Electric Mobile Crane

An L Outfit Model

Special Features Include

There are four distinct movements: luffing hoisting, slewing, and travelling, all controlled from the "operator's seat." Slewing is effected by rotation of the pivoted "castor" at rear of chassis. A safety limit switch is provided, preventing overwinding of jib. An automatic brake controls the hoist shaft, and brakes are fitted to luffing shaft and road axle.

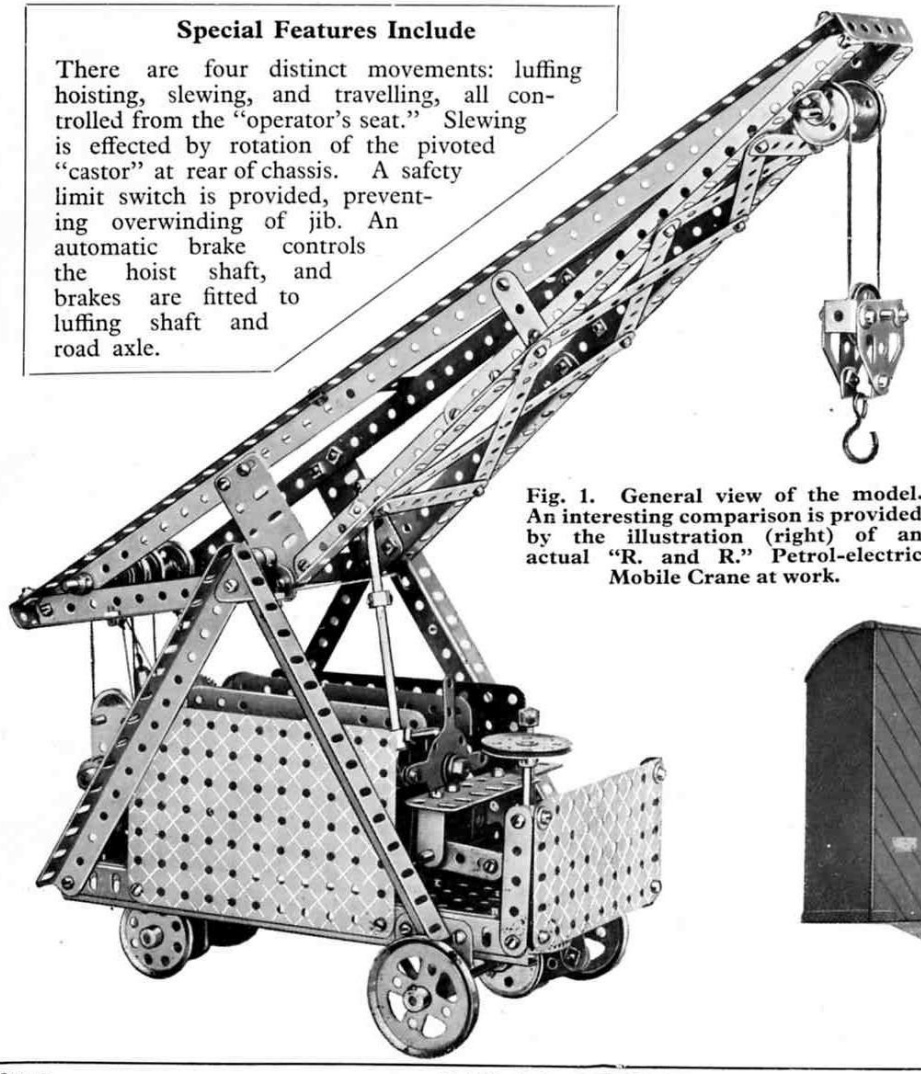
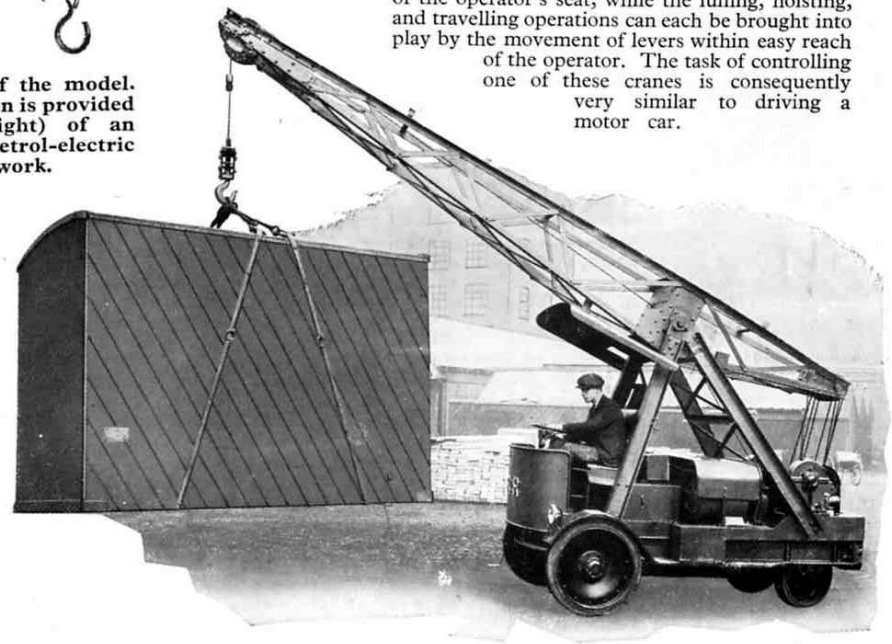


