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JANUARY 1969

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MAP HOBBY MAGAZINE

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FORD ESCORT TWIN CAM RACING MODEL

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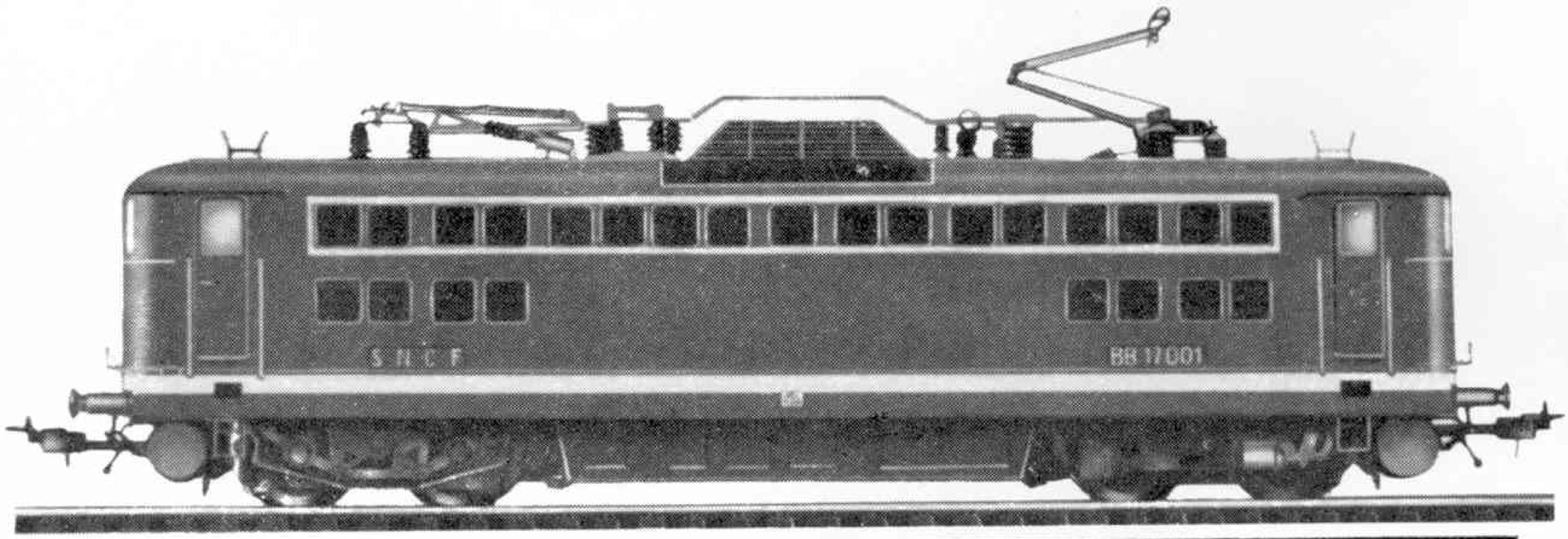

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MECCANO® Magazine

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Editorial Director
D. J. LAIDLAW-DICKSON

Editor
JOHN FRANKLIN

Consulting Editor for Meccano Ltd.
J. D. McHARD

Advertisement Manager
ROLAND SUTTON

MAP **HOBBY MAGAZINE**

FRONT COVER

The Ford Escort Twin Cam thunders up a sandy lane in the Circuit of Ireland Rally. Roger Clark a " Works " Ford driver is at the wheel. This sort of driving has valuable results, as it tests components under the most severe conditions, to make sure the family Escort is as well engineered as possible.

NEXT MONTH

Meccano models include the Lion locomotive for advanced model builders; a pull-along Dachshund dog model from an Outfit No. 1; a Mini-Moke from an Outfit No. 2 also for the youngsters and a giant Level-Luffing Crane built by a reader. Our main feature will be an article on the Fire Brigade with an exciting cover painting of a Fire Engine in action. All of our regular features are included and Militaria is back with us again—detailing all that's new for Battle Gamers. All-in-all a great issue on sale January 3rd—make sure you don't miss your copy.

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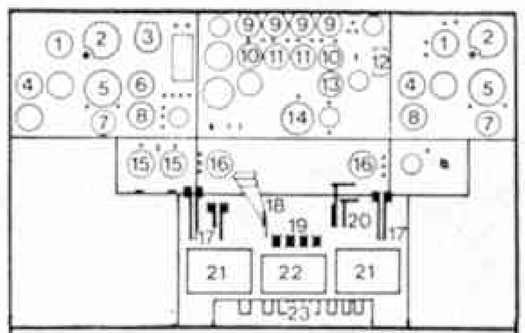
BEHIND THE SCENES WITH THE R.A.F.-1

The VC10 that never was



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10. Slat position indicators
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13. Aileron trim indicator
14. Tacan indicator
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16. Auto-pilot trim indicators
17. Tail trim levers
18. Speed-brake lever
19. Throttles
20. Flap/slat levers
21. Pilot's intercom, control panels
22. Auto-throttles control panel
23. Auto-pilot control panel

Even at 13, you could make a start in the Air Training Corps. You'd get lots of fun and thrills, and it would be a great help in joining the R.A.F. later.

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This is the cabin of a VC10 that will never leave the ground. But it will fly anywhere. It will land at any airport. It can crash into the sea at 200 mph—and then take off again!

It is the R.A.F.'s new VC10 flight simulator—the most advanced in Britain. Packed with intricate hydraulic, electrical and electronic engineering. Outside, it is simply the first 15 feet of the nose of a VC10. Inside, you can't tell it from the real thing. It is used to train air-crew to fly the VC10's of Air Support Command.

It will reproduce every manoeuvre and every hazard a VC10 is likely to encounter. Turbulence, pitching, rolling, fog—almost anything can be arranged! It answers every movement of the control column—or you can switch to automatic pilot. As you throttle back to land, you lower a non-existent undercarriage with a soft thud, and then you hear the sound of the wind rushing through it. As you touch down, you get the authentic jolt of a real plane, and the rumble of the wheels on the tarmac. And it gives aircrew experience in emergencies that would be impossible any other way. After all, who'd bring a real VC10 down into the sea just for experience?

The small picture shows an essential part of the simulator. A relief model of the Brize Norton area, where the simulator is, with the airfield complete with landing lights in the centre. A colour TV camera moves and tilts on a travelling rig which follows the controls in the simulator cabin. The crew can take off from Brize Norton, fly to any part of the world and land there without even leaving the ground; all made possible by new simulator techniques.

The R.A.F. has all kinds of revolutionary new equipment. And more is constantly coming . . . new aircraft, computers, radar systems, electronic test gear, fire fighting equipment, even new filing systems. To operate it and service it all needs dozens of different skills. And in them, the R.A.F. provides a first-class, full-time training. If you're interested in aircraft and technology, the R.A.F. might be the life for *you* one day. Think about it.

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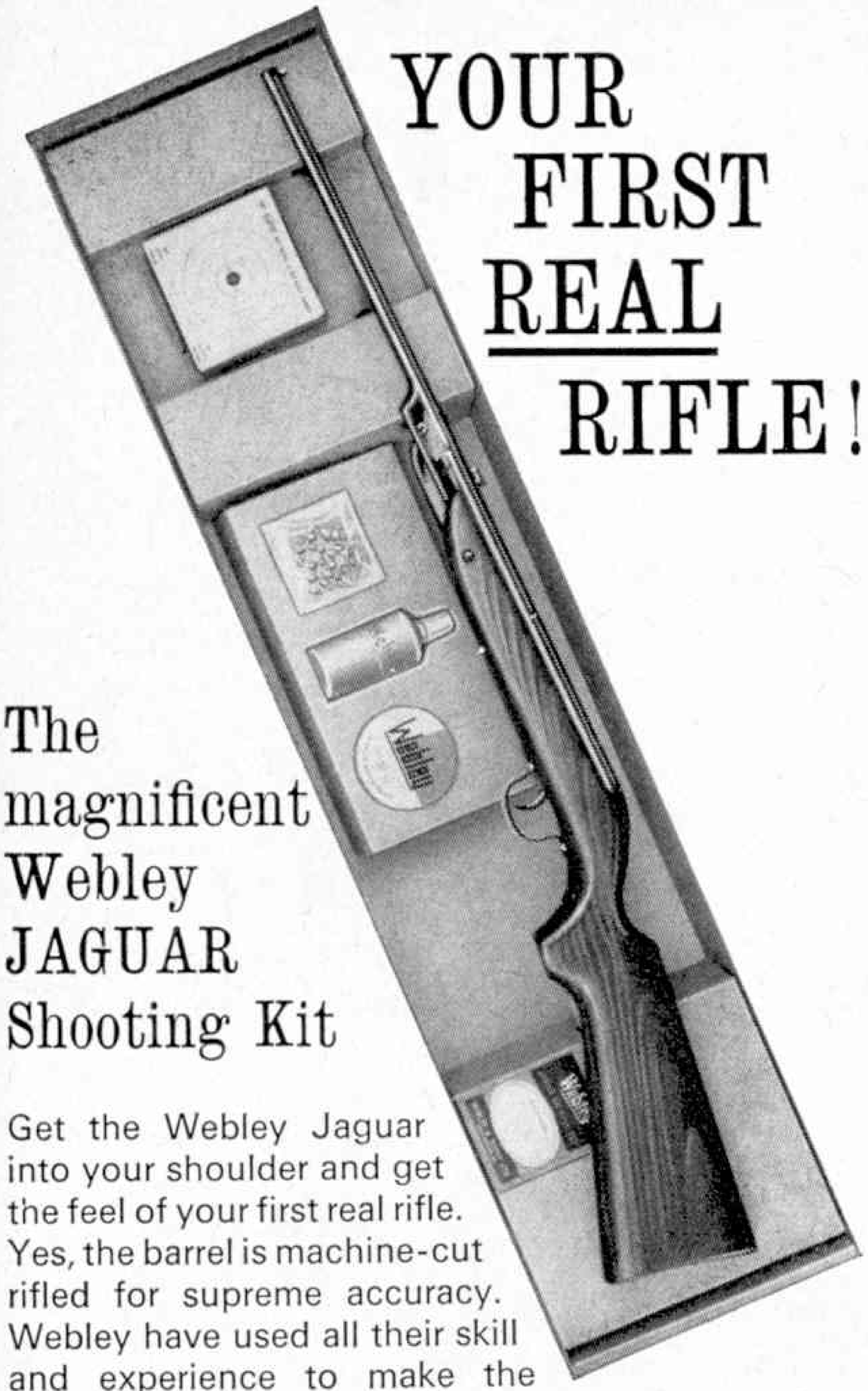

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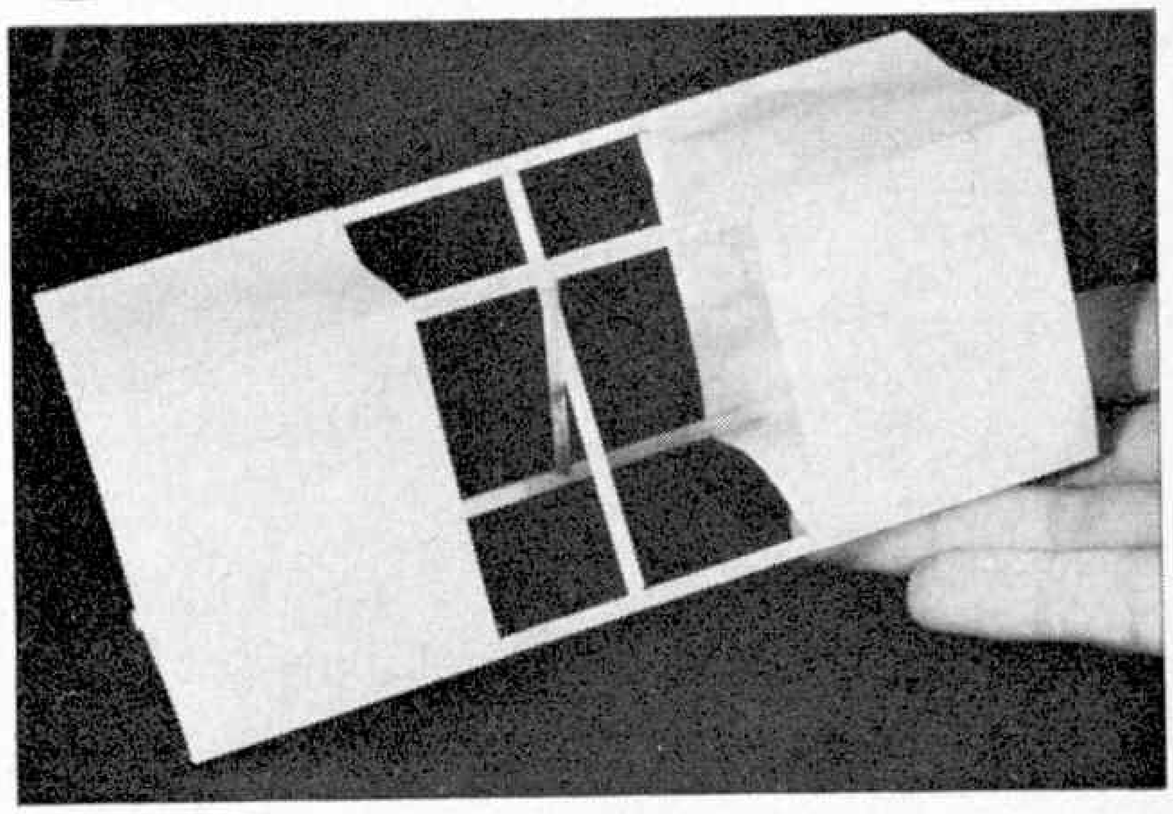
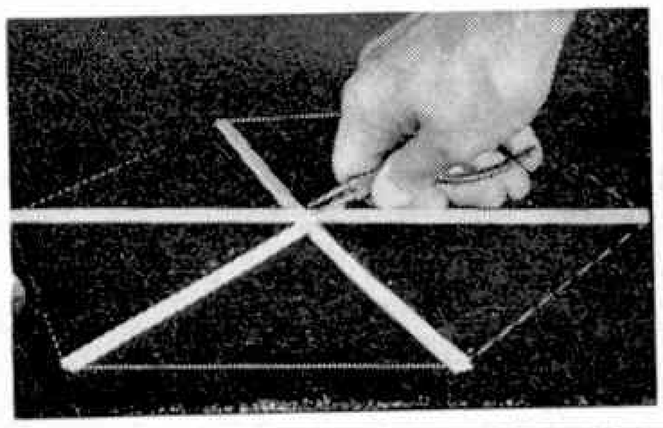
MAKING MODELS WITH Solarbo BALSA



Why not try your hand at kites? For just a few pence you can make a small box kite from Solarbo Balsa strip, plus some tissue for the end panels. Fly on a cotton line. Or for a bigger kite, try the hexagonal type (bottom photo). Again Solarbo Balsa strip makes the main members, pinned together at the centre. Fit a thread outline and cover with model aircraft tissue . . . but don't forget a kite of this shape needs a tail. It's wonderful what you can make . . . inexpensively . . . with Solarbo Balsa.



Solarbo Balsa is specially prepared for model making, so always ask for it by name at your local model shop. If you want further ideas for Balsa models, use the coupon below to order from our selection of plans. (We have not included the kites as the photos should be sufficient guide for making).

Please send me the plans marked. I enclose Postal Order value 1/- 2/6* as per your special Meccano Magazine offer.
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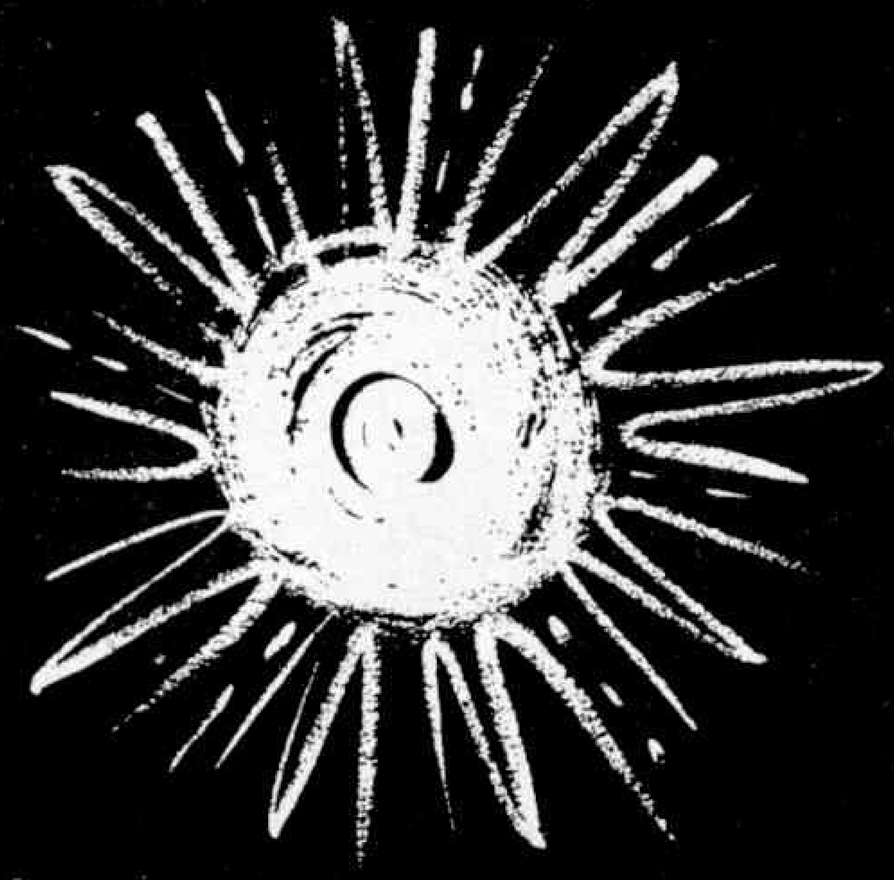

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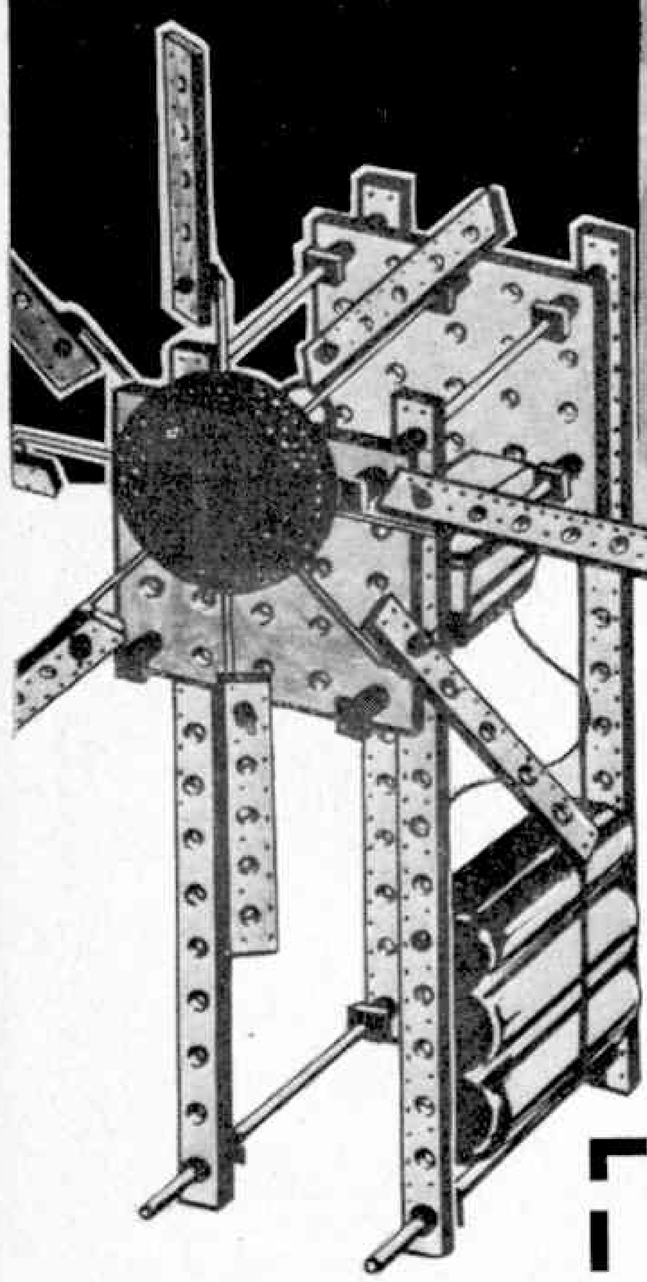

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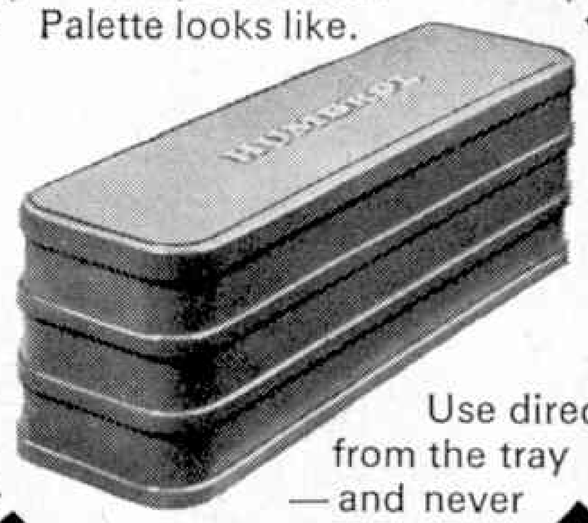

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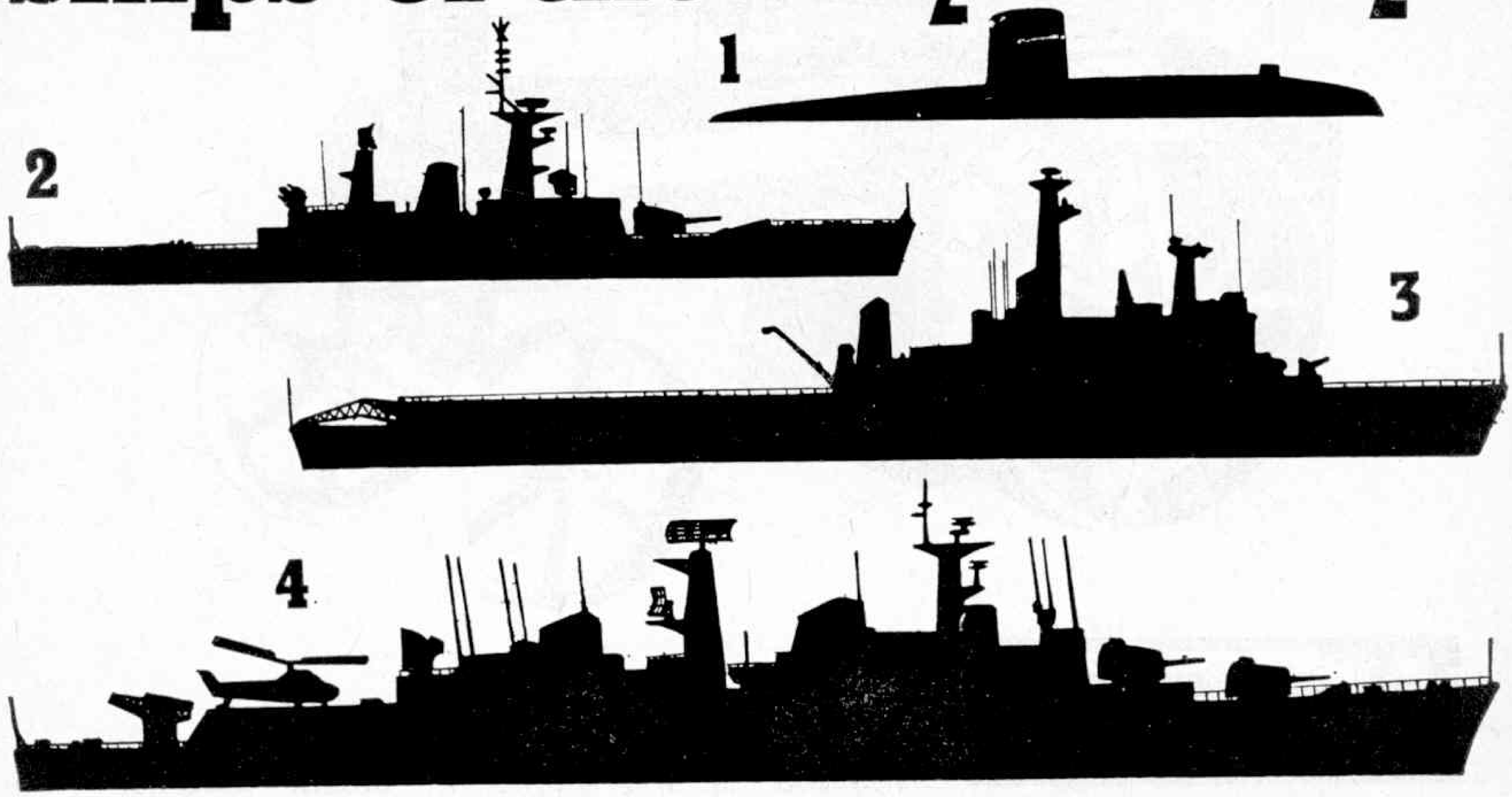

1 **HMS Valiant. A nuclear powered submarine designed to hunt and destroy enemy submarines. She can patrol at high speed—and circle the world without coming up for breath.**

2 **HMS Leander. One of the Navy's new general purpose frigates that can do duty as an anti-submarine and anti-aircraft escort. She carries 4.5 inch guns, Seacat guided missiles and a Wasp anti-submarine helicopter.**

3 **HMS Fearless. An assault ship that carries landing craft, vehicles, tanks and Royal Marine Commandos. The landing craft are launched by flooding compartments so that they can float out through the stern!**

4 **HMS London. A County Class guided missile destroyer. She has missiles that can punch aircraft out of the sky. Powerful guns. Anti-submarine weapons. And a Wessex anti-submarine helicopter.**

These are just some of the new ships of today's Royal Navy. And what amazing ships they are.

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In this technical, push-button Navy the life of a sailor has changed a lot. He's likely to have a skilled man's trade. To earn good money. And he can get ahead quickly. But he's still a man who is a sailor first. A man who loves the sea with a life that gives him travel, and adventure.

If you'd like to know more about life in today's Royal Navy post coupon for free booklet, Now!

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Please send me, without obligation, the 52-page booklet 'The Royal Navy as a Career'.

