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ABC

FRONT COVER

We don't know who the lovely young lady is, but the models are radio-controlled (or sand) yachts from George Siposs in California.

NEXT MONTH

The R.A.F. Museum, windmills, and a study of pollution are three interesting articles scheduled for our next issue.

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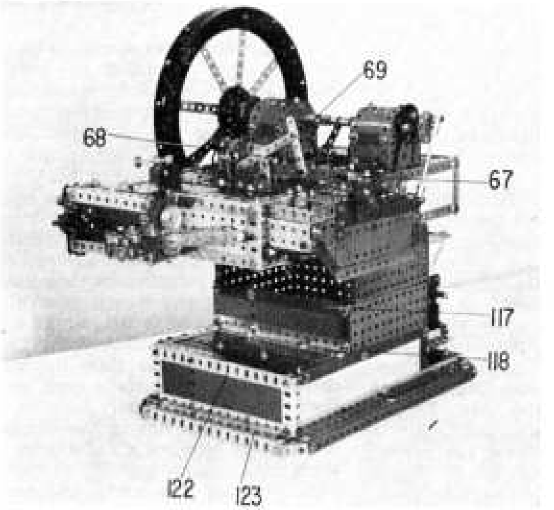


A "Riveting Situation"

—leading up to a Meccano model of an automatic rivet-making machine

Part 1

By P. Blythe

DINKY Toy "Spitfire" wheels, bicycle mudguards, television sets and ladies' handbags may at first sight appear to have little in common. There is a linking factor, however, this being the need for enormous quantities of the products to be manufactured, economically. It is therefore absolutely essential that the components which make up the various products can be put together easily and cheaply and that they do not fall to pieces in use. This is where modern riveting scores over most other fastening systems.

The term "rivet" normally conjures up the vision of a large threadless bolt which is placed by hand into a pre-drilled hole and hammered over to secure the joint. While rivets of this type were used extensively by blacksmiths many years ago, modern automatic riveting bears very little resemblance to such ponderous techniques.

The majority of riveted joints on domestic, electrical and automotive applications require rivets between $\frac{1}{32}$ in. and $\frac{1}{4}$ in. in diameter which are churned out by the million in two basic types—tubular and bifurcated, each having their own particular fields of use.

It is in the riveting of football boot soles, handbags, cardboard and plywood boxes that one normally finds the bifurcated type of rivet which, as its name implies, has a split or slotted shank. These fasteners do not require pre-drilled holes to be provided and are capable of being driven into thin sheet metal and plywood to give an almost indestructible fixing (try taking to pieces a riveted tea chest!). Bifurcated rivets may also be seen reinforcing the pockets of overalls and fixing the metal buttons in place. When a very neat finish is desired on the reverse side of a joint secured by a bifurcated rivet, the turned-back prongs may not be sufficiently smooth. Close inspection of a shopping bag or a dog lead will reveal a small shiny cap into which the rivet is automatically driven during the riveting operation.

So much for bifurcated rivets, but what do we use for securing the pivoting joints of tubular garden furniture and car windscreen wipers? Both of these applications require a very neat and smooth finish with the head and clinch (turned-over end) being similar in size and appearance. The requirement in this case is for a rivet which can be inserted into the work and given a single blow to form the turn-over without any buckling of the shank. In addition to this, for certain applications the joint must pivot with a specified tightness. This rather demanding requirement is very adequately filled by a specially-developed tubular rivet introduced a few years ago and now produced in extremely large quantities.

Further problems are presented when riveting fragile or brittle plastic components of the type commonly employed in the electrical industry. Metal terminals or even additional mouldings are often secured to such components. Joints of this type are further complicated by the material thickness varying greatly from one assembly to the next, while the manufacturers insist upon a tight fixing under all conditions without the bits and pieces becoming broken in the process. Again, continuous research has resulted in a rivet for the job which is a further version of a tubular rivet having a thin tapered wall at the hollow end, to allow the clinch to be formed without undue pressure while remaining sufficiently strong to provide a really secure fixing.

With the increasingly varied and specialised requirements of modern industry the "family" of rivets is being constantly enlarged and now includes shouldered rivets which serve as pivots—have a close look at

Heading, a detailed Riveting Machine built in Meccano by the author. Although it does not actually rivet, it reproduces all the movements of a full-size machine—even down to the realistic clatter!

Left, examples of the many different types of modern rivet, each one designed for its own particular job.

the handle of a one gallon paint can—and electrical terminal pins, the most common application of these being in the channel tuners and printed circuit boards of T.V. sets.

So much for the various types of rivets, but how on earth does one insert a rivet into a pile of components—certain of which have to be correctly positioned—and then form the rivet clinch? The answer here lies in the latest developments of automatic-feed riveting equipment. These machines are usually electrically operated and have a hopper into which the rivets are poured. When the driving motor is switched on, the rivets are sorted to the correct attitude to slide down a track, along which they then travel, finally coming to rest in a pair of spring-loaded jaws which place the rivets one at a time into the stack of components.

The problem of aligning the holes in the parts during assembly is overcome by the use of a device called a "spring centre anvil". The anvil—which forms the clinch of the rivet—has a spring-loaded pilot pin which protrudes sufficiently far to enable the components to be loaded on the pin which then passes through the holes. When the machine foot pedal is depressed by the operator, the rivet is driven through the spring-loaded jaws by a top punch, the hollow shank end of the rivet being located by the domed tip of the anvil pin to guide it down into the pile of components. When the pin is in its fully-down position, the profiled tip forms the clinch of the rivet. This sequence of events takes 1/5th of a second so it will be seen that, with the up-to-date equipment and rivets now available, the system of fastening is well able to cope with modern requirements.

We have discussed briefly the various types of rivets and means for inserting them but what is the best way to go about manufacturing around 100 million rivets in one week—the output of some of the larger producers? A visit to a modern rivet factory is quite a memorable experience due mainly to the terrific noise emitted from the rows of "heading machines" as they are called, munching their way through coils of wire rather like diners eating spaghetti!

There is no better system than Meccano for making your own model heading machine which will faithfully reproduce all the movements of the real thing and with the multiplicity of different movements the completed header is fascinating to watch. The model is not difficult to make and a very large stock of parts is not necessary. Before we plunge into the building details, however, a short description of the construction and operating sequence of the real machine is necessary.

Basically, the original version of the "heading" machine consists of a rectangular frame approximately the size of a small wardrobe laid on its back. This frame is supported on a cast iron stand to provide a conventional working height. Within the frame slides the ram, moving horizontally, this ram being driven by a substantial crankshaft mounted across the frame and running in journals provided towards the rear of the machine. The crank pin carries a connecting rod which, via a toggle linkage, propels the ram back and forth. The linkage is so arranged that the ram makes two strokes per crankshaft rev.

