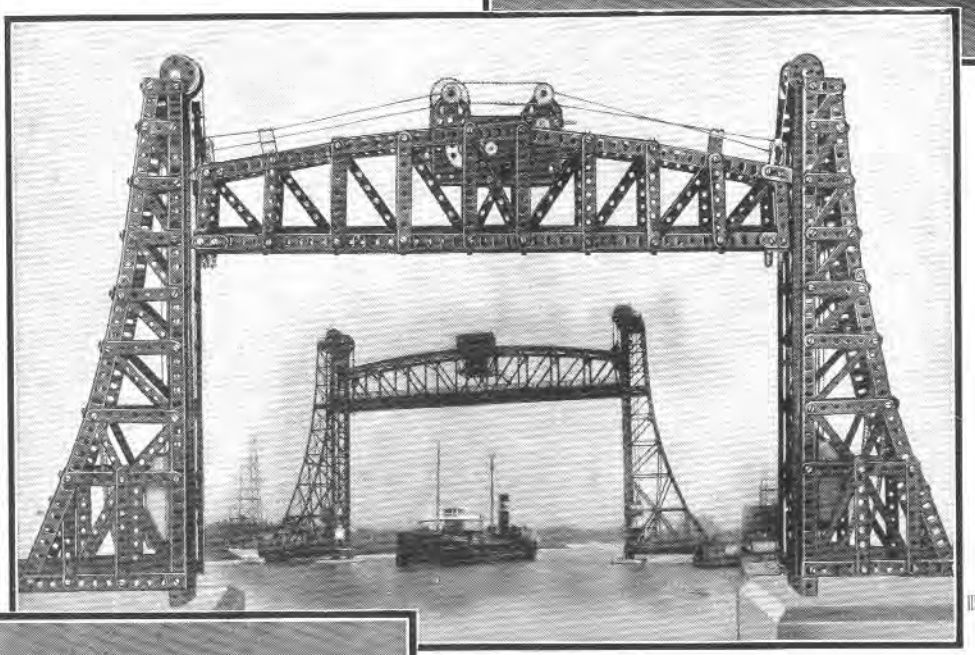
Keen Meccano boys derive greater pleasure from thinking out things for themselves than from copying ready-made designs, and these boys should not miss the opportunity of winning one of the splendid prizes that are offered each month in the "Meccano Magazine." In addition to the prospect of winning a prize, these Contests afford the Meccano boy a chance of measuring his model-building ability with that of his fellows.

Full details of the Competitions are announced each month in the "Meccano Magazine." There is nothing whatever to pay and special entry forms are not necessary. Each Contest is open to every owner of a Meccano Outfit, no matter what his or her age may be, and every competitor stands an equal chance of winning the biggest prize.



The illustration below shows a fine model of the famous German flying boat DO.X. It was built by C. M. Olie, Haarlem, Holland, and was awarded a prize in the "Winter" Contest 1929. The main features of the actual machine have been well developed in the model, and it will be seen that a very neat finish is given to every part of the construction.

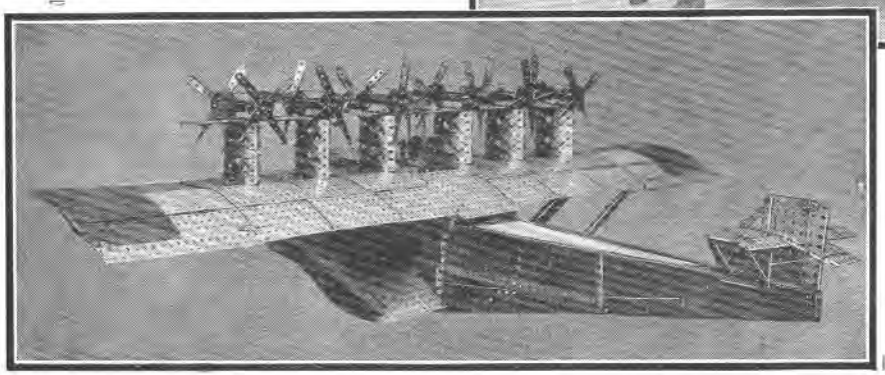
Note particularly the twelve "engines" arranged in tandem on the plane, and the tail fin that supports the tail plane. Ailerons and elevators are other interesting features of this fine model.



B. O. Donovan, Johannesburg, is the builder of the motor car shown above. The realistic appearance of the model is due largely to the painstaking detail work incorporated in its construction.

The composite picture in the centre shows Bridge No. 14 over the Welland Ship Canal, Ontario, Canada, together with a splendid Meccano model of the bridge built by G. L. Vollmer, Ontario, who was rewarded for his efforts by winning the Third Prize in the "Autumn" Model-building Contest, 1929.

The bridge is of the vertical lift type, a design that is very useful when it is desired to cross a canal where the expense of building long approaches vetoes ordinary girder or suspension bridges.



New Models Wanted

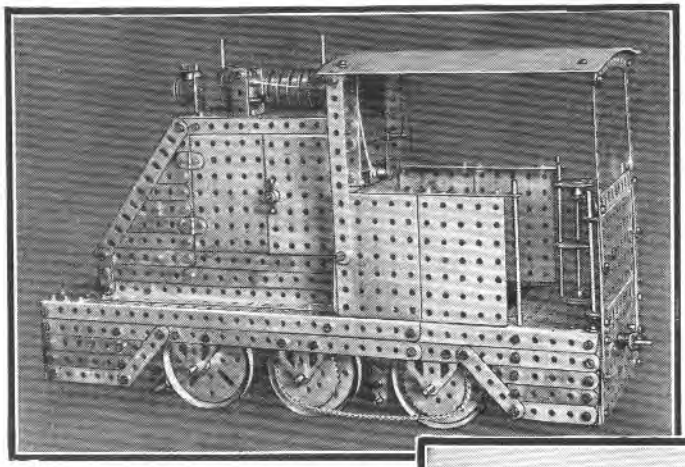
Actual models must not be sent. It is only necessary to send a good photograph or, if this is not possible, a drawing will do provided care is taken in drawing the details. If the model is very intricate, then a written description of the mechanism may be advisable. That is all there is to do in order to compete for the splendid prizes offered.

All models submitted, of course, must be new. That is, a competitor must not copy models from the Meccano Instruction Manuals, or any other Meccano publication.

Prize winning models, if suitable, are included in various new publications, and are also described in the "Meccano Magazine," so that a competitor's model may be rebuilt again and again by Meccano boys all over the world. This in itself will be regarded by most Meccano boys as a sufficient reward for the labour involved.

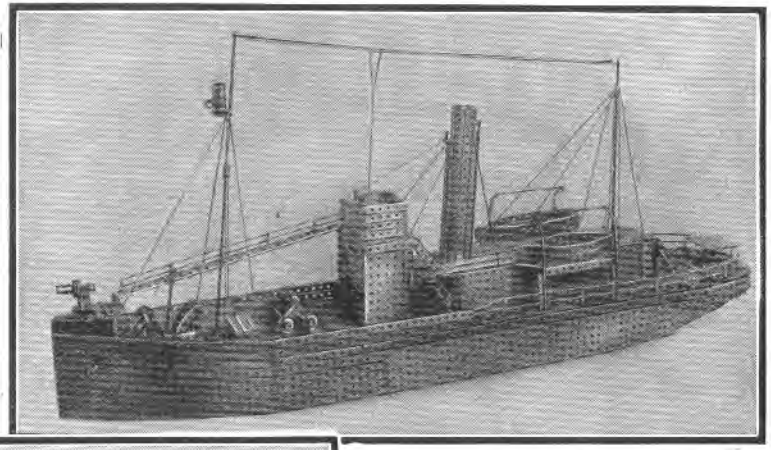
On this and the following three pages we illustrate a number of models that won prizes in recent competitions.