Fig. 1. General view of the model. An interesting comparison is provided by the illustration (right) of an actual "R. and R." Petrol-electric Mobile Crane at work.

IN recent years numerous devices have been invented in an endeavour to solve the problem of high speed handling and transportation of materials and merchandise. One of the most interesting of these is undoubtedly the Petrol-electric Mobile Crane, which is manufactured to patented designs by the well-known firm of Ransomes and Rapier Ltd., of Ipswich, and forms the subject of the Meccano model described in this leaflet.

The crane comprises an entirely self-contained power unit and combines the stability and efficiency of a stationary crane with extreme mobility; and as its travel is not confined to a set of rails, or hindered by trailing cables from an external power supply, its range of utility is practically unlimited.

The power unit consists of a petrol engine that drives a generator which, in turn, supplies current to the luffing and hoist motors and to the two traction motors incorporated in the "castor" that is pivoted at the rear of the chassis—hence the term "petrol-electric." The crane is slewed by rotation of the pivoted castor, which is connected to an orthodox steering wheel placed in front of the operator's seat; while the luffing, hoisting, and travelling operations can each be brought into play by the movement of levers within easy reach of the operator. The task of controlling one of these cranes is consequently very similar to driving a motor car.



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The Meccano model reproduces all the functions of the actual crane, with the aid of a single Meccano 6-volt Motor and an ingenious gear-box. The model also includes a limit switch to prevent overwinding of the jib, an automatic brake on the hoist shaft, and foot brakes on the luffing and road shafts.

Construction of the Model: The Jib

As will be seen from Fig. 1, the Meccano model consists of two main units, the chassis incorporating the gear-box, Motor and steering mechanism, and the crane jib.

For convenience, the constructor should assemble the jib first, and lay this on one side while the chassis is completed, after which the jib is secured in position and final additions made to the model.

The main frame of the jib consists of two 18½″ Angle Girders held apart at the rear end by a 4½″ Girder and at the front by a 2½″ Angle Girder; a 3½″ Strip is also bolted between the 18½″ Girders as shown in Fig. 1. The jib is braced by a framework fixed to its under surface.

A 2½″ Flat Girder is secured to each of the 18½″ members and a pair of 5½″ Girders are attached to the Flat Girders and also to the end holes of the 18½″ Girders. A pair of 13½″ compound girders, each built up from one 5½″ and one 9½″ Girder, are also bolted to the Flat Girders, while their upper ends are secured to the front of the jib frame.

