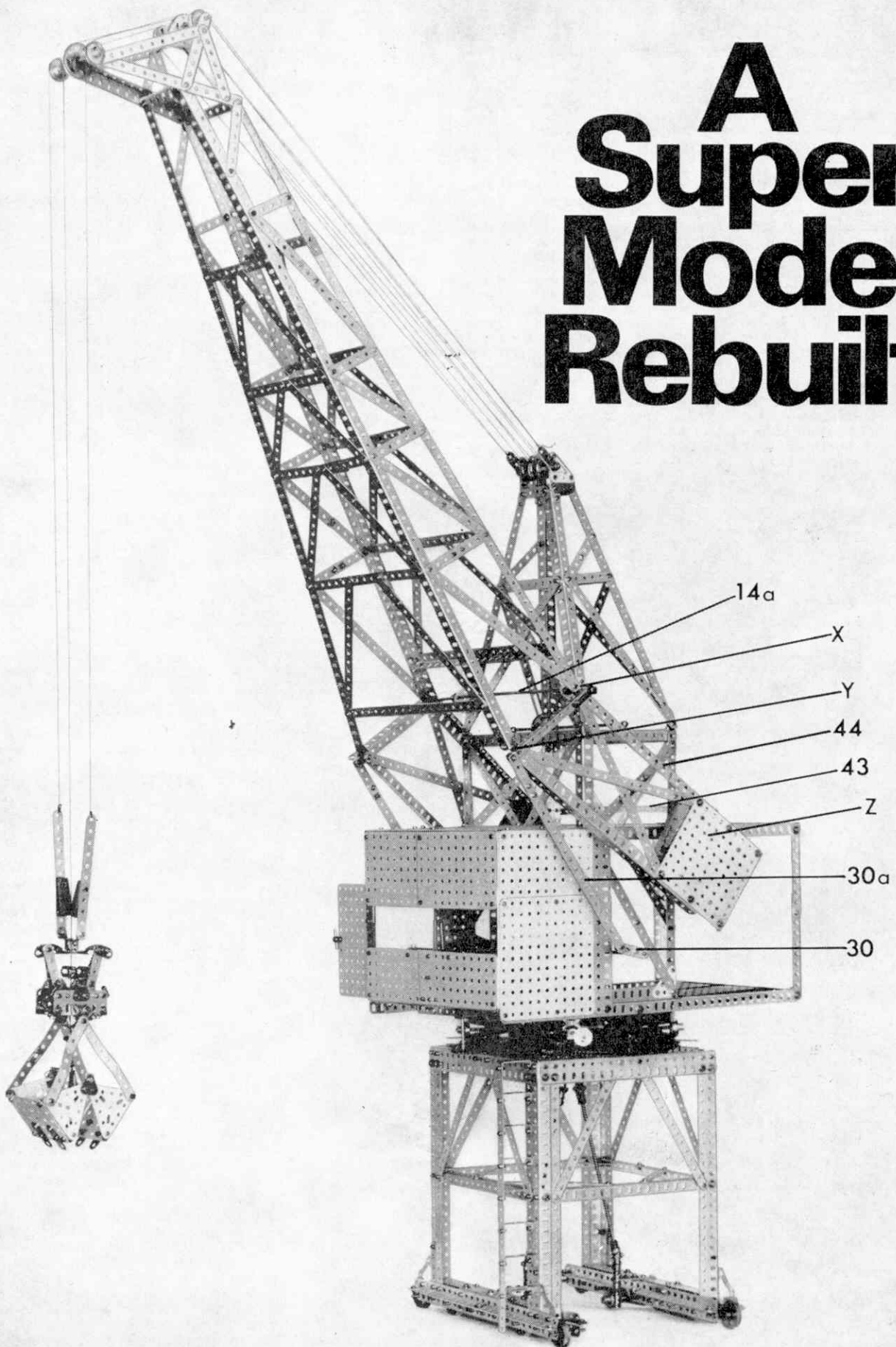


A Super Model Rebuilt



Spanner gives today's advance model builders a chance to produce the gigantic Level-Luffing Automatic Grabbing Crane that was originally described in No. 35 of the world-famous series of Meccano Super Model Leaflets published before the last war.

ASK any die-hard Meccano enthusiast what he would most like to own, and I guarantee that a set of pre-war Super Model Leaflets would stand high in the list. These Leaflets, which must not be confused with the current series of Special Model Leaflets for Outfit No. 10, were published by Meccano Limited in the 1930s, and each one featured a large, highly-advanced construction.

The S.M.L.s, as they were called, proved enormously successful until publication ceased at the start of the war. Ever since then they have been in great demand, but Meccano have been totally unable to reintroduce them as all the blocks and printing plates used in their production were destroyed during the war, along with all existing stocks and even file copies. I, myself, do not have as much as one file copy, let alone a complete set! We do have a few of the original photographs used in preparing one or two of the Leaflets, but these are of little value today as the models illustrated use parts that are now obsolete.