MORE MODEL-BUILDING SUCCESSES

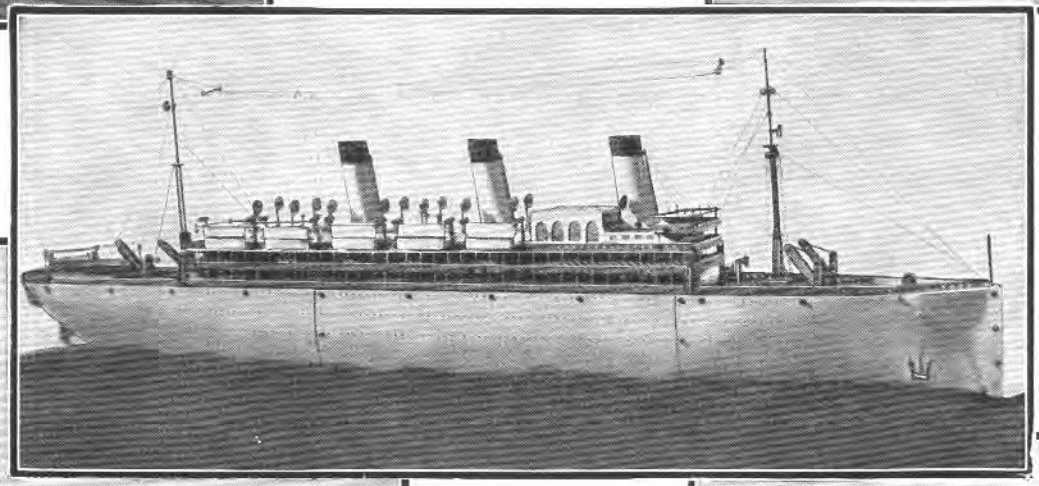


The realistic appearance of the Kerr-Stuart Diesel Locomotive shown on the left earned the model a prize in a recent Meccano Contest. It was built by J. Sephton, Southport, who has succeeded in reproducing with remarkable accuracy the main features of the actual locomotive. Compare this model with that built by J. Stead illustrated on the opposite page.

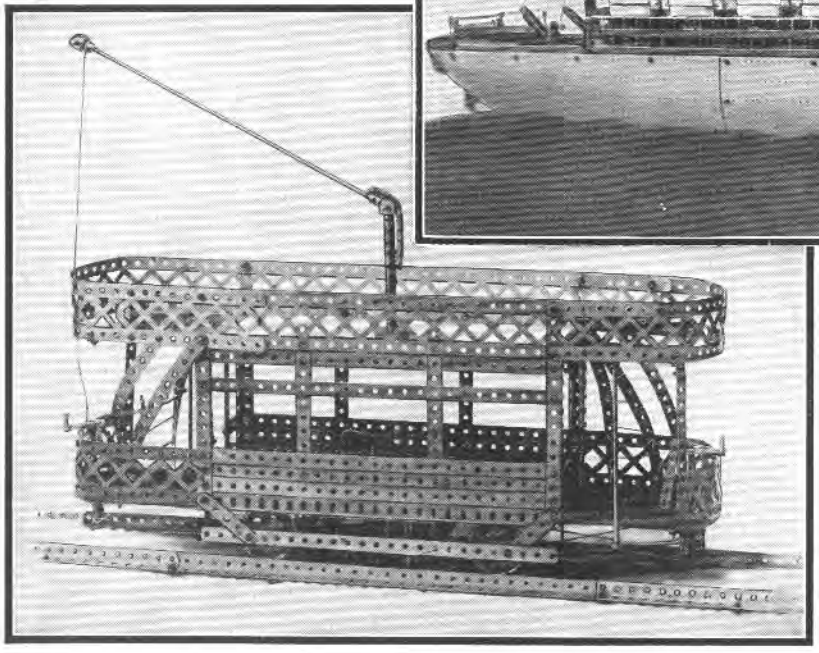
The model of a Norwegian Whaler shown on the right is the work of A. McGregor, Wallsend. It is built to scale and has an overall length of 3ft. 9ins. The vessel is mounted on wheels so that it may travel on the ground.



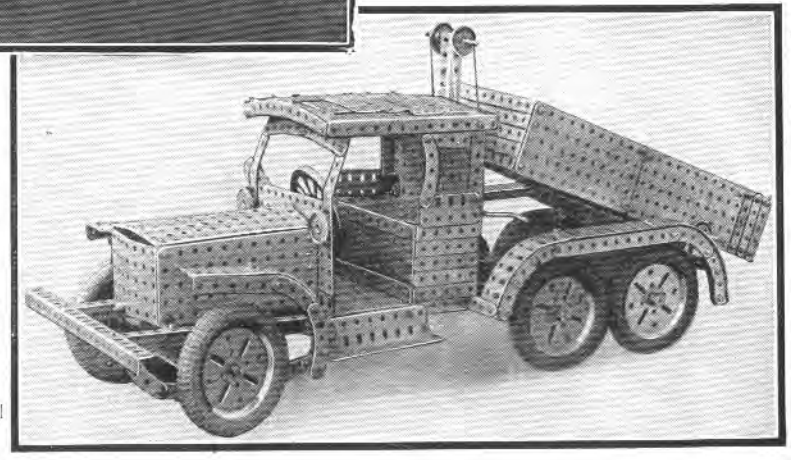
Simplicity and neat construction are features of the model tramcar shown below, built by D. Stonely, Southampton. The model is driven by a 6-volt Electric Motor and is fitted with brake and control handles.

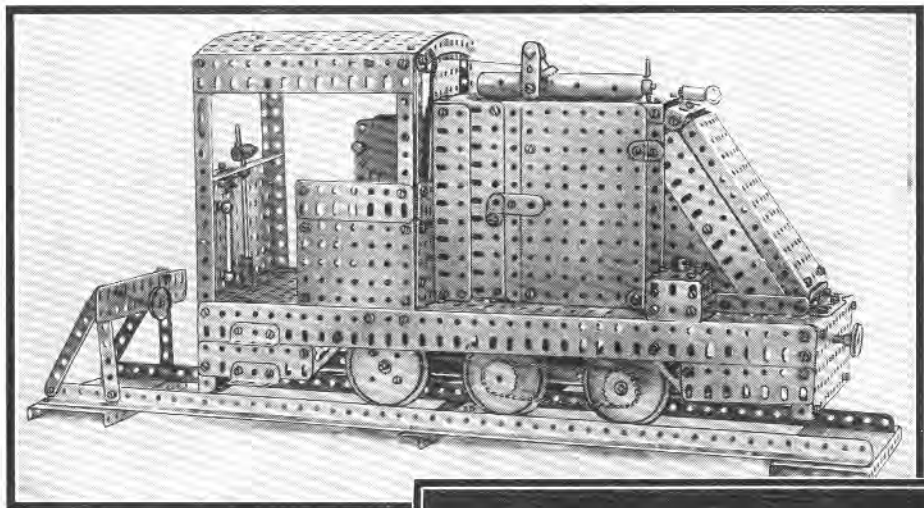


Albert Emmett, Nottingham, is the builder of the tipping Motor Lorry shown below. The chassis is built on six wheels, and the tipping of the body is carried out by means of hand-operated handles, which wind or unwind lengths of cord passed over Pulleys held on Rods journalled in a vertical support at the back of the cab. The ends of the cords are secured to the body, which pivots about an Axle Rod held in the chassis girders at the rear of the model.