In order to counteract any tendency to bend or "buckle" under load, the compound 13½″ Girders are braced by 2½″, 3½″ and 5½″ Strips secured diagonally between them. Two diagonal 5½″ Strips are also bolted to the pair of 5½″ Girders at the rear of the frame. Angle Brackets are bolted to each of the 13½″ compound girders near the top of the jib to provide journals for a 2½″ Axle Rod carrying two 1″ loose Pulleys, which are kept in position on the Rod by means of Collars. A 5″ Axle Rod 61 (Fig. 3) is journalled in the frame of the jib at the rear end, and carries four 1″ loose Pulleys, 1, 2, 3, 4 and two Flat Brackets 5. Collars are placed between each of the Pulleys and also on each end of the Rod itself in order to prevent lateral movement. The jib is now complete and may be laid on one side while the construction of the chassis is proceeded with.

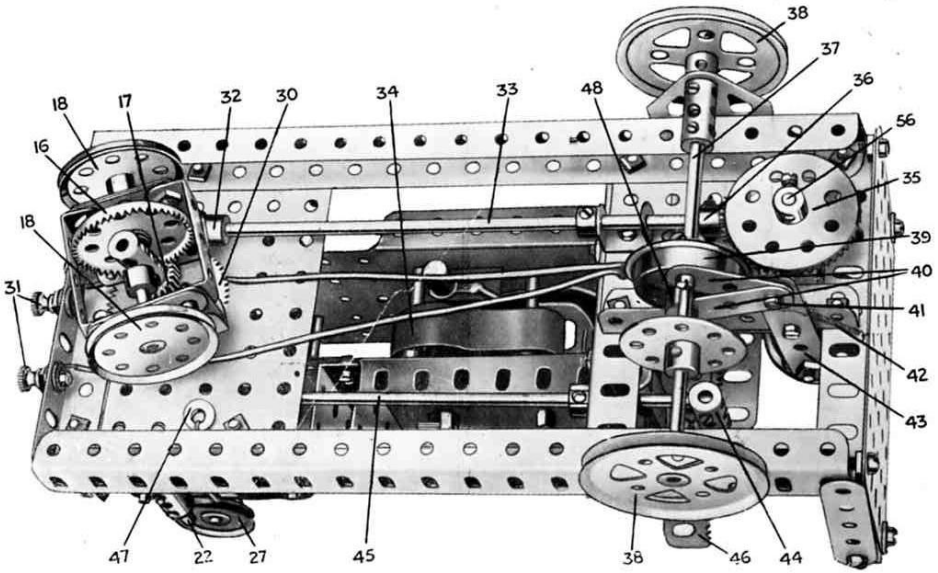

Fig. 2. Underneath view of chassis, showing "castor," steering transmission, and internal expanding brake on front road axle.

The Chassis: Fitting the Motor and Gearing

The chassis frame can be seen in Figs. 2 and 4. Its sides comprise U-section girders, each built up from two 9½″ Girders, and a 4½″ Angle Girder is bolted to these at the front and rear. A further 4½″ Girder is bolted between the two side members, six holes from the front end of the chassis, and a 3″ Girder is secured to the centre of this and also to the 4½″ Girder forming the front end of the frame. The rear of the frame is covered by a footplate consisting of a 4½″×2½″ Flat Plate while a 2½″×2½″ Plate is attached to the front right-hand side of the frame. Flat Plates are also attached in an upright position to the front and side girders, but these should not be bolted in place until a later stage in the construction of the model.

Two 2½″ Angle Girders are secured to the 4½″×2½″ Flat Plate and to the rear 4½″ Angle Girder, and 2½″×2½″ Flat Plates are bolted to them. These Plates form journals for the shafts of the gear-box and also provide support for one end of the Electric Motor. The Motor gearing should now be built up, and the Motor itself is afterwards secured in position on the chassis, and the gear-box, other fittings then being added.

A Worm 26 (Fig. 4) mounted on the armature shaft of the Motor meshes with a ½″ Pinion 25 (Fig. 3) which is secured to one end of a 2″ Axle Rod journalled in a Channel Bearing bolted to the Motor side plate. In fixing the Bearing to the side plate of the Motor, a Washer should be placed on each of the securing bolts to space the Bearing the correct distance from the Motor.