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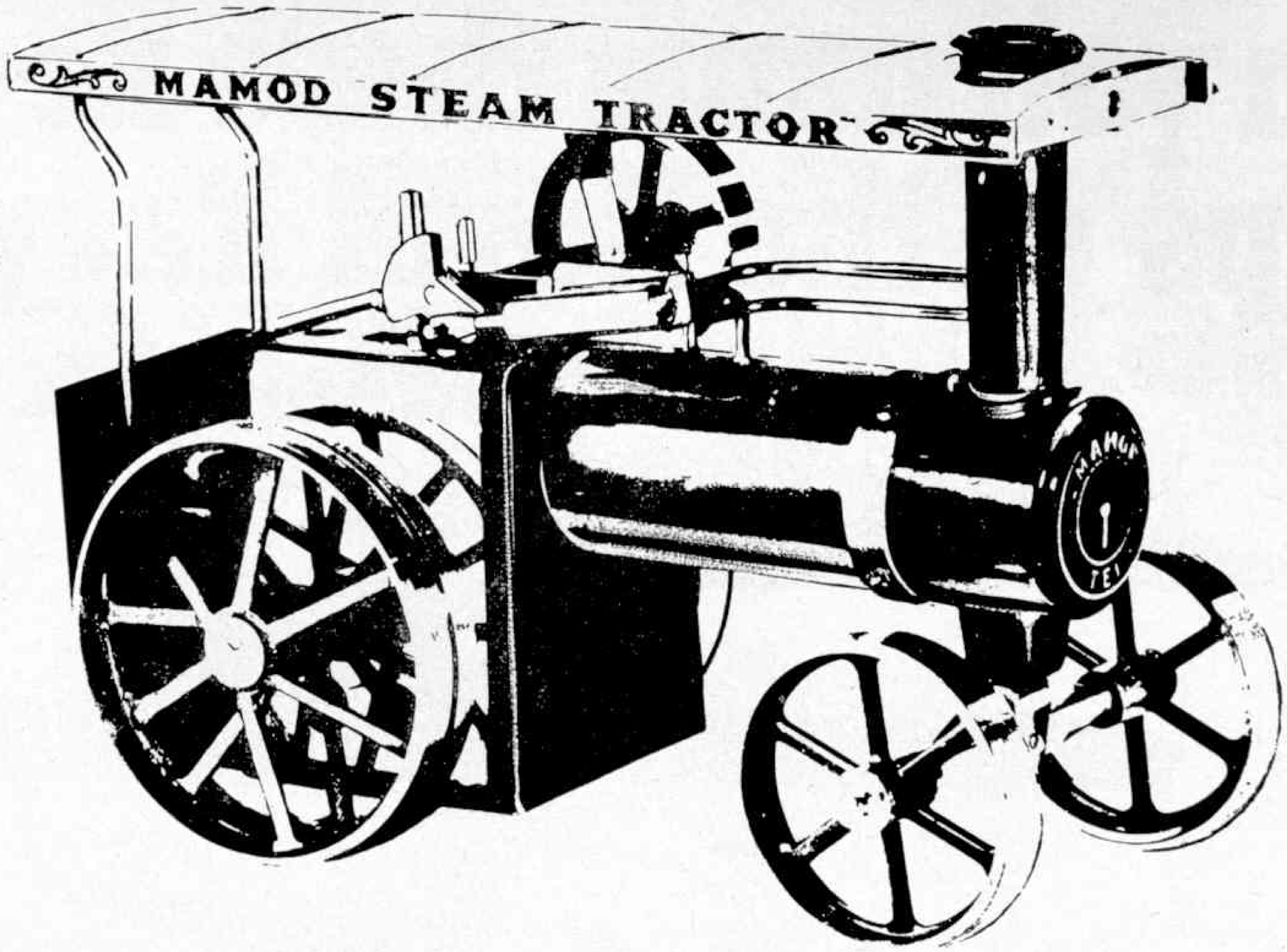

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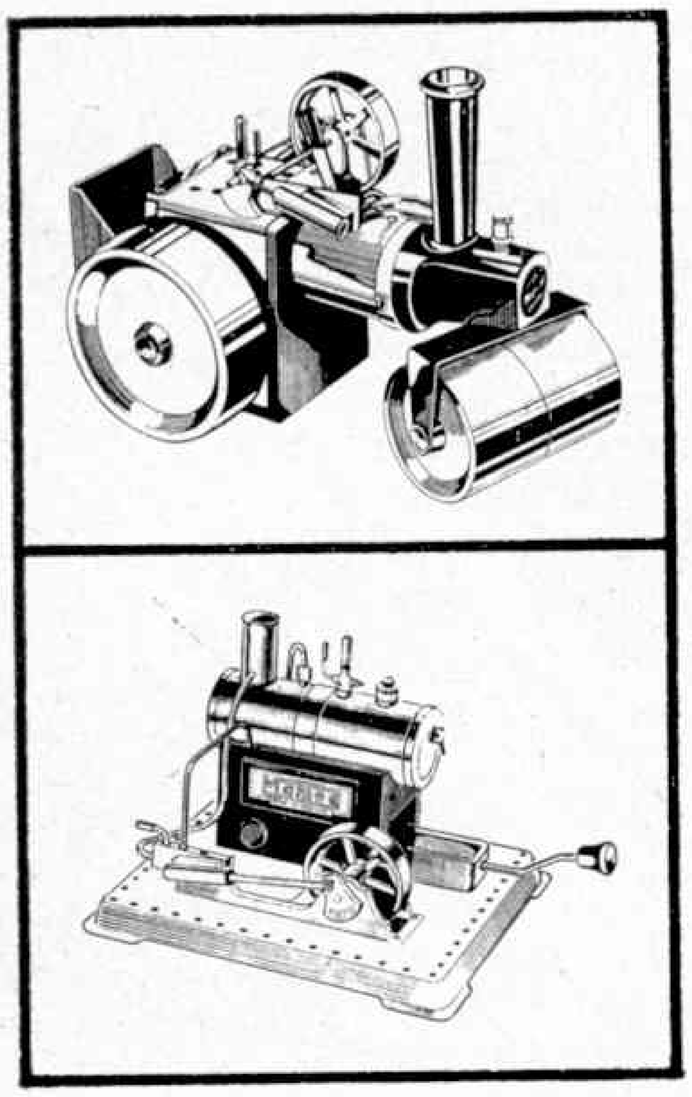
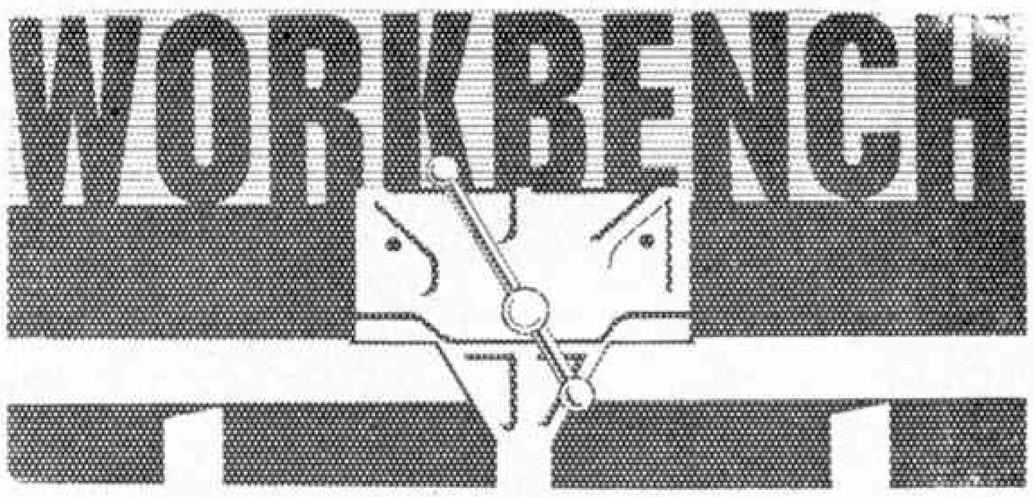




Model Engineer Exhibition

THE 38TH Model Engineer Exhibition opens at the Seymour Hall, London W.1. on Tuesday 31st December, 1968, and will continue daily, except Sunday, until Saturday, 11th January, 1969. It will be a joint effort by the seven monthly magazines published by the M.A.P. Hobby Magazine Group including MECCANO MAGAZINE to present a really interesting varied display of all kinds of models, both static and working. Leading model shops and manufacturers in the model trade will be selling and demonstrating their products.

Now that steam locomotives are no longer operating in full size, the magnificent live steam model locomotives pulling passengers on the track will be specially attractive. This will be organised by the Society of Model and Experimental Engineers and visitors will have a chance not only of watching, but also of taking a trip behind some of these powerful miniature coal-fired steam locomotives operating on tracks between 3½ in. and 5 in. wide, yet able to haul up to 20 passengers.

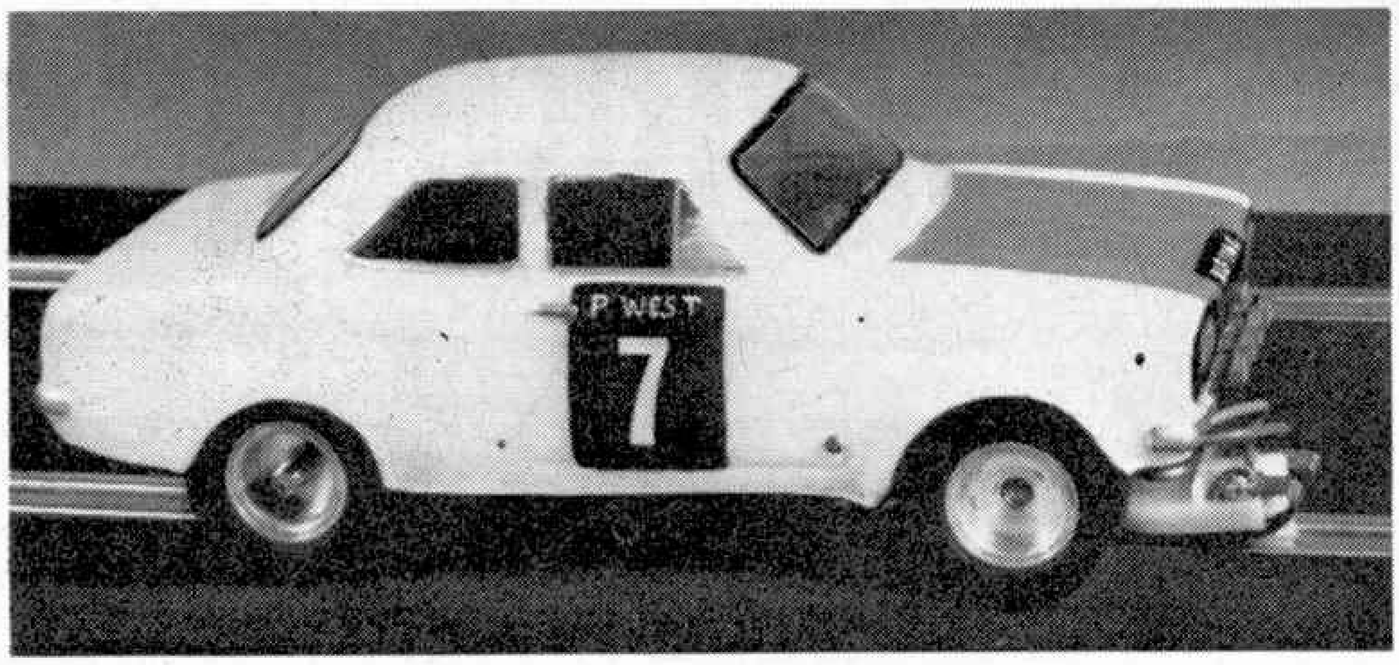
A novelty this year will be working road vehicles on a road alongside the permanent way which will display many beautiful steam road vehicles, traction engines, steam rollers and the like in scales of from 1/12th to 1/8th full size. These will be demonstrated in steam during the show and should offer, for the first time, an opportunity for visitors to see how these immensely popular models perform.

Further exhibits which will actually be working include a very fine Fleischmann model railway layout. Then there will be an attempt made to beat the world record for non-stop performance of an electric powered model train. This, at the moment, stands at 153 miles (according to Guiness Book of Records) and we hope to establish a new record during the exhibition. Also on show, under the auspices of the Tramway and Light Railway Society, is a fascinating working model tramway layout. Many of our younger visitors will probably have never seen a tram in operation and this will at least produce nostalgic memories for many others. Scale here is 1/16th, with 3½ in. track gauge which enables considerable detail to be shown. Tramway models representative of London, Manchester, Belfast and other British systems will be shown. Some of our club exhibitors will be showing models working under compressed air and the organisers' own stand will be embellished by a number of aircraft flying under electric drive. (This is aeromodelling's answer to the electric racing car.) Model car collectors will have an opportunity of seeeing many of the model cars which are now changing hands at quite fabulous prices, sometimes £50 for a car which cost at its original play-sale price some 6d. or 1/-. Cecil Gibson is showing his well-known collection of Dinky Toys with additional models by collecting friends. To provide a balance a complete range of Dinky Toys as available today is shown. Then there will be a display of Meccano models, both manufacturers' professional models and the equally beautiful, some say even more beautiful, products of the Midlands Meccano Guild in traditional red and green Meccano, which are all amateur-built models by enthusiasts.

At a time when contemporary-built models are changing hands in the auction rooms at up to £2,000 each, the display of 200 or more of the country's leading models, insured for over £100,000 should convince visitors that these auction prices are by no means above the value of the goods displayed. In many cases, ten years or more has been devoted to perfecting these super detailed masterpieces. They are all made in home workshops with very limited tools, but to this is added unlimited time, patience and ingenuity. Models on display include steam locomotives, beam engines, internal combustion engines, railway accessories, workshop equipment, both contemporary and historical, architectural models. Marine entries include large power models, such as have recently been taking part in an offshore radio control competition at Torbay, and many glasscase models of unbelievable delicacy. Other models are suitable for radio control, powered by steam, electricity or internal combustion engines.

THE EDITOR AND STAFF SEND SEASONAL GREETINGS AND BEST WISHES FOR THE NEW YEAR TO ALL MECCANO MAGAZINE READERS

Shown here, in their specially designed display packs, are two super new Gift Sets from Dinky. At left, the Superfast Set containing the Jensen FF, the Jaguar "E" Type, 2 + 2 and Aston Martin DB6. On the right is the International G.T. Set containing the De Tomaso Mangusta, the Dino Ferrari and Ford G.T.



At left: Our heading photograph shows the author's Escort ready for action on his home track. The fictitious driver's name painted on the door, would on reflection have looked neater in " Letteraset " or " Blick Dry-Print ". At right: Another view of the Escort shows the front end treatment. The four " spotlights " were carved from scrap plastic out of an old kit.

RIKO FORD ESCORT TWIN CAM

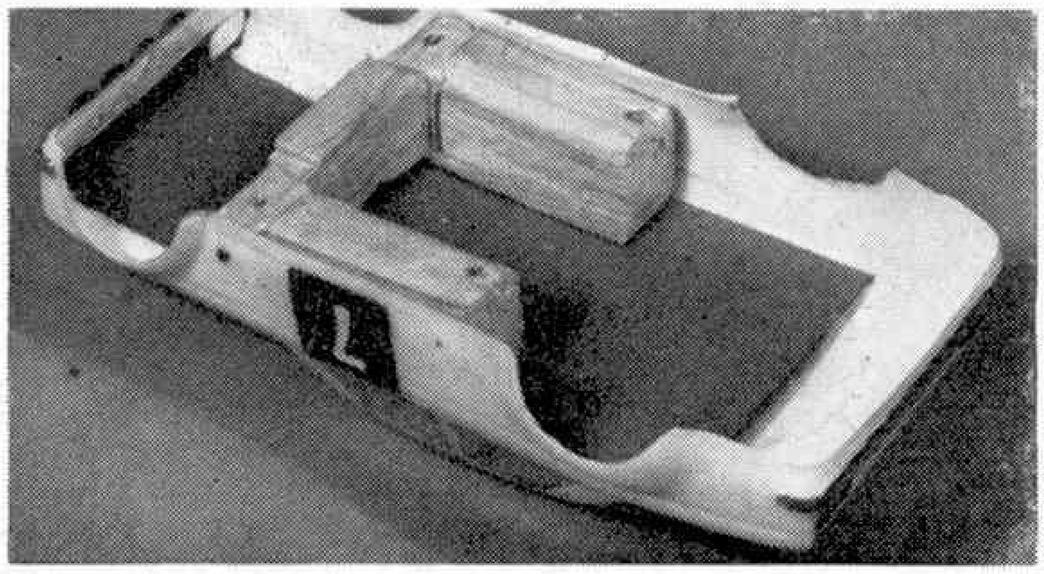
Dave Rothwell describes the construction of a hot electric slot racing car made from standard RIKO parts. This model is an ideal introduction to club slot car racing on a low cost basis.

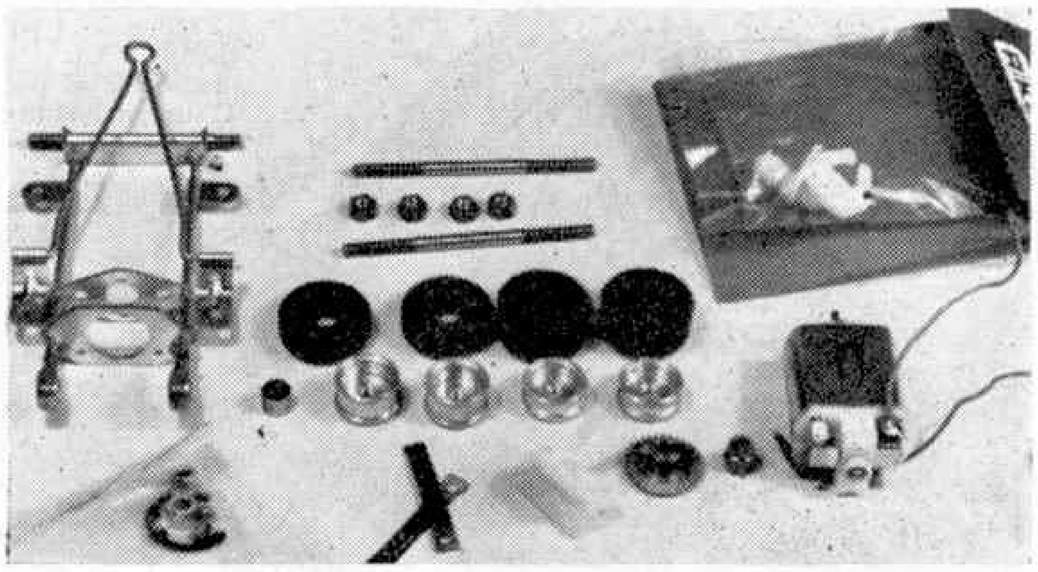
THE COVER of this month's magazine, shows a Works Ford Escort Twin Cam in rally trim being put through its paces during the Circuit of Ireland by Roger Clark. These cars are specially prepared by experts, in this case the Competition Department of the Ford Motor Company, in order to rally test components and materials under the worst possible conditions. This provides valuable information for the engineers so they can ensure that the road car you buy is as good as modern engineering can provide.

In the same way, as the fastest full size cars are impossible to buy " over-the-counter " so, generally speaking, are the best slot cars. A look in at your local model car club will show you that the most consistent winners are those who have either extensively modified a standard kit model, or built their car up from various special parts to finish up with a car which suits them personally. There are of course some excellent kits and ready-to-race cars available, but most will agree that greater satisfaction can be obtained by knowing that the car's performance and looks are largely dependent on ones own efforts. One other advantage is that there is less chance of anyone else building a model identical in every detail.

All the items used in the construction of this 1/32nd scale Escort are from the " RIKO " range of slot car racing equipment distributed by R. Kohnstam Ltd., 13-15A High Street, Hemel Hempstead. We chose to use these particular parts because the range is extremely large and the price within the reach of most pockets. See the special 24 page catalogue in the centre of this issue for details of the full " RIKO " range.

Why a Ford Escort ? Quite simple really. This is the latest from Fords, and a nice looking car, and secondly it also happens to be the latest vacuum formed body shell produced by " RIKO ". The shell also boasts flared wheel arches, so it can have a slightly

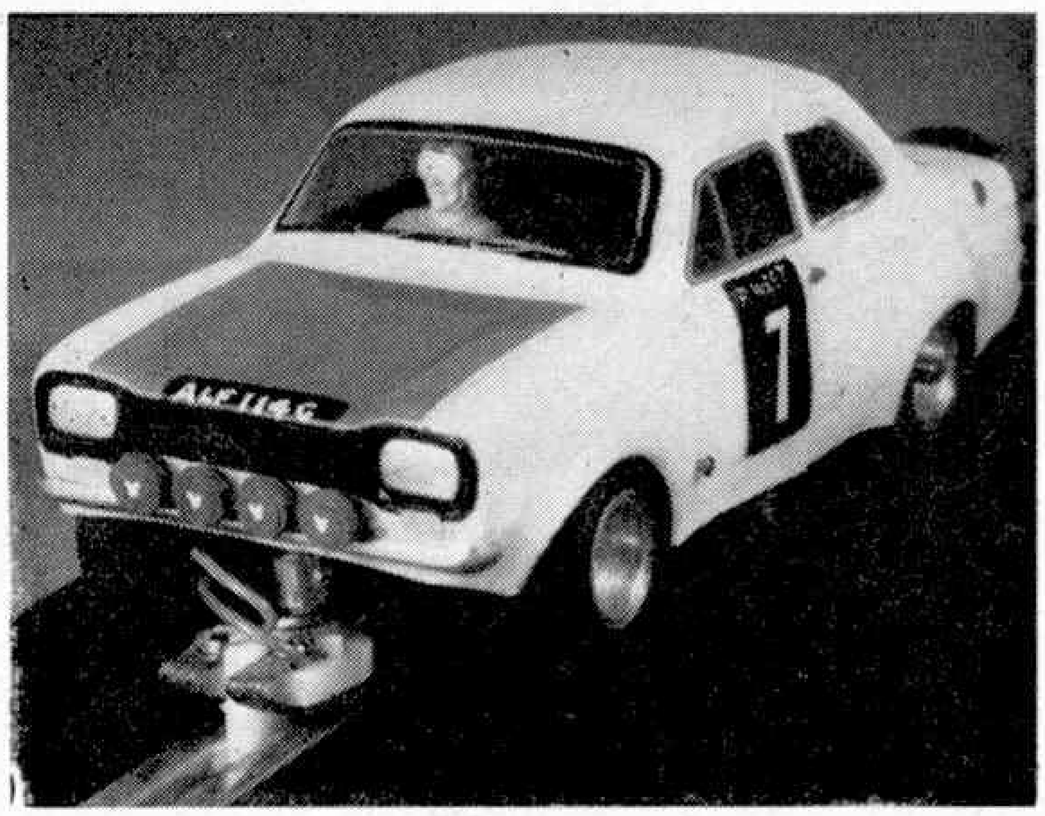




wider wheelbase than usual and thus give the car just that bit more stability.

One has to choose the components carefully: for instance it is essential to ensure that the chassis is the correct one for the motor selected, the mounting brackets on the various chassis vary in shape and size, thus restricting the types of motors that can be fitted, however, if your model shop is helpful you should be able to get the right parts. A list of all the components used to make the Escort is included for would be constructors. The same principle of construction can be used to make dozens of different cars.

The first step is to fit the " tin can " type Rikowhip ballraced 16D type electric motor in the brass tube chassis. Do this by sliding the pinion end of the motor through the hole in the fixed chassis mounting plate; slide the front plate on to the nylon brush retainer, and secure it with the two small screws provided in the chassis kit. Use bevel gears, as these run a lot smoother than straight cut gears. As you are using bevel gears you will have to remove the straight pinion on the motor shaft. This can be done with a screwdriver by prising gently between the pinion and back end of the motor, or a small ' C ' shaped gear puller. Slide on the smaller of the two bevel gears, and secure it to the motor shaft with the grub screw. Slide one of the two axles through one of the rear axle mounting lugs and push the second bevel gear on to it then slide the axle through the mounting lug on the far side. Slide a phosphor bronze bearing over each end of the axle and fit a locknut on to each end of the axle, followed by the rear wheels (the widest pair). Tighten one wheel against its locknut, then after checking that the axle turns freely without any sloppiness, repeat for the other rear wheel. Finally, slide the bevel gear along the axle and into mesh with the one on the motor, tightening the grub screw. The front axle is already built into the chassis, and is called a " split axle ", because the axle is cut through in the centre allowing each end to turn separately inside a tube. Fit a locknut on to each end followed by a wheel. Tighten the wheel against the locknut and ensure that it spins freely. Next fit the slot guide shoe (a white nylon " T " shaped fitting) up through the hole in the shortened piano wire fallaway guide arm. Secure it with a bush, locking in place with a grubscrew. Select one of the soft braided pick-up wipers, slip a small self tapping screw through the hole in the end and screw it into the hole at the top of the guide shoe. Before tightening down completely wind one of the motor wires round the screw, under the pick up wiper. Repeat for the second wiper. Incidentally it keeps the wires out of the way if you wind them around a pencil



before fitting them to the guide.

You will notice that this brass tube chassis is completely adjustable for length. The Escort body-shell is fairly small, and the chassis must be at its shortest to fit. To mount the body shell on the chassis you will need a piece of balsa wood $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in., cut into 3 pieces and cemented together in a " U " shape, as shown in the photograph. The chassis should be securely mounted to the blocks with small wood screws, and the tyres then fitted on to the wheels (wide tyres on the rear wheels). A trial fit of the chassis unit to the body shell should give you an idea of where to shave the balsa wood to obtain a " snug " fit.

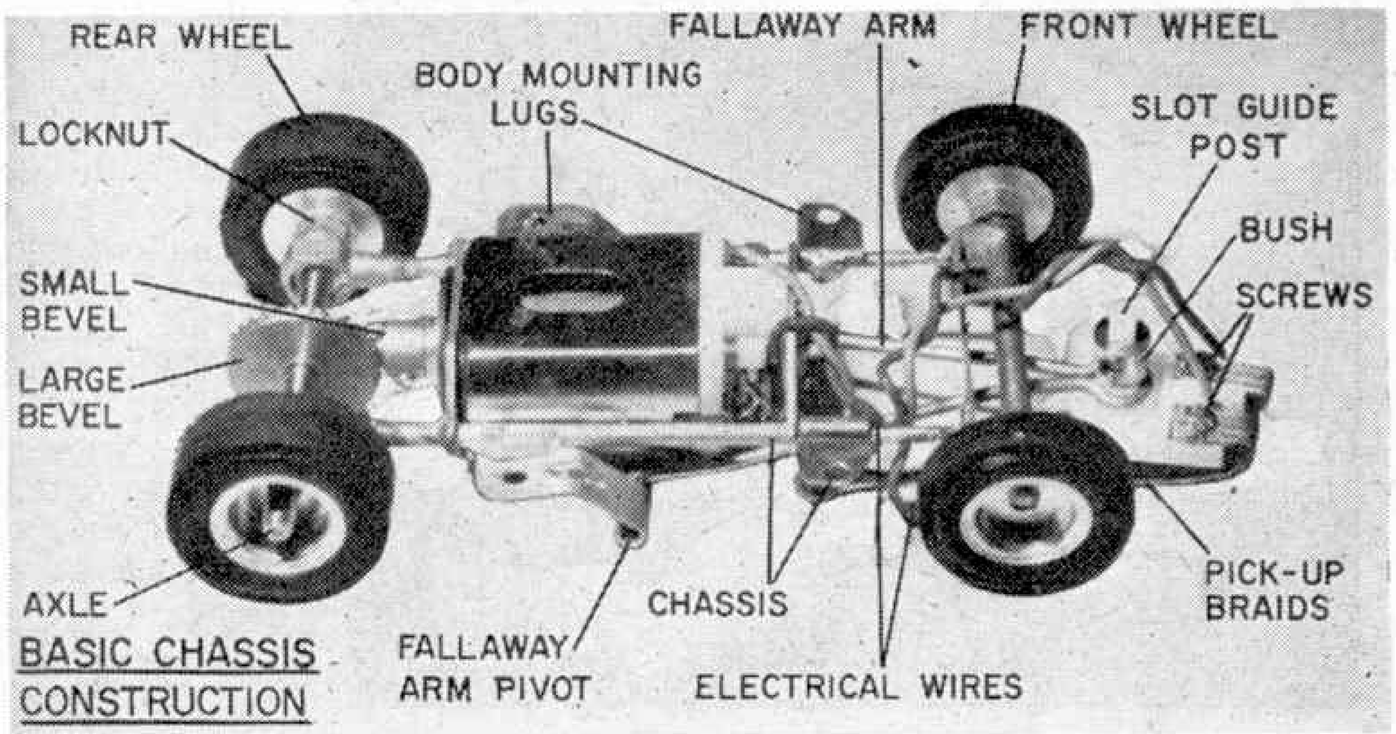
In last month's " Building a Riko Slot Car " feature the methods for removing excess plastic from the clear plastic shell, and how to go about painting the model from the inside were described. Obviously it would be rather a waste of space to cover this method again, so we will use the space available here to suggest various other ways of making your body shell attractive.

The method used by some builders, is to paint the body shell from the outside. The advantage of doing it this way is that painting detailed parts such as door handles etc. is far simpler, and they look neater than when painted inside of the shell. This becomes more apparent when a two-tone body is contemplated as the dividing edge between one colour and another can be made a lot straighter and with far less trouble. Possibly the biggest difficulty, when painting the outside of the shell as planned, is that of dust or brush lines spoiling

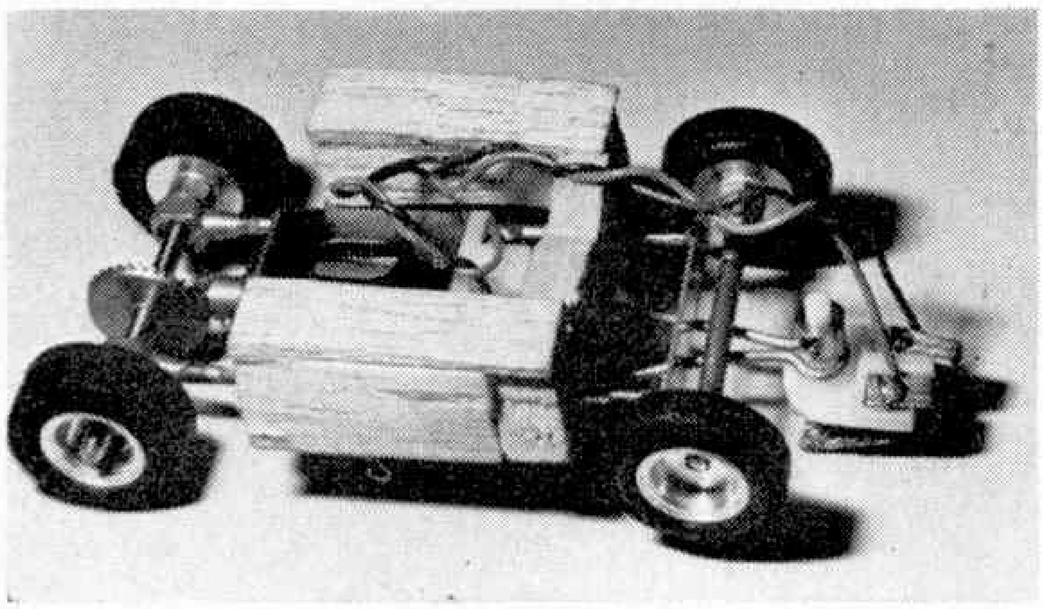
Far left: The underside view of the completed body shell shows the balsa wood sub frame in place. The chassis has been removed to show how these balsa blocks should fit.