Above is illustrated a strikingly realistic model of an Atlantic liner, built by Frank Van Bulck, of Paris, from Meccano parts and cardboard. The decks, constructed from Angle Girders, give the model a very fine appearance, and the addition of miniature life-boats adds to its realism.



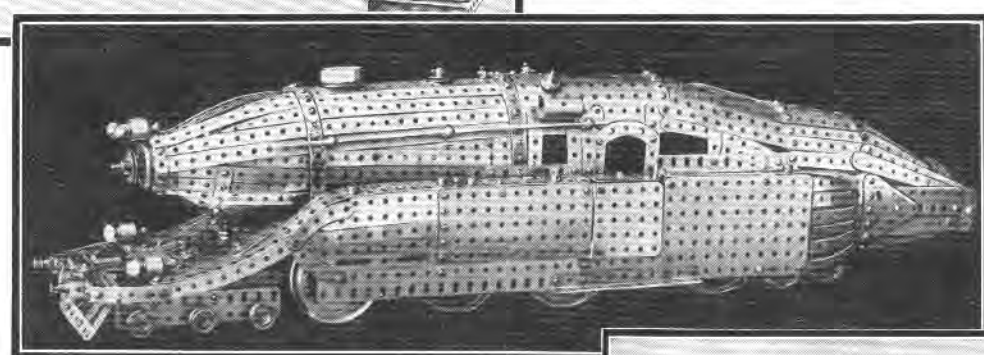


A Kerr-Stuart Diesel Locomotive

The model illustrated above represents the famous Kerr-Stuart Diesel locomotive. It was built by J. Stead, Cranley. This type of engine, which has been called a locomotive of the future, was fully described in the January, 1929 "Meccano Magazine," and has aroused widespread attention from engineers all over the world. After reading this article many Meccano boys decided to turn their enthusiasm for the locomotive into practical form, with the consequence that a large number of models have been built and literally dozens of reproductions of the engine have been entered in recent Meccano Competitions.

The prototype of this model is powered by a four-cylinder Diesel-type engine mounted in the frame. The motor is fitted with an orthodox four-throw crankshaft and a flywheel, the latter also incorporating one member of a cone clutch similar to the type that is to be found in many motor cars. From the clutch the drive is carried by means of a transmission shaft to a gear box situated in the front portion of the frame and incorporating a reverse drive. For starting purposes a single-cylinder petrol engine is employed to turn over the crankshaft until a working temperature is reached in the cylinders of the main engine.

Stead's model is remarkable on account of its neat appearance and its abundance of external fittings, while the internal mechanism is none the less ingenious. The model is driven by means of the Meccano Electric Motor that can be seen projecting into the front portion of the cab, its armature shaft being coupled to the rear pair of driving Wheels by way of a two-speed and reverse gear box and Sprocket Chain. Further Sprocket gear is then used to couple these Wheels with the forward pair of drivers. This form of construction provides a clear space in the main body of the engine, into which is fitted the Accumulator for supplying current to the Motor. The Accumulator is easily removed for charging purposes by opening the hinged doors fitted at each side of the engine. On connecting the Accumulator to the terminals of the Motor, the model becomes an entirely self-contained unit. The external fittings have been very cleverly designed, in particular the exhaust expansion chamber that is mounted on the top of the main body of the engine. It is composed of a number of Sleeve Pieces and Chimney Adaptors, which are held together by means of an Axle Rod passing through the centre holes of the Adaptors and a Collar placed on each end. A Threaded Pin secured in the threaded hole of one of these Collars represents the short pipe through which the exhaust gases in the actual engine finally reach the atmosphere, after passing through the manifold and expansion chamber.

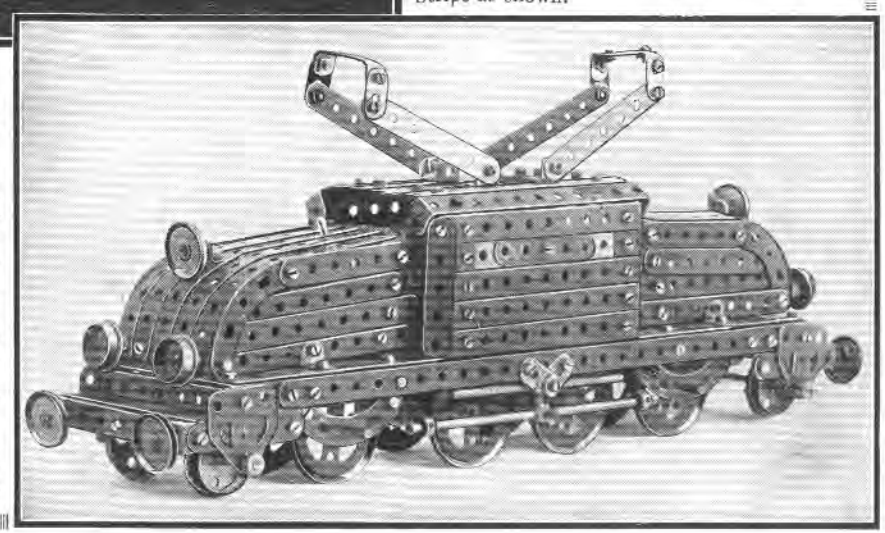


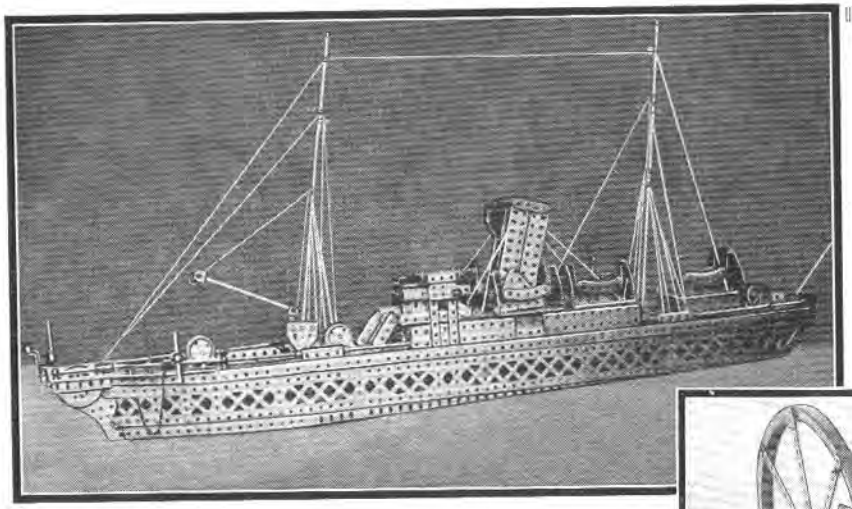
A Locomotive of the Future

Many ingenious entries were submitted in connection with a special "Engineering of the Future" Contest that was announced in the "Meccano Magazine" recently, and one of the most interesting is the remarkable locomotive built by J. Ringnalda, Leeuwarden, Holland, shown in the centre of this page. According to its builder, locomotives of this type will be common sights to the people of 2000 A.D.! An excellent feature of the model is the sweeping streamline construction of the main frame, which is really remarkably well constructed when one considers that the builder had to design the entire model without the aid of any existing prototype on which to base his ideas. It will be noticed that electric lamps are fitted in place of old style oil lamps.