A Bevel 24 is secured to the other end of the 2″ Axle Rod and meshes with a further Bevel that is mounted on a shaft journalled in the Motor side plates. This latter shaft also carries the ½″ diameter ½″ wide Pinion 51 (see Fig. 4).

The Motor is secured to the side plates of the gear-box by means of a 3″ Axle Rod passed through the top holes of the 2½″×2½″ Flat Plates and through the perforations in the Motor side plates, Collars being employed to keep this Rod in place. Packing, in the form of three Washers, should also be slipped on to the Rod against the right-hand side plate of the Motor in order that perfect rigidity may be obtained. The front of the Motor rests on the lateral 4½″ Angle Girder, and is secured rigidly to this by means of ½″×½″ Angle Brackets.

The operator's seat (see Figs. 1 and 4) consists of a 3″ Flat Girder attached directly in front of the Motor switch to the lateral 4½″ Girder by means of 1″ Reversed Angle Brackets. A 3½″ Rack Strip 46 (Fig. 4) is bolted to the seat and projects from the left-hand side, where it acts as a "catch plate" for the gear shift lever 57.

Assembly of the Gear-Box

Before placing the gears and shafts in the gear-box the support for the gear control shaft 45 (Fig. 2) and selector arm must be fitted. This consists of an Angle Bracket that is secured to a 2½″×½″ Double Angle Strip bolted between the side plates of the gear-box in the position shown in Fig. 3, the round hole of the Angle Bracket providing one journal for the Rod 45. The latter is supported at the front end of the model in the lateral 4½″ Girder.

The Rod 45 carries a Crank, which forms the "selector arm" and is fitted with a bolt secured in its slotted hole, the web of the Crank being butted against the face of the Angle Bracket in which the Rod 45 is journalled. A Coupling 44 (Fig. 2) is secured to the front end of the Rod and carries a 2″ Axle Rod 57 fitted with a Collar forming the gear control lever, the Rod 57 being pressed tightly against the teeth of the Rack 46, thus preventing unwanted movement of the gears in the gear-box.

The sliding primary shaft of the gear-box consists of a 3½″ Axle Rod carrying a 57-teeth Gear Wheel 10 which takes a drive from the Pinion 51 (Fig.4), a ¾″ Pinion 49, and two Collars placed one on each side of the bolt secured in the Crank forming the selector arm. A Collar 20 (see Fig. 3) is also fixed on the extreme end of this shaft.

A secondary shaft, which does duty as the hoist drum, is journalled in the 2½″×2½″ Plates two holes directly above the sliding primary shaft, and carries the 50-teeth Gear 7, a 1″ fast Pulley 27 and two Collars, one of which is fitted with a standard bolt in place of its set-screw to provide an "anchorage" to which one end of the hoist cord may be tied.

The luffing shaft 15 carries a 50-teeth Gear 14 (Figs. 3 and 4) and a 1″ fast Pulley 9, the two Collars securing this Rod in place each being equipped with a standard bolt to which the ends of the luffing cord are fixed. A further 3½″ Rod, mounted two holes above the shaft 15, carries two 1″ fast Pulleys 8 and 28 and a Flat Bracket 6 mounted between two Collars in a central position on the Rod.

The operation of the gears in the gear-box is as follows. The Gear 10 remains constantly in mesh with the Pinion 51. For travelling, the gear lever 57 is pulled hard over to the right against the end of the operator's seat. This causes the ¾" Pinion 49 to engage with the ¾" Contrate 29, and the drive from the Motor is then transmitted to one of the road wheels of the castor, in the manner to be described later.

To operate the jib, the lever 57 is pushed slightly to the left, thus disengaging the ¾" Pinion 49 from the ¾" Contrate 29, and bringing it into mesh with the 50-teeth Gear 14 on the luffing shaft.

The last of the three movements—that of hoisting the load—is brought into action by moving the lever 57 still further to the left. Pinion 49 is then disengaged from the Gear Wheel 14 and engaged with the 50-teeth Gear 7 mounted on the hoisting shaft. The action of moving the sliding primary shaft into this position also causes the Collar 20 which is mounted upon it to press against the Rod 22, and thus releases the automatic band brake on the hoisting shaft. The construction of the brake mechanism is detailed later.