Left: The basic RIKO parts laid out prior to assembly. One of the axles shown will not be needed as the chassis unit comes complete with a " split " axle mounted on the front.

At right: The complete chassis unit with all the RIKO components clearly indicated for easy identification. The fallaway guide arm was shortened to fit inside the Escort body shell.



BASIC CHASSIS CONSTRUCTION



The balsa sub-frame firmly attached to the chassis and now ready for installation in the RIKO body shell.

the model. The simplest way to overcome the latter is to use one of the " Aerosol " sprays, masking off all areas *not* to be sprayed with " Sellotape " or similar. The cost of such sprays however, is rather prohibitive, and this factor may make many of you decide that a brush finish will have to be used. The most important point here, is to use only the best possible brushes. *Don't* be tempted to use an *old brush* of the type usually found in children's paintboxes. These almost without exception are very poor quality, thick stiff bristles being fine for little brother and his paintbook, but definitely out for model painting. Go to your model shop and invest in a couple of Sable Hair brushes, one medium sized for large areas, and one fine for painting in small details. These brushes will give a perfect finish to the paint as far as lack of brush marks go, and are well worth the 5s. or so for their purchase.

The problem of dust settling on wet paint is always rather a nuisance. Try to paint your models in a dust free atmosphere, and when completed cover the work with a box lid. Possibly the most popular method of painting clear shells to-day is the " Inside-Outside " method. The main body colour is applied to the inside of the shell (don't forget to put the transfers on first) and all detailing, such as headlamp lenses, bumpers etc. from the outside.

Painting the body shell inside removes the problem of brush marks and dust and more important prevents the paint-work from becoming scratched when the car is being raced. Extra detailing on the outside is far easier, especially with very small parts. Perhaps a description of just how the Escort was painted will give you a better idea of how to tackle the job.

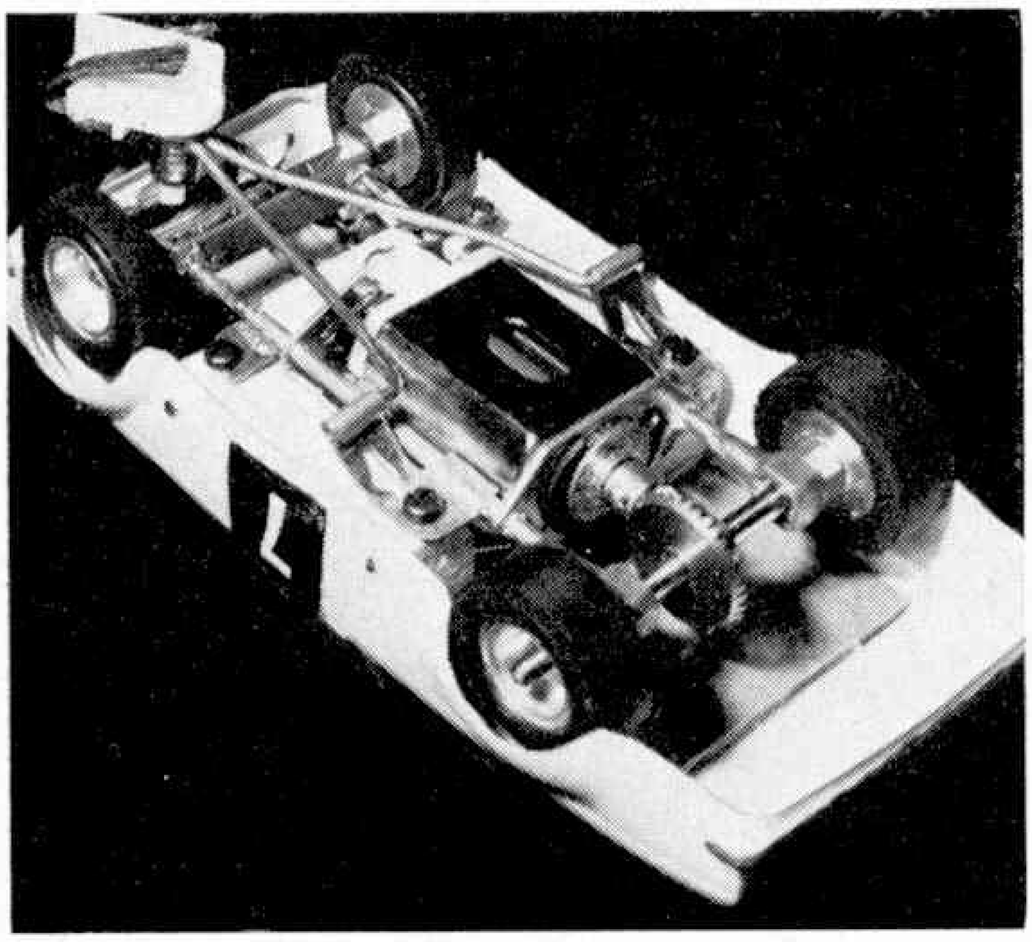
Using a medium sized brush, start by painting the main areas of the shell i.e. the roof, boot, mudguards and doors white. The slim door pillars were very carefully painted using a fine brush. If you get any paint on the windows *don't* attempt to remove it until dry, (unless you do it in the very early stages when it is best to wash all the paint away with white spirit and start again). Leave it to dry completely; then carefully scrape it away with a sharp knife, taking care not to scratch the plastic. The bonnet was left clear until the main body colour had dried, then it was painted blue, once again from the inside. The headlamp silver lenses were the only other parts painted from the inside (a fine brush for these). The radiator grill was painted, matt black, (fine brush). The front and rear bumpers are silver (fine brush). Similarly, only in gloss black, the number plates, front and rear, and the edge of the rear window. The windscreen and side window frames, door handles and petrol cap were once again silver, (fine brush). A rectangle was made on both doors using Sellotape to frame it. Then the inside area was filled in with matt black, left to dry and the " Sellotape " removed. White transfers were then applied and when dry, covered with clear varnish to protect them. The letters and numerals on the number plates were written very carefully in white using the fine brush.

The Rally lamps were made from odd bits of plastic from an old car kit cemented into the front, and painted red.

This completes the body painting, so let's turn our attention to the 1/32nd scale driver. RIKO do not sell one at the moment but there are several to choose from at most model shops. Paint his overalls white, face pink, goggles silver and his helmet any bright colour. Cut out a piece of card to fit across the interior between the bonnet and boot. Paint one side of it matt black and glue the driver to it. Fit it into the shell using " Sellotape " to hold it in place. Drop the chassis unit into the shell, and push four pins through the sides of the shell, into the balsa wood chassis support blocks to hold it in place. Your car is now ready for final adjustments. Turn each wheel slowly to see that it does not foul the body at any point, if it does either cut away a bit of the shell, or if the fouling is severe, re-position the chassis.

The gear will need a certain amount of running in before the car will perform at its best. Smear a small amount of toothpaste on the gear, and slowly run the car on the track for 15 minutes. (Toothpaste is a mild abrasive, and will wear away any excess metal on the gear teeth.) When the gears are meshing together nicely, wash away the toothpaste and lightly oil the gears and axles. Check that the tyres are running true on the wheels and your model should now be ready to challenge the rest of the field, we hope as successfully as Ford's full size Escort Twin Cam.

Parts Required: R779 Group S Ford Escort Body Shell 6s. R704 Adjustable Tubular Chassis 12s. R801 Deluxe Slot Guide 2s. 11d. R156 Budget Pack (wheels, tyres, axles etc.) 8s. 11d. R817 Bevel Gear and Pinion 6s. 11d. R1015 Rikowhip Motor 31s. Drivers Head 2s. Total Cost £2 19s. 9d. Also available, Interior and Drivers Head, part R649 at 2s.



This underneath view of the completed car shows how neatly the parts all fit in. Note the width of the rear tyres.

TRANSPORT TOPICS by Mike Rickett

PART OF last month's "Topics" dealt with the various improvements that are due to take place on the Tal-y-llyn Railway, a privately owned narrow gauge line operating in North Wales. Like many of the other privately owned and preserved lines existing in different parts of the country, the Tal-y-llyn relies heavily on volunteers and although it does have a small permanent staff, they could not hope to complete all the work of improvement without the enthusiastic support of their members, who voluntarily give their time and skill during weekends throughout the winter months.

First of all, to shatter any illusions you may have, do not expect to be given an engine to drive, whichever railway you decide to help on. After all, driving such a complicated machine like a locomotive is a very skilled business and where passenger carrying is concerned, the engine driver has to have passed a Ministry of Transport test, because the safety of many people are his responsibility. It is also doubtful if you would be given the task of firing a locomotive, because even this is not as easy as it seems. A fireman for instance has to know how to inject water into the boiler and also be prepared to shovel literally tons of coal into the firebox, in exactly the right place, within the space of only a few hours. He has to know all about brakes, and at the end of the day, know how to clean out the fire, and occasionally clean out the boiler tubes.

Learning to fire, let alone drive an engine takes a long, long time, and if any reader is really determined to make this his mission in life, then he must be prepared to pay regular visits to the railway of his choice, possibly every weekend, getting to know the permanent staff, and gradually gaining their confidence. At first, no matter what the new volunteer ultimately wants to do, particularly during the summer season, when most railways are especially busy. the volunteer must be prepared to do the most humdrum jobs. I remember when I first volunteered, being given the job of helping to weed the station platform —much to my disgust. It is however something that is very necessary.

By lowering his sights a little and by being willing to help with everything, the volunteer will meet a great many interesting people, all with the same interest, and he will be made very welcome by most of the preserved railways. Volunteers are always wanted to help on track replacement, repair or clearance, rolling stock repair, maintenance of buildings and lineside structures, if they are enthusiastic enough to learn from others. If you want to become a volunteer, you should join a railway preservation society like the Festiniog or the Tal-y-llyn. If you actually want to join in working parties or are willing to travel to the railway under your own steam, the best course of action is to write to the Manager of the railway concerned letting him know your abilities, and also your age, if under eighteen, and finally how often you would like to attend.

It is however important to turn up if you say you will, because the railway may well have counted on your support for a particular purpose. In some cases, it is better to join a local branch of the preservation society of your choice and although it is obviously impossible for me to give the addresses of all branches from every preservation society, what I would be willing to do would be to send your letter to the appropriate railway, if you address it to me c/o Meccano Magazine.

Above: The interior of part of the rebuilt Euston station in London. Right: K4 2-6-0 "The Great Marquess" restored to original L.N.E.R. livery and running on the preserved Middleton Railway near Leeds.

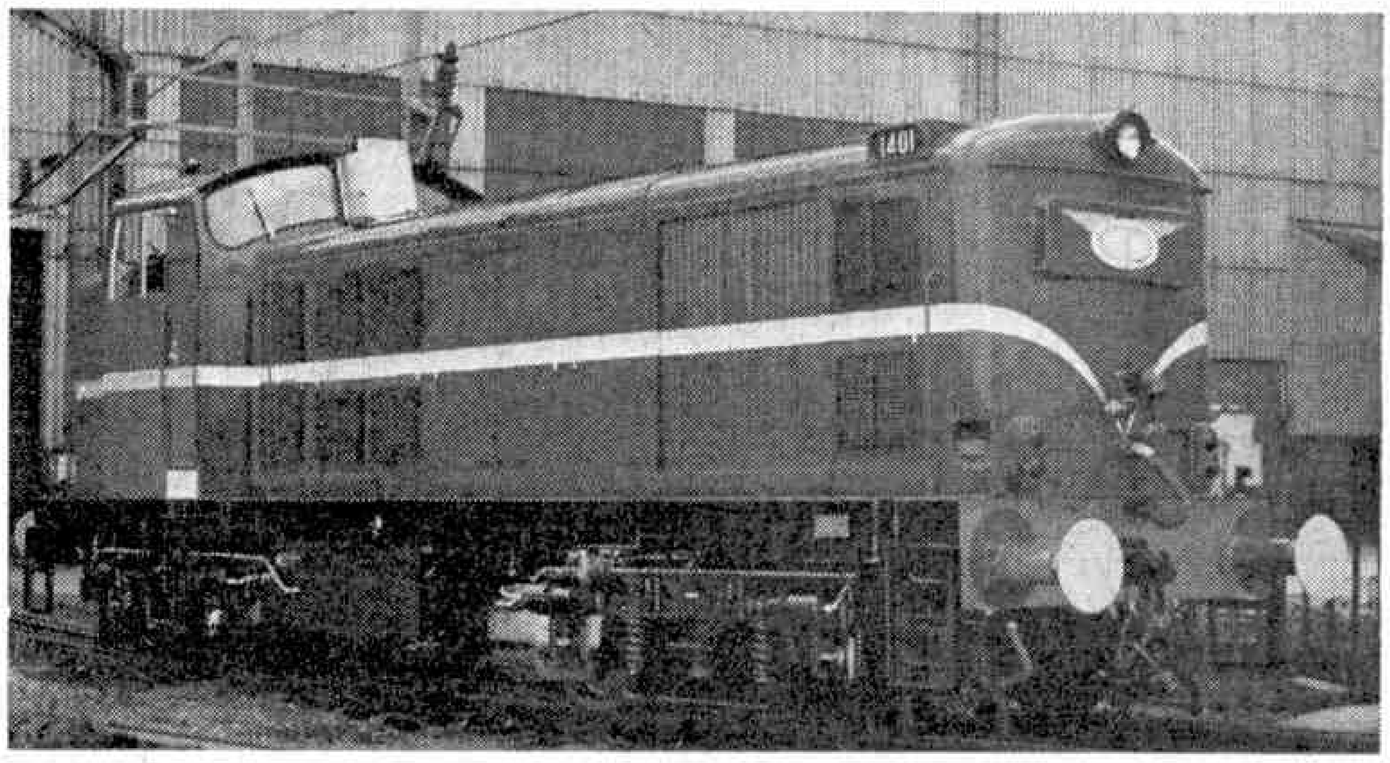
From improvements on small privately owned lines, we pass on to improvements to one of the oldest main line railway termini in Britain and certainly the oldest in London, which at last has emerged from its rebuilding with a face lift. At a cost of £15 million Euston Station is now the most modern in Europe and was officially opened by Her Majesty The Queen in October. The rebuilding of the station had previously been under consideration before both World Wars, and was undertaken as part of the London Midland Region's project for the electrification of its main routes linking London, the West Midlands and the North West.

A new concept which the new Euston makes use of is a travel centre inside the concourse, itself a new departure with a grey-green marble terrazzo-tiled floor, walls that are almost entirely glazed and a 647 ft. frontage finished in gleaming white mosiac and polished black granite. Now Euston has a total of eighteen platforms, varying in length from 700 ft. to 1,300 ft., three of which are used for parcels traffic.

For places a little farther away from home are the coaches recently supplied to the Congo from the Washwood Heath, Birmingham, works of Metropolitan-Cammell. Inspected by Embassy Officials of the Congo, these first class coaches will form part of a special train to be used by the President of the Republic in celebrations at Kinshasa next month to mark the third anniversary of the new regime. They were originally built as part of an order for 27 coaches for Rhodesian Railways, but after twelve had been delivered, sanctions were imposed following U.D.I. This order is the first to be secured by Metro-Cammell from the Congo and is worth £300,000.

It has also recently been confirmed that Ghana Railways and Ports has ordered from English Electric ten 2,025 h.p. diesel electric locomotives for its main freight routes. The locomotives, which are specially designed for heavy duty operation at high efficiency, will be the most powerful units ever to be employed there, and they will be used to pull trains of bauxite, manganese, timber and cocoa—commodities which play an important part in the Nation's economy. This is the fourth repeat order to be received from Ghana and will, when delivered, bring the English Electric fleet there up to forty-seven.

Specialists in locomotive construction, English Electric have supplied engines to many overseas railways and we show in one of the photos, a locomotive built for the Portuguese Railways. Built at Newton le Willows, forty of these were ordered, all for 5 ft. 6 in. gauge to be completed in Lisbon by the Portuguese Manufacturer, Sorefame.



One of the 50 Bo-Bo locos built and designed by English Electric.

RADIO TELESCOPES AND THE COSMIC

by Charles A. Rigby

WIDELY DIFFERENT from the conventional instrument used by astronomers, the radio telescope is another means of studying the heavenly bodies. Like man-made satellites they are also used for exploratory purposes but rather differently. This has given birth to the new and fascinating science of radio astronomy since radio waves or cosmic signals are emanated and reach earth over vast distances.

These emanations are picked up by the 'ear' of the radio telescope, otherwise the parabolic reflector referred to as a 'dish' or 'bowl', and heard as radio noise on receivers. By means of recording instruments this radio noise like atmospherics is shown as a graph with a distinct pattern, according to the source from which received. The discovery of radio astronomy came about quite by accident. In 1931, an American electrical engineer, Karl Jansky, working at the Bell Laboratories in New York was asked to find the cause of atmospherics in long-distance radio and telephone calls and by chance discovered that radio waves were reaching earth from outer space. This discovery meant that astronomers could detect stars they could not see with ordinary telescopes. However, the work he did was almost totally neglected. Later, an amateur astronomer, Grote Reber, built the prototype of the modern radio telescope in his garden, and many more people began taking interest in the new science.

With the beginning of the space age, the science also attracted interest in various countries including Britain, America, Russia, South Africa and France. No wonder that in so many countries, radio telescopes were wanted for future use. The US Navy's massive 600-foot parabloid 'dish', weighing some 20,000 tons was completed in 1962, and both Cornell University and the US National Radio Astronomy Observatory have radio telescopes with exceptionally large reflectors. Britain has several, including that at Jodrell Bank, near Manchester, and there are three at Cambridge, one at the University, and another at the Mullard Radio Observatory. Other telescopes were built for the Royal Radar Establishment at Malvern, and at Chilbolton' Hampshire, for the Department of Scientific and Industrial Research (DSIR).

Perhaps the best known in Britain is that at Jodrell Bank. The new telescope, the Mark II, has an accurate balanced paraboloid steel bowl with elliptical aperture with the focus in the aperature plane. This elliptical aperture measures 125-ft. on the major axis and 83 ft. 4 in. on the minor. A unique feature of the instrument is the use of a digital computer connected 'direct on line' with the Ward Leonard closed loop servo drives, giving a demanded velocity type of control. The revolving superstructure which carries the bowl is of concrete. In this respect and also in the form of the azimuth and elevation drive, the design is similar to that of the 85-ft. diameter satellite communications aerial of the GPO station at Goonhilly Downs in Cornwall.

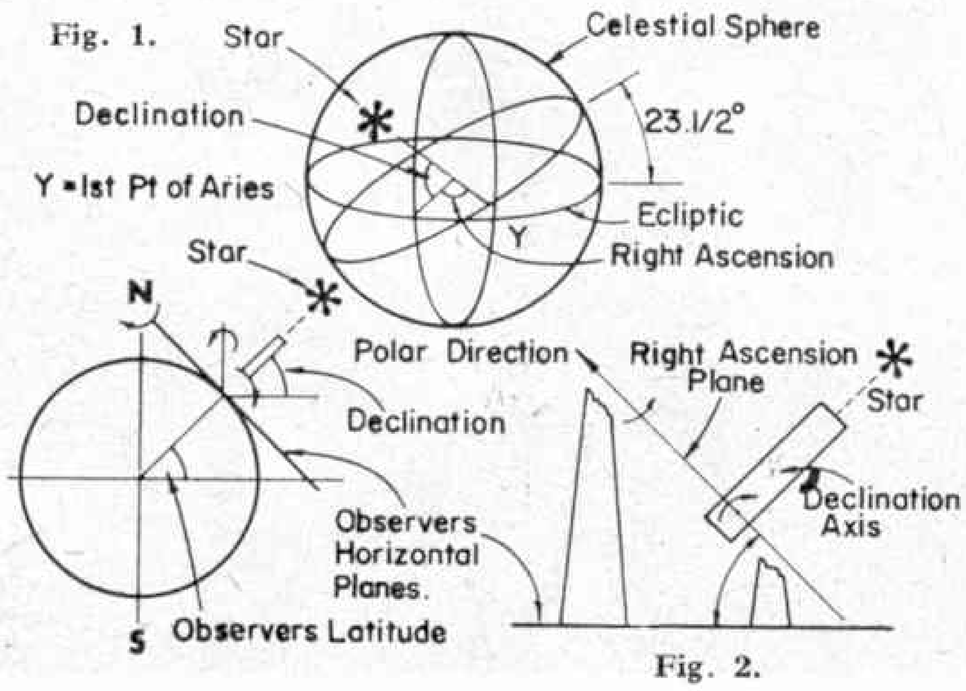
Australia acquired her radio telescope in 1961 for the Radio Physics Laboratory of the Commonwealth Scientific and Industrial Organisation. This is built on farm land some 13 miles north-west of Parkes in New South Wales, the site being chosen because its extremely low electrical noise level allows very weak signals from distant stars to be received without interference. Most wonderful to sightseers is the huge 210-foot diameter parabolic 'dish' or 'bowl' with its 'trellis work' presenting a symmetry of true geometric shape. One of the largest steerable instruments in the world, its huge 'dish' is mounted alt-azimuth fashion like a naval gun or theodilite on a 40-ft. concrete tower.

Canada's largest steerable radio telescope acquired by the National Research Council is sited at Algonquin Park Radio Observatory, Ontario. One of the major engineering problems was the designing of the system to control the 150-foot parabolic reflector for astronomical work in winds of up to 50-m.p.h. This was solved by mounting the telescope in vertical and horizontal axes, and making it follow the apparent motion of a master equatorial unit mounted at the intersection of the telescope's axes. The master equatorial unit is driven at a rate equal to the earth's speed of rotation, pointing steadily at the target star or radio source. Accuracy in pointing is better than 10 seconds of arc.

As many know, there are various types or styles of instrument. As will be noted from the photographs, the Jodrell Bank Mk. II reflector is quite different from that of Australia's, which has a 'trellis style' dish, being more like a 'bowl'. Actually, before starting on such a job, it is usual practice to make a model first, as will be seen from the photographs. There are many other differences in the superstructure, and other parts of the telescope. A steerable instrument calls on the resources of many diverse branches of engineering for its design and construction: electrical, mechanical and electronic, as well as structural.

The fundamental component is the paraboloid reflector which must have the property of concentrating at its focus, all incoming radio waves arriving in a direction parallel to the axis of revolution. An aerial or feed placed at the focus and pointing at the reflector thus receives, in elementary terms, a beam of radiation proportional to the reflector area, from a direction defined by the paraboloid axis.

The mounting of the reflector or 'dish' is also important. The 'dish' of Australia's radio telescope is mounted on a 40-ft. high concrete tower, while at Jodrell Bank, bowl tilting (elevation) motion is by screw, nut, and connecting rod, the lower end of the rod being attached to the nut and the upper end to the bowl structure, which is able to pivot through bearings



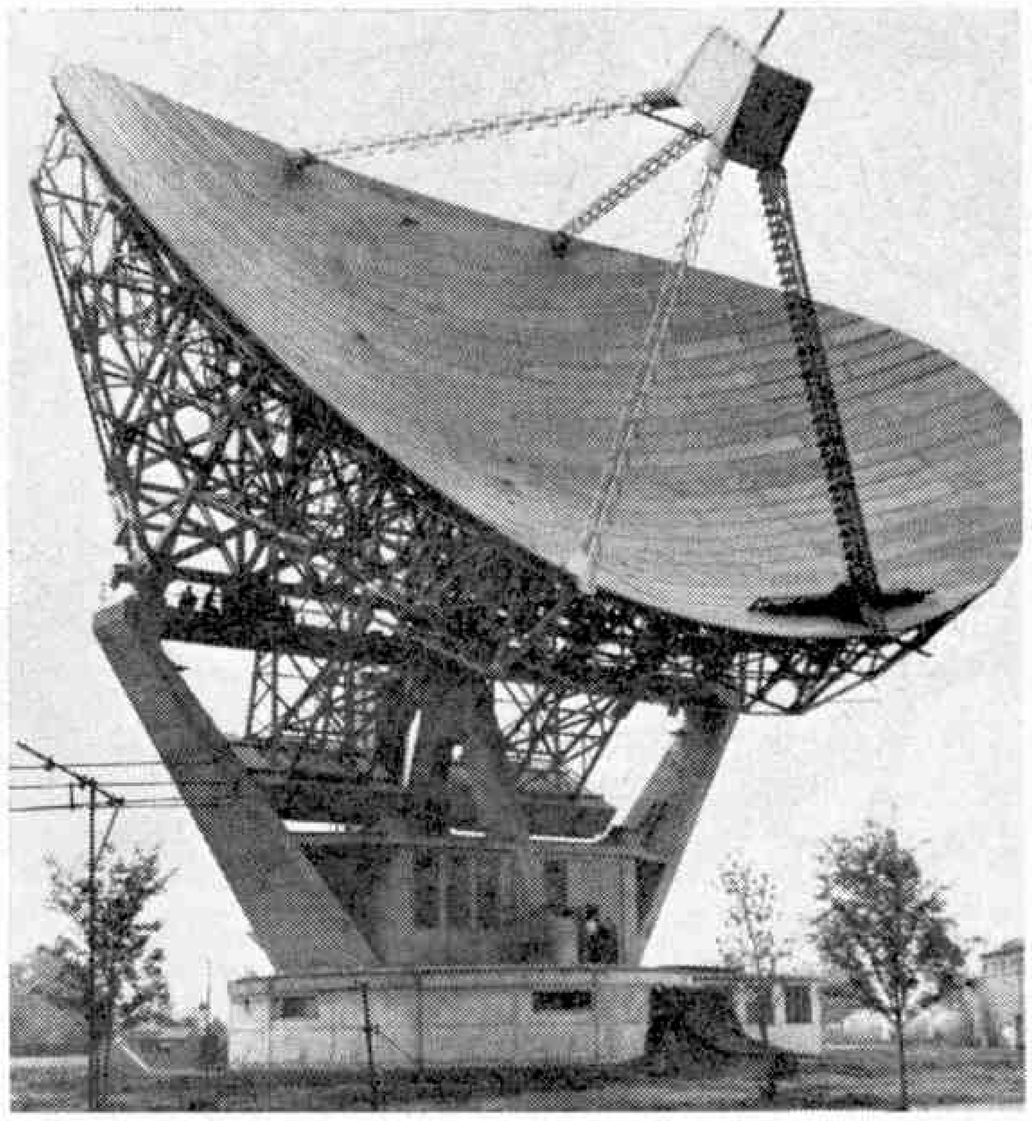
mounted on the top horizontal beam of the pre-stressed concrete structure. There are also the various places in the actual building where the scientists work and the engineers get busy, such as the computer and control desk, the master equatorial room, motor room, cable room, hub room, radio room, store room and other necessary parts essential for the efficient handling of the radio telescope.

Referring again to Jodrell Bank Mk. II, this telescope is principally intended for use as follows: (a) Observation of fixed radio sources, (b) Scanning a particular area of the sky in order to prepare radio intensity contour maps, and (c) Satellite tracking—the telescope is then steered to follow a particular orbit from predetermined positional information. In (a) and (b) the computer is used to compute out the rotation of the earth while in (c) it will be acting as interpolator accepting pre-calculated pointing angles at perhaps one second intervals and calculating intermediate angles at perhaps 50 times per second.

The following is also important. The position of celestial objects is defined in terms of a latitude-longitude system of co-ordinates in which all objects are assumed to lie on the surface of a sphere of large but not infinite radius whose centre is the earth. The equatorial plane and polar directions are taken as those of the earth produced to meet the surface of the sphere. The reference point of longitude, or as it is better known the 1st point of Aries, is the point of intersection of the equatorial plane and the plane of the sun's relative motion about the earth (the ecliptic). In fact there are two such points of intersection corresponding to the position of the sun on March 21st and September 21st and the former is chosen as the point of reference.