A Fine Electric Locomotive

The lower illustration is a model of an Electric Locomotive that secured a prize for R. Brenni, Mendrissio, Switzerland, in a recent Competition. The chassis of the model is constructed from Angle Girders, and the driving wheels are represented by 2in. Pulleys; 1in. Flanged Wheels are used for the bogies. The main bodywork, together with the pantagraph current collector, which is mounted on top of the loco, is constructed from Strips. Both ends of the body are nicely rounded off by the judicious use of small radius Curved Strips and 5½in. Perforated Strips as shown.





A Fine Meccano Model Steamer

Mr. L. W. Grey's model steamship is shown above. Centre : A tandem compound steam engine, by Mr. S. Bentley.

At the head of this page appears a fine model of a cable-laying ship built by Mr. L. W. Grey, of East Ham, London. A striking feature of the model is the great amount of detail work put into the deck fittings, which include six life-boats slung on realistic davits, two large winches for manipulating the cable, a derrick, anchor complete with chains, taffrail, and gangways, all of which are designed and constructed with great care. A Meccano Boiler slightly compressed would probably have looked better if used for a funnel instead of the square funnel built up from Flat Girders, but the escape pipe and business-like whistle would be hard indeed to improve. An alternative method of constructing the funnel would be to use Strips connected together by Flat Brackets.

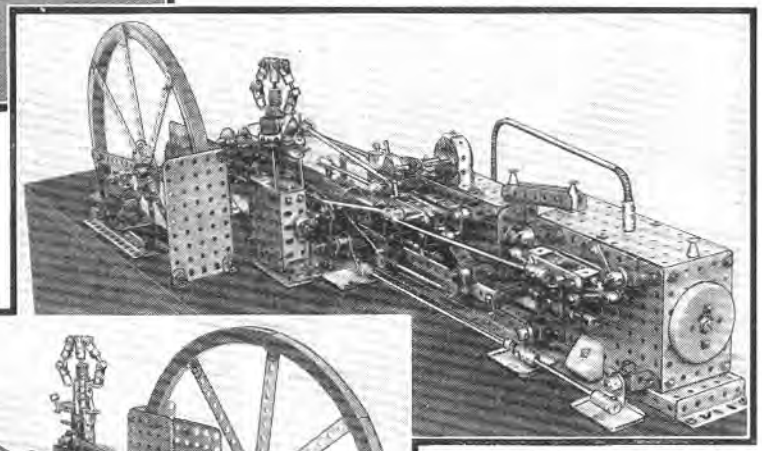
Mr. Grey has realised that a water-line model is a more practicable proposition in a Meccano model of a ship than one having a complete hull, as the moulding necessary in the latter case entails much bending, twisting and other distortion of Strips or Braced Girders, if these are used.

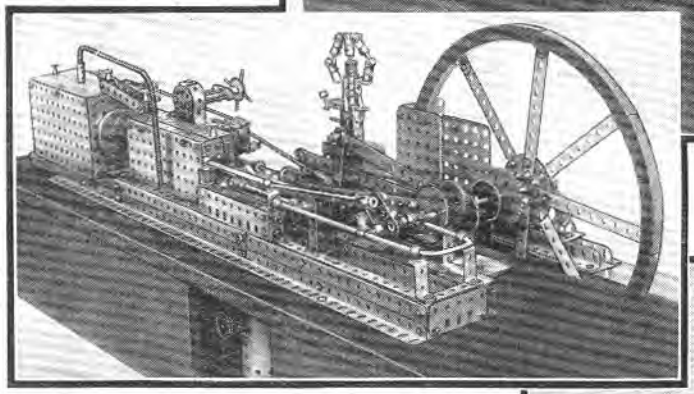
Meccano boys who wish to turn their attention to the construction of model ships should refer to the Meccano Instruction Manuals, as several new models of this nature are included in the latest editions.

Tandem Compound Steam Engine

In the centre of the page is a splendid example of painstaking model-building by Mr. S. Bentley, of Bingley, Yorks. It will be seen that the model represents a tandem compound steam engine and that it is fitted with Corliss pattern valve gear, controlled by a centrifugal governor. The engine is built to a scale of one inch to the foot and all parts of the engine are correctly proportioned. Model-builders should note particularly the built-up flywheel, which is composed of Channel Segments bolted together in the usual manner. When the model was completed, it was found that the flywheel was too light to ensure satisfactory running, so Mr. Bentley filled the grooves of the Channel Segments with concrete and then enamelled the rim. The result is a very efficient wheel and a free-running engine. Considerable ingenuity has been shown in constructing the various parts of the model, and one detail in particular that savours of the master craftsman is the use of Meccano nut and bolt tins in the capacity of drip trays to catch any oil drops that may be thrown from the crankshaft journals.

The neatness of the built-up governor is a particularly noteworthy feature in the construction of which Swivel Bearings and short Rods play an important part.

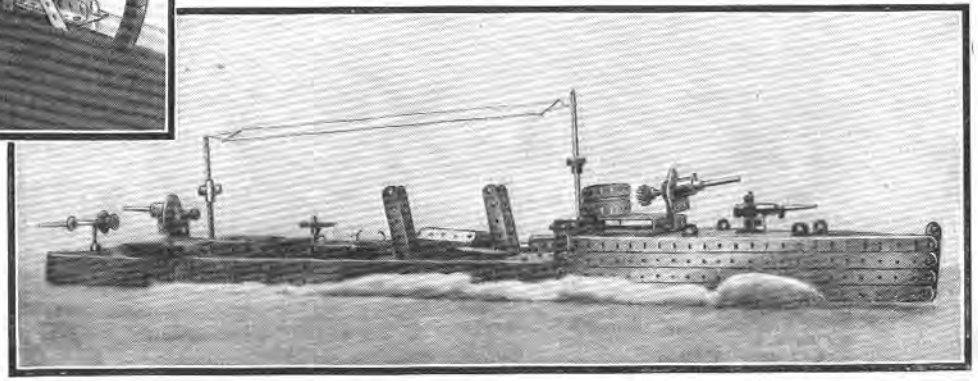




A Meccano Destroyer

Warships are always popular subjects for model-building competitions, and a particularly fine example of this type is the splendid model of H.M.S. "*Amazon*" shown at the foot of this page. It was constructed by Derek Walbourn, of Loughborough, and was awarded a prize in the "Autumn" 1929 Model-building Contest. Model-builders who are able to refer to the "M.M." for November 1928 will find on page 893 a photograph of the prototype of this model. The model is exceptionally well built and possesses the characteristic outline of the actual ship. Added realism has been obtained by the use of cotton wool to represent the waves created by the bows of the vessel as she passes through the water.