Generally speaking, circumstances have combined to make what few copies of the Leaflets still exist into highly-prized collectors items. This fact, however, does not make the models, themselves, obsolete. On the contrary, they are as good now as they ever were, but, owing to our own lack of Leaflets, we have simply not been able to do anything about giving them a second showing until now, despite the number of requests from readers. It is only thanks to the personal collection of the Meccano Magazine's chief model-builder that we are now able to do something to rectify the situation. He, it turns out, has most of the old S.M.L.s and, while it is economically unfeasible for Meccano Limited to prepare new Leaflets, using the old ones as a basis, we see nothing to prevent us from building and featuring an occasional 'Super Model' in the 'M.M.'. Acting on our convictions, therefore, we feature below Super Model No. 35 Level-Luffing Automatic Grabbing Crane, slightly modified, of course, to enable current

parts to be used where now-obsolete parts were fitted to the original.

Presentation Problems

You will see from the following text that I have departed from my usual practice of giving complete step-by-step building instructions. Unfortunately, this was unavoidable, as the enormous size of the model made such instructions quite out of the question, but I do not think any great set-back results. Anybody keen enough and with sufficient parts to build the model will, I feel, already be something of a Meccano expert and will not require complete instructions, provided good illustrations are included. This point is strengthened by the fact that the original S.M.L.s did not give step-by-step instructions.

The S.M.L., itself, posed another problem, however—should we completely rewrite the general instructions or should we simply reprint the S.M.L. text, changing only that referring to the slightly modified sections of the model? In the end we decided on the latter course, not, as you may think, because it appeared easier, but so that we could feature, as close as possible, Super Model Leaflet No. 35 in the Meccano Magazine for the historical interest of our readers. The following, including the out-of-sequence numbering, is the result:

Level-Luffing Automatic Grabbing Crane

In the ordinary type of crane a considerable amount of power is necessary to raise the jib on account of its weight and the effect of the load. How the load affects the operation may be easily demonstrated by means of a Meccano crane. If the jib is luffed in and out with the hoisting barrel 'braked', the load will be found to rise and fall also, so that power has to be expended in this direction as well as in lifting the dead-weight of the jib. In practice this means an increase in running costs, especially in the case of cranes engaged in the handling of ships' cargoes, etc., where it is necessary to luff the jib almost continuously.

In order to eliminate some of this waste of power, many cranes are fitted with balanced jibs and level-luffing gears. The balanced jib gets over the difficulty of the dead-weight of the jib, and the level-luffing gear counteracts the effect of the load by making the crane hook maintain always the same height above the ground whilst the jib is being luffed. Hence the luffing motor only has to overcome friction, so that the motor can be of much lower power than is necessary with the ordinary non-compensated crane. Also it will be readily appreciated that the driver can handle a load with a much clearer conception of its path when it follows a horizontal course instead of a constantly varying one.

One of the simplest and most efficient balanced-jib level-luffing systems and one, therefore, that goes a long way to reducing running and maintenance costs, is the 'Toplis' gear, which is the type reproduced in the Meccano model. In order to make matters quite clear

to the reader we show in Fig. 12 a line drawing of the layout of the 'Toplis' gear. The hoisting rope passes up from the hoist barrel to a pulley in the superstructure head B. From here it passes round one of the pulleys at the jib head A, back round the remaining pulley at B, and lastly over the second pulley at A, and so down to the load.

Now point B is at such a distance above the jib pivot that when the jib head A rises through, say, 3 in., the distance AB decreases by 1 in. Owing to the fact, however, that there are three falls of the hoisting rope passing between A and B, the shortening of the distance AB by 1 in. means that the end of the rope to which the hook is attached is paid out 3 in. Hence the load remains level throughout the entire luffing range.

Another common feature of most cranes is that the jib is luffed by a rope or ropes that are wound upon a barrel; but in the case of the prototype of the Meccano model, the jib is luffed by means of a system of cranks and links, and this method of operation is reproduced accurately in the model. It holds several important advantages over the usual system. For example, limited switches and their attendant gear are rendered unnecessary, since it is obvious that with the crank-operated jib it is impossible to over-luff. Another advantage of equal importance is that the motion of the jib reaches a maximum speed round the middle of the luffing range where it can safely be used, and falls off rapidly to zero at either end. Luffing ropes have the great disadvantage that they require overhauling periodically, and there is always the possibility of breakage. With the crank-operated system these defects are eliminated.

The Meccano crank-operated level-luffing grabbing crane that forms the subject of this leaflet demonstrates in a truly remarkable manner the features of an actual crane of the type in question.

Construction of the Meccano Model

The construction of the model should be commenced by building the gantry. This is of massive construction, for it has to support a very heavy load. A glance at Figs. 2 and 3 will show that the four main supporting Girders 1 are each composed of a 1 1/2 in. Angle Girder and two 1 1/2 in. Strips, bolted together so as to give an 'L' Section to the Girder, which is one of the shapes best calculated to resist effectively the crushing or compressive stresses to which these members are subjected. The bottom of the Girders are attached near the ends of the Girders 2, in which the Road Wheel Axles are journalled. Each Girder 2 consists of two 1 1/2 in. Angle Girders bolted together to resemble in section the letter 'T'—a form that easily resists the stresses set up in this part of the structure. Corner Gussets are employed to strengthen the connections between the Girders 1 and 2.

It will be realised that the top cross Girders or 'beams', to which the 9/8 in. diameter Flanged Ring forming the lower portion of the

built-up roller race is bolted, are subjected to severe downward-acting bending stresses due to the weight of the crane proper. Consequently, each beam consists of a 9 1/2 in. Angle Girder to the downward flange of which is secured a Flat Girder of similar length. This construction, by strengthening the flanges, reduces the tendency of the lower edges of the Girders to tear asunder. The above-mentioned lower section of the roller race is built up from a 9/8 in. diameter Flanged Ring to which two 9 1/2 in. Strips are fixed at 90 degrees to each other. Four Single Bent Strips are attached to the vertical flange of the Flanged Ring, as shown.