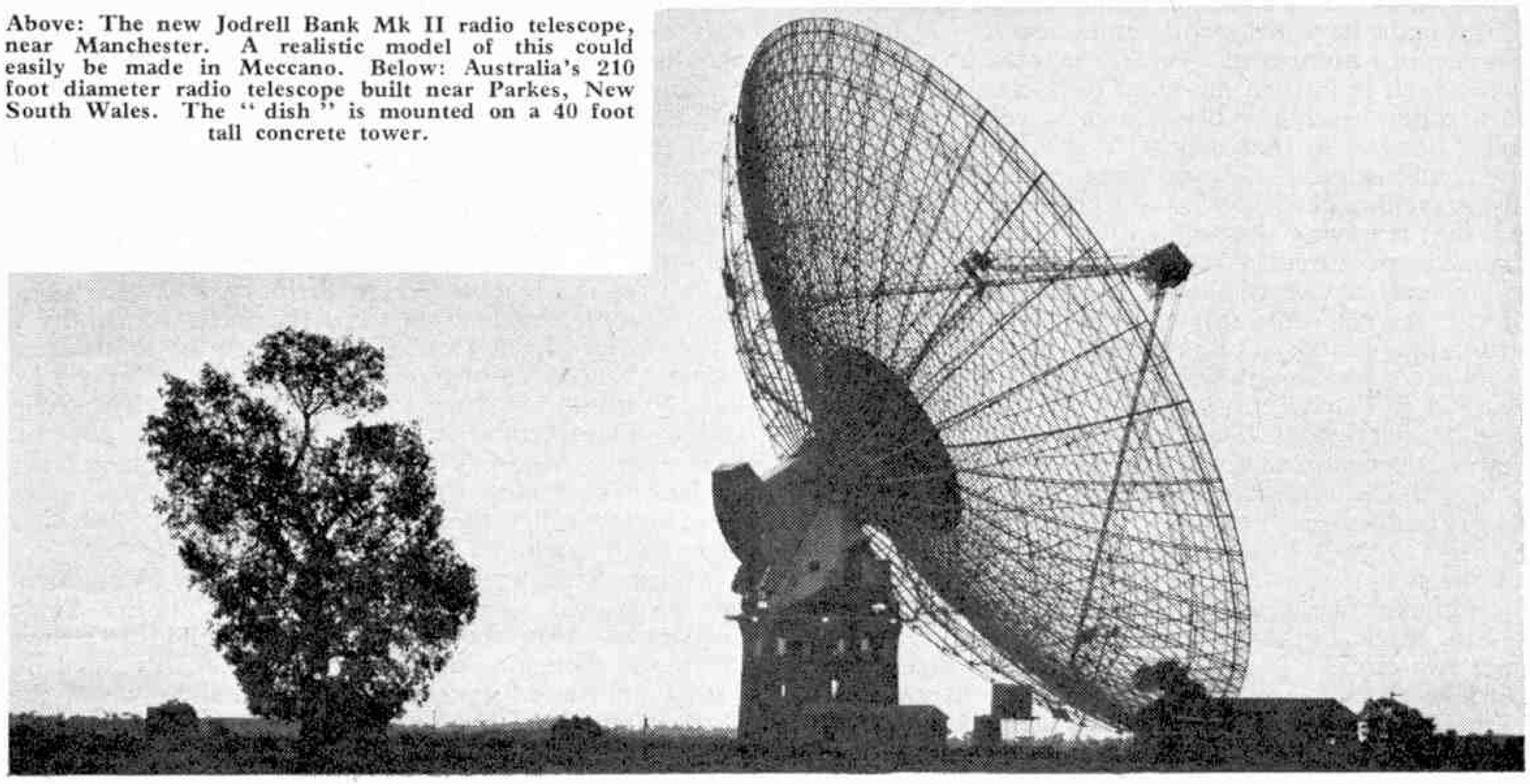
It will be apparent from Fig. 1 that to an observer situated on a plane parallel to the equator, a fixed star will appear to change in azimuth only. This fact is used in the design of mounts for all optical telescopes which greatly simplifies the problem of observing fixed objects in that once the axis of the telescope has been aligned to the angle of declination, it need only be driven at the same rate and in the opposite direction to the earth's rotation in the right ascension plane.

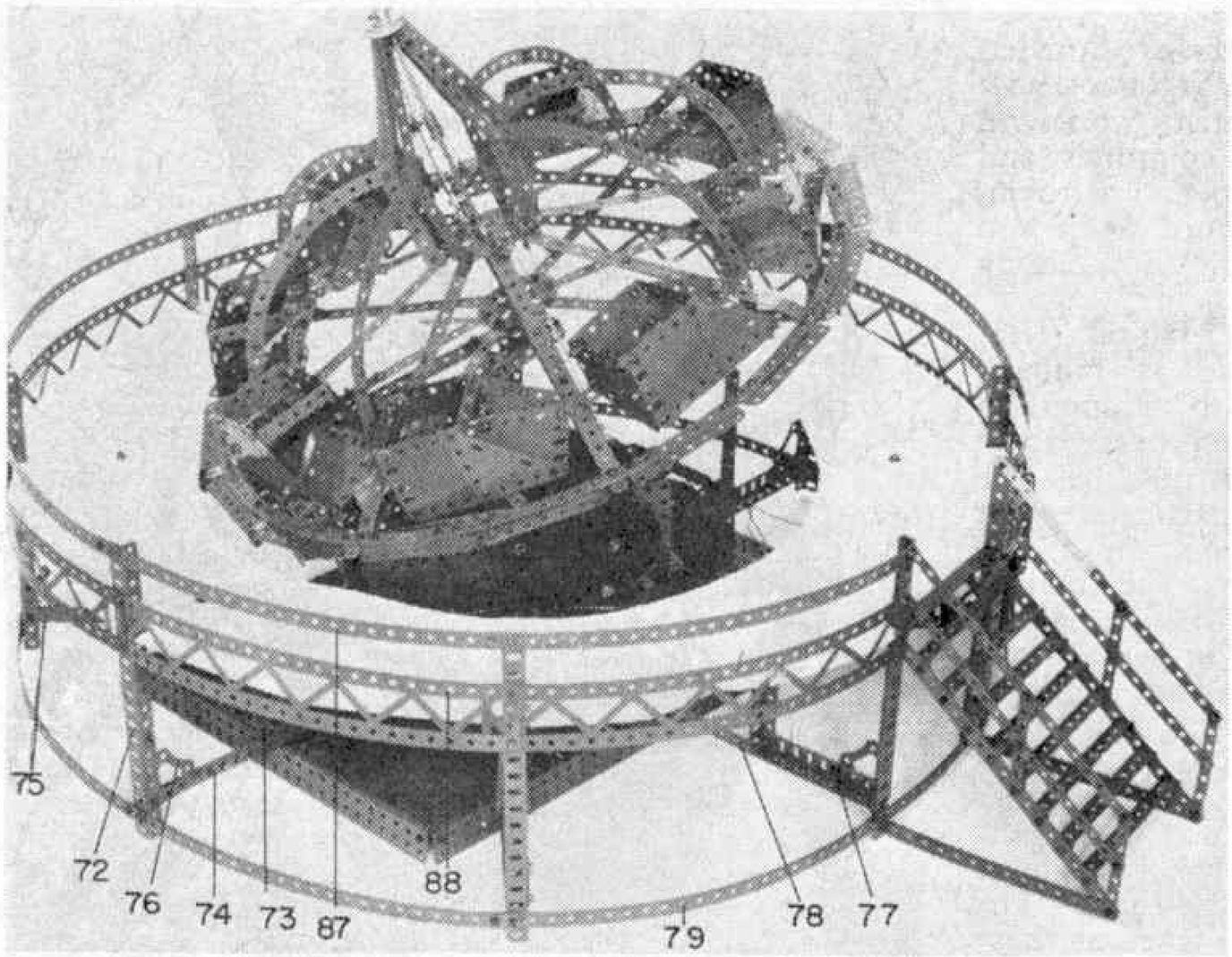
The big dish of a radio telescope when in operation may not only be listening to things tremendously far



away, but listening to things incredibly long ago. The graphs produced vary a great deal according to the heavenly body and other factors. The planet of Jupiter has attracted the attention of radio astronomers lately because of its nearer position to earth. Astronomers speak of 'light years away or distant' so that the statement "6,000,000,000 light years away" implies that the star or point of light looked at or seen, started on its journey to earth 6,000,000,000 light years ago. In other words, one would be looking back 6,000,000,000 light years into the past. It seems impossible but such a star has been seen by radio astronomers who reported that it was just 'a faint and tiny dot of light in the middle of a scattering of stars'. The astronomers at Mount Palomar were told where it was and they were asked to search for it with the 200-inch astronomical telescope which they did.

Above: The new Jodrell Bank Mk II radio telescope, near Manchester. A realistic model of this could easily be made in Meccano. Below: Australia's 210 foot diameter radio telescope built near Parkes, New South Wales. The "dish" is mounted on a 40 foot tall concrete tower.





MECCANO SATELLITE

by Spanner

HAVE YOU older readers re-visited a permanently-sited fairground recently after a break of several years ? If so, I'll guarantee you were surprised by the numerous new machines that have been invented of late to thrill—or upset—those brave heroes who have the courage to try them !

Up to a few years ago a fair was a good one if, besides the usual sideshows, it had dodgems, several roundabouts, a big-dipper and, of course, a Waltzer. Nowadays, these things, while still necessary amusements, are a bit old-hat. All sorts of better, more terrifying machines have appeared: raceways, flying jets whose height can be controlled by the " pilot " and a whole variety of twisting and twirling machines that make me—at least—feel as if I'm about to die !

One example of the last type has provided the inspiration for the new Meccano model featured here. The original was found at New Brighton fair where it is known as " The Satellite " but I expect that different fairgrounds have different names for it. It basically consists of a number of " cars " mounted on a revolving disc which is in turn mounted on a cranked arm fixed to a roller bearing. The arm also revolves with the roller bearing so that, when the model is in operation the combination of the two speeds results in the upper disc travelling particularly fast in relation to the ground. As the revolving motions take place, however, the cranked arm extends causing the upper revolving disc to tilt and, as the arm itself is revolving, the position of the disc is constantly changing so that somebody sitting in a car doesn't know where he is !

By using two Power Drive Units, it has been possible to make the model reproduce all the movements of the original, yet, despite the apparently complicated operation, construction is reasonably straightforward. Beginning with the central arm section, a base for the roller race is built up from two 18½ in. Angle Girders 1 joined by two 12½ in. Angle Girders 2 and two 12½ in. Strips 3. The vertical flanges of both sets of Girders are extended by suitable Flat Girders, as shown. A further two 18½ in. Angle Girders 4 are bolted between Girders 2, then two similar Flat Plate arrangements are fixed to Girders 1, each arrangement consisting of two 5½ × 3½ in. Flat Plates 5 connected by a 4½ × 2½ in. Flat Plate 6 to result in a 12½ in. long compound flat plate. A 9⅞ in. Flanged Ring 7 is fixed to the centres of Strips 3 and Angle Girders 4, the securing bolts also fixing two 9½ in. Strips 8, at right-angles to each other, to the Flanged Ring.

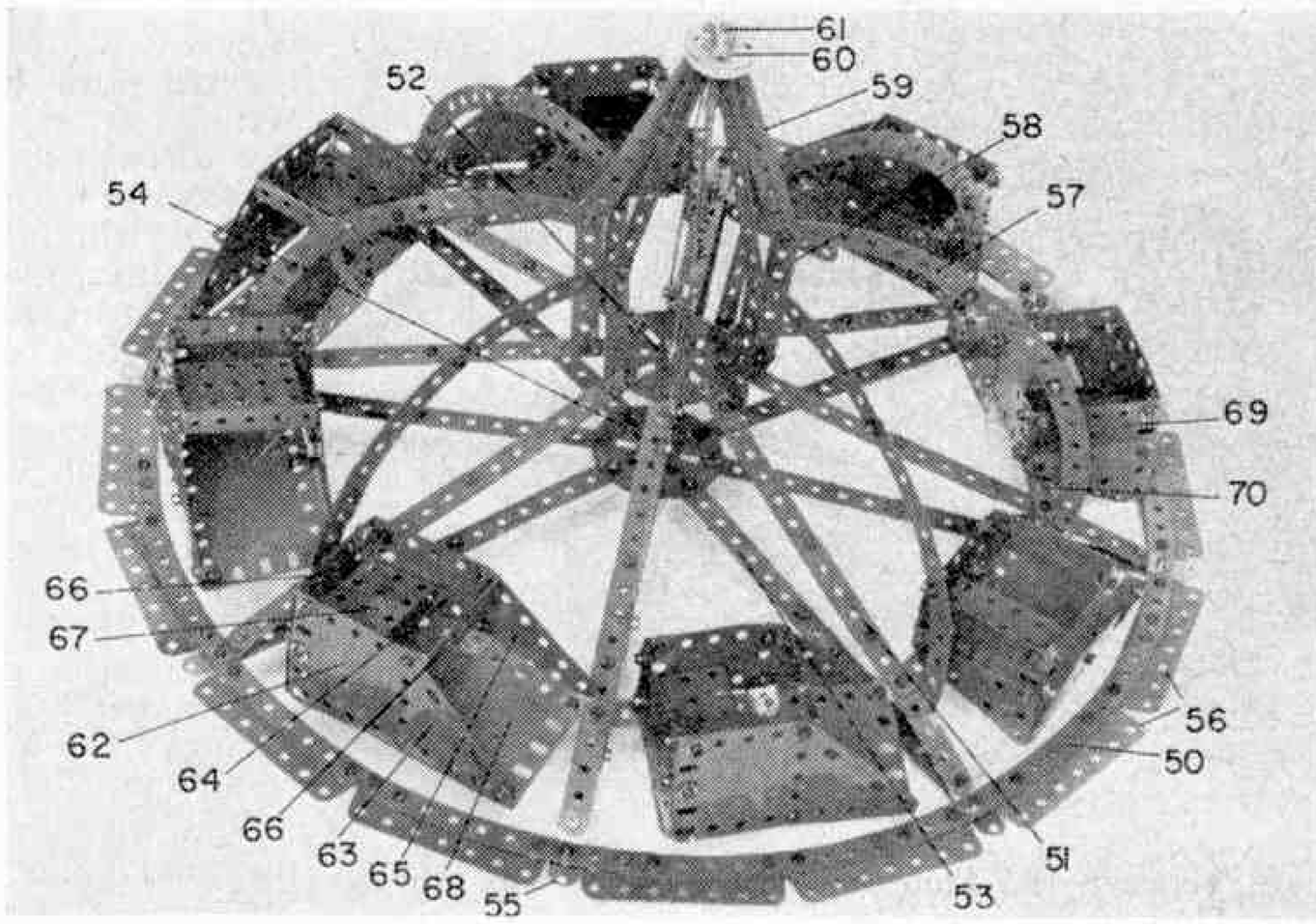
At this stage, the drive for the central rotating arm should be produced. Two 2½ × 2½ in. Flat Plates 9 are attached to one of the earlier-mentioned Flat Plate arrangements by 2½ in. Angle Girders, further 2½ in. Angle Girders being bolted to the tops of the Plates. The latter Girders are joined by two 2½ in. Angle Girders 10, the flanges containing the circular holes being vertical. Passed through the centre circular hole in outside Girder 10 is a 1 in. Rod 11 on which two Compression Springs and a Short Coupling are mounted. Journalled in the inside transverse bore of this Short Coupling and in Flat Plate 6 is a 4 in. Rod 12 carrying, in order, a 2 in. Pulley with Motor Tyre 13, a Coupling, a 1½ in. Contrate Wheel and a Collar, the last holding the Rod in place. Note that the Rod passes through one end transverse bore of the Coupling which, incidentally, should be loose on the Rod. Inserted loose into the longitudinal bore of the Coupling is a 2½ in. Rod held in place by a Collar and carrying a ½ in. Pinion in mesh with the 1½ in. Contrate Wheel and a 1½ in. Sprocket Wheel 14. This Sprocket is connected by Chain to a ¾ in. Sprocket on the output shaft of a Power Drive Unit bolted to one Plate 5.

Bolted to the other Flat Plate arrangement are a 2½ in. × ½ in. Double Angle Strip 15 and two 1½ × ½ in. Double Angle Strips 16, the latter joined by a 2½ in. Strip. Each Double Angle Strip 16 is attached to the adjacent lug of Double Angle Strip 15 by a 2 in. Perforated Slotted Strip. Journalled in the 2½ in. Strip and in Flat Plate 6 is a 3 in. Rod carrying a 1½ in. Pulley with Motor Tyre 17 and held in place by a Collar. The Pulley with Motor Tyre will later serve as a steadying roller for the upper section of the roller race which is another 9⅞ in. Flanged Ring 18.

Tightly fixed to this Flanged Ring are a 9½ in. Strip 19, positioned diametrically, and two 4½ in. Angle Girders 20. Note that the latter are mounted with their horizontal flanges uppermost and are actually fixed on ¾ in. Bolts passed through the horizontal flanges of the Girders and held by Nuts in the Flanged Ring. A 1½ in. Insulating Flat Girder (Elektrikit Part No. 508)

At left: One of the latest " amusements " for giving thrills at fairgrounds is the " Satellite ". This large Meccano model reproduces all the nerve-shattering movements of the original.

At right: A close-up view of the complete upper rotating disc with its cars. Although it may look complicated, this part of the model is, in fact, quite easy to build.



Below: In this view of the model, the framework and superstructure have been removed to show the main base and elevating arm sections with their separate drive arrangements.

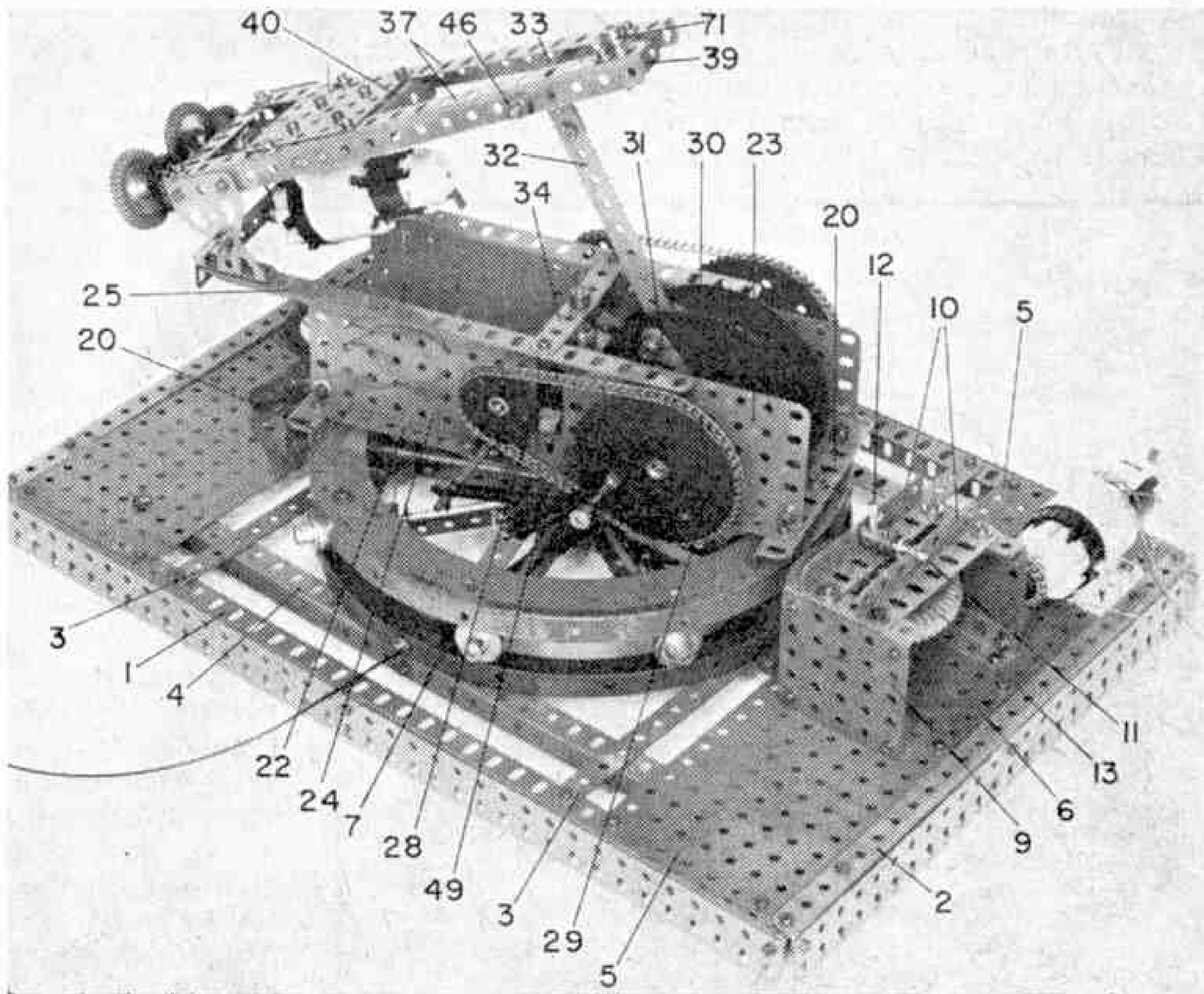
is bolted to this Strip, the securing Bolts passing through the seventh and eighth holes of the Strip and a 1 in. Wiper Arm 21 is secured to the Insulating Girder.

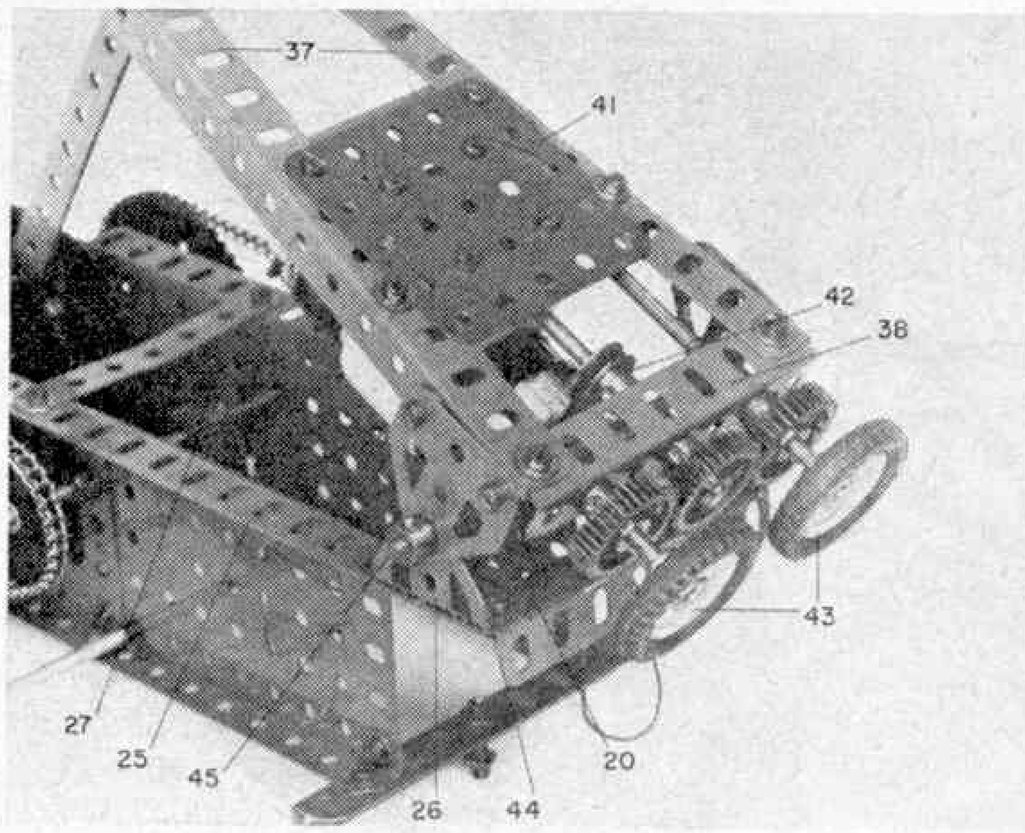
Bolted between Angle Girders 20 are two 9½ in. Angle Girders 22 to each of which two 4½ × 2½ in. Flat Plates 23 and 24 are secured, a distance of one hole separating the Plates. (A distance of five clear holes separates the Girders.) A further two 9½ in. Angle Girders 25 are bolted to the upper edges of Plates 23 and 24 in such a position that they project four holes beyond Plate 24, after which the projecting ends are connected by a 3½ in. Angle Girder, the securing Bolts also helping to fix two Trunnions 26 to Girders 25.

The inside edge of each Plate 24 is overlayed by a 2½ in. Strip to help provide extended bearings for a 5 in. Rod carrying a ½ in. Pinion 27 at its centre and a 1½ in. Sprocket Wheel 28 at each end. These Sprockets are connected by Chain to two 3 in. Sprockets 29, each mounted on a 2 in. Rod journalled in Flat Plate 23 and in a Double Bent Strip bolted to the Flat Plate. Fixed on the inside end of each Rod is an 8-hole Bush Wheel to which a 4 in. Circular Plate 30 is bolted, one of the securing Bolts helping to secure two Cranks 31, one to each side of the Plate as shown. Washers are mounted on the remainder of the securing Bolts to ensure an even lie. Held in the bosses of both sets of Cranks 31 is a 1½ in. Rod, in the centre of which two 5½ in. Strips 32, one on top of the other, are fixed. Another Crank 33 is secured to the upper end of these Strips.

A 3½ in. Strip 34 is now bolted between the sixth holes of Angle Girders 25. Journalled in this Strip and in Strip 19 is a 6 in. compound rod carrying a Worm and held in place by Collars, one above Strip 34 and the other below Strip 25. The Worm engages with Pinion 27. Fixed on the rod immediately beneath the lower Collar is a Commutator 35 (Elektrikit Part No. 551) which makes permanent contact with Wiper Arm 21 The compound rod, by the way, consists of one 2 in. Rod and one 4 in. Keyway Rod 36 joined by a Coupling.

Incorporated in the elevating section of the central arm is the drive unit for the upper rotating disc. Before it can be fitted, however, the arm section is built up from two converging 9½ in. Angle Girders 37 joined at one end by a 3½ in. Angle Girder 38 and towards the other end by a 1½ in. Angle Girder 39, this Girder being secured through the second holes of Girders 37. Girders 37 are further joined through their twelfth holes by a 2½ in. Angle Girder 40, the securing Bolts also fixing a 2½ in. × 2½ in. Flat Plate 41 in position. The Plate is additionally secured by the trapping action of Washers mounted on Bolts fixed in Girders 37, then a Power Drive Unit is attached to the underside of the Plate by Threaded Bosses so as to leave a





space between the Plate and the base of the Power Drive Unit.

This space allows three 5½ in. Rods to be journalled in Girders 38 and 40, each Rod carrying a 1 in. Gear and held in place by a Collar. A ½ in. Pulley 42 is fixed on the centre Rod beneath Plate 41 and is connected by a 2½ in. Driving Band to a ½ in. Pulley on the output shaft of the Power Drive Unit. A 1 in. Pulley with Motor Tyre 43 is fixed on the outside end of the two remaining Rods, as shown. A Flat Trunnion 44 is now bolted to each Girder 37 but is spaced from it by two Washers *on the inner securing Bolt only*. This makes the Trunnions parallel and enables the complete construction to be pivotally connected to the previously-described section of the arm by a 4½ in. Rod 45, held by Collars in the apex holes of Flat Trunnions 44 and Trunnions 26. Crank 33 is mounted on a 3 in. Rod 46, held by Collars in the fifth holes of Girders 37.

Having completed the elevating arm, it can now, if required, be fitted to its base. A " spider " for the roller race is easily built up from a Face Plate 47, to which eight radiating 2½ × ½ in. Double Angle Strips 48 are bolted. Journalled in the lugs of each of these Double Angle Strips is a 5 in. Rod held in place by a Collar and a Spring Clip and on the end of which a ¾ in. Flanged Wheel is mounted. The Flanged Wheels run on the flange of Flanged Ring 7. The central arm section is lowered until Flanged Ring 18 lies on the Flanged Wheels, at which time Keyway Rod 36 should pass free through the boss of Face Plate 47 to be fixed in the boss of a Double Arm Crank bolted to the centre of one Strip 8. Pulleys with Motor Tyres 12 and 17 should engage with the flange of Flanged Ring 18, the former being pressed hard against the Ring by the action of the Compression Springs on Rod 11.

You will, of course, have realised that Pulley with Tyre 13 drives the revolving arm, using the friction drive method. It is therefore a good idea to glue strips of sticking plaster or emery paper, etc., to the flange of Flanged Ring 18 to increase adhesion.

The weight of the elevating arm is counteracted by six Tension Springs 49 in two sets of three, each set held by a Collar on a Long Threaded Pin fixed in the face of Sprocket Wheel 29. The other ends of two of the Springs are tied to Strip 19, while the third is mounted on an 8 in. Rod held by Spring Clips in Flat Plates 24.