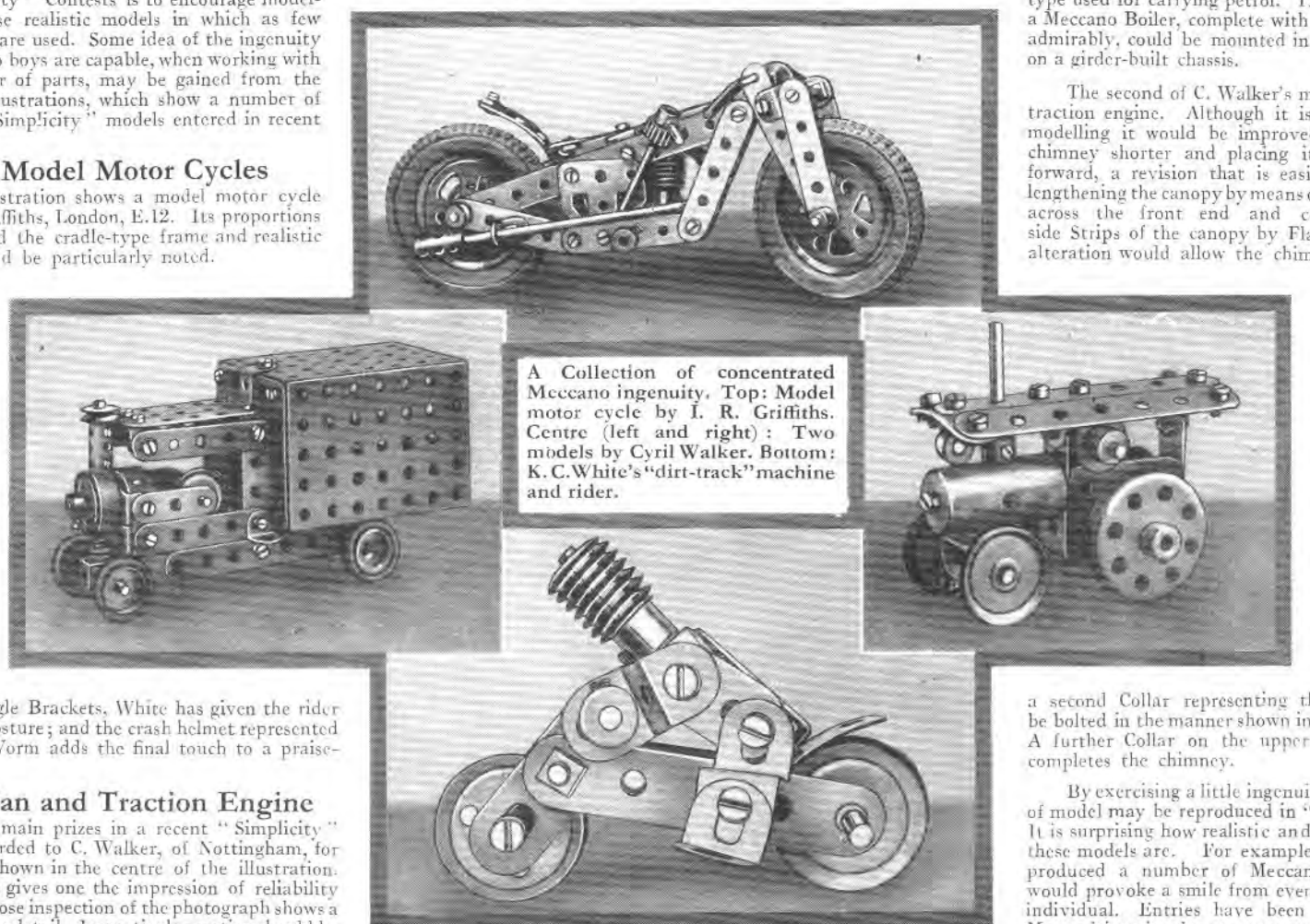
H.M.S. "Amazon" modelled in Meccano by Derek Walbourn.



SOME of the most ingenious uses to which Meccano parts may be adapted have come to our notice through the medium of "Simplicity" model-building competitions, several of which have been announced in recent issues of the "Meccano Magazine." Many boys make their models unnecessarily complicated, and the purpose of the "Simplicity" Contests is to encourage model-builders to devise realistic models in which as few parts as possible are used. Some idea of the ingenuity of which Meccano boys are capable, when working with a limited number of parts, may be gained from the accompanying illustrations, which show a number of prize-winning "Simplicity" models entered in recent contests.

Interesting Model Motor Cycles

The top illustration shows a model motor cycle built by I. R. Griffiths, London, E.12. Its proportions are excellent, and the cradle-type frame and realistic front forks should be particularly noted.



A Collection of concentrated Meccano ingenuity. Top: Model motor cycle by I. R. Griffiths. Centre (left and right): Two models by Cyril Walker. Bottom: K. C. White's "dirt-track" machine and rider.

K. C. White, London, S.W.8 who has won several prizes in Meccano contests is the builder of the dirt-track machine and rider seen in the bottom picture. This amusing little model combines absolute simplicity with realism, and the effect would be hard to improve upon. With the aid of a few Angle Brackets, White has given the rider a most lifelike posture; and the crash helmet represented by a Meccano Worm adds the final touch to a praiseworthy effort.

Removal Van and Traction Engine

One of the main prizes in a recent "Simplicity" Contest was awarded to C. Walker, of Nottingham, for the two models shown in the centre of the illustration. The removal van gives one the impression of reliability and power, and close inspection of the photograph shows a wealth of realistic detail. In particular, notice should be taken of the locking handle and screw on the smoke-box door of the boiler, the swivelling front axle, and the neat manner in which the engine has been reproduced.

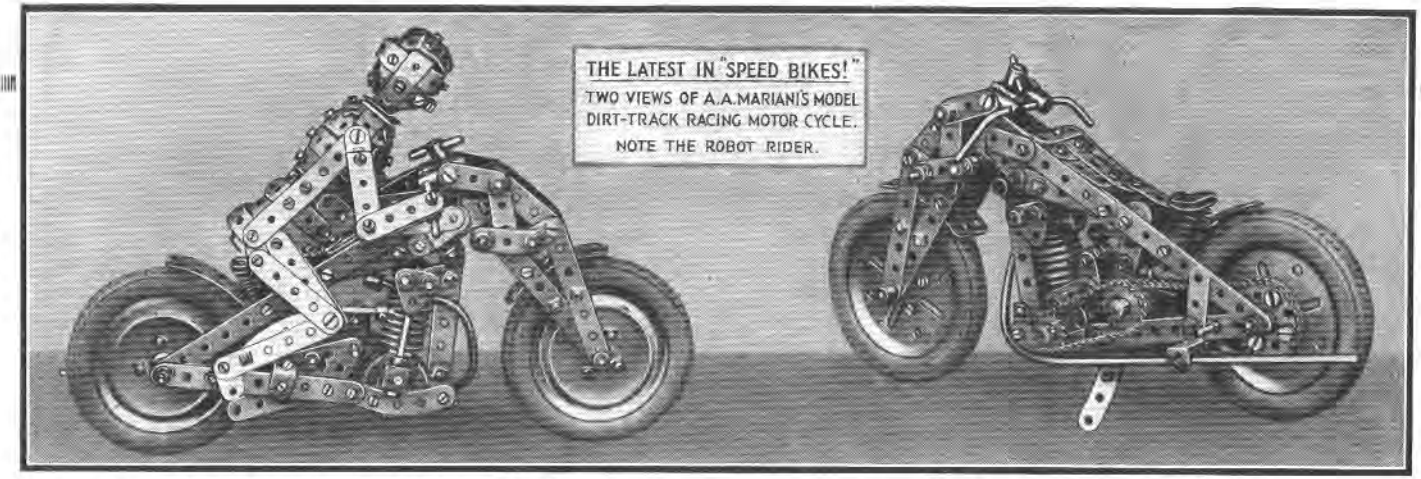
This model may be easily converted from a covered van into a heavy-duty tractor, as it is fitted with a low-built trailer of the type used for transporting locomotives and other heavy loads. The van body could be removed from the chassis, and a stout pivot placed over the rear axle. The trailer could then be attached to the vertical pivot, which would serve also as a drawbar.

Another variation of this model might be made by fitting a large container of the type used for carrying petrol. The tank, for which a Meccano Boiler, complete with ends, would serve admirably, could be mounted in a sloping position on a girder-built chassis.

The second of C. Walker's models represents a traction engine. Although it is a fine example of modelling it would be improved by making the chimney shorter and placing it a little further forward, a revision that is easily carried out by lengthening the canopy by means of a 1½" Strip bolted across the front end and connected to the side Strips of the canopy by Flat Brackets. This alteration would allow the chimney to be passed through a hole nearer the front end of the model.