The Castor and Steering Gear

The underneath view of the Chassis, Fig. 2, shows the construction of the castor and the method of coupling the steering gear to it. The frame of the castor is composed of two 1½" Angle Girders to which are bolted 1½" Flat Girders. Two 1½"×½" Double Angle Strips are bolted between these, and the flanges of the Angle Girders are secured to the face of the 57-teeth Gear Wheel 30 by means of ⅜" Bolts, Collars being placed on the shanks of the bolts to space the Girders away from the Gear Wheel. The road axle consists of a 2½" Rod which carries two 1½" Pulley Wheels 18, the 1½" Contrate 16, a Coupling, and two Collars. Of the two road wheels one is fixed to the shaft, while the set-screw of the other is removed and the wheel is held in place on the end of the shaft by a Collar.

The complete castor pivots about a 2" Axle Rod that is passed through the 4½"×2½" Flat Plate forming the floor of the gear-box (Figs.2 and 3), and is journalled in the centre hole of the 2½"×½" Double Angle Strip secured between the sides of the latter (Fig. 3) and in the end of the Coupling on the road axle. The ¾" Contrate Wheel 29 previously referred to is secured to the upper end of this Rod, and a ½" Pinion is slipped on to its lower portion between the Gear 30 and the Coupling.

The castor is rotated by means of a Worm 32 (Fig. 2), secured on an 8" Rod 33. This Rod is journalled at its rear end in the 4½" Angle Girder forming the end of the chassis frame (a 1½" Strip being bolted to the Girder to provide a round hole as a bearing for the Rod) while a Double Bracket provides the front journal.

A ½" Bevel 36 is fastened on the front end of the Rod 33 and gears with a 1½" Bevel 35 mounted on the Rod 56, which represents the steering column. This Rod is journalled in the 2½"×2½" Flat Plate secured to the front of the frame and also in a Double Bent Strip bolted to the Flat Plate. A 1½" Pulley Wheel 55 fastened to the top of the Rod 56 represents the steering wheel.

The Brakes and Control Gear

The brakes fitted to the model are realistic and effective. There is an automatic band brake acting on the hoisting drum, a foot brake fitted to the luffing mechanism, and a further foot brake acting on a drum secured to the front road shaft, the last-mentioned brake being of the internal-expanding pattern.

The automatic brake fitted to the hoisting shaft (see Fig. 3) consists of a 1" Pulley 27, acting as the brake drum, around which a length of cord 23 is passed. One end of this cord is pushed through a hole in the chassis base plate and tied to a Washer 47 (Fig. 2) underneath the frame. The other end of the cord is fastened round the shank of a ⅜" Bolt 19 secured in the tapped hole of a Collar mounted on a 2" Rod. This Rod is journalled in a 1½"×½" Double Angle Strip secured to the frame of the crane, and also carries a Coupling in which is secured a 1" Axle Rod 22.

A piece of Spring Cord 21 is twisted round the Rod 22, and its other end is attached to the gear-box side plate by means of a bolt and nut. The Spring 21 and Cord 23 are adjusted so that the cord is normally taut around the groove of the Pulley 27 and the brake is therefore "on." On moving the sliding primary shaft in the gear-box until the ¾" Pinion 49 engages with the 50-teeth Gear on the hoist shaft, the Collar 20 strikes the Rod 22, thus causing the bolt 19 to move upward, thereby releasing the tension of the cord around the Pulley 27.

This brake ensures that the hoist shaft is "locked" at all times except when the lowering or raising of the load is being undertaken by means of the Motor, and in this way the possibility of an accident is avoided.

The foot brake acting on the luffing shaft 15 can be seen in Fig. 4, and comprises a 1" Pulley 9, which serves as the brake drum. Around this is passed a length of cord 11, one end of which is fastened underneath the head of the bolt 12, while the other end is tied to a short length of Spring Cord 50. The Spring Cord is secured to a bolt screwed into the tapped hole of a Collar mounted upon a 6½" Axle Rod 52. The forward end of this Rod 52 carries a Compression Spring 53 held in place by means of a Collar.