Now we come to the actual revolving disc carrying the cars. A ring is built up from fourteen 5½ in. Curved Strips 50 suitably overlapped to result in the ring having 120 holes. Two sets of spokes are then produced, one from eight 8½ in. compound strips 51, attached to a Face Plate 52 by Obtuse Angle Brackets, and the other from eight 9½ in. compound strips 53 bolted direct through their end two holes to another Face Plate 54. All the compound strips each consist of two overlapping 5½ in. Strips. Spokes 51 are attached to the ring by Obtuse Angle Brackets while spokes 53 are fixed direct to the ring, a single Bolt being used to secure the Obtuse Angle Bracket and the lower spoke in each case and, at the same time, extending the lower spoke with a Fishplate 55. Sixteen 3½ in. Flat Girders 56 are bolted around the ring to provide a flat surface to which the separate friction drive for this part of the model will be applied.

Eight 10 in. compound curved strips 57 are next each produced from three 4 in. Stepped Curved Strips, suitably overlapped. One end of each compound strip is attached by an Angle Bracket to appropriate spoke 53, the other end being bolted to the joint between a 3½ in. Strip 58 and a 4½ in. Strip 59. Strip 58 is attached by an Angle Bracket to corresponding spoke 51 while Strip 59 is wedged inside a 1⅛ in. Flanged Wheel 60 mounted on a 12 in. compound rod 61, obtained from one 4 in. and one 8 in. Rod joined by a Coupling. Compound rod 61 is also held in the bosses of Face Plates 52 and 54.

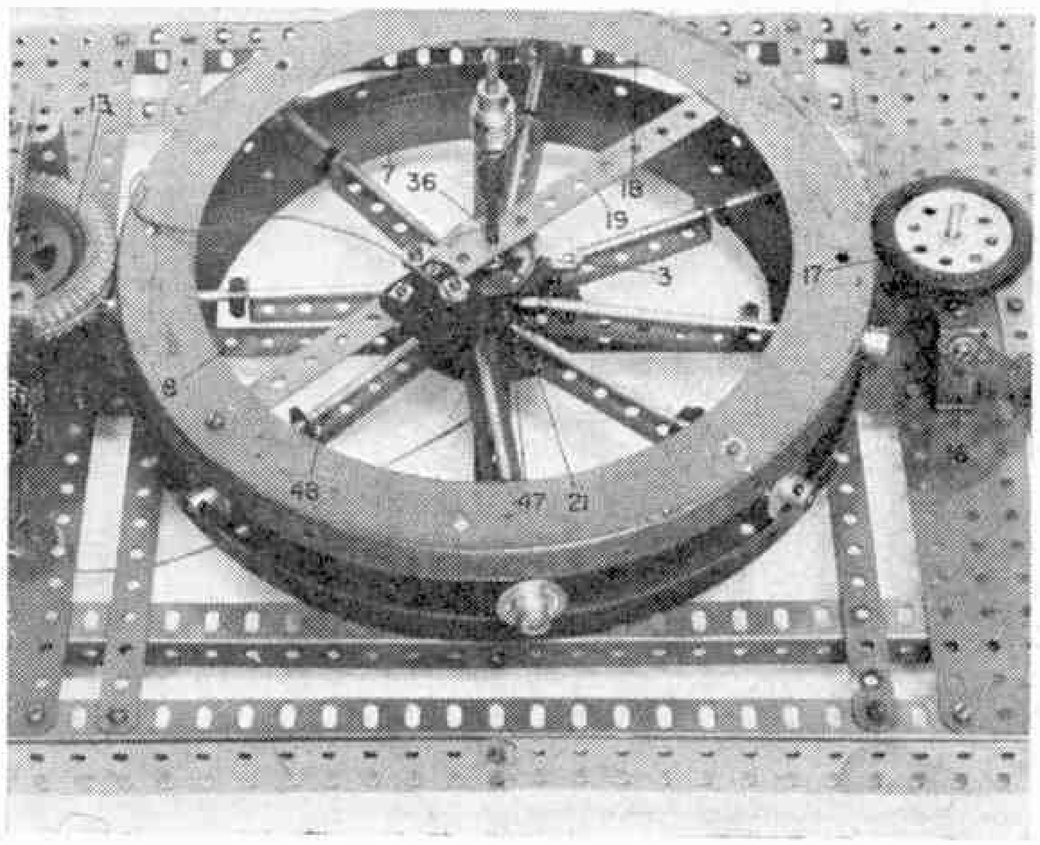
Turning to the cars, each of these is similarly built, one side consisting of a 2½ × 2½ in. Flexible Plate 62 extended by a 2½ × 2½ in. Triangular Flexible Plate 63, and the other side being a 2½ × 1½ in. Flexible Plate 64 extended by a 2½ × 2 in. Triangular Flexible Plate 65. The sides are joined by two 2½ × ½ in. Double Angle Strips 66 and a 2½ × 1½ in. Flanged Plate 67. An angled floor is provided to correspond with the angle of the revolving disc and is obtained from a 4½ × 2½ in. Flexible Plate 68 attached to the smaller side by Obtuse Angle Brackets and to the larger side by Angle Brackets bent to an acute angle. A 2½ × 1½ in. Flexible Plate 69 extended by a 2½ × 1½ in. Triangular Flexible Plate completes the back of the car which is then fixed to spokes 51 by a 1½ in. Strip 70 at the rear and by a Fishplate at the front.

Once the revolving disc has been completed, it is mounted on the elevating arm by inserting compound rod 61 in the boss of a Double Arm Crank 71 bolted to Angle Girder 39, a Collar spacing the boss of Face Plate 54 from the boss of the Crank. A Compression

PARTS REQUIRED

17—1	1—16	8—48c	2—111
7—1a	1—16a	8—48d	6—111c
4—1b	1—16b	8—51	2—115
36—2	3—17	4—52a	2—115a
8—2a	1—18a	30—53a	1—120b
12—3	1—18b	26—54	2—126
2—5	1—20	22—59	2—126a
8—6a	1—20a	5—62	4—133
2—7a	8—20b	2—63	1—142a
2—8	1—21	2—63d	2—142c
14—8a	2—22	2—64	1—142d
6—8b	2—23a	4—70	2—146a
8—9	2—24	1—72	2—167b
4—9a	2—26	14—89	16—188
4—9b	1—28	24—89b	8—190
5—9d	3—31	1—94	8—191
1—9f	1—32	2—95a	8—221
16—10	1,000—37a	2—95b	8—222
40—12	1,000—37b	7—99	8—223
32—12c	500—38	1—100	1—230
1—13a	6—43	4—103a	4—235b
4—14a	2—45	2—103b	8—235f
9—15	2—48	16—103d	1—507
1—15a	26—48a	4—108	1—508
2—15b	24—35	3—109	1—511
			1—532
			2—551

The built-up roller bearing fitted to the model. Note that the Flanged Rings 18 and 19 should run on the flanges of the Flanged Wheels incorporated in the "spider" of the bearing.



Spring is mounted on the rod, beneath the Girder to provide tension and is held in place by a further Collar. With the disc in position, Pulleys with Motor Tyres 43 should coincide with Flat Girders 56.

This leaves us with the circular superstructure to be built which presents no great problems. Six supports are each produced from a 9½ in. Angle Girder 72 attached to a 5½ in. Angle Girder 73 by a 7½ in. Angle Girder 74, the last projecting a distance of six holes past Girder 73. In four of the supports the connection between Girders 72 and 74 is strengthened by a 1½ in. Corner Bracket 75, while a Corner Gusset 76 is used in the remaining two supports, then the top of Girder 73 in each case is connected to Girder 72 by a 4½ × ½ in. Double Angle Strip. Another two supports are next built up; identical to the first six except that 7½ in. Girder 74 is replaced by a 4½ in. Angle Girder 77, then all the supports are attached to the roller race base, the first six by bolting Girders 74 direct to the base and the last two by extending Girders 77 with 9½ in. Strips 78. Notice that the two slightly different supports are placed diametrically opposite each other.

Girders 72 are now connected by a complete ring made up of eight 12½ in. Strips 79 bolted through the second holes of the Girders. A set of steps are added, one of the uprights being supplied by one 9½ in. Girder 72 and the other by a further 9½ in. Angle Girder 80. The uprights are joined by a 5½ in. Strip 81, attached by Angle Brackets, the securing bolts also fixing two 9½ in. Strips 82 in place. The other ends of these Strips are connected to the lower ends of the uprights by 7½ in. Strips 83 then the steps are provided by eight 5½ × ½ in. Double Angle Strips 84 bolted between Strips 82. A handrail at each side is supplied by two 9½ in. compound narrow strips 85 attached by two 3½ in. Narrow Strips 86, as shown.

Enclosing the whole superstructure, except the entrance-way, is a "fence" obtained from seven 12½ in. Strips 87 extended by one 5½ in. Strip, and seven 12½ in. Braced Girders 88 extended by one 5½ in. Braced Girder.

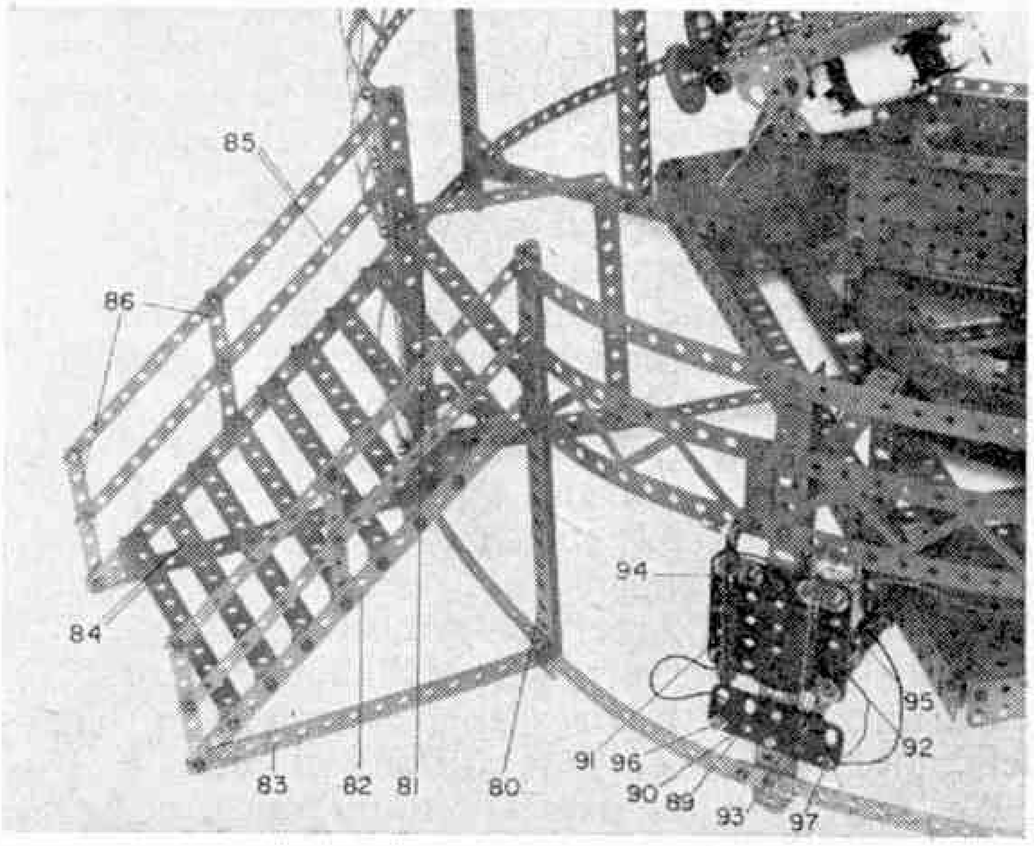
Finally, as far as construction goes, a floor is provided by hardboard or cardboard segments bolted to the Double Angle Strips joining Girders 72 and 73. This, at least, is the cheapest way of doing it, but, if you had sufficient parts, you would almost certainly be able to use Plates of various sorts.

All that now remains to be seen to are the electrical circuits. First, however, a switch assembly is produced from a 2½ × 2½ in. Insulating Flat Plate 89 bolted to one Girder 72, a 2½ in. Insulating Flat Girder 90 being fixed lower down the same Girder. Two 3½ in. Strips 91 and 92, each carrying a Threaded Pin to act as a handle, are lock-nutted to Angle Brackets 93 bolted to Plate 89, then a further two pairs of Angle Brackets 94 and 95, arranged "back-to-back" as shown, are fixed to the upper corners of the Plate. The free lugs of these latter Brackets should be bent apart slightly to allow Strips 91 and 92 to fit tightly between them. The enamel should be scraped from the Strips where they are lock-nutted to Brackets 93 and where they make contact with Brackets 94 and 95 to ensure that good electrical connections will be made. Two terminals 96 and 97, supplied by Bolts are fixed to Insulating Flat Girder 90.

Coming finally to the wiring of the model, Angle Brackets 93 are connected together by a short length of insulated wire, then terminal 96 is connected to one of the Angle Brackets. Terminal 97, on the other hand, is earthed by connecting it to some part of the model (we used Flanged Ring 7), making sure that the connection is not insulated by the enamel of the part to which it is connected. In the case of the Power Drive Unit fixed to the roller bearing base, one of its motor leads is simply connected to terminal 97, the other being connected to Angle Brackets 95.

The Power Drive Unit fixed to the elevating arm is just as simple. In this case, one of its motor leads is connected to Commutator 35, while the other is earthed. (We connected it to Flanged Ring 18). The last job, however, is a little more complicated. A length of very thin insulated wire is connected to Wiper Arm 21 and is then threaded down the slot in Keyway Rod 36 to be finally connected to Angle Brackets 94. The leads from the power source are taken to terminals 96 and 97.

Note it is essential that all earthed connections make good electrical contact, therefore it is advisable to remove the enamel from around the points where the connections are to be made. Remember also that, for the upper motor to work, earthed current must pass through the roller bearing. To ensure that this happens, the enamel should be removed from the ends of the flanges of Flanged Rings 7 and 18.



In this view of the Meccano Satellite, the steps of the model as well as the electrical switch gear controlling the two Power Drive Units are clearly shown.

Great Engineers No. 12

WILLIAM MURDOCK

(1754–1839) by A. W. Neal

WILLIAM MURDOCK was born in 1754 at Auchinleck in Ayrshire. As a young man he worked in his father's mill and helped to maintain its machinery, also no doubt, he helped with millwrighting undertaken by his father for local clients. It also seems, that he played a prominent part in the construction of bridges and masonry.

The limited scope offered by his environment was insufficient to satisfy his growing ambitions and, having heard of the developments being undertaken by James Watt at Soho, he went there in 1777. He was interviewed by Watt's partner Mathew Boulton who was very impressed, especially by his wooded hat which he had made 'in a bit laithey of my own contriven'.

In 1779 Murdock was sent to Cornwall and worked diligently on erection and repair of the Watt steam engines, smoothing out troubles with the Mining Captains and acting as a general agent. Boulton wrote from Cornwall to Watt, in 1781:

"Murdock hath been indefatigable ever since he began . . .", an opinion he held to the end.

During the little leisure time he had at Redruth, Murdock built a model steam carriage. This was a three-wheeled vehicle with a small copper boiler heated by a spirit lamp. The bore of the cylinder was only ¾ in., and the stroke was 2 in. This little engine, possibly the smallest one at that time, worked by the expansion of steam, the exhaust being discharged direct into atmosphere.

Watt was not very pleased about Murdock's experiments and advised their termination. His letter of September, 1786, to Boulton said:

"I have still the same opinion concerning the steam carriage, but, to prevent more fruitless argument about it, I have one of some size in hand. In the meantime, I wish William could be brought to do as we do, to mind the business in hand, and let such as Symington and Sadler throw away their time and money in hunting shadows."

It is possible that Watt was just a little jealous of Murdock. Living, as he did, with inventors, Murdock became inspired with the same spirit. He was suggesting new advances and, in 1791, took out his first patent. It related to a method of protecting the bottom of ships by the application of a kind of chemical paint.

But Murdock is better known for his work in the coal gas field, although there were others turning their attention to this subject. It is recorded that in 1792 he was lighting his house with coal gas, using an iron retort from which pipes were run to the various rooms of his home. He also filled metal containers with gas so that portable lamps were possible. He used to light the way for himself home across the moors with a bladder of gas attached to a suitable jet. He raised the subject with James Watt, Junior, in 1794, suggesting a patent should be applied for, but nothing was done. He demonstrated his apparatus at the Polgooth mine and at the Neath Abbey Company's iron works in Glamorganshire, but they made little impact although he showed its "strong and beautiful light".

In 1798 he returned to Soho for good where he continued his experiments in gas, and in 1808 he communicated his findings to the Royal Society, in a paper (which gained for him the Society's Rumford Medal). In this he said:

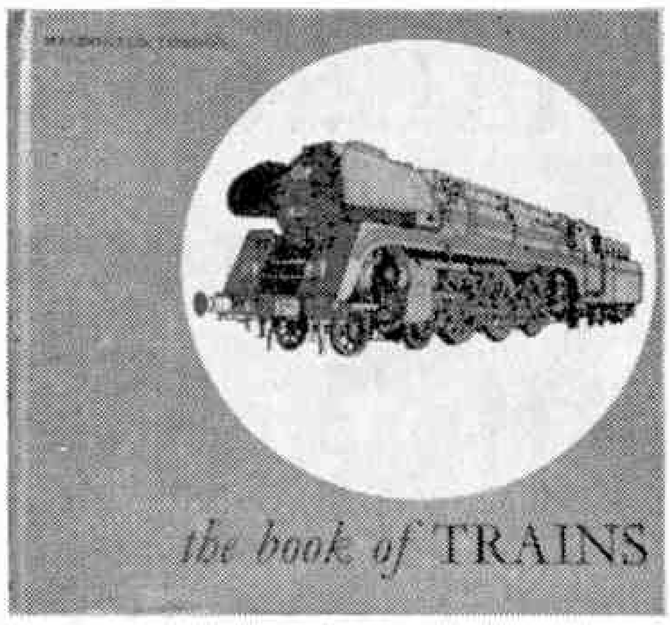
"My apparatus consists of an iron retort, with tinned copper and iron tubes through which the gas was conducted to a considerable distance and there was burning through apertures of varied forms and dimensions. . . . The gas was also washed with water and other means were employed to purify it."

By 1812 Frederick Winsor had founded the Chartered Gas Light and Coke Company, the first commercial gas undertaking and the gas industry of to-day was on its way.

In 1799 Murdock took out a patent for several important inventions. Firstly; an endless screw working into a toothed-wheel, for boring engine cylinders. Secondly; the casting of a steam-jacket and cylinder as one piece, instead of being separately made. Thirdly; the double-D slide-valve which resulted in a saving of steam. And lastly; improved rotary engines.

He also took out patents for cutting columns out of solid blocks of stone, a lift worked by compressed air, the conveyance of mail through a tube exhausted by an air-pump. He installed water heating apparatus of his own design at the baths at Leamington. Indeed, he was a born mechanic and an inventor of genius, and always a gentleman. He died in 1839, at the age of 85.

RECOMMENDED READING



"The Book of Trains" Published by Macdonald and Co. Ltd. Price 15s.

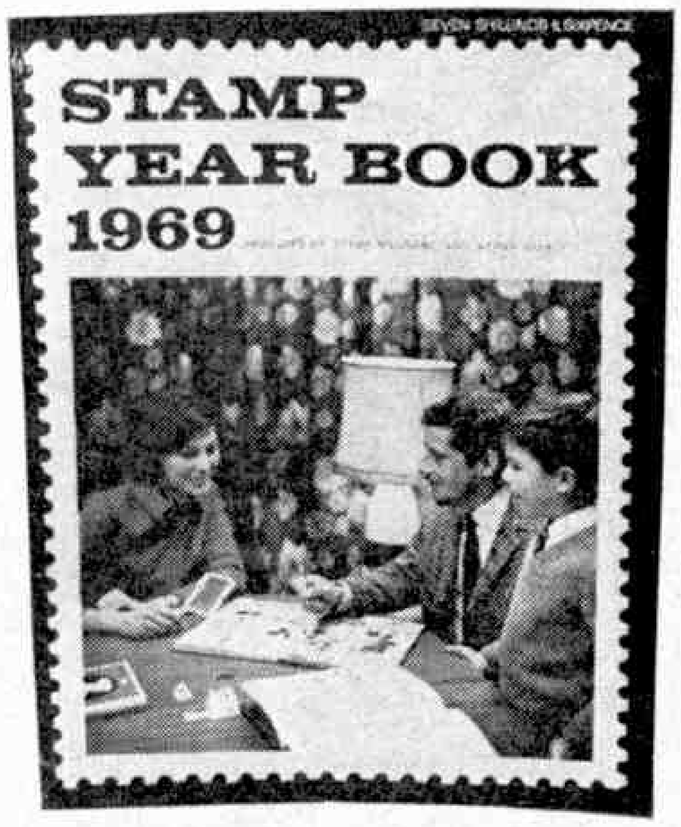
For all those interested in locomotives and railways, we can recommend The Book of Trains by J. B. Snell, as ideal reading. This book is one of a series of four books called 'Classics of Transportation'. It first describes the beginning of the railway and how a steam locomotive works, its boiler design, cylinders and wheel formation. For instance, the book reveals that early boilers produced steam at a pressure of 25 to 50 pounds per square inch, whereas, the modern ones produced steam anywhere from 200 to 300 pounds. These higher pressures were needed to obtain more power within the limits of space and weight, and to increase efficiency. Then, from page 24 onwards, the book shows locomotives from the early beginnings of the nineteenth century, such as Stephenson's Rocket, to the streamlined monsters of the present day, like the Diesel-Electric Northern Pacific. Every locomotive is illustrated by a fully coloured drawing, and is accompanied by a mass of detailed and fascinating information about it. The book has 127, 5½ in. x 5 in. pages containing over 50 illustrations.

Boxed Books. Aircraft. Price 30s.

We are so used to reviewing conventional books that Boxed Books—Aircraft came as rather a surprise to us. This in fact is a stout cardboard box containing 49 loose, heavy-weight board pages. We unfortunately picked it up upside down on one occasion and of course all the pages fell out over the floor and had to be put back in order. It does provide a nicely prepared simple aircraft history reference and each page depicts a famous chapter in aviation with a photograph on one side and a few technical details on the reverse. This does not strike us as particularly good value for money at 30s. The idea of getting a book on aircraft, is usually, to keep it as a reference book; while loose pages would be ideal for Mum's cookery book so that she can just take the page she requires, it does not seem a very good idea for an aircraft book.

"A Century of Traction Engines" Published by David & Charles Ltd. Price 45s.

Here, for all steam enthusiasts, is a long-awaited reprint of a standard work which quickly earned an international reputation after its first publication. A Century of Traction Engines, by W. J. Hughes, tells the story of what is possibly the most fascinating of all prime-movers. Its 251, 8½ in. x 5½ in. pages take you, from the earliest period of experiment, through the years of the nineteenth and early twentieth centuries when steam was supreme. The Boydell system, Bray's 'feathering' wheels, Crompton's epic journey by Thomson road steamer, special engines for expert, four-wheel drive, caterpillar-tracked engines, steam in the defence of Malta; all these and many more fascinations are included in the book. This book is partly founded on a lecture which the author has delivered to numerous learned societies over the past ten years. So after expanding a two-hour lecture into a full-length book, the author has endeavoured to tell the story of the traction engine and road locomotive from first to last, within reasonable scope of both the average reader and the technically-minded reader. Every lover of steam will revel in this book, and the serious student will obtain new light on his subject. This is indeed everybody's book of the traction engine.

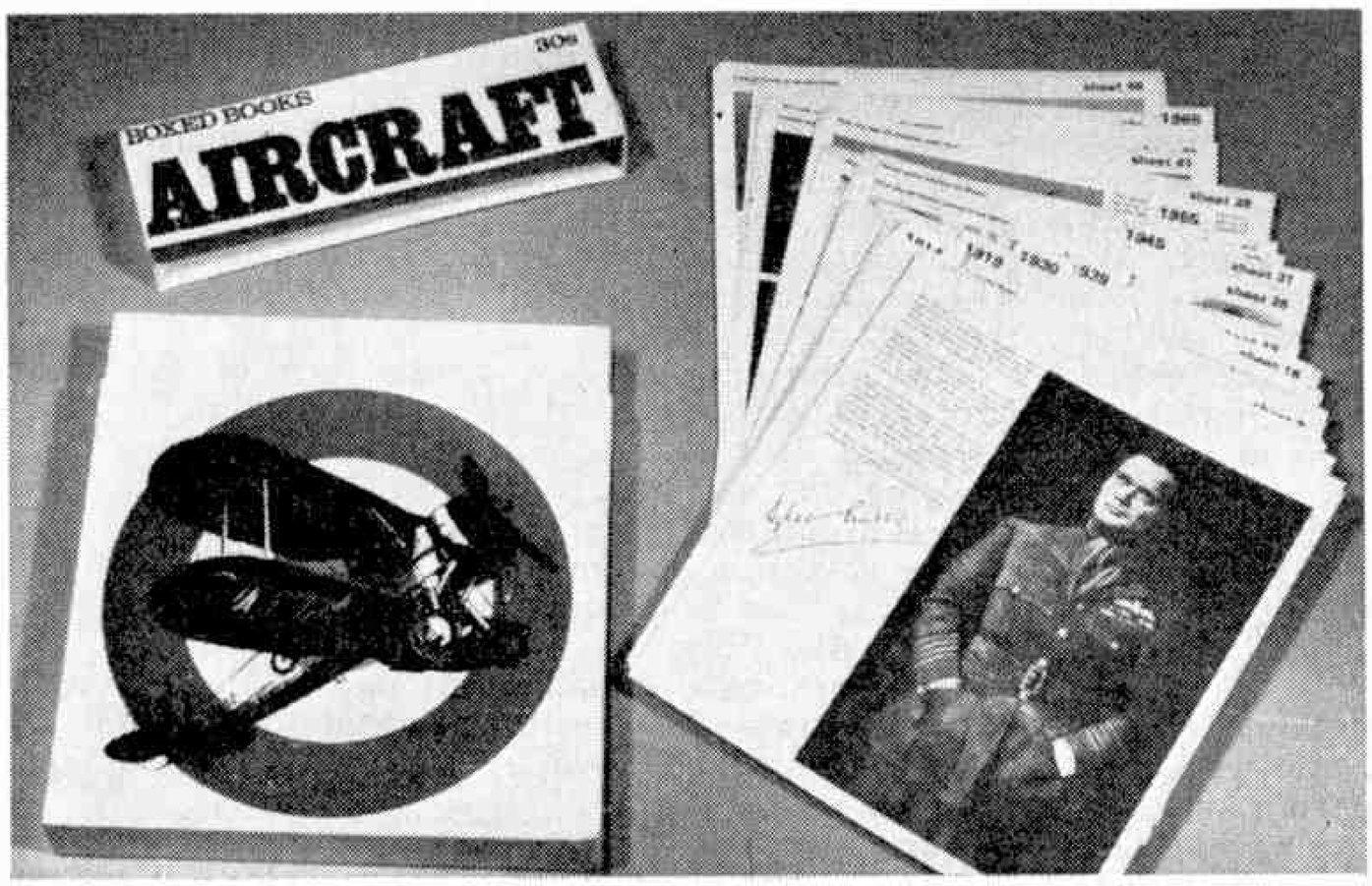


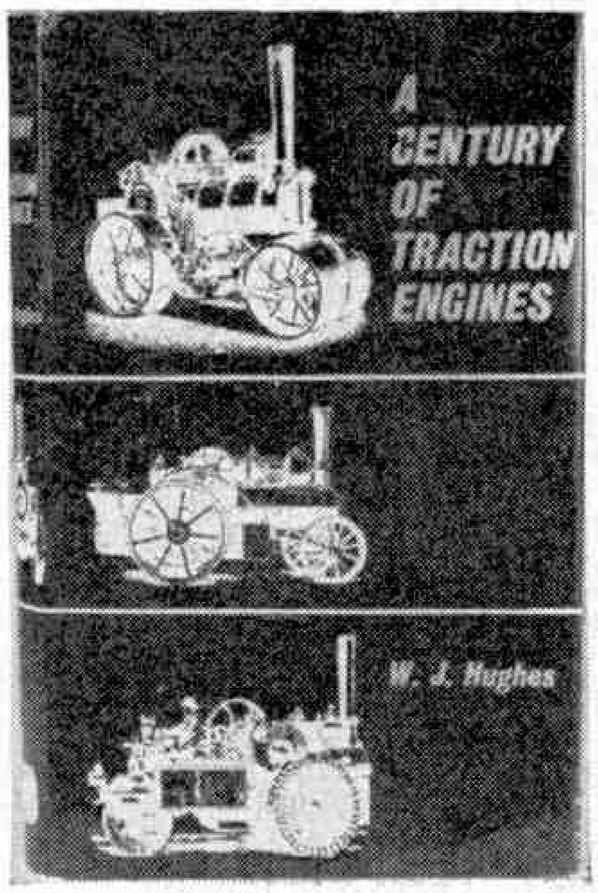
Stamp Year Book 1969. Published by Link House Publications Ltd. Price 7/6d.