A Crank should now be bolted to the upper surface of the centre Strip of the canopy, and its boss utilised to represent a portion of the chimney. A 1" Rod passed through and secured in the boss could carry at its lower end, below the canopy, a Collar, to which a second Collar representing the dynamo might be bolted in the manner shown in Walker's original. A further Collar on the upper end of the Rod completes the chimney.

By exercising a little ingenuity almost any type of model may be reproduced in "simplicity" form. It is surprising how realistic and amusing some of these models are. For example, a recent Contest produced a number of Meccano "men," which would provoke a smile from even the most serious individual. Entries have been received showing Meccanitians in almost every walk of "life," and among others of outstanding interest is a model of a dance band, including a pianist, saxophonist, trombone and concertina players, and jazz drummer. Rods passing through the back of the stage produce the different movements by means of Cranks and Eccentrics.



THE LATEST IN "SPEED BIKES!" TWO VIEWS OF A.A.MARIANI'S MODEL DIRT-TRACK RACING MOTOR CYCLE. NOTE THE ROBOT RIDER.

A "Speed Bike"

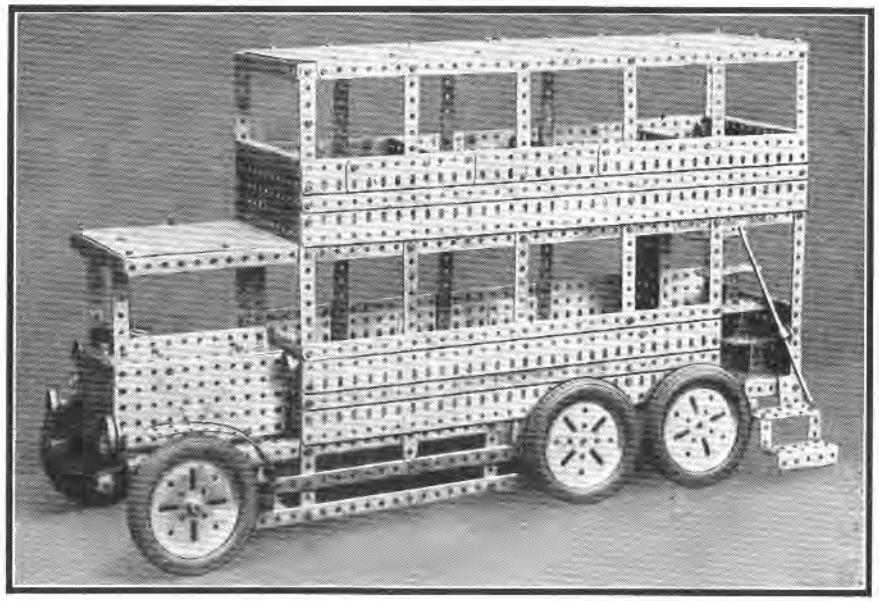
The interest taken by Meccano boys in the development of the motor cycle is testified by the models of all types that have formed a large percentage of the entries in recent model-building contests. One of the best recent examples is that built by A. A. Mariani, London. The model is illustrated on this page and the two views shown leave no room for doubt as to the type of motor cycle the model represents. Its clean and "racey" appearance at once proclaims it a "speed bike," while the Meccano rider with his crash helmet and businesslike attitude adds to the already vivid impression of speed!

The various component parts of an actual dirt-track machine are carefully worked into the model. The steering head is equipped with a damper that can be adjusted so as to damp the vibration of the steering column. This damper is composed of a wing nut actuating a short Screwed Rod which, when turned in a clockwise direction, tightens up the head bearing, so causing friction and damping the sideways movement or wobble of the front wheel. The front forks are sprung from the frame of the model in a manner very similar to that used in actual machines.

The main portion of the frame is designed on the "cradle" pattern, and is fitted with a saddle tank. The "engine" is of the single cylinder type; the camshaft, which operates the inlet and exhaust port tappets, being placed at the top of the cylinder. The cylinder is built up from a number of Pulley Wheels bolted together, while the crank case consists of two Bush Wheels spaced apart by a number of Double Brackets. The Rod shown passing up the side of the cylinder represents the secondary shaft connecting the crankshaft with the cam-shaft by means of bevel gears; the 1" Triangular Plate and the Double Bracket being used as covers to encase the gearing that would be used in an actual machine.

Although the figure of the rider is constructed entirely from ordinary Meccano parts, it is curiously lifelike. "Robot," in addition to possessing a workmanlike crash helmet, is jointed in no less than nine places! He can thus assume many other attitudes besides the one that he has taken up in the photograph, which evidently indicates grim determination to break the record.

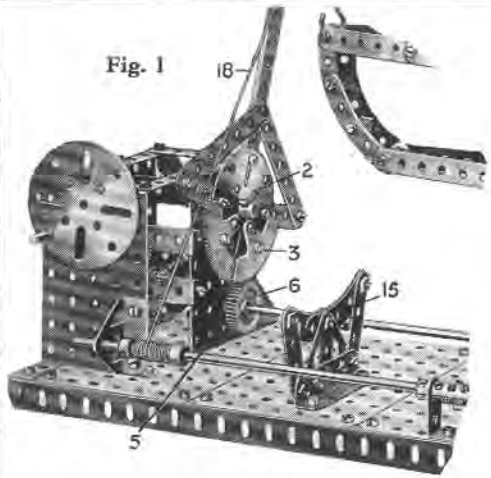
The construction of model motor cycles is by no means a simple task, for in addition to possessing a good knowledge of the features of actual machines, the constructor must also exercise considerable time and ingenuity in fitting the various units into the smallest possible space.



A "London General" Omnibus

The other model illustrated on this page is of a six-wheeled omnibus, and was built by Edgar Bell, of Felixstowe. At a glance one can appreciate the typical "coachwork" of the famous London vehicles. Stairs are provided from the rear platform to the upper deck, with a two-step extension on to the road. The driver's seat is placed by the side of the engine to conform with latest practice, and Ackermann steering is provided. Equipment includes two headlights, two side lights and a tail light; and there is seating accommodation for a large number of passengers. The springing is of considerable interest. Half-elliptic springs are used at the front, while double inverted semi-elliptic springs mounted on a central pivot give the rear wheels ample flexibility. Each rear wheel is secured on its own independent axle, and the drive is taken by the leading pair. Those behind are free to turn.

Fig. 1



How to Use Rack Segments and Rack Strips

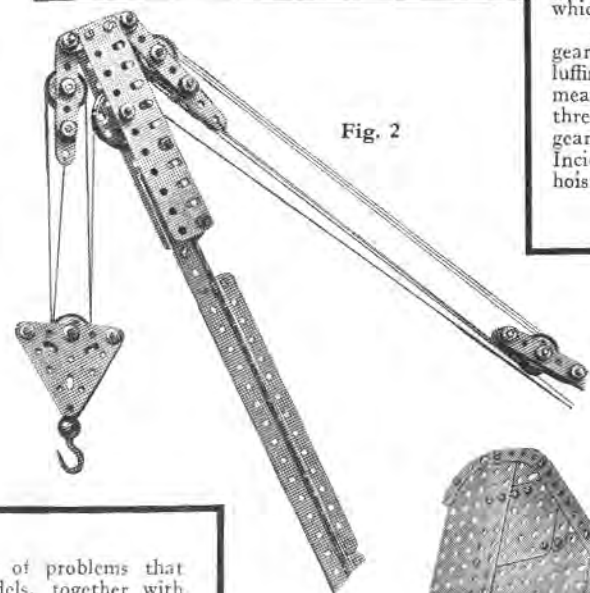
Rack Segments improperly used are liable to cause trouble, for when two or more are used under certain conditions they do not fit together exactly at the joints. This trouble can be avoided, however, by spacing the Segments 1/32" apart at their tips. Gears will then be found to mesh with the teeth of the Rack Segments perfectly. A case where this difficulty is likely to be met occurs in the model boat-lowering gear shown in Fig. 1. In this, two Rack Segments are bolted to a Face Plate to form a semi-circular gear wheel, which carries the davit arms and is driven by a 1" Gear Wheel.