Having reached this stage of the construction, it will be found that the gantry is still far from rigid in spite of the strength of its main members. In fact, if the base be held firmly, it is possible to push the top horizontally in nearly every direction. This defect is due to a lack of strength at the corners, and in order to obtain the required rigidity it is necessary to add to the structure diagonal corner 'ties'. The various ties in the model take the form of Strips. As in the actual crane, the forces at work are always pulling on the ends of the ties in the model, and each tie is pulling against its neighbour, or an opposing external force, so that it may be said that a continual tug-of-war is taking place, in which neither side gains the advantage, unless a bolt pulls out or a tie breaks!

The Idler Travelling Wheels are secured to Rods that are journalled in the slots of the Girders 2 so that they are free to rise and fall therein, but the Driving Wheel Axles are journalled in Strips that are bolted over the slots of the Girders. In this manner the whole weight of the model is thrown on to the Driving Wheels, so ensuring proper adhesion of the Wheels on the rails.

The arrangement of the drive to the Travelling Wheels is identical on each side of the gantry, and the construction is as follows. A Rod 7 carries on its end a 7/8 in. Bevel, which is in mesh with a similar Gear on a 1 in. Rod that is journalled in 2 1/2 in. Strips 3 and in a Coupling 5 on the Rod 7. The Coupling is, of course, quite free on the Rod, and the 2 1/2 in. Strips 3 (which are trebled for strength) are bolted across a 9 1/2 in. Flat Girder 10. The latter is attached to 4 1/2 in. Angle Girders that are secured to the top flanges of the Girders 2.

The other end of the 1 in. Rod is fitted with a Universal Coupling 4, and this is connected by an 8 in. Rod 6 to a further Universal Coupling. The latter, in turn, is secured to a Rod that is journalled in a 2 1/2 in. by 1 in. Double Angle Strip and in one of the 9 1/2 in. Strips bolted to the Flanged Ring and carries a 1/2 in. Pinion above the Double Angle Strip. The Double Angle Strip, itself, is attached to the same 9 1/2 in. Strip by Trunnions. The Pinion is in constant mesh with a second Pinion which is secured to a Rod 9 (Fig. 4) that will pass completely through both the upper and lower portions of the roller race when the model is assembled. It will be seen that by rotating the Rod 9, the Rods 7 are both driven

at the same speed via the train of three $\frac{1}{2}$ in. Pinions, the universally-jointed Rods 6 and the $\frac{7}{8}$ in. Bevels. The drive is transmitted finally to the wheels by Sprocket Chain, which passes over $\frac{3}{4}$ in. and 1 in. Sprocket Wheels secured on the Rods 7 and the Wheel Axles. Before laying the gantry aside and continuing with the construction of the model, it is important to see that the transmission works as freely as possible. Bearings and gears should be oiled lightly, and small adjustments made if necessary with this end in view.