At the front of the ram is superimposed the tool slide which moves up and down, this being driven by a separate mechanism. The tool slide carries two press tools, one mounted above the other. As the rivet is formed in two blows, the sequence of events is that the ram moves forward with the tool slide "down" to partially form the rivet head. The ram then moves back when the tool slide is lifted up ready for the second forward stroke to complete the rivet.

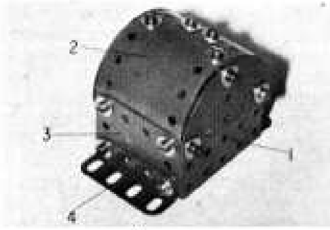
Cams and eccentrics mounted on the outboard ends of the crankshaft drive the ancillary mechanisms while a large flywheel on the left-hand end keeps everything working smoothly. Two cams are fitted to the flywheel side, one for operating the punch mechanism to produce hollow rivets, while the other cam is employed to actuate a "knock-off" linkage which ejects the completed rivet into the catchment tray. Finally, on the left-hand side is an eccentric to operate the wire feed mechanism.

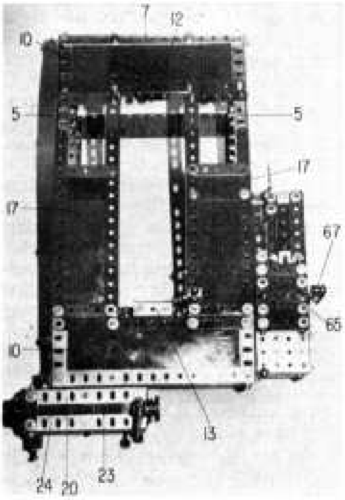
On the right-hand end of the crankshaft is located a cam for the toolslide lift mechanism, while a crank mounted on the extreme end operates the cut-off device, i.e. a mechanism which slices off the slugs of wire from which the rivets are produced. As mentioned above, the crankshaft is mounted towards the rear of the machine, so that long connecting rods extend towards the front to impart the cam and eccentric movements to the various mechanisms which are situated round the actual forging area.

The rivets themselves are made from coils of wire which are mounted horizontally upon a reel standing in front of the forging machine. When the machine is operating, the end of the wire passes through straightening rollers and enters a cut-off die, the end projecting sufficiently far to make a rivet of the chosen length—plus a bit extra for the rivet head. The slug of wire is then cut off by a cutter slide, mounted on the right hand side of the machine. This cutter carries a little piece of wire across to the main die where it is pushed in by one of the two press tools moving backwards and forwards on the front of the ram. When the ram advances on its first forward stroke, the vertically sliding toolbox is in its "down" position. The slug of wire is given a smart clout to partially form the rivet head. Now, the ram moves back, the toolbox is raised to its "top" position and the ram is driven forward once more on its final stroke to fully form the rivet head. At this instant, a cam on the left hand (flywheel side) operates a rocker, pushrod, second rocker and punch pin to produce a hole in the rivet shank.

Finally, as the ram moves back, the above-mentioned cam advances the punch pin further to eject the finished rivet from the die, where it is knocked off the punch by an extractor mechanism, again cam-operated from the left-hand side of the crankshaft. The wire feed is provided by an eccentric mounted also on the left-hand side of the crankshaft which operates a simple pawl and ratchet arrangement. There are two feed roller shafts, these being geared together and, incidentally, accounting for the only gears in the machine.

Riveting radiator-grille components on a B & TR Co. automatic-feed rivet-setting machine at the British Leyland (Austin Morris) factory at Cowley, Oxford.





Left, one of the two identical crankshaft bearing housings as it appears removed from the machine.

Below, a top view of the main body section without the crankshaft and internal mechanisms.

Model Construction

Turning now to the Meccano model, as already mentioned this is not unusually difficult to assemble although care should of course be taken to ensure framework rigidity and the smooth-running of moving parts. Construction begins with the two crankshaft bearing housings, both of which are identical in construction and may be built up as separate units for subsequent attachment to the machine frame.

Each side plate is made up of a Semi-circular Plate bolted to a 2½ × 1½ in. Flanged Plate 1. The pairs of side plates are joined by 2 in. Strips and a built-up flexible plate 2 comprising two 5½ × 1½ in. Flexible Plates overlapped two holes at their long edges and extended a further three holes each way by two 2½ × 1½ in. Flexible Plates 3. Angle Brackets join the Semi-circular Plates to the Flexible Plates, while mounting flanges are provided by 2 in. Angle Girders 4 bolted as shown.

Body Assembly

In the case of the body, four 12½ in. Angle Girders 5 provide the main side members, these being extended a further three holes forwards by four 5½ in. Angle Girders. The left-hand side panel is filled in by a 12½ × 2½ in. Strip Plate 6 and a 2½ × 2½ in. Flexible Plate, while a 9½ × 2½ in. Strip Plate and a 5½ × 2½ in. Flat Plate are used on the right-hand side. Both side panels are joined front and rear by four 7½ in. Angle Girders 7 while the rear corners and the front right-hand corner only are capped by vertical 2½ in. Angle Girders 8. The back of the body is enclosed by 5½ × 2½ in. and 2½ × 2½ in. Flexible Plates 9, similar Flexible Plates 10 being used to cover the front and rear of the top surface of the body. Plates 10 are fitted beneath the flanges of the frame members.

Two further 7½ in. Angle Girders are bolted across the inside of the body to reinforce the edges of the above-mentioned Flexible Plates, but note that, before fixing these Girders in place, each one has attached to its slotted flange two Flat Trunnions 11 (leave one free hole at each end.) These Trunnions eventually carry the two fore and aft rods on which the ram slides. The rear 7½ in. Girder also carries on its slotted flange a 1½ in. Angle Girder 12, fixed centrally. The forward-facing slotted flange of this short Girder carries at each end, a Hinge.

At the centre of the front 7½ in. Girder is fixed the die block, represented by a Channel Bearing 13 with its sides enclosed by a pair of 1 × ½ in. Angle Brackets. The portion of the Channel Bearing protruding below the Girder has bolted to it the 5-hole side of a Corner Gusset—one hole projecting each end. The downward-facing 4-hole side is on the left and carries a rearward-facing Double Bent Strip 14, the bottom Bolt also retaining an Angle Bracket, its free lug facing towards the front of the machine.

Now the two 7½ in. Girders may be bolted inside the frame, both with their round hole flanges facing the front of the machine. 7½ in. Strips overlay the edges of the Flexible Plates for neatness. The Angle Bracket on the bottom of the Corner Gusset is connected to the main frame by a 2½ in. Strip.

Using its round hole, an Angle Bracket is next bolted through one end hole of each of a pair of 9½ in. Angle Girders 15, a 1½ in. Corner Bracket 16 also being bolted—adjacent to the Angle Bracket—to the right-hand Girder. These Girders, round hole flanges vertical, are now fixed longitudinally within the frame to provide the edges of the ram slideway. Their rear ends are bolted direct to the 7½ in. cross-member Girder, while the front ends are attached by the slotted lugs of the two Angle Brackets to the other 7½ in. Angle Girder cross-member. When correctly adjusted by making full use of the slotted holes, the space between the 9½ in. Girder should be 2⅝ in., i.e. room for a 2½ in. Strip with $\frac{1}{16}$ in. clearance each side.