As with Rack Segments, it is sometimes found necessary to separate the ends of Rack Strips slightly when placed end to end, in order to make the end teeth of the respective Strips conform to pitch, and permit of correct engagement with a Pinion passing over the joint. The Meccano Steam Shovel (see section of model Fig. 5, page 40) is an instance where long rack sections require the use of two 3½" Racks joined together, but in this case the difficulty may be overcome by substituting a 6½" Rack Strip.

Pulley systems are one of the most useful mechanical devices known to engineers and they are none the less interesting and useful to Meccano model-builders. Some degree of dexterity and skill is necessary, however, in assembling the more complicated systems such as that used in the Meccano model Stiff Leg Derrick, a section of which is shown in Fig. 2.

In assembling this system, the built-up pulley blocks used in the luffing gear have, on account of their heavy construction, been found to sag on the luffing cords, thus making the latter liable to undue wear and tear. The best means of preventing this undesirable occurrence is to use standard Meccano three-sheave Pulley Blocks (part No. 153). These form a much neater luffing gear than can be made with the heavy built-up blocks shown in Fig. 2. Incidentally, a single sheave Pulley Block may be used at the jib-head on the hoisting tackle in place of the large built-up block.

Fig. 2

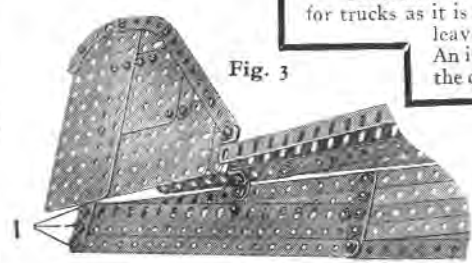


Another "Knotty" Problem Solved

Fig. 3 illustrates a problem the solution of which would probably tax the ingenuity of many Meccano boys. It is a portion of the tail-fin of a seaplane, and owing to the shape of the sloping portion of the fin, and the components used in its construction, it is impossible to bolt the free ends of the Plates, etc., to a Strip for strengthening purposes, because the holes in the various parts do not coincide. This difficulty is best overcome by clamping the edge of the fin between 5½" Strips.

Difficulties are sometimes met in forming smooth running rails for trucks as it is necessary to secure the rails in position and yet leave their surface free from projecting bolt heads. An instance of this appears in Fig. 8 (page 40). Here the centre running rail is clamped between Strips 19.

Fig. 3



Practical Advice on Model-building

ALL Meccano boys at one time or another experience various difficulties in the construction of their models. Advanced model-builders usually manage to solve each obstacle as it is encountered, but newcomers to the hobby are often "stumped" over some constructional feature that appears to be unsurmountable, but which usually is easily capable of solution after a little thought.

With the object of helping all Meccano boys to derive the fullest possible pleasure from their hobby, we give on this and the following page typical examples of problems that may be encountered in building intricate models, together with suggestions for their solution.

Putting in that Awkward Nut!

A very common problem is the insertion of nuts and bolts into places apparently inaccessible to human fingers. When the nut cannot be placed on the bolt shank with the fingers, it is a good idea to stick it on a Strip of suitable length with some "tacky" adhesive. Sometimes nuts can be affixed in this manner to the parts themselves. Fig. 4 shows another instance of this kind of difficulty. The illustration is a section of an electric locomotive, with part of one side removed to show the interior. It will be seen that when the side plate is placed in position, it is impossible to reach the Angle Brackets 6 from the inside in order to place nuts on the bolt shanks. The best way of overcoming the problem is to duplicate each Angle Bracket so that a nut may be clamped between their ends. It is then only necessary to insert bolts in the appropriate holes and screw them home.

It is sometimes useful to attach a length of wire to the bolt shank, which may then be quite easily manoeuvred into the required position.

Fig. 4

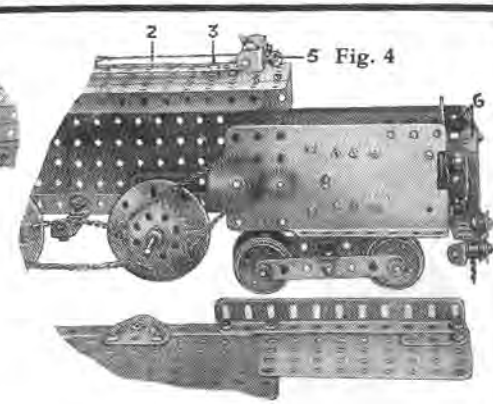
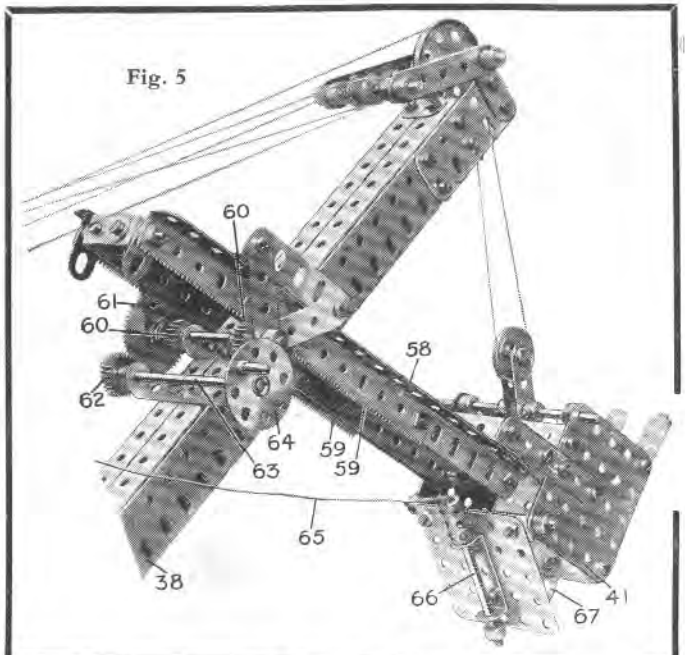


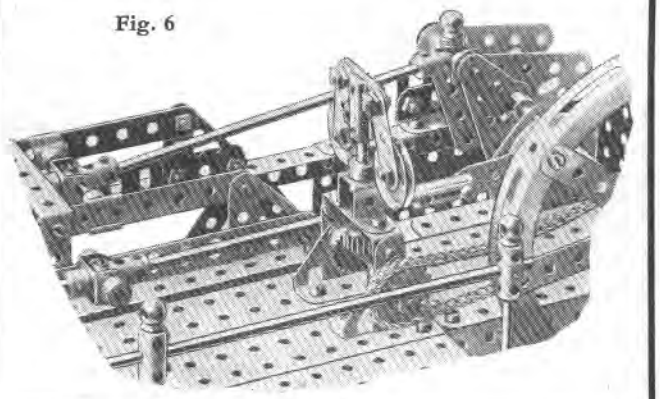
Fig. 5



A Connecting-Rod Difficulty

FIG. 6 illustrates a difficulty that sometimes arises in model engine making, at the point where the valve eccentric is joined to the connecting rod. The union is generally effected by using a Strip Coupling, but such a joint is insecure without a certain amount of packing in the form of stiff paper washers. A better way of overcoming the difficulty without using parts other than Meccano is to fix the Coupling on the valve rod in place of the Fork Piece, and to connect this with the Eccentric on the Crankshaft by means of a single Strip bolted to the Eccentric and attached pivotally to the Strip Coupling by a $\frac{3}{8}$" Bolt, or an ordinary nut and bolt.