The "foot pedal" comprises a Crank 54 fitted with an Angle Bracket and mounted on a 1" Rod journalled in a Cranked Bent Strip which is attached to the under surface of the 3" Flat Girder forming the "operator's seat." The Crank is held to the 1" Rod by means of a ⅜" Bolt inserted in its set-screw hole, this bolt butting against the Collar attached to the end of the Rod 52. On depressing the "foot pedal," the Rod 52 is pushed backward against the force of the Spring 53, and the tension of the cord 11 around the Pulley 9 released. The luffing brake should only be released in this way when the luffing shaft 15 is in gear with the Motor.

The construction of the internal expanding foot brake fitted to the front axle can be seen in Fig. 2. The "brake drum" consists of a 1½" Flanged Wheel 39 mounted on the compound axle 37, which comprises a 4½" and a 1½" Rod joined together by a Coupling, and carrying a 2" Pulley 35 at each end. Two 1½" Strips 40, each fitted with a Collar 48, form the brake shoes and are secured pivotally to the 2½" Strip 43 by a bolt 41 and two nuts, the lock-nut mechanism (S.M. 1) being employed. The Strip 43 is pivoted to a longitudinal 3" Girder fastened to the frame by two bolts and nuts, and an Angle Bracket is secured to the upper end of this Strip to represent the "pedal."

A short length of Spring Cord 42 is attached between the bolt 41 and the frame of the model and serves to keep the brake in the "off" position. By depressing the brake pedal

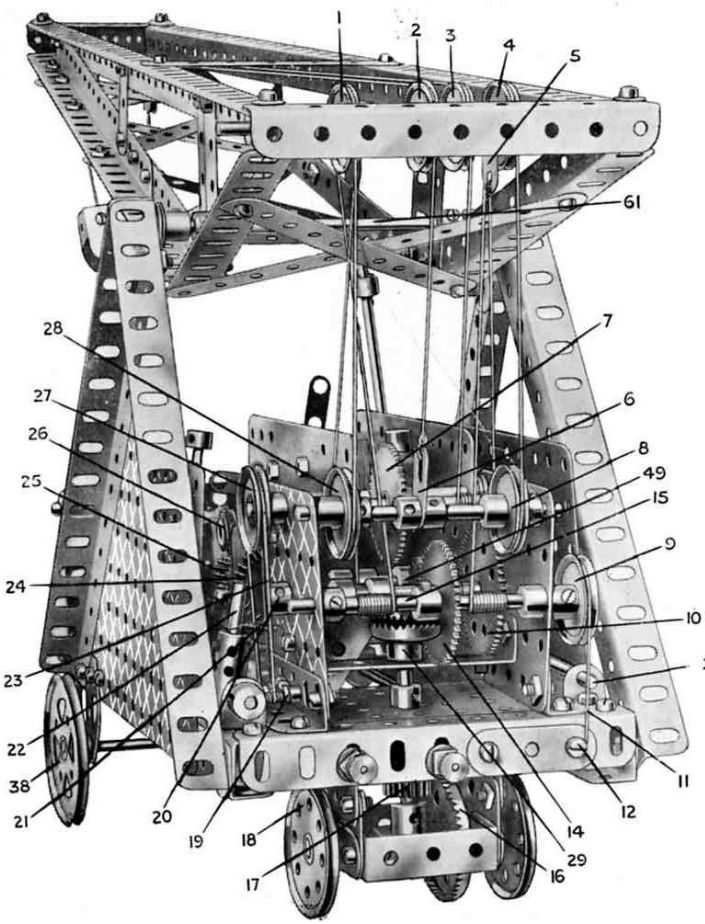

Fig. 3. Rear view of complete crane. This illustration will be helpful when assembling the Gear-Box and luffing mechanism.

the Collars mounted on the Strips 40 are forced against the internal surface of the flange of the Wheel 39 and the necessary friction is created. This brake, although simple, will be found remarkably efficient, only a slight movement of the "foot pedal" being necessary to "lock" the front axle.