A pair of 5½ × 2½ in. Flexible Plates 17 are each extended one hole by two 2½ × 1½ in. Flexible Plates, these being bolted to partially fill in the space at each side of the ram slideway, the gap being at the rear. Suitable Strips overlay these Flexible Plates and 2½ in. Strips are fixed across each side panel as shown. The rear overlaying 2½ in. Strips serve also as a base upon which to bolt the front of the bearing housings. To support the rear of the housings two further 2½ in. Strips are bolted between Girders 15 and the 12½ in. main side-members.

Fixed to the side of the front left-hand corner of the body is a vertical 2½ in. Angle Girder, secured by its slotted holes. The remaining flange projects outwards and to it is bolted, centrally, a rearwards-facing Double Bent Strip 18.

This now almost completes the body assembly and the bearing housings may be secured by bolting the 2½ in. Perforated Strips to the slotted flanges of the 2 in. Angle Girders. Using an 11½ in. Rod, check that all four bearings are precisely in line. Packing Washers should be added as necessary to bring bearings into line.

At the right-hand side of the front of the body is secured a 4½ × 2½ in. Flat Plate 19 fitted inside the frame. Both top and bottom left-hand fixing Bolts also secure, by their round hole flanges, a pair of 4½ in. Angle Girders 20 attached so that their ends project a distance of two holes from the left-hand side of the frame. A vertical 2½ in. Strip 21 joins the end holes of these Girders, thus forming the beginning of the feed roller assembly.

Secured to the forward-facing slotted flanges of the two Girders, at the right-hand end, is a 2½ × 1½ in. Flanged Plate 22 and, at the opposite end, are two forward-facing 1½ in. Angle Girders. The space between these parts—at the top only—is filled in by a pair of 2½ × 1½ in. Flexible Plates 23, overlapped one hole. Note that the right-hand Bolt also secures an over-

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berg season extends from April to July.

The two American scientists say that in choosing a "test" area the first need is to locate a suitable supply of icebergs that are tabular, so that the dangers associated with rolling are avoided. An approximately circular or square iceberg is desirable, but, in the Arctic, sources of large, tabular icebergs are not common. In the Antarctic, where 80 per cent of the world's fresh water—as distinct from salt water—is contained in the ice-cap, the chief sources of tabular icebergs are the large ice shelves that fringe the continent. The most promising sites are the Ross Ice Shelf which would supply icebergs at locations suitable for transport to the arid areas along the west coast of South America, and the Amery Ice Shelf which would supply icebergs at locations accessible to Australia. Another possibility is the Filchner Ice Shelf which could supply bergs to the Namib Desert on the south-west coast of Africa.

The problem of the melting and deterioration of an iceberg as it passes through warm waters is important. Examining three transits, with minimum distances varying between about 3,240 and 4,680 miles, and by towing the icebergs at a realistic average speed of one knot, a period of between 120 to 160 days would be required. The significance of the melting problem is underlined when it is considered that surface water temperatures at the northern ends of the transits are in excess of 20 degrees C. (68 degrees F.) and that temperatures during more than half of the towing distances are in excess of 5 degrees C. (41 degrees F.). However, if it proves economically feasible to tow the larger icebergs there will still be large amounts of ice left when a berg reaches its destination. For example in the Amery–Australia traverse, if the operation starts with a "square" iceberg with lateral dimensions of 1,000 metres, and a thickness of 250 metres, it would end up with an iceberg of 760 × 760 × 130 metres in size, which is 30 per cent of the starting ice. For the Ross–Atecama transit under the same conditions the final block of ice would be 660 × 660 × 80 metres, which is 14 per cent of the starting size. Drs. Campbell and Weeks conclude, "Taking every factor into consideration, the in-transit melting, though significant, is not prohibitive".

As for power requirements, it is calculated that resistance of an iceberg being hauled through the water rises as the square of the velocity, and therefore it is of very considerable economic advantage to tow at the lowest practicable velocity. A single seven or eight thousand horse-power tug, moving an iceberg at about a half knot would have better chance of success than rows of tugs all churning away at once. Slow, steady progress along a suitable ocean current would seem to be the best mode of advance. Estimating the economic feasibility depends on costs of power required as well as the price the water will bring at its destination. One hypothetical calculation starts with lateral dimensions of 2,700 metres, and towing at a rate of about half a knot. Starting from the Antarctic the tug would arrive on the coast of north-western Australia with an iceberg 2,460 × 2,460 × 130 metres in size. This amounts to about 207,000,000,000 gallons of ice, which would be worth about 5.5 million dollars (say £2,300,000), which is one-tenth of the cost of the same quantity of desalinated sea water.

The cost of operating the tug for the twelve day trip to the Antarctic and the 250 day trip back would be slightly under one million dollars (about £420,000). On the other hand a similar iceberg towed from the Ross Shelf to the Atacama Desert would arrive as 101,000,000,000 gallons of ice, which would be worth 2.7 million dollars (around £1,150,000), and the cost of transportation for the 373 day round-trip would be 1.3 million dollars (approx. £500,000). The quality of the iceberg water would be excellent, since the icesheet from which bergs originate is essentially distilled water, and there would be very little intrusion of salt water into the ice during transit. An interesting aside on this is a story reported lately of how an enterprising American firm is exporting ice from the Labrador coast in two-pound bags to pollution conscious Americans. A similar venture is thriving in Greenland. Ice two thousand years old and guaranteed free from pollution has been successfully launched as an export. A report from the Royal Greenland Trade Department (1971) says that 100 tons has been sold on the continent of Europe and in Japan since it was introduced in 1970.

Although millions of tons of ice are ceaselessly breaking away from the polar ice caps these are just as constantly being replenished. Icebergs can be towed away for the production of fresh water, it seems, and ice can be exported to jaded city dwellers. But have the ice caps any other potential value? One of the properties of ice is that it can arrest natural decay almost indefinitely. Some years ago Russian scientists enjoyed (if that is the appropriate word) a banquet of mammoth steaks. They had been cut from carcases of some of these extinct hairy elephants that had been swallowed in the bogs of northern Siberia, had been subsequently refrigerated, and preserved for thousands of years. Professor F. Plummer, a South African scientist, suggested we ought to use the Antarctic as a refrigerator for the world's surplus food. If this had been done years ago, he argued, much could have been done to relieve shortages in the immediate post-war years in Europe and south-east Asia. When the Duke of Edinburgh visited the Antarctic he put forward a similar suggestion.