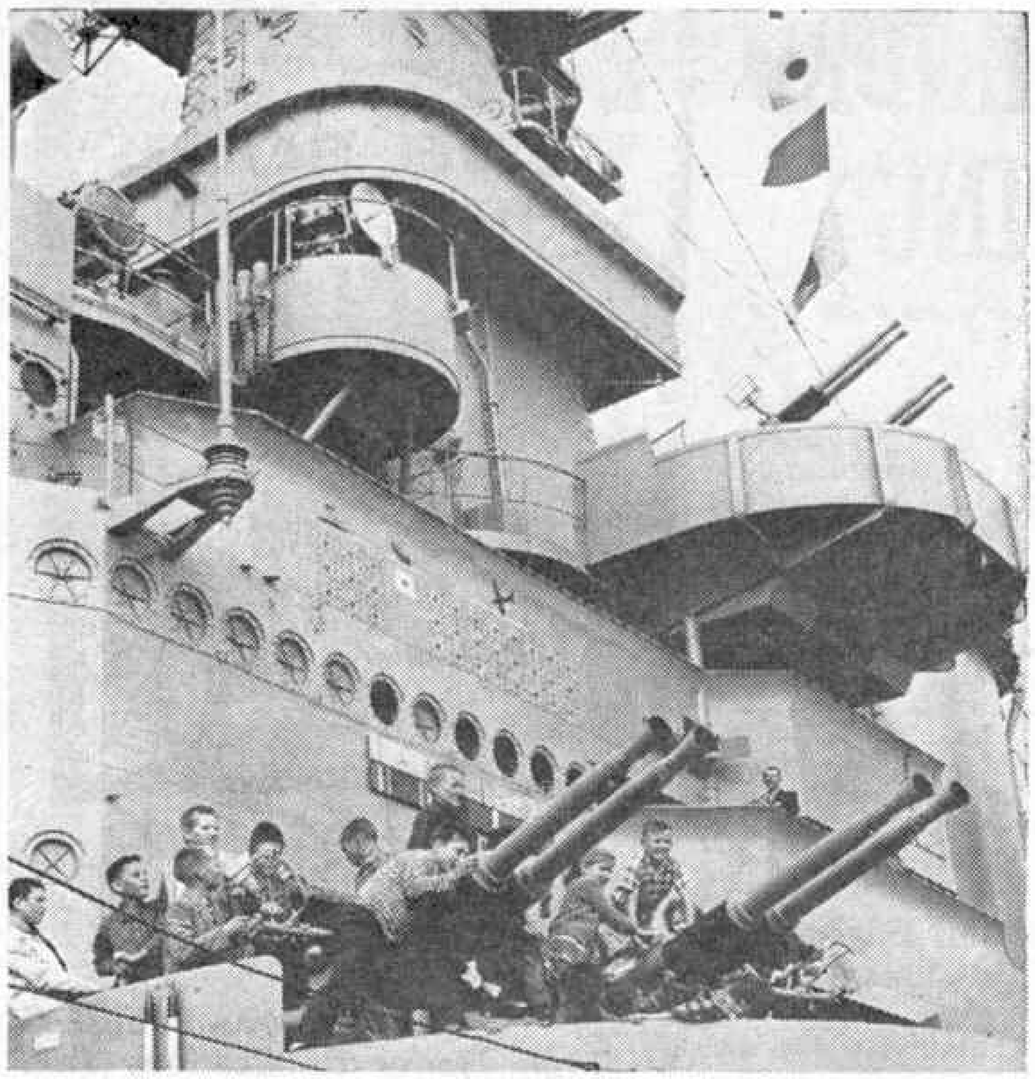
The experts on philately have combined their knowledge to produce a Year Book for stamp collectors. This 124 page book contains reference articles vital to philatelists and yet is written so that a complete beginner can get a survey of the hobby's exciting possibilities. Such names as James A. Mackay, keeper of the philatelic collections in the British Museum, and Meccano Magazine's Stamp Author, L. N. and M. Williams, leading world experts on "Cinderella" material, (items not strictly postage stamps) and Richard West, authority on modern Great Britain varieties, are some of the top-line writers.

Over 300 stamps are illustrated and a large section deals with a survey of market prices over the last eight years.

Stamp collecting has always been very popular, but as this new book clearly shows, it is more than a hobby, it is a way of saving as well. You don't have to be rich to collect stamps, but you might become rich if you do so. Stamp Year Book 1969 could well be the book to start you off.







U.S.S. North Carolina and Newport News Maritime Museum

by Harry McDougall

At left: Visitors man the guns of U.S.S. North Carolina. Right: The gleaming hull is so highly polished it even reflects the small surface ripples at Wilmington. Below on the opposite page: A highly detailed model of King Charles II yacht—King Charles is said to be the father of yachting as we know it.

THE WORD Showboat conjures up visions of stern-wheelers on the Mississippi. But at Wilmington, North Carolina it has a quite different meaning. The Showboat was the name given during World War II to the 35,000 ton USS North Carolina—one of the mightiest naval vessels ever built.

The battleship was completed in 1940, steamed 307,000 miles and saw 40 months of action in the South Pacific but went into honourable retirement shortly after the war ended.

Fourteen years later, when she seemed destined for the scrapyard, the citizens of North Carolina opened a fund to save her from the acetylene torches. The £150,000 required to establish the ship as a memorial was raised in less than nine months and she was towed to Wilmington.

Go aboard the battleship today and you can't fail to be impressed by her sheer size. She may be merely a representative of yesterday's navy, replaced by nuclear-powered aircraft carriers and submarines, but she is still one of the most majestic vessels afloat.

The USS North Carolina was installed at Wilmington as an historical and educational attraction—the largest naval vessel to be honored in this way. Considerable skill was required to nudge the huge vessel around a right angle turn into her present berth on the narrow Cape Fear River. She towers high above the dock, her nine 16-inch guns pointing skyward, and her paintwork is maintained in immaculate condition.

The impressive rows of anti-aircraft guns on her foredeck are evidence of her ability—which she proved on many occasions—to fight off aerial attackers. Nowadays, children love to swing the guns to and fro, firing at an imaginary enemy.

The North Carolina will never sail the seas again. But in her day, with a crew of 108 officers and 1772 enlisted men she was a formidable fighting ship. A museum on board describes the actions in which she won 12 battle stars.

Most of the actions involved bombardments laid down to cover amphibious assaults. She was torpedoed on one occasion and a few of her crew were killed by bombs but her gunners shot down at least 24 attacking planes. The North Carolina was the first new battleship to enter Pearl Harbour after the war began and her battle record included participation in every major US offensive in the Pacific, from Guadalcanal to Tokyo Bay.

After nightfall, during the summer months a Sound and Light spectacular is staged. Various parts of the ship are illuminated intermittently by coloured lights to the accompaniment of an amplified dramatization of the exploits of the ship from the time she was launched until she was retired.

The sound effects—shouted orders, the wail of Klaxons, roar of attacking aircraft, impact of bullets and bombs and the chatter of the anti-aircraft runs—recreate the actions in which the North Carolina fought. When her 16-inch guns are "fired", flames flash from their muzzles and the whine of the shells is heard. All the techniques of sound and light presentations are used to provide a thrilling spectacle.

The USS North Carolina is the largest relic of World War II now on exhibition on the eastern seaboard of the United States but it is not the only one. The coastal states of North America have always been proud of their seafaring traditions, and nowhere is that pride more evident than at the Mariners Museum, Newport News, Virginia.

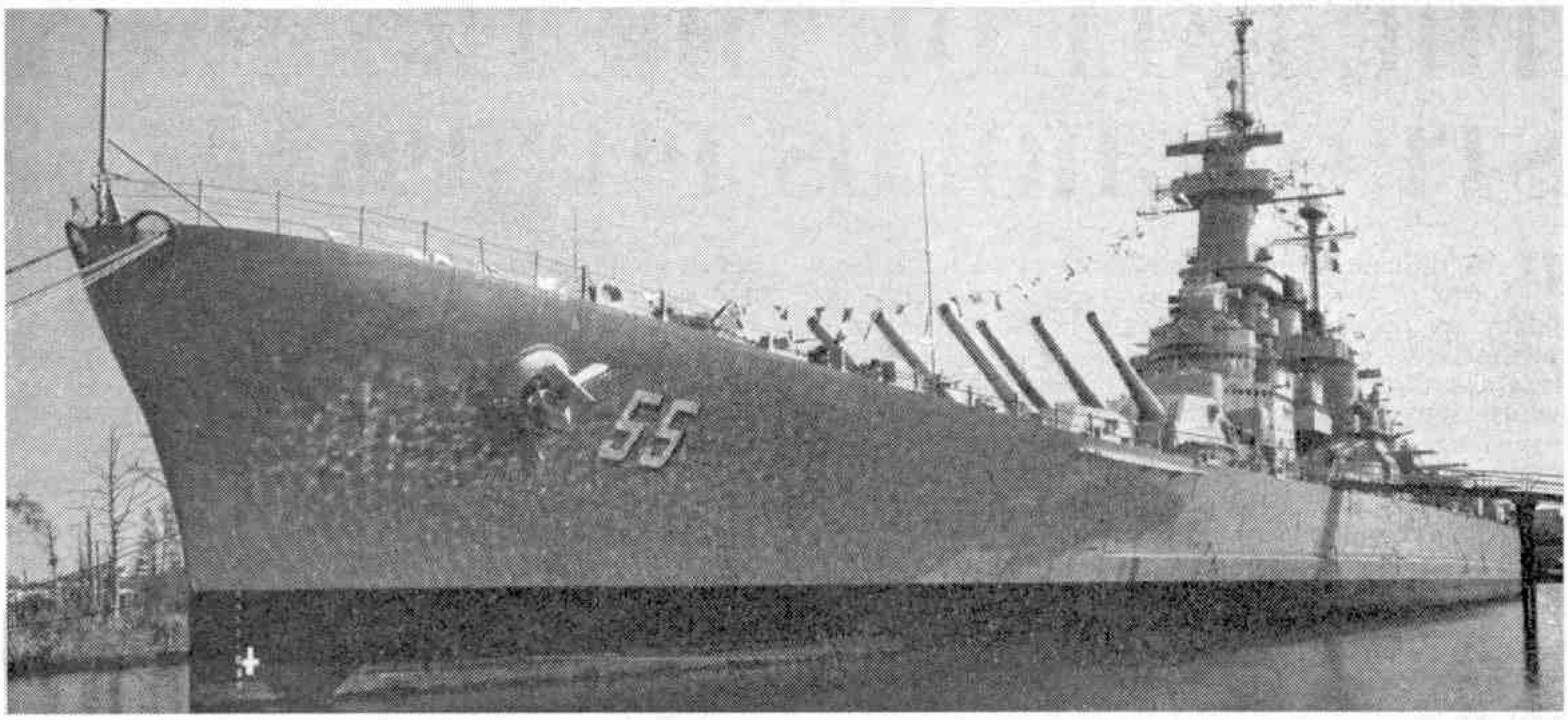
The entrance to the museum is dominated by a huge golden eagle carved from wood. It has a wingspan of 18 feet, weight more than 3000 pounds, and was originally the figurehead of the US frigate Lancaster. The golden eagle is one of many figureheads that adorn the walls of the museum.

The Mariners Museum houses one of the most impressive collections of nautical memorabilia ever assembled. It would be possible to spend several days studying the exhibits, which range from miniature models to full-size boats.

The collection in the main hall centres around a lighthouse lens originally installed in a lighthouse at Cape Charles, Virginia, in 1896.

There are many dioramas throughout the museum. They illustrate, in three-dimensional form, the constructional methods used by shipbuilders throughout the ages.

Some dioramas recreate historical incidents. One depicts the building of the Ark. The scene is based on



the best knowledge of that remote period of history rather than on the romanticised version of the event as imagined by artists. The Ark is shown as a house-on-a-raft built solely to stay afloat rather than as a vessel capable of making a voyage.

One of the most graphic dioramas depicts an incident in the American Civil War—the battle between the ironclads Monitor and Merrimack. It was fought in Hampton Roads within a short distance of where the museum now stands.

There are dozens of subsidiary collections—exhibits relating to sail-making, ship-building, navigation. One room devoted to the history of whaling houses a vast collection of scrimshaw—carvings made by sailors on voyages that sometimes lasted for years.

The collections are constantly brought up to date. One outstanding series of models illustrating the development of the submarine includes miniatures of the latest atomic-powered versions.

It is an indication of the prestige of the Mariners Museum that it was able to acquire the collection of marine memorabilia assembled by the late President John F. Kennedy. The collection includes a model ship presented to him by Nikita Kruschev.

The most interesting of all the models are those in the Crabtree collection. It is housed in a special temperature and humidity controlled room. Sixteen miniatures illustrate the progress of water transportation from 1480 BC to 1845 AD.

It took August F. Crabtree a lifetime of patient work to build the models. The detailing is astonishing; it is so fine that magnifying glasses are mounted inside the showcases so that visitors can get some appreciation of the care and skill which went into making them.

The most elaborately carved vessel of the group is a Venetian galleas. On its stern and quarter, a solid mass of 359 carvings re-creates in miniature the splendour of a once-great Mediterranean power.

An English warship of King James II with 270 lifelike figures shows how ornamentation was used to impress other powers and help to disguise the size of the ship.

The father of yachting was King Charles II. One model, richly decorated with carvings, shows how vessels built purely for pleasure originally appeared.

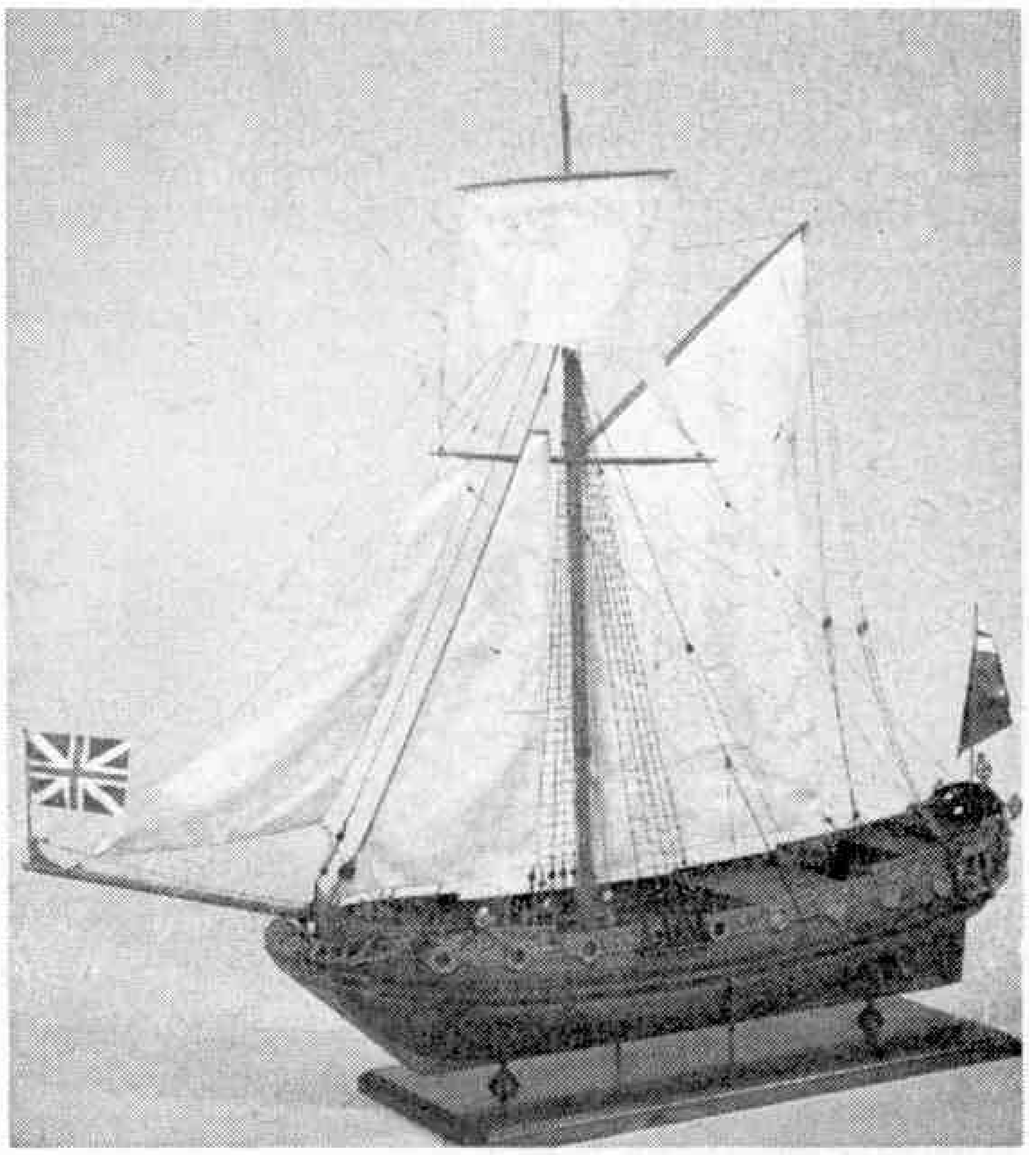
A model of an East Indiaman has been left partly unplanked to reveal the interior construction. The group of figures on this ship is minutely detailed; it impresses visitors with the uncanny skill of the craftsman who built the models.

The museum buildings surround an inner courtyard where full-scale vessels are exhibited—some exposed to the weather and others in barnlike shelters.

The most interesting vessels are midget submarines, of which several examples are shown. Their sleek shapes contrast with that of a broad-beamed sailing boat designed for use in the canals of Holland.

Many of the exhibits are operational. A pull on a lever activates a model of a reciprocating engine. The action of a steam turbine is also shown.

In the courtyard, children go round and round a capstan, hauling up an imaginary anchor, or work at the bilge pumps that bring water up from a well.



THE FALL OF THE TRAMWAY STRONGHOLDS 1948-1962 by M. Evans

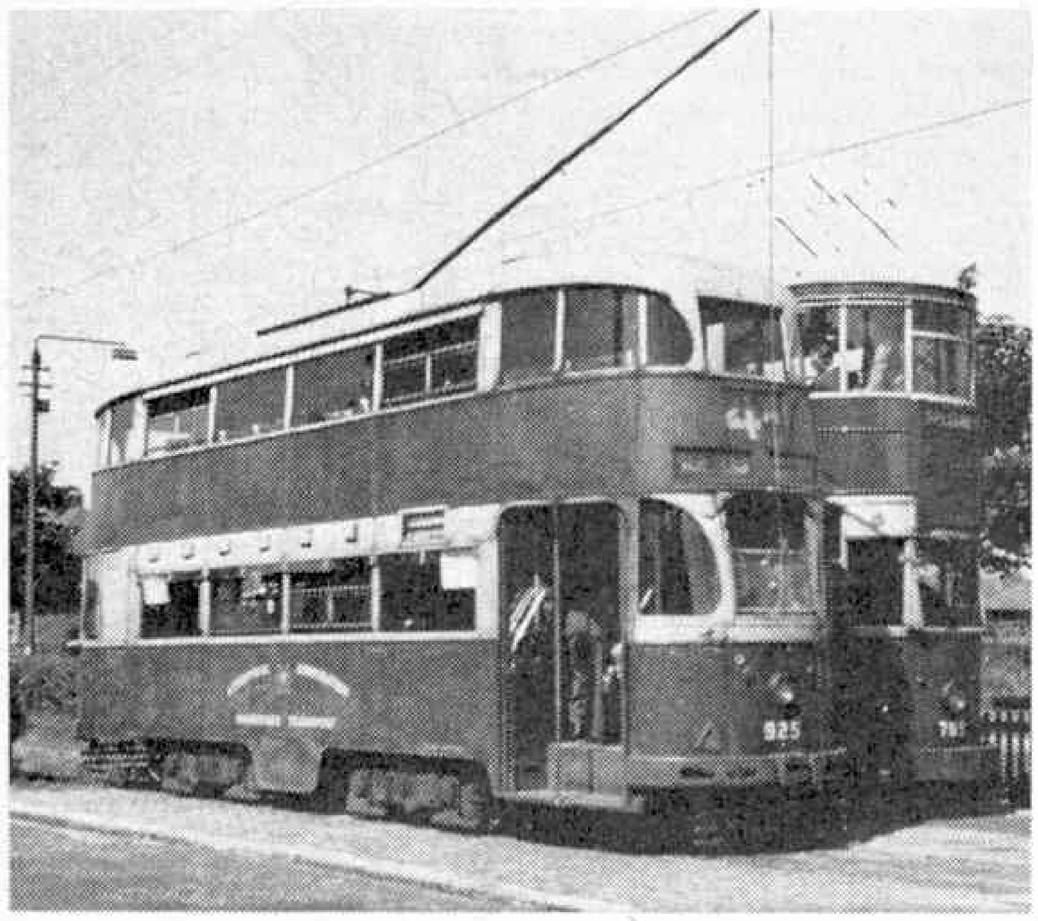
IT IS difficult to appreciate the fact that the large towns of this country, had a very strong pro-tram policy up to a very short while before the decision was taken to scrap their tramways, in favour of buses; it is also difficult to realise that during the late 1940's whilst the remnants of the pre-war tramways were vanishing one by one, Sheffield, Glasgow, Leeds and other centres defied the anti-tram trend of those days. The question which therefore poses itself is: why, in spite of this, did the tram disappear? The best explanation is probably that the planners were no doubt thinking ahead to the time when almost every family would have its own car, and untold congestion would thus accrue.

Certain local events took place in those years, and it may be of interest to recall these in relation to each tramway stronghold. Prior to 1939, Liverpool's tramways had expanded, new routes being opened in the 1930's and new cars entering service. In 1932, the Corporation decided that the system should be modernised, and although Liverpool did have trolleybus proposals the trams appeared to have a very secure tenure. The condition of the Liverpool tramways at the end of the last war was not, however, a very healthy one. War-time conditions required the use of trams for troop-carrying, and one or two other factors militated against large scale post-War tramway development. The cost of rehabilitation would have been prohibitive. So the decision was taken in 1945 to replace the entire tramway system with diesel buses over a ten-year period. Nevertheless, very few persons known to the author considered that Liverpool was a precedent. Despite the fact that the trams were doomed, the Transport Department carried through a programme of overhauling the more modern elements in the tram fleet, and certainly the streamliners looked very attractive in their new light green livery. During 1948/9 there was a certain amount of opposition to the conversion scheme; however, nothing came of this. Next came Sunderland. This town did not possess a system which could be described as modern, but the Council had a pro-tram policy. However, even before the Durham Road extension was opened in 1949, the Council decided that the trams would have to go, the main argument being that the increased volume of road traffic would make tramway operation very difficult. In 1950, Villette Road closed, and by 1954 the Sunderland trams were no more.

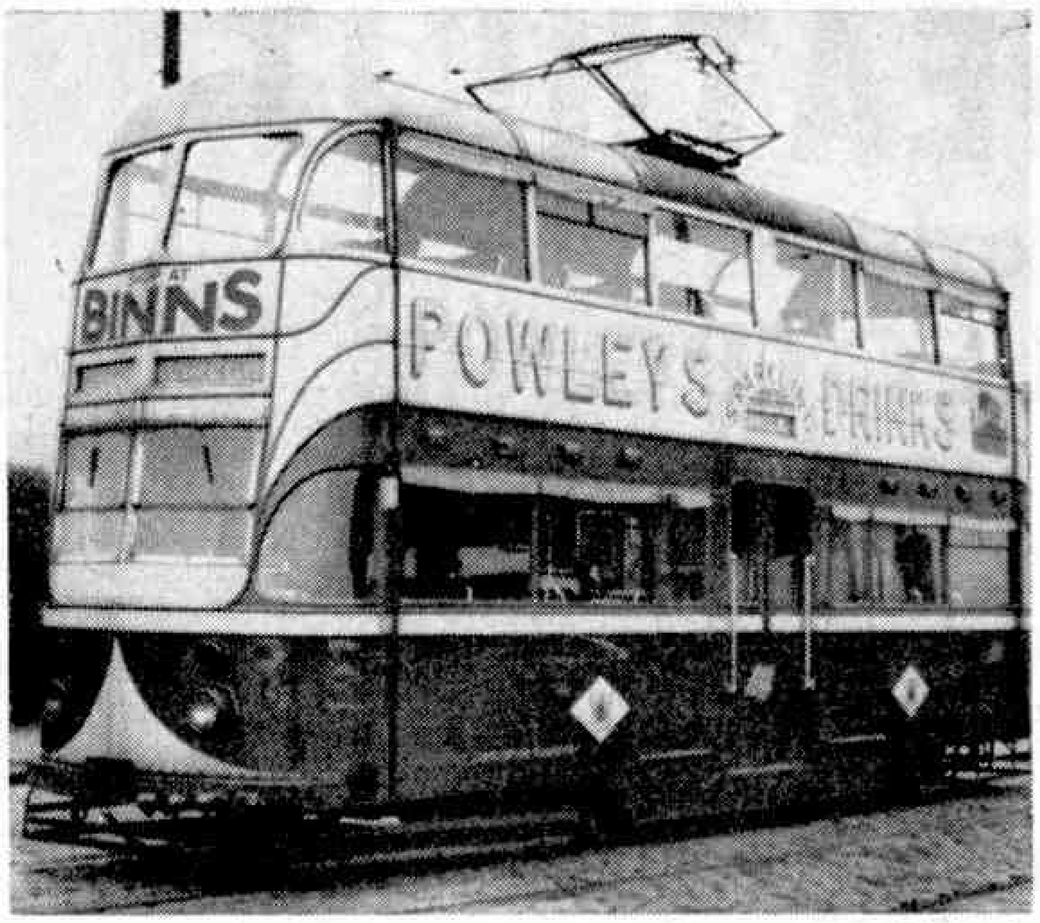
It was with astonishment that the news of the Sheffield scrapping decision was received in 1951. It is true that, in 1949, the Council had ideas of abandoning trams at street level in the central area of the city, but with a view to diverting them underground. The Sheffield trams gave good service and were a delight to ride on; consequently the decision appeared to be a volte-face. Indeed, new cars were coming into service at the time of the above decision, and the last one went into service in 1952. The first route to be converted to buses was the Fulwood to Malin Bridge in January, 1952. Prior to this, the section between Vulcan Road and Templeborough closed in December, 1948, but this was due to the fact that Rotherham had decided in favour of abandonment, and it was by no means an indication of the shape of things to come in Sheffield. Shortly after the closure of the Fulwood/Malin Bridge route, economics stepped in, and no further abandonments took place until March, 1954, when buses replaced trams on the route from Eccleshall to Middlewood.

In September, 1952, Edinburgh announced that all the trams would be replaced by buses. Earlier (1950) one route—a circular service—was converted to bus operation, but there was no actual loss of track, and it was not thought at that period that Edinburgh was interested in tram scrapping. The 1952 decision was not reached very easily. Comparative costs of track renewals, and of acquiring new cars were assessed against the cost of replacement by buses, and of course, the decision went in favour of the latter. Only two years earlier, new cars had entered service. So the Edinburgh trams moved towards their demise.

Two new railcars had been put into service in the Yorkshire city of Leeds in 1953. One would thus have surmised that the future of the trams there was secure. Tram supporters had visions of the streets of Leeds with modern railcars traversing them. But this was not to be; local politics appear to have played a part in the decision to abolish the trams. The Conservative Party wished to retain the tramway system, but the Labour Party considered they were out-of-date, and Labour won the local elections in 1953. The first ill omen, however, was in the early part of the year, when it was announced that the Kirkstall Abbey, and Half Mile Lane routes would close. Half Mile Lane closed in October, 1953, and Kirkstall Abbey in March, 1954. At the time, however, no decision had been reached—there was only talk in the air. It did appear very paradoxical that the



No. 925 on Service No. 4A (Pier Head/Childwall via Church Street and Wavertree Road) in July, 1949. The car was built in 1937 and was one of a batch of 25 (Nos. 918-942). These were mounted on Maley & Taunton bogies. 24 of the cars went to Glasgow in 1953. The livery of the car is olive-green and cream. One indicator gives the destination and the other the geographical route.