On reference to Figs. 2 and 3 it will be seen that two 6 B.A. Terminals 31 are secured on 6 B.A. Bolts fastened to the 4½" Girder forming the rear of the frame. These Terminals, which are of course insulated from the frame by Insulating Bushes and Washers, are connected to the terminals of the Electric Motor by lengths of rubber-covered flex. They thus provide a convenient "outlet" to which flexible cable from an external accumulator or Transformer can be connected, so that the Motor can be set in motion.

General Assembly

The chassis now being complete, the crane jib is secured in place. Two 7½" Angle Girders are bolted to each side of the frame in the positions shown in Fig. 1, and are held together at their upper ends by means of 1" Triangular Plates. A Crank is also bolted to the apex of each pair of Girders to provide bearings for the jib pivot Rod 61.

The 5½" Axle 61 (Fig. 3) forms the pivot about which the jib rotates, and is passed through the top hole in each of the Triangular Plates, into the bosses of the Cranks, and also through the 2½" Flat Girders forming part of the bracing members of the jib frame. Collars are slipped on to the Rod 61 in order to keep the jib frame central with respect to its journals.

The hoisting and luffing cords are now attached, and are shown clearly in Fig. 3. One end of the hoist cord is attached to the Angle Brackets 6 and the cord then led over the loose Pulley 2 and round a similar Pulley on the hoist block. The cord is then returned over the Pulley 3, and finally is wound round the hoist shaft and its end tied to a bolt secured in a Collar mounted on this shaft.

The luffing gear is duplicated, each cord being first attached to a Flat Bracket 5 on the Rod journalled in the jib. It then passes round the Pulleys 8, 28, 1 and 4 and is wound round the Rod 15. Both Cords are tied finally to the bolts secured in Collars on the shaft 15.

The automatic limit switch (see Fig. 1) is next constructed. This consists of a 4" Axle Rod 58 connected to one arm of the reversing switch of the Electric Motor by means of a Swivel Bearing 60. Two Collars and a Handrail Support 59 are placed on this Rod at its upper end, the Handrail Support being secured to the jib in the position shown in Fig. 1.

The Collars secured to the Rod 58 must be adjusted so that as soon as the jib approaches either a perpendicular or a horizontal position, the Handrail Support presses against one or other of the Collars and the arm of the reversing switch of the Motor is pushed into the "off" position, thus "cutting out" the Motor.

A Threaded Pin secured in the boss of the Swivel Bearing 60 provides a means whereby the starting and stopping of the Motor may be controlled independently, from the 3" Flat Girder, which forms the operator's seat.