AMONG THE MODEL-BUILDERS

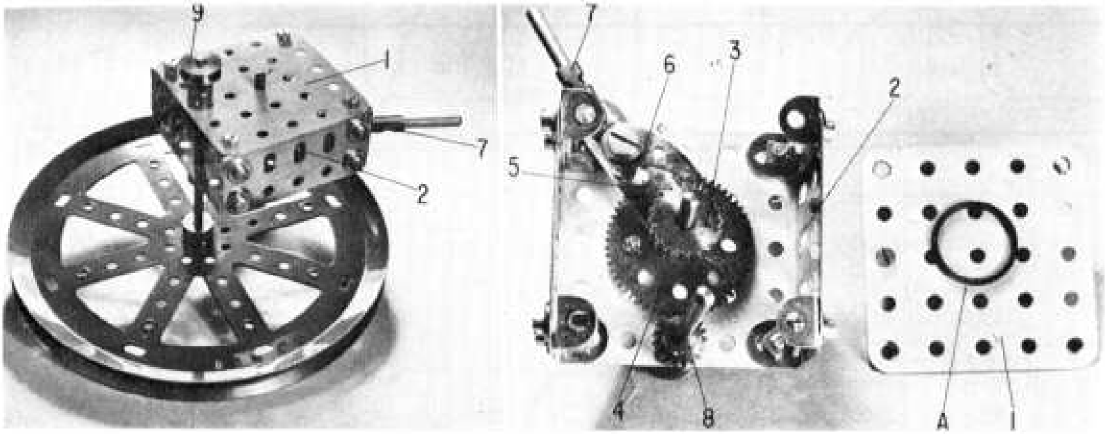
(continued from page 445)

should be secured by a $\frac{3}{4}$ in. Bolt, or one of the long $\frac{7}{32}$ in. Grub Screws.

This idea will of course work only when the unit is positioned as shown, with the framework of the model preventing the Sprocket and Collar 1 assembly from sliding out of engagement with Collar 3. If the requirements of the model prevent this, then Collars 1 and 3 should *both* be fixed on the Rod with small $\frac{5}{32}$ in. Grub Screws and the Sprocket secured to these in the same way as if a Coupling were used.

Our other Plastic/metal hint concerns the use of a Plastic Meccano Axle Rod within a metal Meccano model. There are occasions when a Plastic Axle could be used to advantage in a standard model—as a crane winding drum, for instance—but until now there has been no effective way of mounting it in position and certainly no way of fitting standard Pulleys or gears to it for driving purposes. Both these problems can be overcome, however, by using the method illustrated in the accompanying picture. The two plain Axles in the Plastic Meccano system are hollow and it will be found that the hollow bore fits a standard Meccano Rod very nicely. If a Rod is simply inserted in the bore, of course, the Plastic Axle will just revolve on the Rod and serve no useful purpose, but it can be rigidly secured by "screwing" a Cord Anchoring Spring 1 onto each end of the metal Rod 2 and as far as possible into the end of the Plastic Axle 3. This may be doubtful engineering practice, but it certainly works!

Full credit for both these valuable hints goes to Mr. Pat Lewis of Formby, Lancs, whom I would like to thank for continuing to pass on his ideas to me from time to time.



Several interesting uses can be found for this Ratchet Motor, designed by Alan Wright of Statham, Lymm, Cheshire. In the view on the right, one of the sideplates has been removed to show the internal gearing. Note that the Driving Band (A) has also been removed from the Pawl for the photograph.

Among the Model-Builders

with 'Spanner'

The Pleasure of Experimentation

If asked what he "gets" from his hobby, the average Meccano modeller will probably opt in his answer for the undeniable pleasure obtained during the building of his chosen model and the incomparable feeling of accomplishment when that model stands before him, finished and successfully operating.

This answer, of course, would be perfectly correct, but I venture to suggest that it would not be the whole story. As any experienced modeller will confirm, the Meccano hobby offers more than just straightforward model-building: it offers challenge, it offers absorbing relaxation, but, particularly interesting to my mind, it offers the pleasure of experimentation—tinkering about and following up sometimes vague ideas, rather than reproducing specific structures or movements from plans, pictures or prototypes. It is surprising how often giving free rein to the creative imagination in this way can result in some very interesting models and mechanisms.

From my association with Meccano over the years, I have developed a theory that such "tinkering", with no pre-conceived end product in mind, tends to result in a reversal of normal model-building habits, particularly when mechanisms are involved. Under normal circumstances, the modeller constructs a mechanism to perform a specific job, or in other words, he knows what the mechanism is intended to do when he starts to build it. It is my theory, however, that, when tinkering, he is quite likely to first build a mechanism and then have to find a suitable use to which his creation can be put—thus reversing normal procedure. Searching for a suitable use can be challenging and absorbing, and finding a use—or several uses—can be deeply satisfying.

Ratchet Motor

I suspect that our first constructional item here was the result of experimentation of this type. It comes from 14-year old Alan Wright of Statham, Lymm, Cheshire and is, in effect, a Ratchet Motor, although Alan himself did not give it a name, leaving it up to us to find something suitable. The operation principle is really quite simple, and yet remarkably effective. When a handle, controlling a ratchet mechanism, is pulled, it imparts movement to the Rod carrying the Ratchet Wheel. This movement is transferred through simple step-up gearing to a second Rod from which the output drive is taken, a flywheel also being mounted on this Rod to increase over-run.

The unit illustrated is copied from Alan's original plans and consists of a framework built up from two 2½ × 2½ in. Flat Plates 1 connected together by two 2½ in. Flat Girders 2, attached by Angle Brackets. Journalled in the centre holes of the Flat Plates is a 2 in. Rod on which a Ratchet Wheel 3 and a 57-teeth Gear Wheel 4 are fixed with a freely-moving 2½ in. Strip 5 on the Rod between them. The Rod passes through the lower end hole of the Strip and both the Gear Wheel and the Ratchet Wheel are each spaced from the adjacent Flat Plate by two Washers. Locked in the centre hole of Strip 5 is a Pivot Bolt carrying a Pawl with boss 6 which engages with the Ratchet Wheel, against which it is held by a 2½ in. Driving Band threaded through the centre hole in the Pawl and looped over a Bolt fixed in nearby Flat Plate 1. A Rod and Strip Connector 7, carrying a 1½ in. Rod, is bolted to the top of Strip 5.

Held by Collars in the lowest centre holes of Flat Plates 1 is a 3½ in. Rod, carrying a ½ in. Pinion 8 which meshes with Gear Wheel 4. Each Collar is spaced from its Plate by one Washer, while the Pinion is spaced by two. A ½ in. Pulley 9 is fixed on one end of the Rod for drive take-off purposes and, finally, a 6 in. Pulley is fixed on the other end to serve as the flywheel.