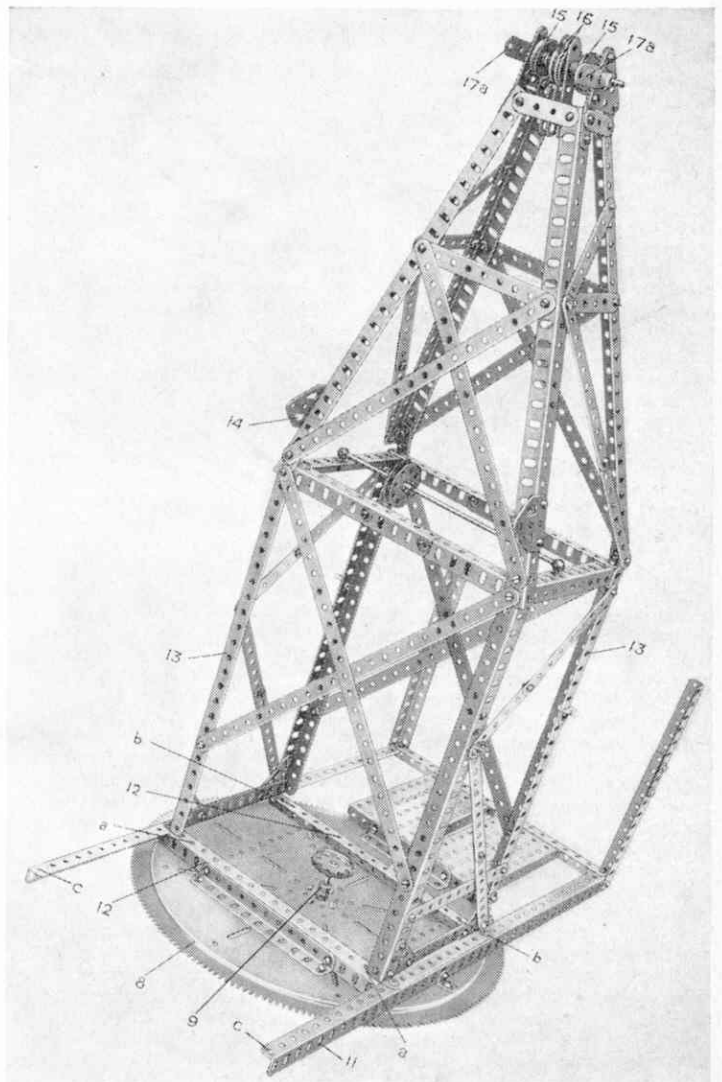
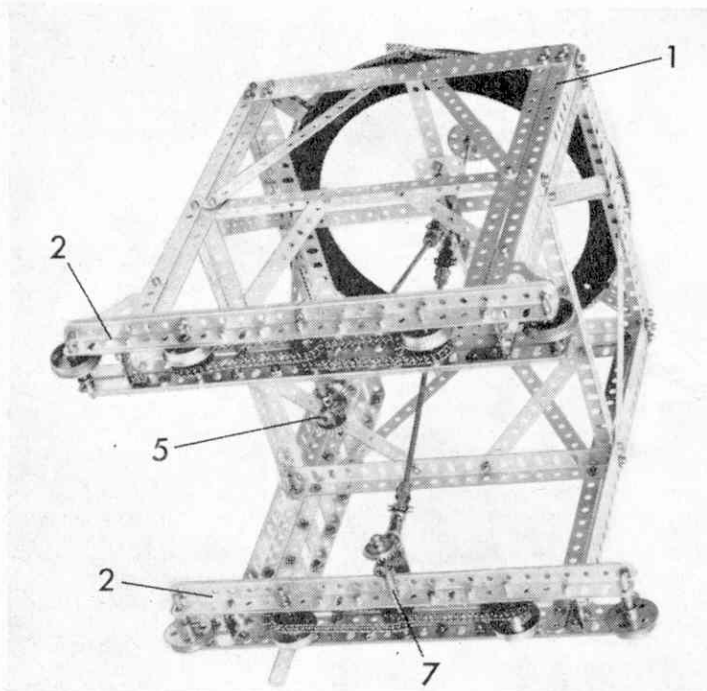
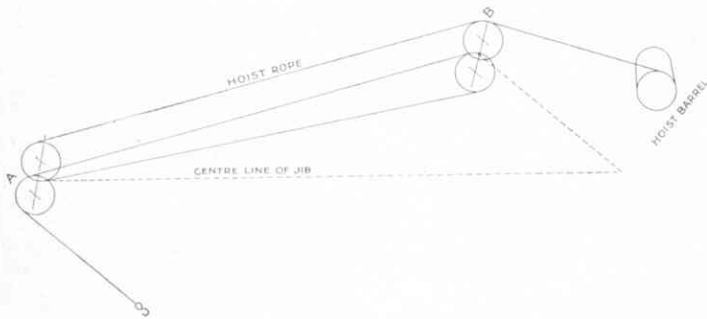
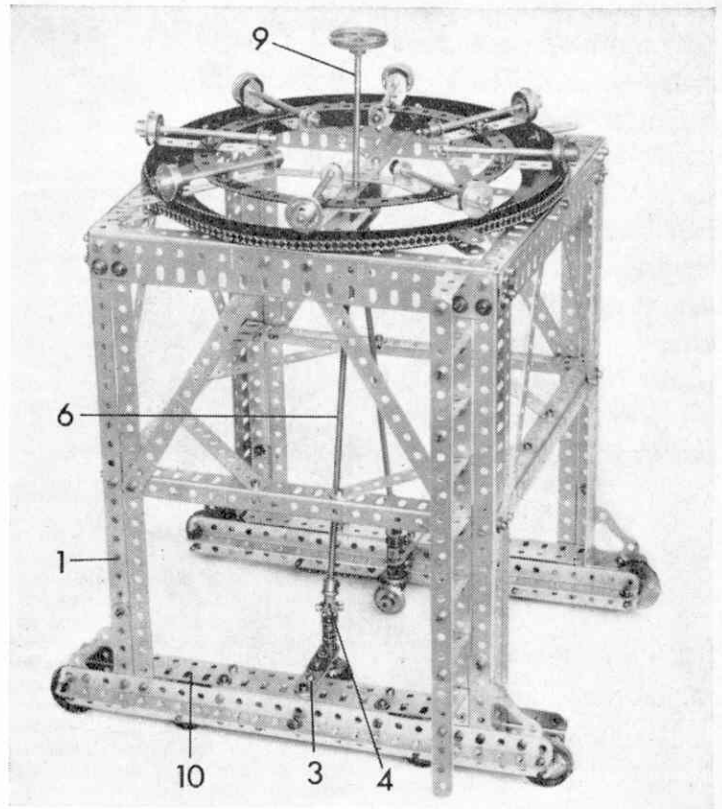
The Swivelling Superstructure

As will be seen from Fig. 4, the swivelling superstructure is built upon the upper portion of the roller race. (The accompanying illustration is one of the original photographs and shows the superstructure built onto the Toothed Disc of pre-war Part No. 167 Roller Race. In today's model this part is replaced by a second $9\frac{3}{8}$ in. diameter Flanged Ring attached to Angle Girders 11 by $1\frac{1}{2}$ in. Angle Girders. These are bolted to Angle Girders 11 on the inside and are then secured by one Nut and Bolt to the Flanged Ring. The two $5\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Flanged Plates shown in the illustration still remain and are fixed to the Flanged Ring by a $3\frac{1}{2}$ in. Angle Girder, the securing Bolt also holding one end of a $9\frac{1}{2}$ in. Strip to the Flanged

Ring. At its other end, this Strip is bolted to the Flanged Ring in the diametrically opposite position.) The vertical $12\frac{1}{2}$ in. Girders 13 comprising side members of the tower are attached to $5\frac{1}{2}$ in. Angle Girders on the side Girders 11, and the points of attachment are strengthened by means of Corner Brackets.