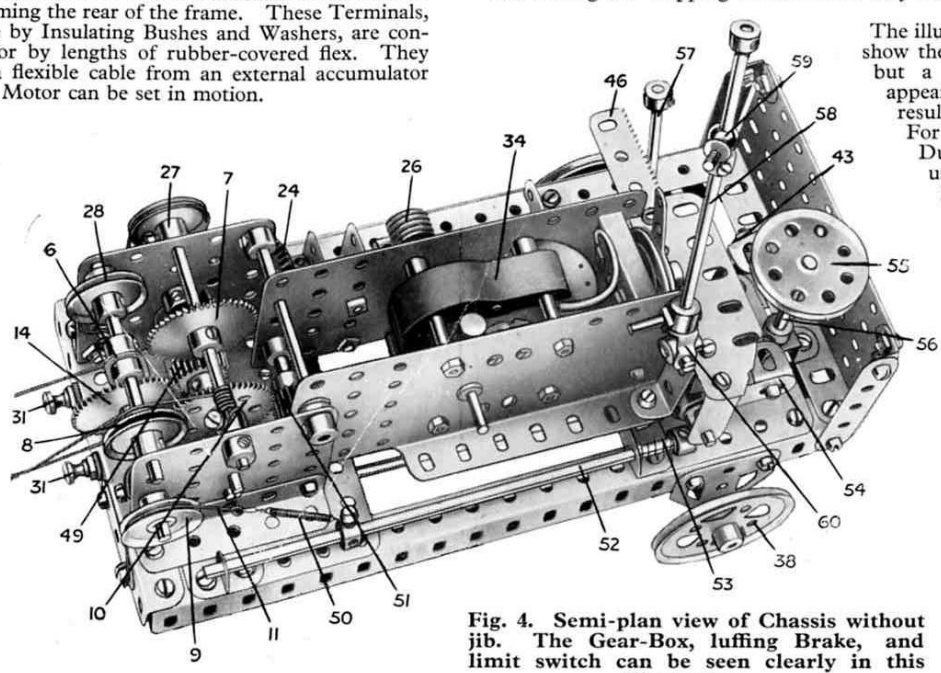

Fig. 4. Semi-plan view of Chassis without jib. The Gear-Box, luffing Brake, and limit switch can be seen clearly in this illustration.

The illustrations of the crane included in this leaflet show the front and rear road wheels without tyres, but a considerable improvement, both in the appearance and operation of the model, will result if Meccano Dunlop Tyres are fitted. For the front pair of wheels Meccano 2" Dunlop Tyres (part No. 142a) should be used, while 1½" diameter Tyres (part No. 142c) may be fitted to the 1½" Pulleys which form the "castor" wheels.

Final Adjustments

In connecting either an accumulator or Transformer to the model a length of rubber-covered flex should be used. The wires should be scraped clean at one end and attached to the positive and negative terminals of the accumulator, or the "output" terminals in the case of a Transformer. The other ends of the wires should also be cleaned of insulating material and secured to the Terminals 31 (Figs. 3 and 4) that are mounted on the rear of the chassis.

The Motor may now be set in motion and the gear lever 57 moved into different positions so that the various Gears are engaged. In all probability it will be necessary to make slight adjustments to the positions of the Gears and Pinions on the shafts in the gear-box before smooth working is obtained.

The adjustment of the automatic hoisting brake is quite a simple matter, successful operation depending on the length and tension of the Spring Cord 21 and the Cord 23. The luffing brake can be adjusted to give best results by moving the Collar mounted on the Rod 52 either backward or forward, thus increasing or diminishing the tension of the Spring 50.

The front road axle brake does not make use of a spring to keep it in the "on" position, this being effected by pressure on the foot pedal 43. The tension of the return spring 42 should therefore be adjusted so that it merely keeps the Collars 48 attached to the Strips 40 clear of the internal surface of the flange of the Flanged Wheel 39, when pressure on the pedal is released. All moving parts should be kept well oiled.

Parts Required.

4 of No. 2	4 of No. 9d	2 of No. 16b	2 of No. 26	100 of No. 37	2" of No. 58	2 of No. 111a	2 of No. 182
2 „ 2a	1 „ 9e	3 „ 17	1 „ 26a	24 „ 38	45 „ 59	3 „ 111c	2 „ 182a
4 „ 3	2 „ 9f	4 „ 18b	2 „ 27	2 „ 40	4 „ 62	2 „ 124	2 „ 1563
4 „ 5	3 „ 10	1 „ 20	2 „ 27a	1 „ 44	4 „ 63	4 „ 126a	2 „ 1575
7 „ 6a	8 „ 12	2 „ 20a	1 „ 28	1 „ 45	3 „ 72	1 „ 136	2 „ 1583
2 „ 7a	1 „ 13a	3 „ 21	2 „ 30	2 „ 48	2 „ 77	1 „ 147a	12" „ 1587
6 „ 8a	1 „ 14	4 „ 22	1 „ 30a	1 „ 48a	1 „ 103c	1 „ 147b	Electric Motor
4 „ 8b	4 „ 15a	6 „ 22a	1 „ 30c	2 „ 52a	2 „ 103f	1 „ 148	
4 „ 9	5 „ 16	1 „ 24	2 „ 32	2 „ 53a	2 „ 103h	1 „ 160	
4 „ 9a	4 „ 16a	1 „ 25	2 „ 35	1 „ 57	1 „ 110	1 „ 165	