The particularly interesting thing about this mechanism is how, with a little thought, it can be put to a number of different uses. Alan tells me that he first tried it out, without the flywheel, in a go-cart, but with little success as the cart moved only when the lever was pulled. He does say, however, that the unit can be used in stationary models where short bursts of movement are required and I think this is perhaps the best course to follow when using the mechanism as a power unit. It does have a couple of other uses, though, as the Head of Meccano's Model Department pointed out when I mentioned it to him. For instance, by removing the flywheel and reversing the positions of Gear Wheel 4 and Pinion 8 to give a step-down ratio, it can be used as a Ratchet Jack—the type of unit which is used for dragging heavy objects and pulling tree stumps out of the ground (the jack is anchored to a fixed point and the ratchet used to wind in a cable attached to the load). The use which really appeals to me, however, is as a game. By taking the mechanism as described, mounting it in a suitable support and fitting a cardboard disc to the face of the flywheel, you have a first-class "fun machine". The card disc should be marked off into segments and a fixed pointer added. When the operating handle is pulled, the disc spins and, when it stops, the segment opposite the pointer denotes the winner.

As I have been writing the previous paragraph, the thought has just struck me that the segments on the card could be numbered, then the machine could be used in place of the throwing dice with board games such as Monopoly, Ludo, etc. This, I must finally add, illustrates what I was talking about earlier, namely the fun of finding uses for "unplanned" constructions.

PARTS REQUIRED

1—6	1—19c	18—37b	1—147b
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1—16	1—26	1—38d	2—72
1—17	1—27a	3—59	2—103f
1—18a	18—37a	1—147a	1—186
			1—212

Simplicity Model

Next, I would like to draw attention to the delightful simplicity model Oil Lamp featured here. This also was submitted by Alan Wright, although it is actually the work of Alan's sister Elizabeth. Now a young lady of 16, Elizabeth designed the model when she was eleven and I think all will agree that its obvious realism proves a remarkable talent in an 11 year-old! It consists of nothing more complicated than two ¾ in. Contrate Wheels 1, fixed with teeth interlocking on a 1½ in. Rod secured in the boss of a 1 in. Pulley 2, and yet it certainly captures the air of one of the old-fashioned oil lamps which were widely used for illumination until the introduction of electricity. Note how the Pulley Grub Screw has been replaced by a standard Bolt to represent the wick control wheel. An excellent little model, Miss Wright!

PARTS REQUIRED

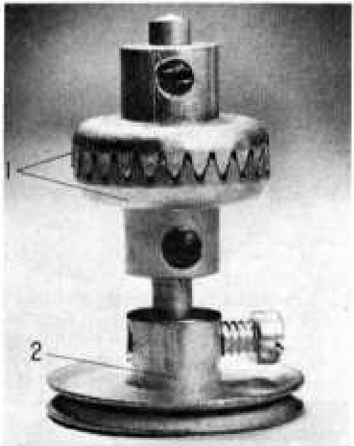
1—18a	1—22	2—29	1—37b

Plastic and Metal Hints

We now have a pair of very useful hints for those modellers who, on occasion, make use of a combination of Plastic Meccano and metal Meccano in their models. The first is a money-saving idea applied to the Caterpillar Track Pack when it is used with metal models. As readers will know, the Track Links contained in the Pack run on Plastic Meccano Sprocket Wheels which are themselves designed to fit onto the large-diameter Rods included in the Plastic Meccano system. If the track is required to be used with standard Meccano Rods, therefore, Couplings must first be fixed on the Rods so that the Plastic Meccano Sprockets can in turn be fixed to these. Being brass, however, Couplings are expensive items. The current U.K. retail price of a single unit is 21p, therefore a way of reducing cost is desirable and this is precisely what the first idea does. Instead of a Coupling, it uses two Collars, thus reducing cost by almost half as the Collars currently sell at 6p each.

The idea is really quite simple. A Collar (hidden in the illustration) is first fixed inside the threaded section of the Plastic Meccano Sprocket 1 by the Sprocket's Collet Nut 2 in the normal way. The assembly is next positioned upon its supporting Rod, then a second Collar 3 is *fixed* on the Rod inside the other end of the Sprocket in such a position that the fixing Screw in this Collar engages with the dog clutch section of the Sprocket boss. Thus, when the Rod revolves, the protruding Screw causes the Sprocket to turn also. To obtain the best results, Collar 3

(*continued on page 438*)



The "simplicity" model Oil Lamp which was built by Miss Elizabeth Wright when she was 11 years-old.

This picture illustrates a method of fixing a Plastic Meccano Sprocket Wheel to a "metal" Meccano Rod using Collars instead of a Coupling. Under operating conditions, the assembly would of course be mounted against the supporting framework.

Below, a simple, but effective way of fixing a Plastic Meccano Axle onto a "metal" Meccano Rod.