The Pulleys 15 and 16 and the $1\frac{1}{2}$ in. Strips 17a are mounted loosely on a Rod that is journalled in Corner Brackets at the top of the tower, to which they are attached by $2\frac{1}{2}$ in. Strips and Fishplates. The Pulleys 15 are 1 in. fast Pulleys, which are spaced from the centre pair (1 in. loose Pulleys) by Collars and Washers, and guards, to keep the hoisting cord in the grooves of the Pulleys 16, are formed from $2\frac{1}{2}$ in. Strips. Suitable bracing is added to the tower as indicated in the illustration. The construction of the gear cabin should be fairly clear from the general view, with the exception of the roof, which is composed of three $5\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Flanged Plates and one $5\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Flat Plate. The rear portion of the cabin is left uncovered in order to show the internal construction more clearly, but if desired $9\frac{1}{2}$ in. by $2\frac{1}{2}$ in. and $12\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Strip Plates can be used for filling-in purposes. At certain points these Plates should be made easily detachable.

Next month: The Construction of the Jib, Gearbox and Grab.



A super model rebuilt part 2

The Construction of the Jib

The main constructional features of the jib may be seen fairly clearly by a careful study of Fig. 2. The two lower longitudinal side members each consist of one 24½ in. and one 12½ in. Angle Girder overlapped ten holes, whilst each of the upper longitudinal members is composed of one 24½ in. and one 7½ in. Angle Girder overlapped four holes. The bottom end of the jib is extended at an angle to the main portion by 12½ in. Angle Girders, the ends of which are connected together by 4½ in. by 2½ in. Flat Plates. Where the 24½ in. and 12½ in. Angle Girders, join at X and Y (Fig. 1), Fishplates are used to connect them together.

The upper extremity of the jib is extended by 7½ in. Angle Girders that are bolted to the end holes of the side members, and a 7½ in. Strip is placed over the slotted holes of each Girder in order to give a neat appearance. Bracing should now be added to the sides as shown, care being taken to ensure that the various Strips are disposed exactly as indicated in the illustration.

The completed sides are now joined together. This is effected at the bottom end by Girders, each of which is 10 in. long (one 5½ in. and one 7½ in. Angle Girder overlapped six holes), and is bolted to the top and bottom sides of the jib, 2 in. in front of the Jib Pivot Pin 14a.

The extremities of the two upper longitudinal members of the jib are connected by a 3½ in. Angle Girder and those of the lower members are joined by a 3 in. Angle Girder. Having in this manner determined the taper of the jib, it is a simple matter to bolt into place intermediate cross-members of the correct length and then to add the bracing. The latter is triangulated, which makes the jib very strong, and yet permits of light construction.

The jib head has two distinct sets of Pulleys. One set is at the extreme end of the jib and consists of a 1½ in. Pulley secured to a Rod that has a 1 in. fast Pulley mounted loosely on each extremity. The other set comprises three pairs of Pulleys on a common Rod. The centre pair comprises two 1 in. loose Pulleys, on each side of which are placed Flat Trunnions to act as guards for the hoisting rope, and each of the two remaining sets consists of a 1 in. fast and a 1 in. loose Pulley. The respective groups are spaced on the Rod by Collars and Washers, and the bosses of the fast Pulleys serve to keep the Pulleys away from the supporting frame, so that they all may run freely.

Construction of the Gear-box

The Gearbox (Figs. 5 and 6) enables the four movements of hoisting, slewing, travelling and luffing to be driven from the 6 volt Meccano Electric Motor (a Power

Drive Unit is fitted in today's model) merely by the operation of two levers. A point worthy of note is the fact that it forms a self-contained unit that is readily fitted into the model.

The 5½ in. Angle Girders 18, 18a, are butt-jointed together so that their vertical flanges point in opposite directions, the left-hand pair being bolted to a 5½ in. by 2½ in. Flanged Plate, whilst the right-hand pair are connected together by means of a 2 in. Strip. The Girders 18a also are secured at right-angles to, and two holes from each end of a 9½ in. Angle Girder that will eventually be secured to the ends of the Girders 11 (see Fig. 4). Cross Girders 40, each 7½ in. long, are bolted across the Girders 18, 18a to carry the Centre Plate 19 and the right-hand plate of the gearbox, and a 5½ in. Angle Girder 20. The Centre Plate 19 is a 5½ in. by 2½ in. Flat Plate and it is secured to the Cross Girders by a 5½ in. Angle Girder.

Having now completed the constructional part of the gearbox, we now turn our attention to the gearing. The Mainshaft 21, which is driven by the Motor, has secured to it a 1½ in. Contrate driven by a ½ in. Pinion on the Motor Shaft. On each side of the Mainshaft are two sliding Layshafts 22 and 23, each of which carries a ¾ in. Pinion and a 57-teeth Gear, the latter being in constant mesh with the ½ in. wide Pinion on the Mainshaft.