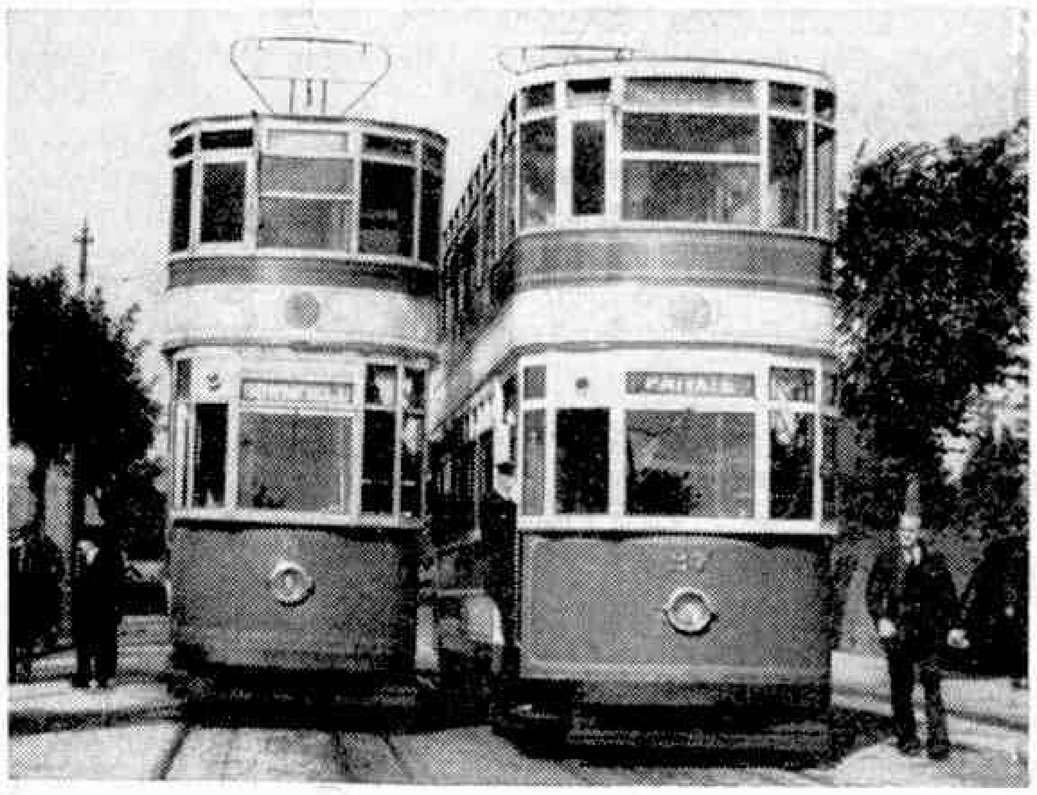
One of the last additions to the fleet (No. 49) working the Rocker-Seaburn Circle in September, 1950. The car is a four-wheeler mounted on Maley and Taunton Swing Link trucks. Note the central entrance, the pantograph and the obliterated word 'Sunderland'— a reminder of the 1939-45 War. During 1940 names were removed from public transport vehicles to prevent town identification.

modern railcars were running around Leeds and the Transport Committee were in fact planning to remove the trams from the streets. Shortly afterwards the placards announced "Leeds' trams to be scrapped", Labour would redeem its pledge. In November, 1953, the full conversion plans were made known. Some routes had closed prior to 1953, but such conversions were solely due to special circumstances After the withdrawal of trams from both Kirkstall Abbey and Compton Road routes in March, 1954, over twelve months elapsed before the next (Gipton) closure, in April, 1955. It has been alleged that if Labour had failed to win the local elections in 1953, the decision to scrap the Leeds system would not have been made.

Next to be converted was Aberdeen. Early in 1955, plans were announced for the replacement of all tram routes by buses. Here, as in the case of Edinburgh, costs were compared, and the bus came out on top. A lot of hard cash would have been necessary to effect a pro-tram policy in Aberdeen! No, circumstances in the field of economics were adverse to the tram in this country! In 1954 the Rosemount route closed with a certain amount of ceremony, and so did the Mannofield in 1953. At the time this took place, however, it was stated that no more tramway abandonments in Aberdeen were envisaged; indeed, Queens Cross Depot had only been built in 1949, and enlarged in 1951. Moreover, 20 new cars were placed in service after the war. Things were not looking too bright in Dundee either; its system could not be regarded as modern—in fact, the newest car in the fleet had been constructed in 1930. When the scrapping proposals were made, the future of the trams was vigorously debated in the Council Chamber, many Councillors being unconvinced that the bus was the solution. Proposals to convert the Blackness, and Ninewells routes were underway, and the conversions duly took place. So strong was the pro-tram feeling at the time, however, that the overhead and track were left intact, in case the bus services should prove unsuccessful. One Councillor even went so far as to say that, if the buses were not suitable, new trams would have to be ordered! However, things did not work out in favour of the trams, and the opposition to the replacement scheme abated.

Finally came Glasgow itself. Mr Fitzpayne, the Manager, made the recommendation, in May 1957, that the trams should be gradually replaced, mainly with buses. For two years Glasgow could not make up her mind. As far back as 1953 the city had rejected the report of a Transport Commission, as regards the part dealing with tramway abandonment. In the Summer of 1955 Mr. Fitzpayne announced his plan to reduce the tramway services over five years. Out of 25 services, 18 would remain. It was thus obvious that Glasgow was endeavouring to avoid "taking the plunge". The pertinent question anyone could ask was "what will happen when the older cars become due for replacement?" There was no market for trams in Great Britain, and therefore the cost of new cars and equipment was too great to be even considered. Possibly, as has been suggested, if this country manufactured trams, as Germany does (Duwag) then the position of Glasgow would have been quite different in 1957—an interesting speculation, and one that might put the finger on an essential part of the question. The trams departed from the streets of Glasgow route by route until the final one, Dalmuir West, was withdrawn in September 1962.

Looking back in retrospect the question often arises; why, all other things being considered, did the tramway strongholds fall? Economics certainly played their part, but there is one factor which seems to be largely overlooked. Prior to scrapping decisions taken in the above places, there had been suggestions from time to time in one or two of them, including Glasgow, that the trams should be replaced by some other form of transport. Indeed, it has been stated that Sheffield was the only municipality that never made one anti-tram proposal, and Sheffield certainly had a tram fleet that was modern to a reasonable degree, whereas other towns did not approach anywhere near 40% in fleet modernity. The fall of the tramway bastions may be regarded as a tragedy by enthusiasts but it was one that could not have been averted. Tramway supporters can, however, take comfort in the fact that at least some local authorities did compare respective costs i.e. tram versus bus—a sure indication that they were by no means convinced that the bus provided the ultimate solution.



Cars on the Downfield route in 1950. No. 27 appears to be the L.R.T.L. special car. Both cars are on EMB S/L trucks. Note the bow collectors and the fact that there are two indicators. Dundee had 103 cars in all and most of them were four-wheelers. Single-deck cars were also operated (Hilltown route). The livery was light green and cream and the gauge 4 ft. 8½ ins.

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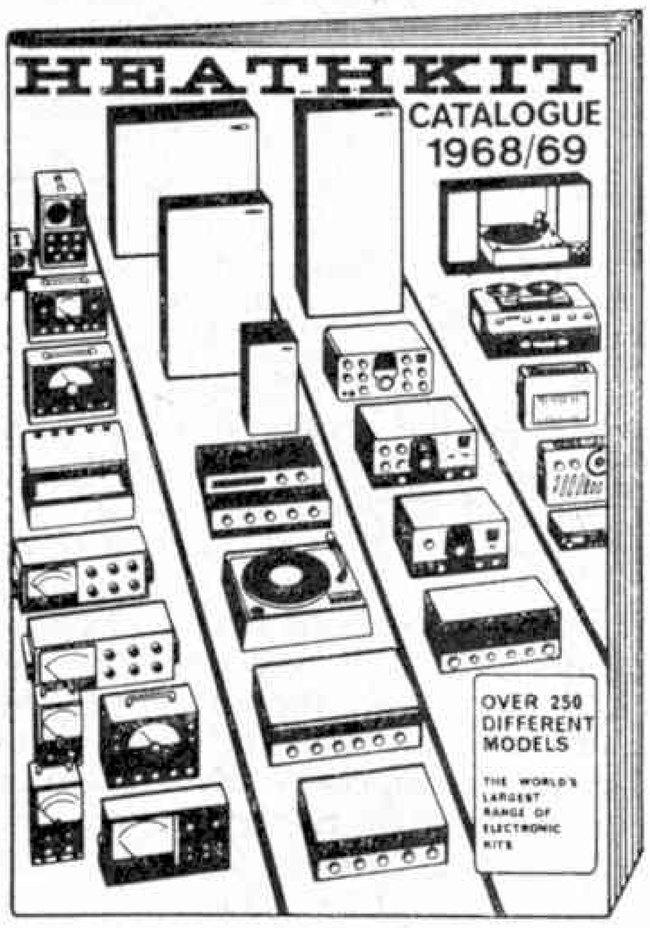

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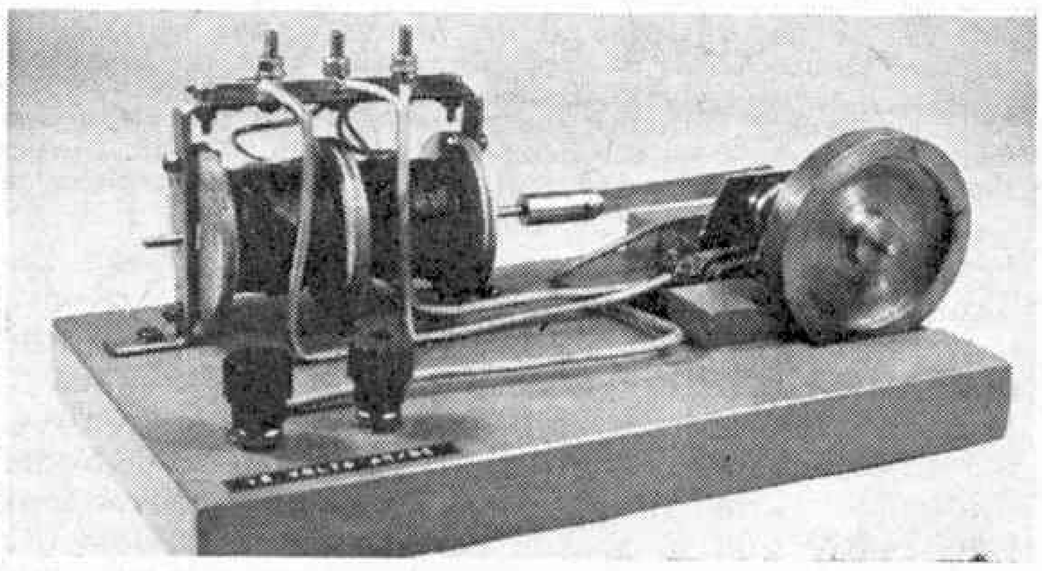


AN ELECTRIC "STEAM" ENGINE

by Dennis Horler

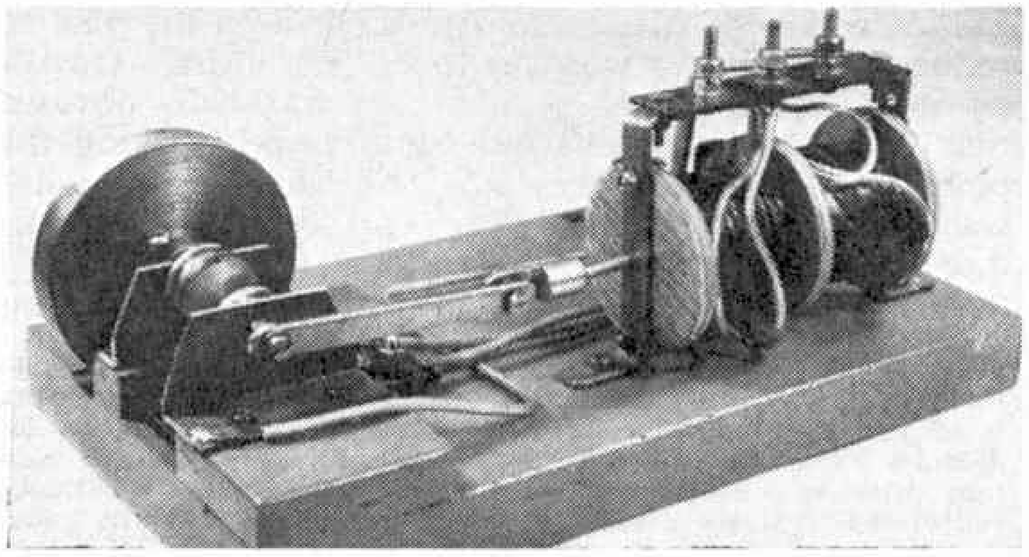
THERE IS little more exciting than watching the various motions of the connecting rods, eccentrics and link motion of a steam engine. Unfortunately to build a steam engine at home or at school calls for precision machine work and the cost of a boiler to power it.

This exercise provides you with the appearance of steam engine motions without steam—another method of using electro-magnetism to produce rotation.

Historical

James Watt made the first steam engine as we know it in 1769, this was not a great success. It was improved in 1774 but was only single acting. The engine received its steam at one end of the cylinder only, thus relying on the momentum or stored energy

Above and below: Two views of the completed engine by Dennis Horler. This reproduces the old steam motions with the aid of electricity that originally helped to displace steam.



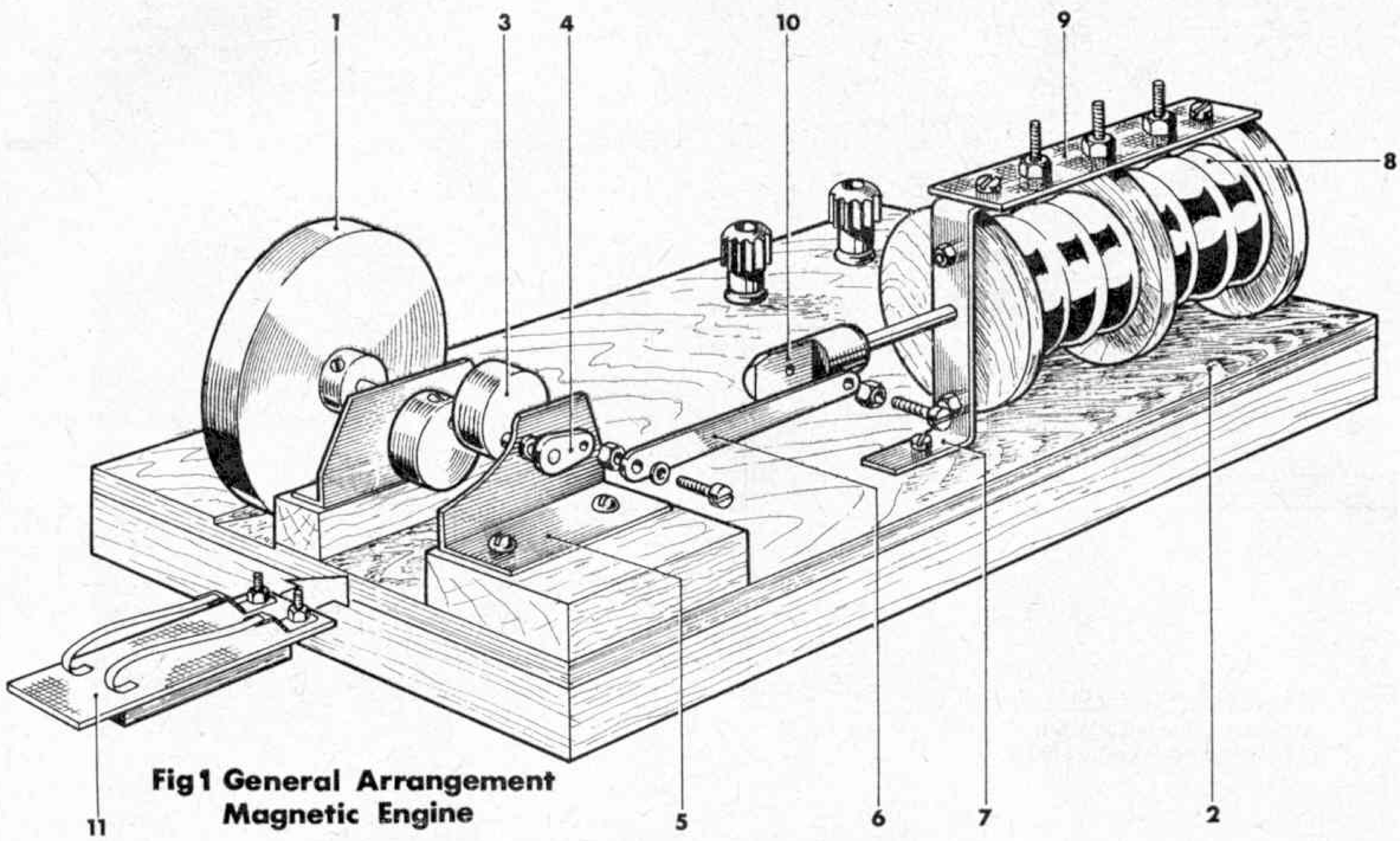


Fig 1 General Arrangement Magnetic Engine

in the flywheel to return the piston on its backward stroke. This resulted in unbalanced running and very low efficiency.

In 1781 Watt took out a patent for the double acting engine. In this engine steam was applied alternately to each end of the cylinder under control of the slide valve operated by an eccentric from the crankshaft. This produced better efficiency and more uniform balanced rotation. The double acting force is utilised in our magnetic version of the steam engine.

Principle of Operation

A crank is a means of converting a reciprocating motion into a circular or rotating motion. An eccentric does the opposite, it converts a circular motion into a reciprocating motion. As in a full size steam engine, our model makes use of both devices.

The double solenoid, with each coil wound in opposite directions pulls a central armature to each opposite end if energised alternately. The coils are energised by means of eccentric switches arranged to make and break at the correct time in relation to the position of the crank. The engine runs on 15 volts AC or DC the running current is 1.8 amps with coils each wound from ¼ lb. of 26 SWG enamelled copper wire. This is not critical; if you use thinner gauge wire—say 30 SWG and wind more turns the current can be reduced and also the voltage. This is due to the fact that the strength of the magnetic field is due to the product Amps x No. of turns.

Materials

All materials used are easily obtainable, you may modify the dimensions within reason to use what may be found in your junk box. The shaft, flywheel and bearing brackets could be Meccano parts. Any lathe work necessary could be done by the local garage or possibly a word with the school metal work teacher may produce results. The wood can be obtained from any Do It Yourself shop. The brass strip could be valance rail supplied by local stores for hanging curtains. Coil wire, insulating material, terminals and BA nuts, bolts and washers can be obtained from radio repair stores or firms advertising in radio magazines. The total cost of all components should not be more than 15/-.

Construction

Full details are given in the drawings and therefore step by step instructions are not necessary. It is advisable to make the base first by pining and gluing the top to the side and end pieces and then fixing the bearing blocks. The hollow space beneath the base provides clearance for the bolt heads or nuts and if you wish you may conceal your wiring. At this stage decide the size flywheel you intend to use if different from that shown and cut the flywheel 'well' to suit. Check that the top surface of the wood bearing blocks are level, as the shaft when fitted in the bearing brackets must be reasonably horizontal or else it will run to one side in operation.

The eccentrics can be made of brass, copper or alloy, but alloy is much easier to drill and tap. If you have no suitable taps and use brass or copper you could solder the eccentrics in position on the shaft, but this would not make them so easy or convenient to adjust.

The piston rod with its iron armature should present no difficulty; ⅛ in. dia. brazing rod is ideal and most garages use this. You must remember to round or chamfer the ends of the armature to prevent sticking or rubbing in the solenoid bore.

Perhaps the most tedious task is winding the solenoid, this is best done on a lathe or in a handrill, the drill being clamped in a vice. You can make a professional job if you solder a length of flex to each end of the coil wire and cover it with a length of sleeving. Don't forget to wind the second coil in opposite rotation to

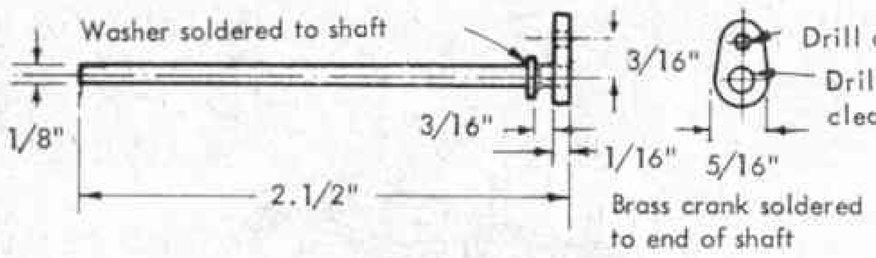


FIG. 5. CRANKSHAFT AND CRANK. Detail 4.

Material - mild steel and brass

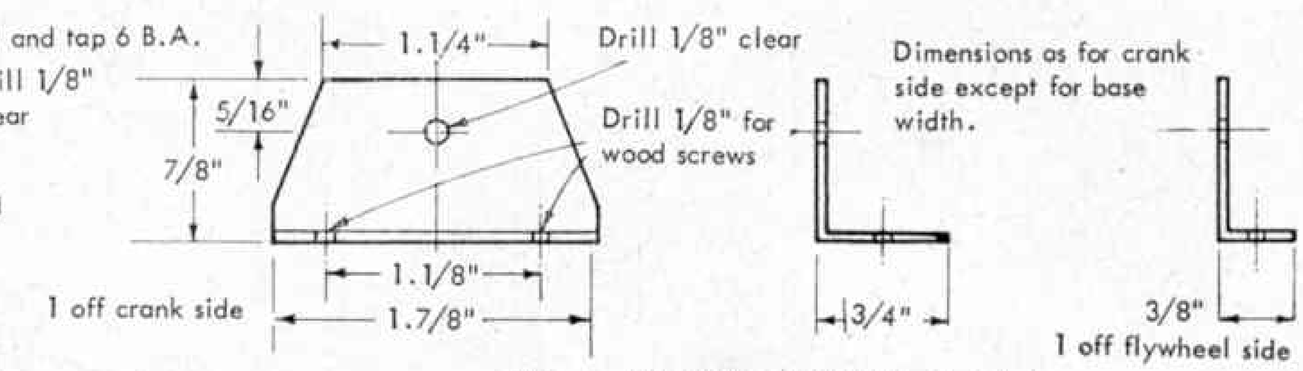
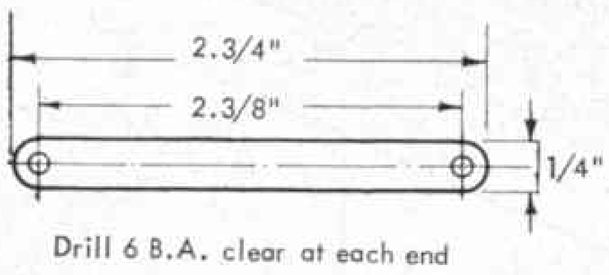


FIG. 6. BEARING BRACKETS. Detail 5

Material - Brass or mild steel 1/16" thick

FIG. 7. CONNECTING ROD. Detail 6.

Material - brass 1/16" thick



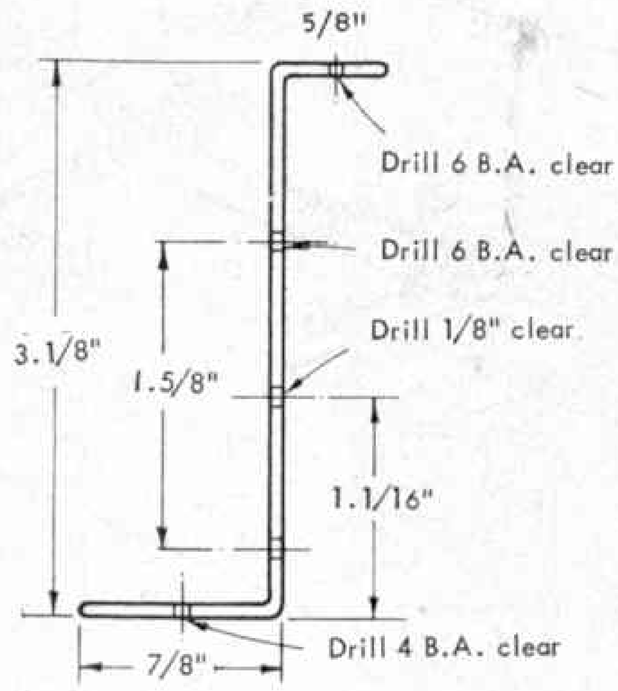
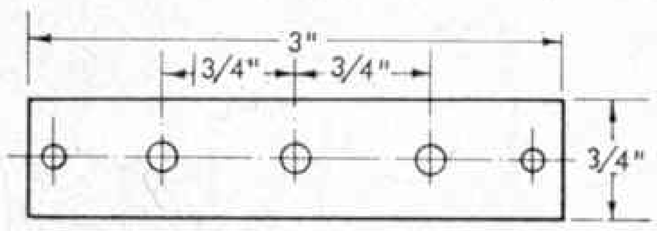


FIG. 8. SOLENOID SUPPORTS. Detail 7.

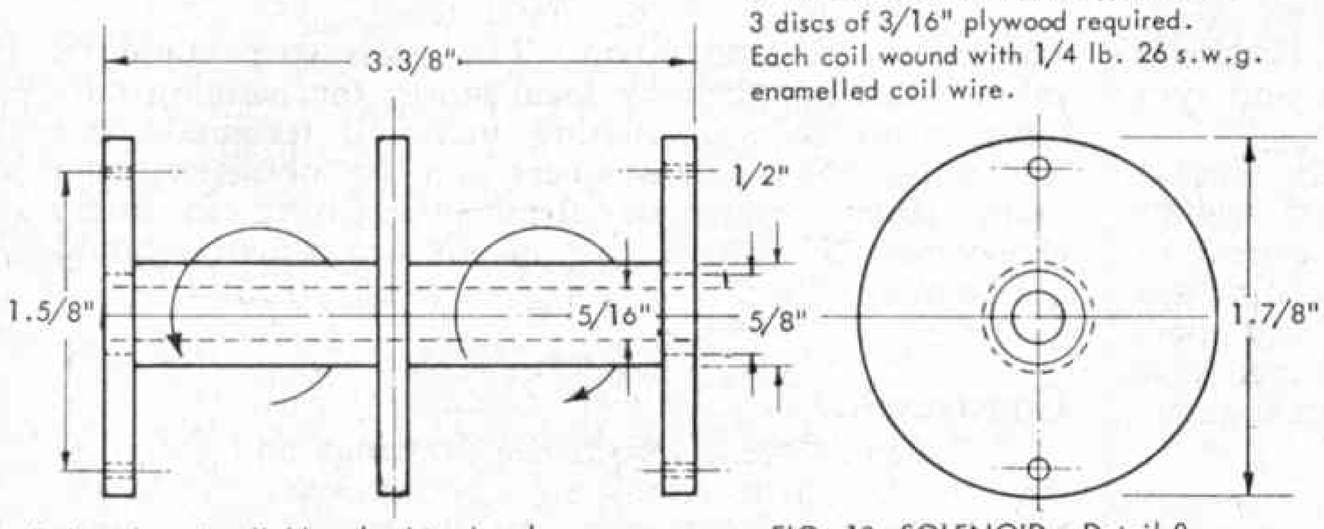
Material - brass strip 3/8" x 1/16" (curtain pelmet rod) 2 off required.



Mark off end fixing holes from Solenoid assembly and drill 6 B.A. clear

FIG. 9. TERMINAL BLOCK. Detail 9

Material - Paxolin or similar 1/16" thick



Drill 2 holes in each end 6 B.A. clear.
3 discs of 3/16" plywood required.
Each coil wound with 1/4 lb. 26 s.w.g. enamelled coil wire.

Ends and centre divider glued to dowel. Arrows indicate direction of rotation of coil turns.

FIG. 10. SOLENOID. Detail 8.

Material - dowel and plywood.

2 Brass shim brushes or fingers bent to shape as shown.

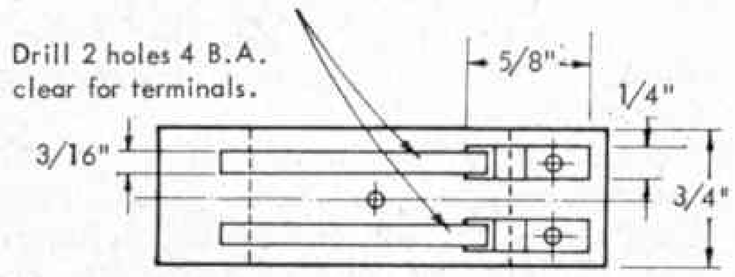
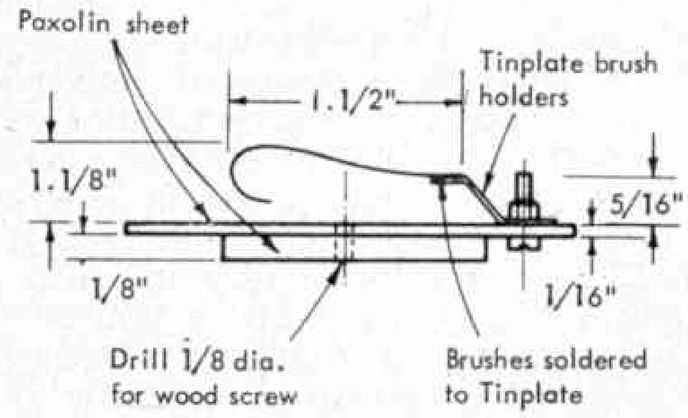


FIG. 12. CONTACT BRUSH ASSEMBLY. Detail 11

Material - Brass Shim, Tinplate and Paxolin.