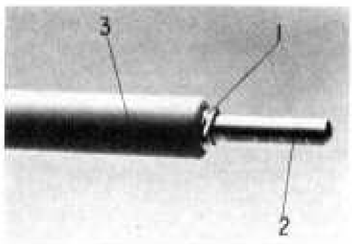


FIG.1

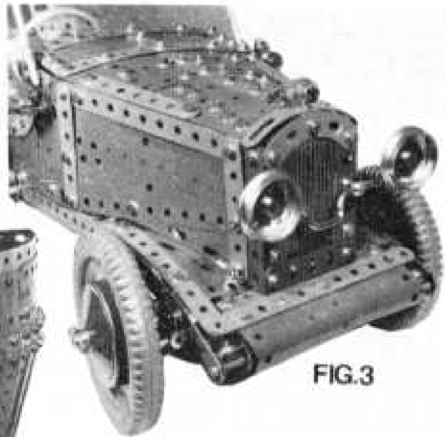


FIG.3

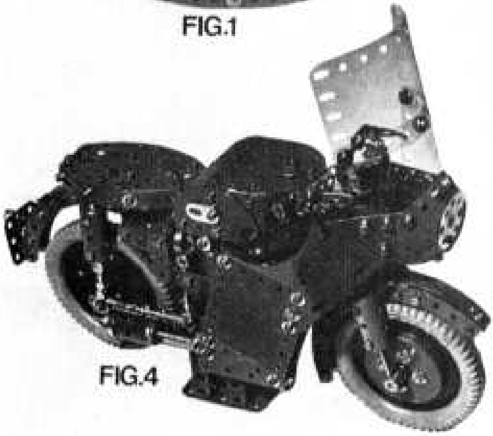


FIG.4

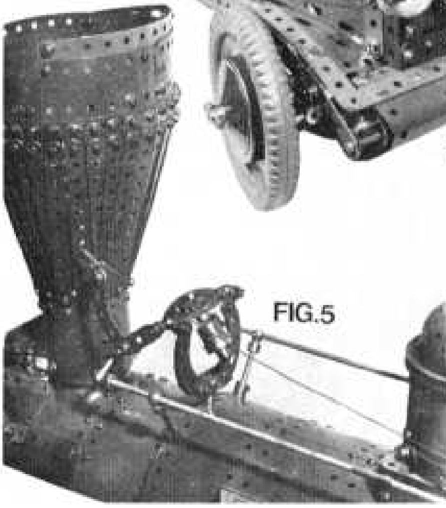


FIG.5

MECCANO PARTS AND HOW TO USE THEM

Part 9

By B. N. Love

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

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

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

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

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

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

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

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

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

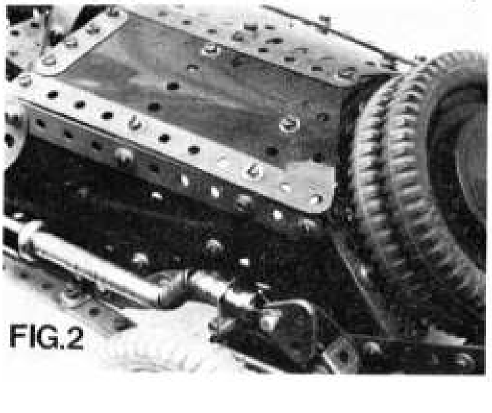


FIG.2

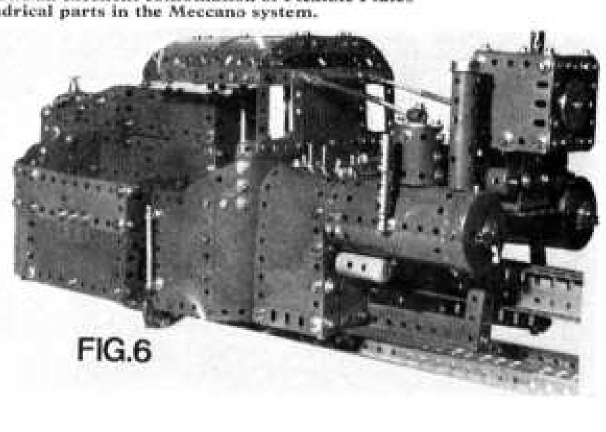


FIG.6

Build a Mobile Tower Crane

'Spanner' describes a working model for Meccano No. 7 Set owners

HIGH in the Meccano popularity stakes are—and always have been—cranes of all shapes and sizes. Often has it been said that cranes form ideal subjects for Meccano modelling, and this is a statement which I would not dream of contradicting. I couldn't, even if I wanted to, because it's absolutely true! Cranes do lend themselves perfectly to reproduction in Meccano, their design features usually corresponding exactly with the outline shapes of many Meccano parts. You might say, "They're naturals".

From the average modeller's point of view, however, the realism it is possible to achieve is only part of the story. Of equal, if not greater importance is the fact that Meccano cranes can be easily made to work just like the real things; they can be made to lift, luff, slew and travel so that, having been built, they can be realistically used, thus allowing the modeller the continuing enjoyment of operation, in addition to construction. And, as I have often said before, we all know a working model can give considerably more satisfaction than a static reproduction.

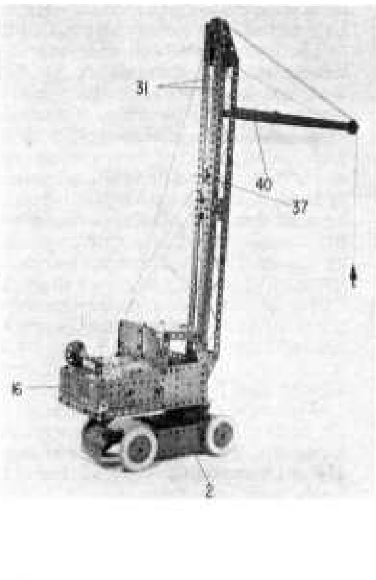
With this in mind, we feature here an interesting model of a Mobile Tower Crane, built with a No. 7 Meccano Set. Although not tremendously complex and detailed in design, it does capture the general lines of its full-size counterpart and it certainly reproduces its movements, thus resulting in a very worthwhile offering.

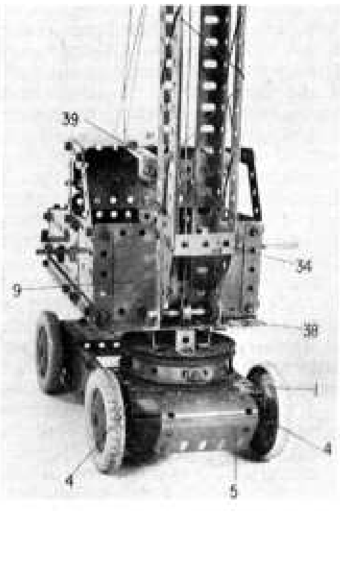
Construction begins with the mobile chassis. Two 3½ × 2½ in. Flanged Plates 1, separated by a distance of five clear holes, are connected together by two 5½ in. Strips and two 5½ × 1½ in. Flexible Plates 2, bolted between the side flanges of Plates 1. The centres of the Strips and Flexible Plates at each side are connected by a 3½ × ½ in. Double Angle Strip 3, while four Flat Trunnions 4 are bolted, one to each flange of each Plate 1 to provide bearings for the two road axles. Each axle is supplied by a 5 in. Rod and is journalled in the centre vertical holes of the relevant Flat Trunnions where it is held in place by 2½ in. Road Wheels. A U-section Curved Plate 5 is bolted to the outside edge of one Plate 1, while an ordinary 2½ × 2½ in. Curved Plate is secured to the other Plate 1 to nicely round off the chassis.

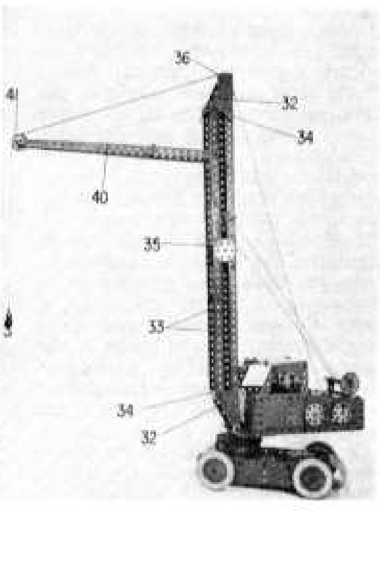
Fixed by ⅜ in. Bolts to the top of the Flanged Plate carrying Plate 5 is a 3 in. Pulley, the boss of the Pulley coinciding with the second row (from rear) centre hole of the Plate. Packing Washers are carried on the Bolts as necessary. Attached by an Angle Bracket to the top of the Pulley is a circular arrangement 6, built up from four Formed Slotted Strips, bolted together. The Strips should be curved slightly more than as supplied and use must be made of their slotted holes to ensure that the resulting circle fits inside the raised lip of the Pulley and sits on the flat area of the face.

Crane Body

Turning now to the body of the crane, a strong base is produced from a longitudinal 5½ × 2½ in. Flanged Plate 7, flanges upward, which is extended two holes forward by a laterally-mounted 4½ × 2½ in. Flat Plate 8. Bolted to the forward flange of Plate 7 is a 4½ × 2½ in.