The Layshaft 22 is moved in its bearings by the Crank 36, which is secured on an 8 in. Rod that carries the Lever 37. The Layshaft 23 is actuated in a similar manner by the Lever 39 through the medium of the Crank 38. Both Cranks carry bolts, the shanks of which locate between Collars spaced a short distance apart on the Rods.

By sliding the Layshaft 23 to the right the ¾ in. Pinion is brought into engagement with a 50-teeth Gear 26. This Gear is secured to a Rod carrying a ¾ in. Contrate that is in mesh with a Pinion on a Rod 41. The latter is journaled in a Flat Trunnion that is bolted to the front top edge of the Gearbox and also in one of the 5½ in. by 3½ in. Flat Plates forming the front of the cabin. It has secured to it a ¼ in. Bevel, and this meshes with a 1½ in. Bevel on a short vertical Rod on the lower extremity of which is fixed a 1 in. Sprocket Wheel 35.

A reinforced bearing is provided for the Rod carrying the Bevel and the 1 in. Sprocket Wheel 35 by bolting a 7½ in. Girder across the Girders 18a beneath the floor plates. The Rod also passes through the end hole of a Strip that is bolted to the upper portion of the roller race.

On moving the Layshaft 23 to the left the ¾ in. Pinion is brought into mesh with a 50-teeth Gear 27 on the Hoisting Barrel Shaft. The Hoisting Barrel 31 consists of a Sleeve Piece, one end of which is

passed over a ¼ in. fast Pulley secured against the face of the 50-teeth Gear, and it is held firmly in place by means of a ¼ in. Flanged Wheel that is pushed on to its other end.

The Hoisting Barrel is fitted with an automatic servo brake that allows the load to be hoisted with perfect freedom, but applies the brake when the barrel tends to unwind. An unequal-armed Crank, composed of a 2 in. Strip bolted to a Double Arm Crank, is fitted on the end of a Rod that is journaled in the Gearbox Sideplate and in the 5½ in. Angle Girder 20. The Rod may be operated by the Lever 33 that is secured to it by a Coupling; by raising the Lever the brake is released. A short length of Cord is passed round the Brake Drum 32 and its ends tied to the shanks of bolts on the extremities of the Crank. The automatic servo effect is accounted for by the fact that the points of attachment of the brake band to the Crank are at different distances from the fulcrum.

A 50-teeth Gear 25 is secured to a Rod that also carries a ½ in. Pinion. The latter will mesh eventually (when the Gearbox is mounted in place) with a 1½ in. Contrate on the upper end of the Rod 9 (see Fig. 4). In this manner the drive will be transmitted from the Gearbox to the wheels.

The last movement to be considered is that of luffing the jib. The two luffing cranks, each obtained from a Crank overlaid by a 2 in. Strip, are secured on the extremities of an 11½ in. Rod 29, which has fixed to it a ¾ in. Contrate that meshes with a ¼ in. Pinion 28 on a short vertical Rod. The latter has a further ¼ in. Pinion that meshes with a Worm on the Rod carrying the 50-teeth Gear 24. The Rod with the Pinion 28 is journaled at its bottom end in a Strip and at its upper end in a Corner Bracket that is attached to the Flanged Plate by a 1½ in. Angle Girder. One of the bolts that serve to secure the 1½ in. Angle Girder to the Plate is also passed through a 2½ in. Angle Girder, which is bolted vertically to the Plate for strengthening purposes.

Finally, the Power Drive Unit is secured to the 7½ in. Angle Girder 40 bolted between Girders 18a by ¾ in. Bolts and to the 5½ in. by 2½ in. Flat Plates 34, bolted in positions shown to form the floor of the Gearbox, by ordinary Bolts.

Final Assembly of the Model

We now come to the most interesting stage of the construction, that of fitting together the various units to form the complete model. The Gearbox unit should be first fixed into position on the Girders 11 and 12 between the Girders 13, securing it at points a, b and c, shown in Fig. 4. It will be necessary to remove the Rod temporarily before sliding the Gearbox into place, with the control levers to the front.

A 'spider' for the roller race is now obtained from a 7½ in. Circular Strip, to which eight 2½ in. by ½ in. Double Angle Strips are bolted at 45 degrees to each other. Journaled in the lugs of each Double Angle Strip is a 3½ in. Rod, carrying a Collar on its inside end and a ¼ in. Flanged Wheel on its outside end. The 'spider' is placed on the lower Flanged Ring of the roller race, then the superstructure is lowered on to it so that the upper Flanged Ring of the roller race coincides with the Flanged Wheels of the 'spider'. The 5 in. Rod passes freely through the 9½ in. Strips bolted to the Flanged rings and also through a 1 in. Corner Bracket 42 attached to a 5½ in. Angle Girder that is bolted to a 5½ in. by 2½ in. Flat Plate in the centre of the Gearbox. Mounted on the upper end of the Rod is a 1½ in. Contrate Wheel that meshes with the ½ in. Pinion on the shaft carrying the Gear 25. The upper Race should bed down quite evenly on the ¼ in. Flanged Wheels and the complete superstructure should turn at a touch.

The jib is mounted pivotally on the front of the tower by passing the 11½ in. Rod 14a through the Flat Trunnions 14 and through the bosses of Cranks that are secured to the side of the jib. It is now necessary to add weights at Z in the shape of pieces of scrap lead melted into blocks of the required shape, or large quantities of Meccano parts, until the jib is accurately balanced. The connecting Strips 30a may then be attached pivotally by lock-nutted bolts to the luffing cranks 30, while a 12½ in. Strip 43 is bolted to the top of the Angle Girders 44 in the third hole from the end.