Fig. 6



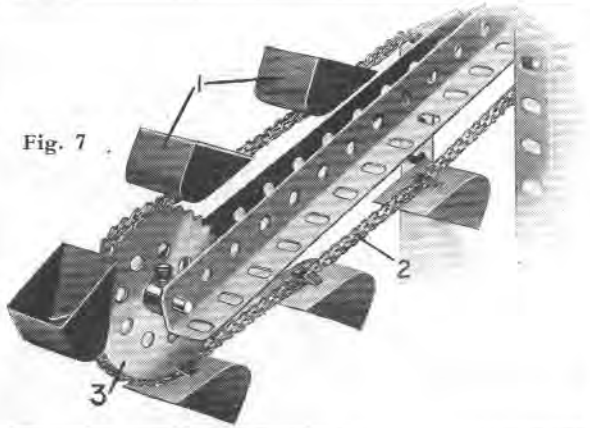
How to make "True" a Built-up Crankshaft

A problem that occasionally confronts the model-builder is the construction of an accurate and "true" built-up crankshaft. Usually such a part is composed of Cranks or Couplings, which are secured on Rods to represent the journals and crank pins of the crankshaft. In order to ensure that the finished crankshaft is quite true, each crank member, consisting of one crankpin and two webs (Cranks or Couplings) should be built up on a Rod, which is removed only when the crankpin has been secured as rigidly as possible to the Cranks. When an ordinary Crank is used as a web, each end of the crankpin is attached to the Crank by a second Crank, and they are bolted together face to face.

Reinforced-Bearing Problems

In many models it is desirable to reinforce bearings in order to reduce wear of the rubbing surfaces to a minimum. A journal of this description consists generally of a Bush Wheel or a Double Arm Crank, which is bolted over the hole in which a Rod is to be journalled. When using a pair of reinforced bearings trouble is likely to arise unless care is taken to see that they are in perfect alignment, and in order to test them a Rod should be passed through each bearing in turn, until the end of the Rod is stopped by butting against the opposite bearing. If the end of the Rod coincides exactly with the centre of each hole, both bearings are in alignment and no difficulty will be experienced in getting the Rod to turn freely. If, on the other hand, the Rod does not turn freely, transverse pressure should be brought to bear on the Rod, until the fault is corrected.

Fig. 7



Using Dredger Buckets

Young model-builders seem to experience difficulty in attaching Dredger Buckets to Sprocket Chain so as to ensure satisfactory running of the Chain over Sprocket Wheels. The clip on the Bucket should first be pushed through the Chain (see Fig. 7) the ends then forced apart against the sides of the link, and finally pressed up against the underside of the Bucket. This ensures entry of the Spocket teeth into the link carrying the clip.

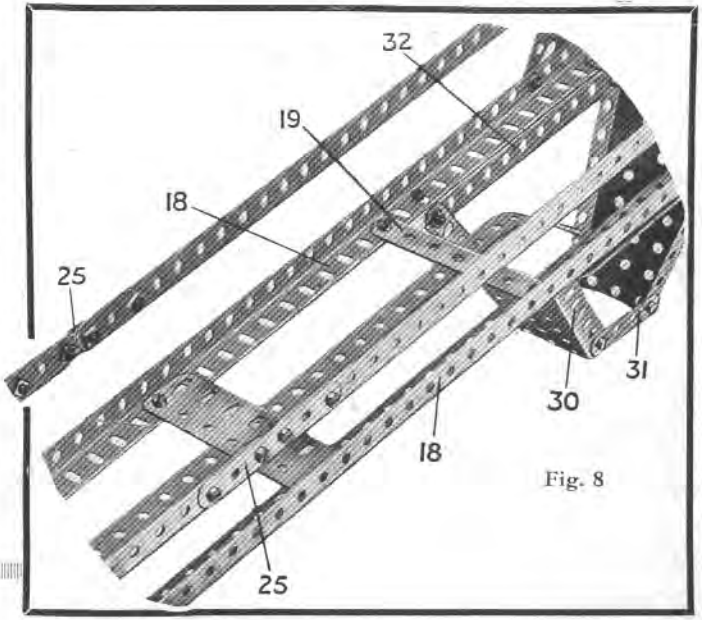


Fig. 8

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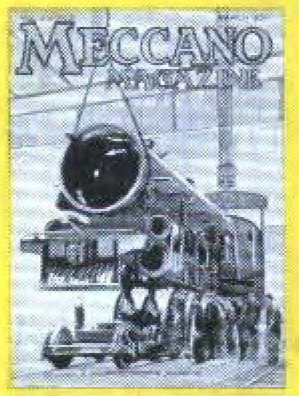

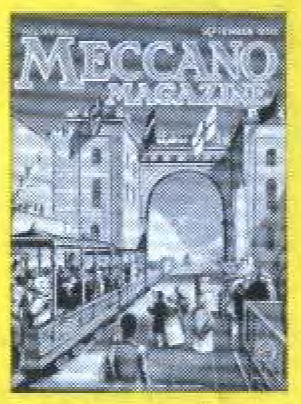

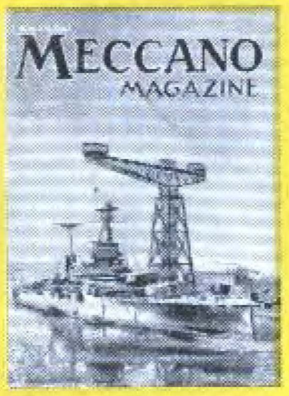

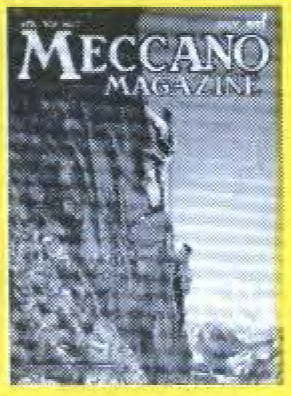

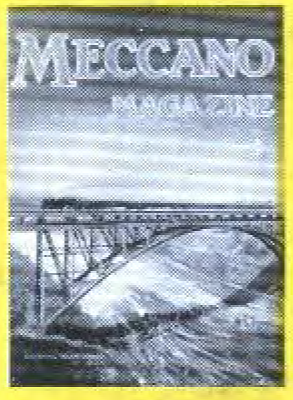

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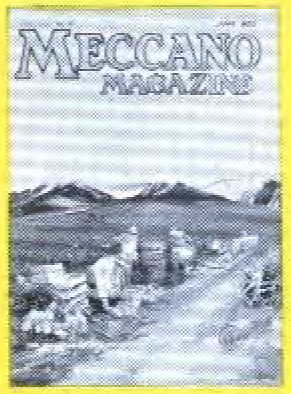

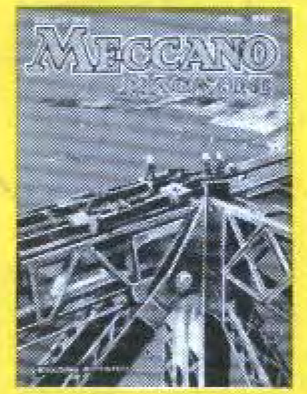

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