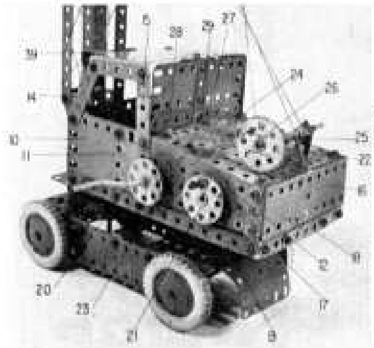


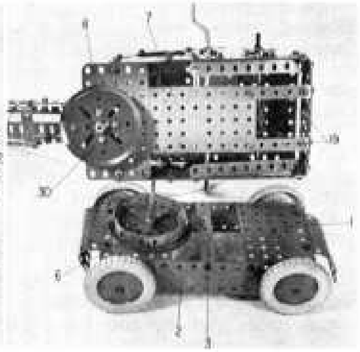


Left, general view of the completed Mobile Tower Crane showing its realistic outlines.

Centre, a frontal view of the body and chassis, showing the method of fixing the tower in position.

Right, Meccano Outfit No. 7 contains all the parts needed to build this Mobile Tower Crane.





Far left, construction of the crane body and the positions of the control handles are clear from this close-up view of the left-hand side of the model.

Left, in this view of the model, the superstructure has been separated from the chassis to show the underside of the body.

Flexible Plate 9, the ends of which are overlaid by 2½ in. Strips and the lower corners attached to Plate 8 by Angle Brackets. The upper corners of Plate 9 are attached by Angle Brackets to the side of the model, each of these sides being similarly built up from a 2½ × 2½ in. Flexible Plate 10, a 2½ × 1½ in. Flexible Plate 11 and a Flanged Sector Plate 12, all overlaid along their lower edges by a 7½ in. compound strip 13, supplied by two overlapping 5½ in. Strips. The lower forward corner of the side is attached to Plate 8 by another Angle Bracket.

Note that the Bolt fixing the upper Angle Bracket to the side also holds in position a 2½ in. Strip 14, this being angled rearwards slightly to serve as part of the cab window surround. Another 2½ in. Strip 15 is bolted to the cab side, through its seventh hole, then the upper end of this Strip is connected to the upper end of Strip 14 by a third 2½ in. Strip, the securing Bolts also holding the cab roof in position. This is simply supplied by a 5½ × 2½ in. Flexible Plate, curved to shape at the ends.

Also curved to shape at the ends is a 5½ × 1½ in. Flexible Plate 16, bolted between Flanged Sector Plates 12 at each side to enclose the back of the body. The lower securing Bolt at each side also holds a Fishplate 17 in position, the lower end of this Fishplate being bolted—along with an Angle Bracket—to the rear end of compound strip 13. The Angle Brackets at each side are connected by a 4½ in. compound strip 18, built up from two overlapping 3½ in. Strips, the connecting Bolts themselves fixing two more Angle Brackets to the inside of the compound strip. The free lugs of these Angle Brackets are connected to Flanged Plate 7 by two 3 in. Strips 19.

Before completing the top of the body and back of the cab, the jib and load controls should be fitted and wound with cord while there is still room to move. The load control is supplied by a 5 in. Crank Handle 20 extended, with a Rod Connector, by a 1½ in. Rod, the resulting shaft being journalled in the second row centre holes of Flanged Sector Plates 12 where it is held in place by an 8-hole Bush Wheel at one side and a Spring Clip at the other. A standard Meccano Bolt screwed into one tapped bore of the Bush Wheel boss engages with the shank of another Bolt, held by a Nut in a nearby hole in the Flanged Sector Plate, to act as a brake. The shaft must therefore be able to slide a short distance in its bearing to enable the brake to be disengaged. A Collar is mounted on the shaft inside the body and near to the left-hand Sector Plate to serve as a "stop" preventing the shaft from sliding more than the required distance.

The jib control is supplied by a 5 in. Rod journalled in the sixth row (from the front) centre holes of Flanged Sector Plates 12, where it is also held in place by a Spring Clip and an 8-hole Bush Wheel 21. A Collar inside the body is again added to the Rod to act as a "stop". A Threaded Pin is secured to the face of the Bush Wheel to serve as a handle and the same braking system is again used. Length of Cord are secured to the control shafts, the forward load-hoisting Cord being threaded through the bottom centre hole of Flexible Plate 9 and the rear jib cord later being threaded through a hole in the top of the Body.

The body top itself consists of a 4½ × 2½ in. Flat Plate 22 and a 5½ × 1½ in. compound plastic plate 23, both bolted between the upper flanges of Sector Plates 12. The compound plate is built up from two 2½ × 1½ in. Plastic Plates, the join being overlayed by a 2½ in. Strip 24 which is also bolted to Flat Plate 22. It is through the rear end hole of this Strip that the jib Cord is threaded.

Bolted to the top of Flat Plate 22, in the positions shown, are two 1 × 1 in. Angle Brackets 25, in the end holes in the spare lugs of which a 3½ in. Rod is journalled, being held in place by a Spring Clip and a 57-teeth Gear Wheel 26. A Pivot Bolt is locked in the face of the Gear Wheel to serve as a handle, while a ½ in. Bolt screwed in the boss of the Gear engages with the shank of a standard Bolt, secured in the second hole of the nearby Angle Bracket lug, to act as a brake. The Rod must, again, be able to slide a short distance in its bearings to enable the brake to be disengaged. Cord wound round the Rod will later control the tower attitude.

The back of the cab is now completed by a 4½ × 1½ in. compound flexible plate 27, built up from two 2½ × 1½ in. Flexible Plates, and a 4½ in. compound strip 28, built from two 2½ in. Strips, the joins being overlaid by a vertical 2½ in. Strip 29. The compound plate and overlaying Strip are bolted to one lug of a Double Bracket secured to the centre underside edge of the cab roof, while the compound strip—with the same overlaying Strip—is attached by an Angle Bracket (made slightly obtuse) to the centre forward edge of compound plastic plate 23.

Finally in the body section of the model, a 3 in. Pulley 30 is secured by four ½ in. Reversed Angle Brackets to the underside of Flat Plate 8, the Pulley boss coinciding with the second row (from the front) centre hole of the Plate.

The completed body can now be located on the chassis. A 3½ in. Rod is passed through the appropriate hole in Flat Plate 8 and is *fixed* in the boss of Pulley 30 with a little under 2 in. of Rod projecting downwards. This protruding length of Rod is then located, *free*, in the boss of the 3 in. Pulley secured to the chassis, where it is held in place by a ½ in. Pulley with boss beneath Flanged Plate 1 of the chassis. Pulley 30 rotates on circular arrangement 6 built up from the Formed Slotted Strips.