The hoisting cord is attached to the hoisting barrel 31, and is led over one of the pulleys 16 at the superstructure head, passing through a guide pulley on its way. The guide pulley consists of a 1 in. loose Pulley running between two Bush Wheels mounted on an 8 in. Rod that is secured by Handrail Supports to the tower. From Pulley 16, the cord passes over one of the centre pair of Pulleys at the jib head, back over the remaining Pulley 16 and then to the other centre Pulley on the jib head, after which it runs over the 1½ in. Pulley at the extremity of the jib and so down to the load hook or grab, to which it is secured.

The Single Suspension Grab

Although the model may be used as an ordinary crane by fastening a Loaded Hook to the end of the hoisting cord, its interest is vastly increased by the addition of a grab.

The grab employed on the model is known as the single suspension type, and is opened and closed merely by manipulation of the hauling rope, instead of depending for its operation, as is quite usual, upon two distinct falls of rope wound on separate barrels.

Fig. 7 is a general view of the

single suspension grab, whilst Fig. 8 shows the grab head partly dismantled. From the latter view it will be seen that the mechanism of the grab is ingenious yet, at the same time, remarkably simple. The construction of the jaws themselves should not present any particular difficulty since they are fairly apparent from the illustration. The apices of the Triangular Plates forming the sides of the jaws are attached pivotally by lock-nutted bolts to 1 in. Triangular Plates that are locked rigidly to each end of a 2½ in. by ½ in. Double Angle Strip 1, and four connecting links (4½ in. Strips) are attached pivotally to the outer ends of the jaws by lock-nutted bolts. The Double Angle Strip 1 is weighted by the addition of a number of 2 in. Strips or a 50-gramme weight, to make the jaws open.

The side plates 2 (Fig. 8) carrying the operating mechanism are 3 in. Flat Girders, which are connected together by 1 in. by ½ in. and ½ in. by ½ in. Angle Brackets 3, 3a. On the side plate shown detached are fixed two 1 in. Triangular Plates that carry 1 in. by ½ in. Angle Brackets 4 and 5, and to the Bracket 5 is secured a Double Bracket, with two Flat Brackets 6 bolted to it. Two Washers are placed between each Flat Bracket and the Double Bracket for spacing purposes.

The hooks 7 are composed of 2½ in. Strips bent to the shape shown in the illustrations and attached by means of ½ in. Bolts to 57-teeth Gears. The ends of the Strips are each fitted with a Pawl and a Flat Bracket. The catch 9 is composed of a Centre Fork shortened by ½ in., held in the end bore of a Coupling, which also carries a Handrail Support 10 and a balance weight 11 consisting of a 1 in. Rod to the end of which is secured a Collar. The Gears are arranged to mesh with each other so that the Hooks 7 lie at the same angle to the perpendicular, and the Rods on which they are secured should be perfectly free to turn in the side plates 2.

The Handrail Support 10 of the catch is mounted freely on the spindle of the right-hand Gear, and a ½ in. Bolt 8 is secured by double nuts to the Gear in the third hole from that in which the 2½ in. Strips are secured. Each hook is kept in the normal position by a piece of Spring Cord 12, one end of which is attached to the side plate and the other to a set-screw inserted in the boss of the 57-teeth Gear. Each piece of Spring Cord should be partially carried round the boss of the 57-teeth Gear before it is attached, so that its effort to come back to its normal state, and not its actual tension, is utilised to return the hooks. If it were used in the normal way, the tension would be too great for the purpose in view.

The connecting links between the grab proper and the grab head are attached by lock-nutted bolts to the 1 in. Triangular Plates, and the hoisting cord 16 is secured to the cross member 1. The cord is then threaded through the round holes in the lower guide 4 and a large knot made in it in such a position that when the jaws are open the knot rests on top of the guide. The cord is then passed through the