Tower and Jib

We come next to the tower and jib, both of which are quite straightforward. The tower consists of two 22½ in. compound angle girders 31 (each built up from two 12½ in.

Angle Girders overlapped five holes), connected together by three 1½ in. Strips bolted through their third, twenty-third and forty-fourth holes, counting from the top. A 2½ × 1½ in. Triangular Flexible Plate 32 is bolted to each end of each compound girder, then two 18½ in. compound strips 33 are bolted, as shown, between the free corners of the Triangular Plates, at the same time fixing a 1½ × ½ in. Double Angle Strip 34 between the ends of the two compound strips at top and bottom. Each compound strip is built up from two 12½ in. Strips, overlapped thirteen holes. A 6-hole Wheel Disc 35 is bolted between the centres of the compound strip and compound girder at each side of the jib, while Cord is also threaded back and forth between the strip and girder and between the two strips to represent cross-bracing.

Held by Spring Clips in the upper end holes of compound girders 31 is a 2 in. Rod, on which two 1 in. Pulleys with boss 36 are freely mounted. A 3½ in. Rod carrying a fixed 1 in. Pulley 37 is journalled in the nineteenth holes of the girders, then the tower is pivotally connected to the body by a 2 in. Rod passed through the lower end holes of the girders and through the vertical lugs of two Angle Brackets bolted to the forward edge of Flat Plate 8. A ½ in. Pulley without boss 38 is mounted on the Rod, which is held in place by Spring Clips. A "stop" to prevent the tower from pivoting backwards onto the body is provided by a 2½ in. Strip bolted to the free lugs of two 2½ × ½ in. Double Angle Strips 39 which are in turn bolted to the underside of the cab roof in such a position that they project three holes forward.

Pivotally attached to the tower is the jib which consists quite simply of two 12½ in. Strips 40, lock-nutted through the seventh holes of compound strips 33. Strips 40 are themselves connected together through their ninth holes from the tower by a 1½ in. Strip, attached by Angle Brackets, while a 1 in. Rod, carrying two 1 in. Pulleys without boss 41, is held by Collars in the end holes of the Strips.

This leaves only the cording arrangements to be completed and the model is finished. The load cord attached to Crank 20 and projecting from the front of the body is passed round Pulley 38 in the base of the tower, is taken upwards and over left-hand Pulley 36, down and around left-hand Pulley 41 in the jib and is then completed with a Loaded Hook, tied to the end. The jib control cord projecting from the top of the body is taken up and over right-hand Pulley 36; down and around right-hand Pulley 41 and is then brought back up and tied to upper Double Angle Strip 34. The remaining tower attitude control cord is simply taken up and around Pulley 37, then is brought back and tied through the rearmost centre hole in Flat Plate 22 to finally complete the model.

PARTS REQUIRED

6—1	1—18a	2—48	4—187
6—2	1—18b	2—48a	4—188
2—3	2—19b	1—48b	3—189
2—4	1—19h	1—52	2—190
13—5	3—22	2—53	1—191
4—6a	2—22a	2—53a	2—192
4—8	1—23	2—54	2—194
2—10	1—23a	1—57c	1—199
1—11	2—24	4—59	1—200
16—12	2—24c	6—111c	1—213
2—12a	1—27a	1—115	4—215
2—15	7—35	4—125	4—221
1—15a	133—37a	4—126a	
3—16	129—37b	1—147b	
2—17	28—38	1—176	

Riveting *(continued from page 434)*

laying 1½ in. Strip and an Angle Bracket. The forward ends of the short Angle Girders and the flanges of the 2½ × 1½ in. Flanged Plates are now joined by a further pair of 4½ in. Angle Girders 24, the upper right-hand Bolt fixing a second Angle Bracket in place. The vertical flanges of Girders 24 are connected by two 2½ in. Strips, one each end.

The left-hand bearings for the feed roller shafts are provided by two 1½ in. Flat Girders 25 bolted by their slotted holes to the vertical flanges of the 1½ in. Angle Girders. These should be adjusted to give correct meshing of two 1 in. Gear Wheels.

Bolted between the vertical slotted lugs of the two Angle Brackets is a Stepped Bent Strip 26 which simulates the device which applies pressure to the wire feed rollers. An inverted ¾ in. Bolt projects from the Bent Strip and is secured by Nuts so that a Collar 27 can be attached by one tapped hole. The "tommy bar" is provided by a 1 in. Rod passed through the Collar with two further Collars fixed one each end.

Fixed to the centre of a 4½ in. Strip is a 1 × ½ in. Angle Bracket 28, the slotted hole of which carries a Threaded Pin. On this Pin is mounted the rivet punch and extracting rocker which is made up from a stack of five 4½ in. Strips bolted together. These are secured to the Threaded Pin by a Collar and the assembly is then bolted to the vertical 2½ in. Strips at the front of the wire feed housing, inside the housing, the left-hand Bolt also securing in place a Double Bent Strip 29 fitted with a ¾ in. Bolt and Nuts to regulate the movement of the punch rocker. Finally, a further 4½ in. Strip is secured across the housing to complete this part of the assembly.

Crankshaft

Next we come to the crankshaft, the left-hand half of which is provided by a 5 in. Rod and the right-hand side by a 4 in. Rod. Two Cranks 30 form each web, these being mounted upon the Rods with bosses outwards and securely locked in place. A Collar 31 and two Washers fill the space between each pair of crank arms, these being retained by Pivot Bolts passing through the slotted holes of the Cranks and screwed into the tapped holes of Adaptors for Screwed Rod 32. Two 3 in. Strips 33, which form the connecting rod, are fitted on to the plain shanks of the Adaptors which are then locked together by a Coupling 34 to provide a rigid crank pin, additional packing Washers being added to ensure a good fit.

Ram

In the case of the ram, a 2½ × 2½ in. Flat Plate 35 forms the top of the unit, this being overlaid each side by 3½ in. Strips. The four fixing Bolts—one at each corner—also retain (attached by their round hole flanges) a pair of 2½ in. Angle Girders 36 bolted across the assembly.

Two 2½ × 1½ in. Flanged Plates 37 form the front and back of the ram, but before these are fixed into place, both are fitted with a 5½ in. Angle Girder 38 centrally attached by the round hole flanges, these forming the runners upon which the ram slides. To the centre of the front Flanged Plate, is fixed a Coupling 39 with its longitudinal bore vertically disposed. The two fixing Bolts must carry Washers to ensure that, when the Coupling is secured, a Rod can slide freely up and down. This Coupling forms the bearing to carry the tool slide. The front and rear 2½ × 1½ in. Flanged Plates may now be bolted to the vertical slotted flanges of the 2½ in. Angle Girders, the two Bolts fixing the rear Plate in place also securing in position a 1½ × ½ in. Double Angle Strip 40, to which the toggle links are subsequently pivotally attached. Finally, the ends of the two 5½ in. Girders are connected by a pair of 3 in. Strips 41, bolted one each side. *(To be continued)*