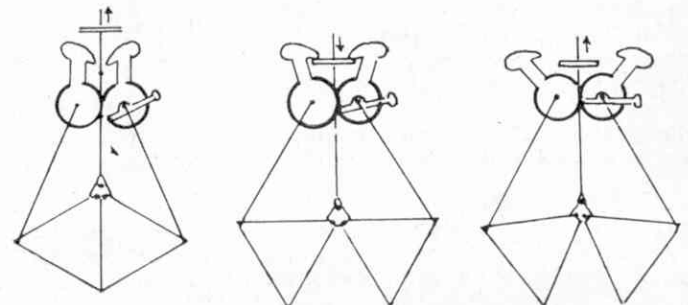
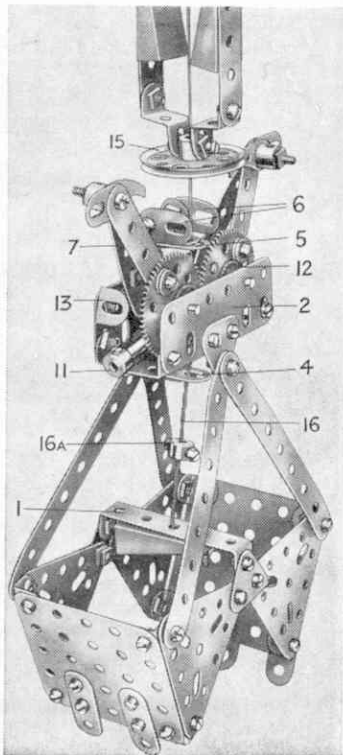
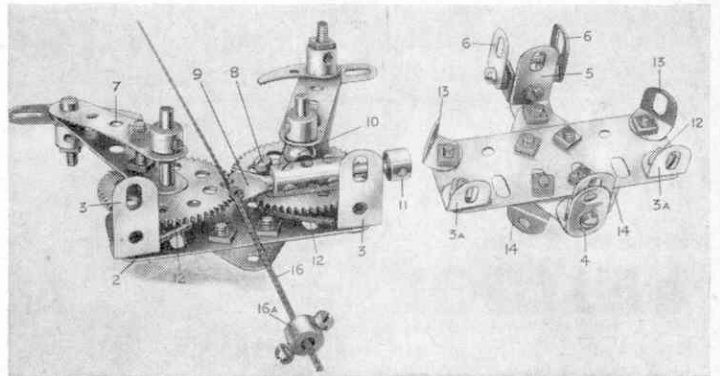
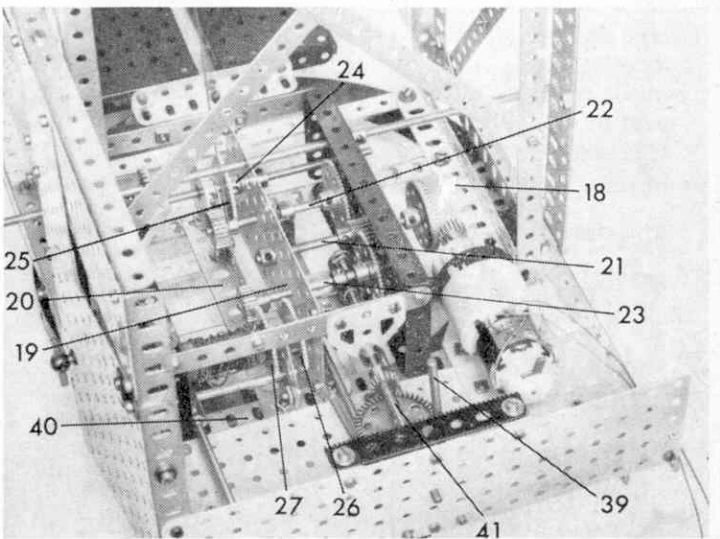
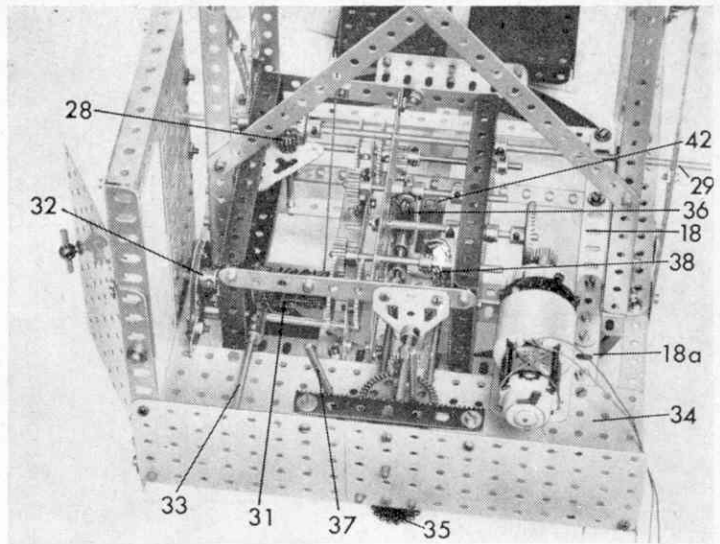
upper guide 5 and through the 1½ in. Pulley 15, which is termed the 'suspender ring'. This consists essentially of a 1½ in. Pulley that is hung by two cords 17 from the jib head. These cords are each passed over the Pulleys 15 on the tower (Fig. 4) and over the outside pairs on the jib in exactly the same manner as that followed with regard to the hoisting cord, but the ends of the cords are attached to 1½ in. Strips 17a at the top of the tower, and are not let down to a winch. A winch may be added if it is desired to effect discharge at different levels, otherwise it is only necessary to adjust the suspender to the most convenient height and then secure the ends of the cords to the Strips 17a. The object of the pulley system is to maintain the suspender in one horizontal position through all luffing angles in accordance with the Toplis principle.

The diagrammatic illustrations (Figs. 9-11) should help to make clear the operation of the grab. The grab should be assumed to be approaching the suspender with jaws closed (Fig. 9). In this position the hooks 7 are resting against the stops 6, the catch 9 is not touching the cord, and the knot is above the catch. The Pawls on the ends of the hooks are now forced over the rim of the suspender, thus allowing the catch to rise and bear against the hoisting rope.

Now if the latter is lowered, the weight of the grab is borne by the hooks and the jaws open. As the grab opens to its fullest extent the knot in the hoisting cord passes to the underside of the catch 9 (Fig. 10).

To release the grab from the suspender, the hoisting rope is hauled in a little, thus causing the knot to bear against the underside of the catch. The latter bears, in turn, against the ½ in. Bolt 8 and the arms of the hooks fall back on the stops

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Diagrams illustrating the operations of the grab