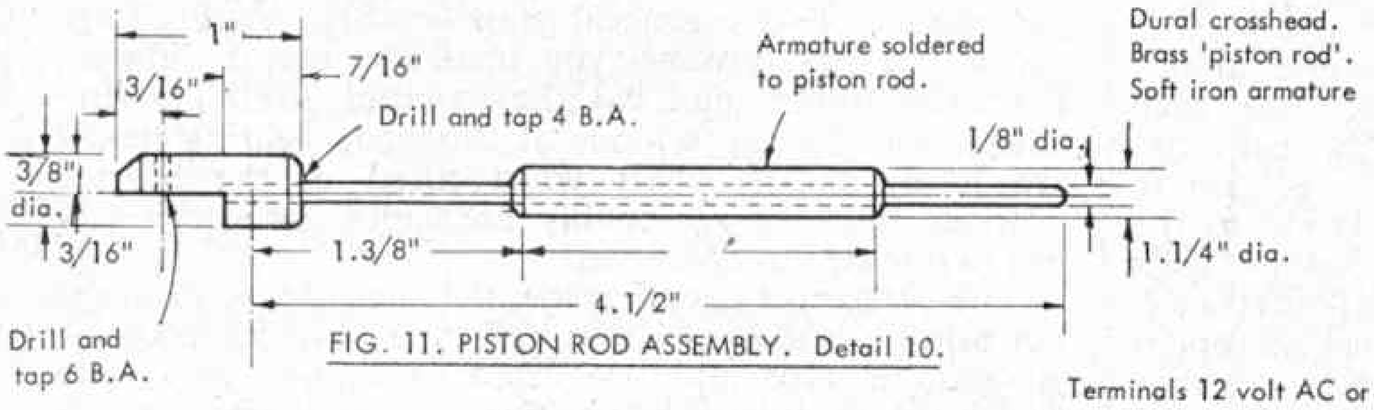


FIG. 11. PISTON ROD ASSEMBLY. Detail 10.

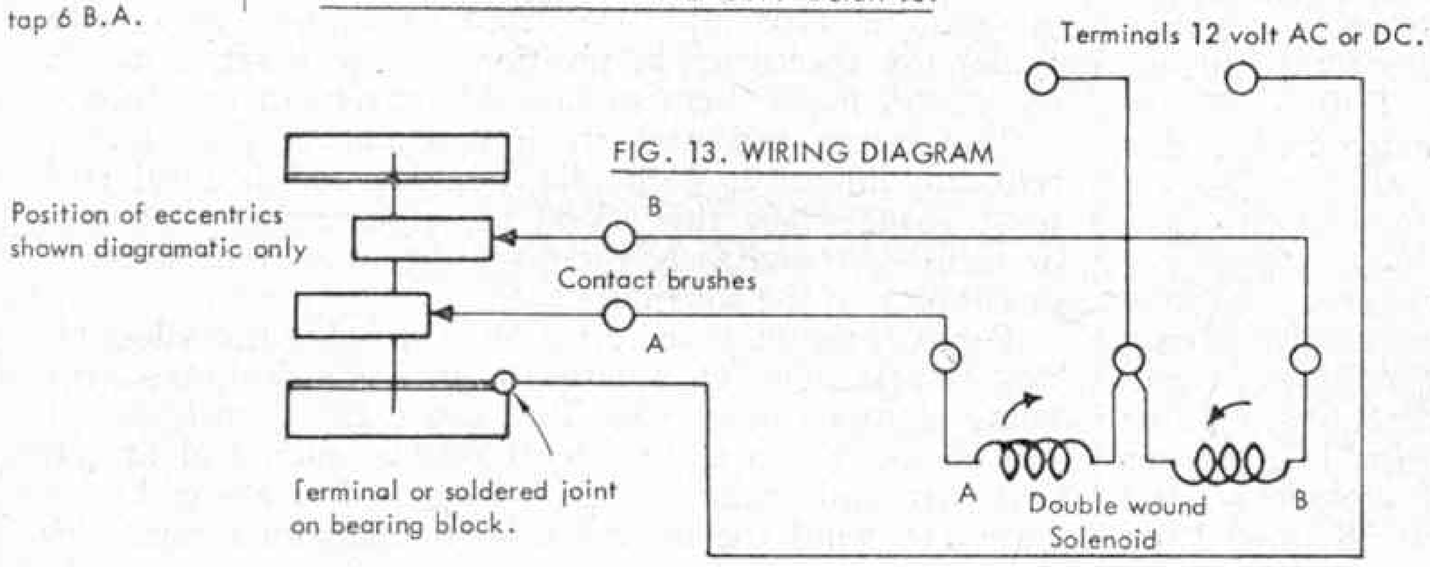
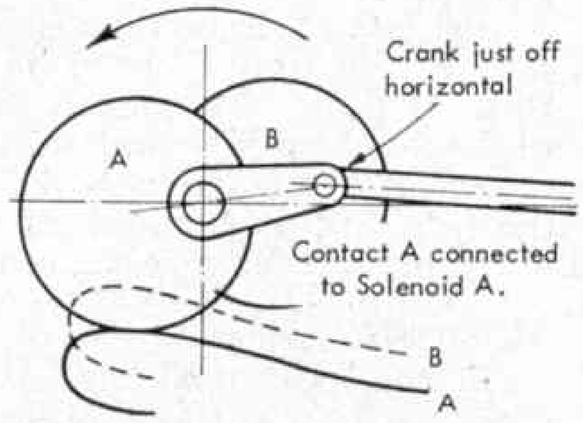


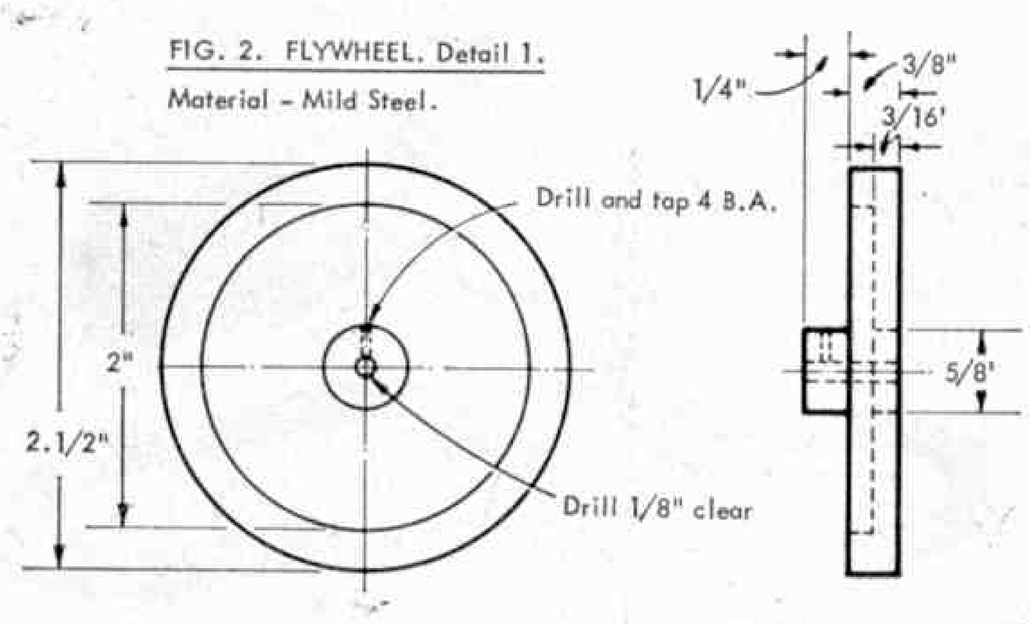
FIG. 13. WIRING DIAGRAM

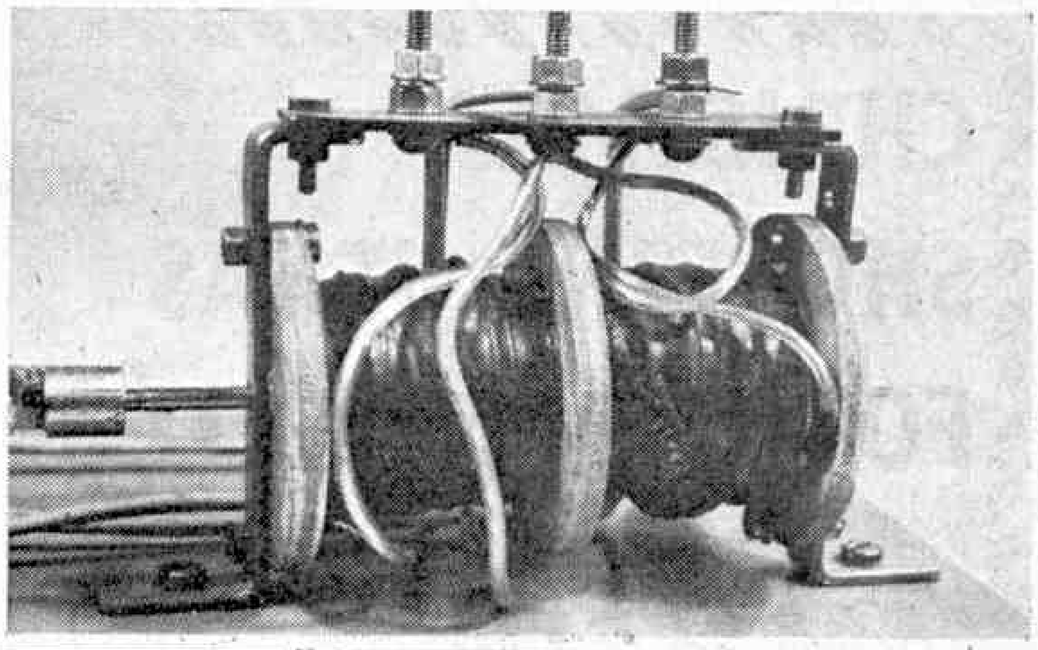


Brush B must break contact with eccentric B just before Brush A makes contact with eccentric A. This must take place when crank is just off horizontal in direction of rotation.

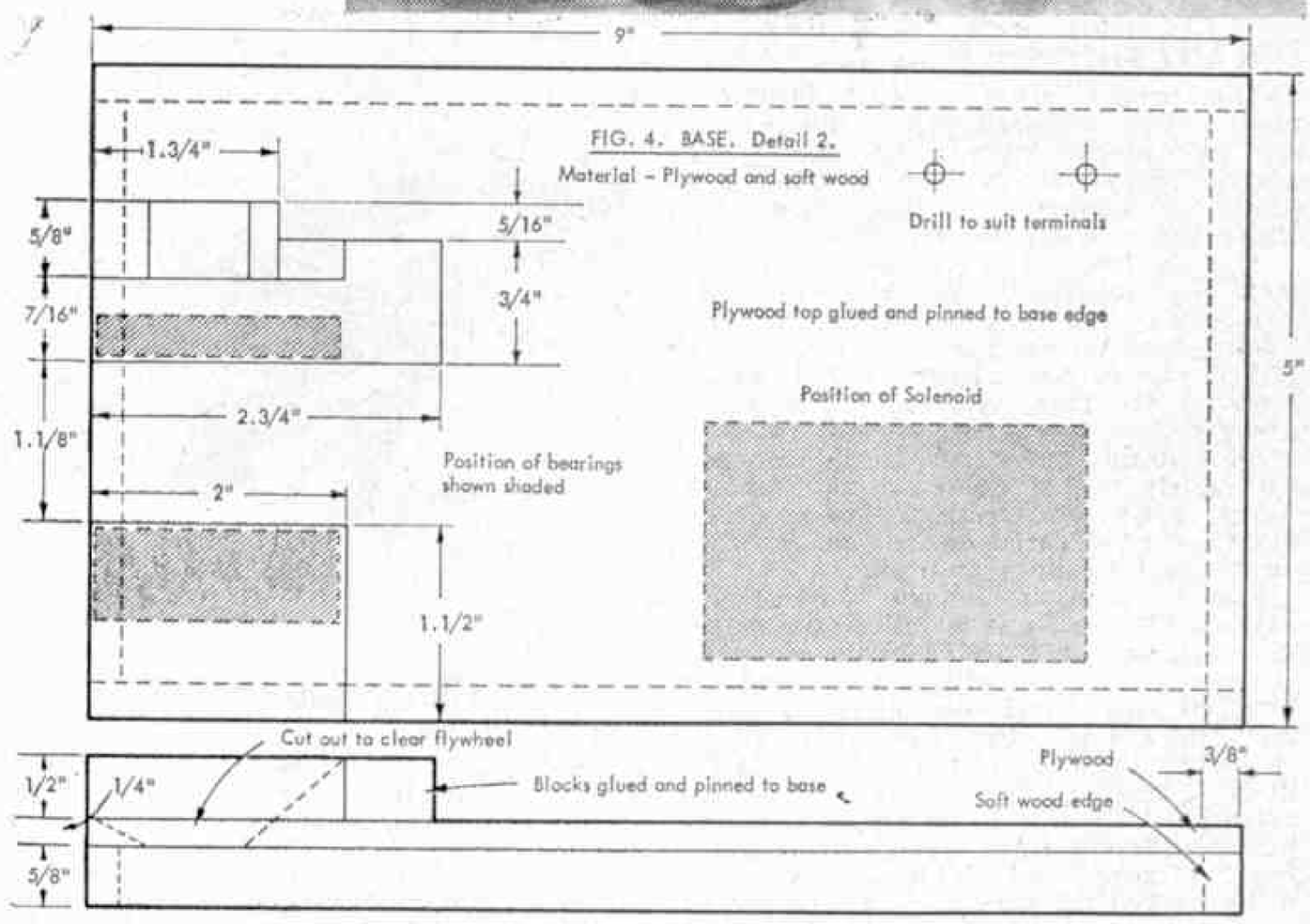
FIG. 14. ADJUSTMENT OF ECCENTRICS

Continued on page 31 behind the 24 page RIKO catalogue





This close-up view of the solenoid coils shows how the terminal connections and solenoid brackets are fixed in place. Note the use of plastic sleeving over the coils.



The two eccentrics can be seen here mounted on the crankshaft. If you cannot find a suitable flywheel a local engineering shop can machine one up.

the first. The solenoid is built as an entirely separate unit, complete with fixing brackets and terminal block. This can then be used for other models or experiments —such as an Old Time Beam Engine. Note that all coil ends are brought out to the terminal block.

The contact strips are bent as shown and are made of spring brass or brass shim. Provision is made to renew these by soldering replacements to the tin plate holders. Due to the relatively high current, scraping action and high speed rotation the contacts may require replacement after several hours running.

Setting to work

Now that you have completely assembled your engine, it's now ready for the test bed ! Check to see that it runs freely, and you should be able to produce easy rotation of the flywheel by pushing and pulling the end of the piston rod to and fro. Make sure all bolts are tight except of course the pivot bolts at each end of the connecting rod.

Next you must adjust the eccentrics, this is clearly shown in the drawing. Oil all bearings and sliding parts with a little light oil and apply a thin film of grease or vaseline to the contact brushes.

Now wire up to a 15 volt AC or DC supply, switch on and the engine should rotate, gradually building up speed. If the engine does not rotate but only hums give the flywheel a helping turn, and away she goes.

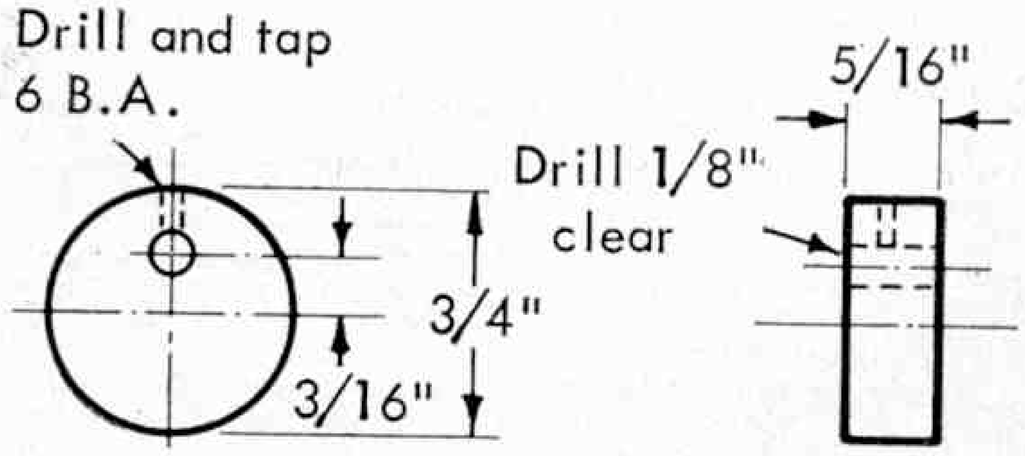
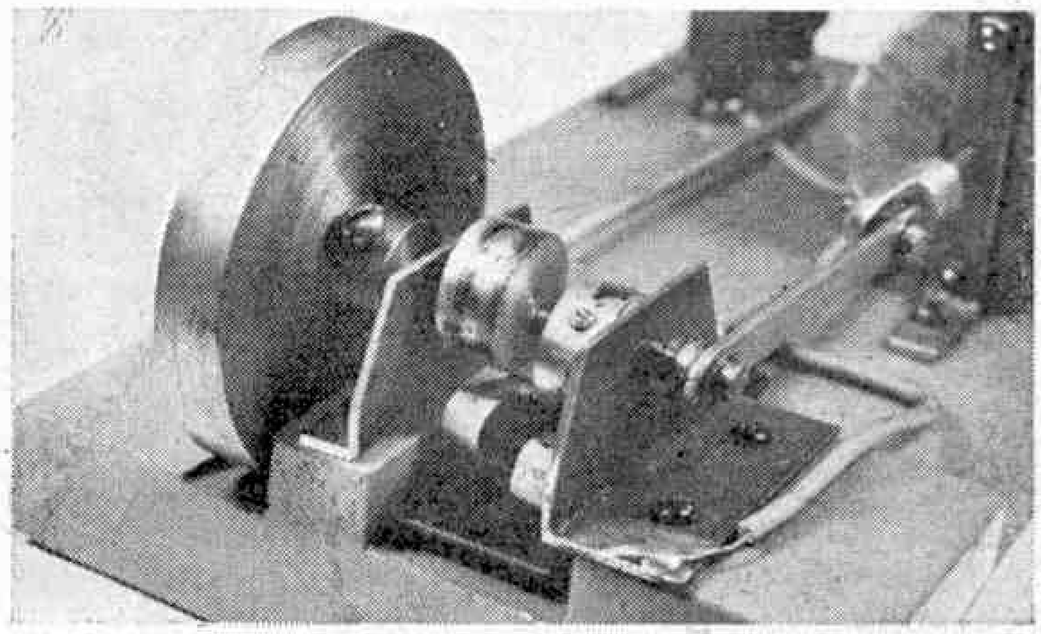


FIG. 3. ECCENTRIC. Detail 3.

2 off required
Material - Duralamin or Brass



CHRISTMAS SHOPPING IDEAS FOR THE MODELLER

" MATCHBOX " Motorway

The producers of " MATCHBOX " models, Lesney Products, have introduced an economical method of motorising your " MATCHBOX " cars. This is a simple attachment, costing only 1d., which fits onto the bottom of the model.

The Motorway's big advantage is that there are no troublesome electrical contacts under the track sections. The only electrical connections are from the hand controllers to the batteries or transformers, and from the track back to the transformers.

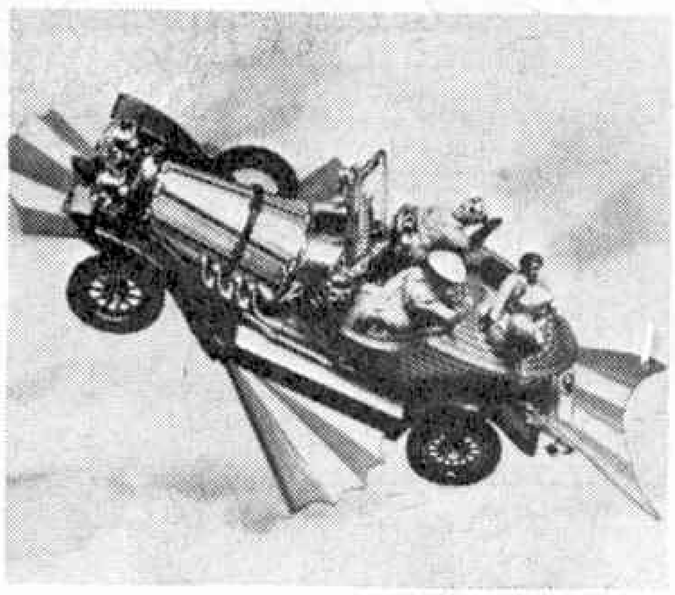
As batteries can be used, children can play safely out of doors without fear of damp grass or electric shocks. The models can be raced against one another or in opposing lines of traffic.

The track itself, or the " MATCHBOX " Flyover as it is called, builds up into a figure of 8 and consists of 13 ft. of track complete with bridge and its supports, two hand controllers, 10 drive pins and stickers, two spiral drive units, an instruction book plus two " MATCHBOX " models all costing 95/-. An extension kit is also to be marketed allowing 16 different track layouts to be built. Further more, this Motorway concept is to be backed up with an adequate spares service.

The Duesenberg Town Car by Monogram

The chosen car for the well-to-do people in the 1930's was the Duesenberg, of which the most elegant was the Murphy-bodied Town Car. Monogram has reproduced all the feeling and detail of this famous motorcar in their latest Classic Series kit, costing 46/-.

Monogram's 1 : 24 scale model of the Duesenberg Town Car is made up of 143 highly detailed parts in black, white, clear and chrome. The model has a removable bonnet which reveals a 320 h.p. straight eight engine and supercharger. The car's interior, chassis, etc., are realisticaly detailed, even down to the whitewall tyres which are moulded in white and so do not require painting. The body work is finished in gloss black, with black simulated leather top and interior.



Corgi's Chitty Chitty Bang Bang. Price 22/6d.

The latest and most delightful release from Corgi is the star from A. R. Broccoli's film 'Chitty Chitty Bang Bang'.

At first sight the car looks remarkably like a gentleman's 4/5 seater touring carriage that was common in the early 'twenties'. But on close inspection, one finds hidden beneath the running boards, a pair of wings which are automatically opened with a touch of the handbrake. Also, at the front and rear of the car can be found stabilisers, which are manually operated.

'Chitty', measuring 6⅜ inches overall, is graced with an array of shining instruments. These include a pair of gleaming brass Marchal head-lamps, an oval brass radiator, a polished aluminium bonnet retained by a Brooklands safety strap, and four outside exhaust pipes.

On either side of the brass-bound windscreen are jewelled sidelamps. A spare tyre, which awaits use, and a snake tubular horn are fitted on the off-side. The upholstery is of course padded and the instruments' panel is silver plated.

This is ideal as an ornament for a shelf but not, we think, as a child's toy as it is rather delicate for rough handling.

Airfix H.M.S. Fearless in 50 ft. : 1 in. Scale. Price 5/2d.

H.M.S. Fearless, launched in December 1963, is, along with her sister ship Intrepid, the largest British naval vessel to be designed and built since World War II. It is equipped to transport and land Army units and to act as floating headquarters during amphibious operations.

The kit, which, when built, measures just over 10 inches long, has two helicopters, six landing craft (4 L.C.A.s and 2 L.C.M.s), motor whaler and motor cutter, dinghys and life rafts.

The ship itself has floodlights, Sea Cat launchers and 40 m.m. guns. Also the stern ramp can be raised and lowered as can the forward and midships gangways.

Inclusive of all this are full assembly and painting instructions, transfers and display stands.

The T'rantula by Monogram

The T'rantula is one of a series of " Fun Cars " which includes the Beer Wagon, Garbage Truck and Red Baron, all costing 30/9d.

Except for the Model 'T' radiator, shell gas tank and motometer, the T'rantula (a representation of a dragster) is completely up-to-date with a highly detailed 427 SOHC Ford engine featuring a split G.M.C. supercharger. The exhaust heads are shaped like spider legs and the spoiler at the front is designed like a pair of spider pincers. The model is moulded in " spider green " with many chrome parts. Also included in the kit is a 1¼ inch Tarantula spider and pin back. The spider can be displayed with the model or worn on the lapel or as a tie tack.

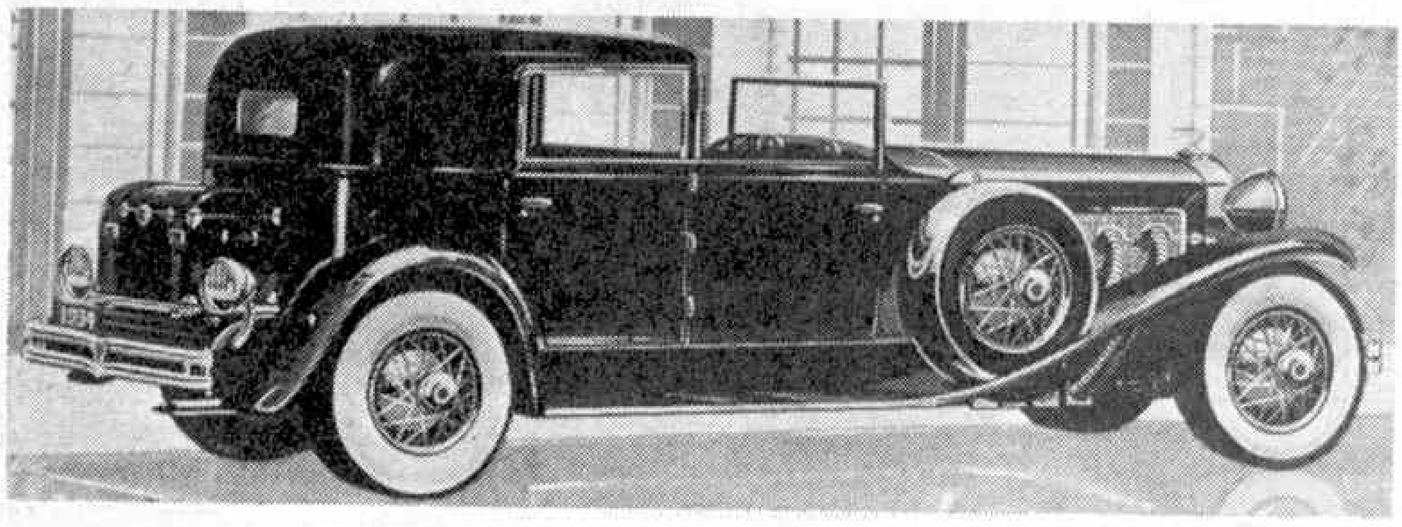
This 1 : 24 scale model can be displayed in either wheelie position with the front wheels off the ground or with the four-panel, blossomed chute in position.

The Jet King Blowtorch

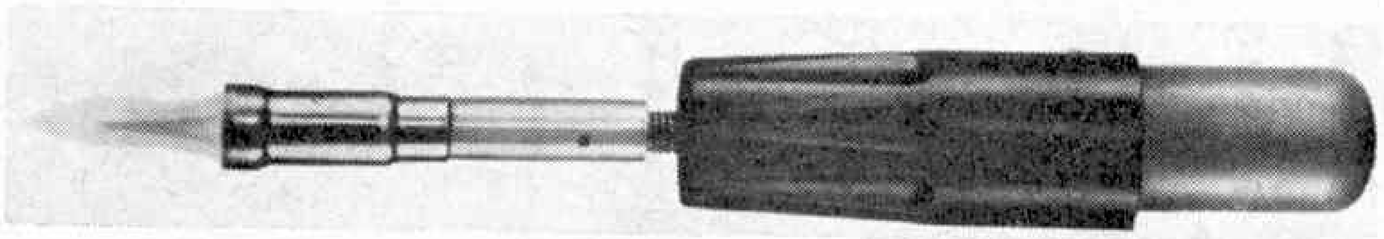
The Walter Kidde Company Ltd. has brought out an amazing multi-purpose tool called the Jet King Blowtorch.

This fantastic little tool solders, brazes, fixes leaks and wiring, plumbing, lights fires and countless other jobs. Powered by a gas filled cartridge, the Blowtorch fits lightly into the hand enabling finger-tip control to reach those normally inaccessible places with precision and ease.

There is both a blowtorch (which



Top right: The Lesney Products Motorway displayed in the basic layout. The " MATCHBOX " cars are motorised by the use of a simple attachment costing 1d. Above left: Corgi's Chitty Chitty Bang Bang shown in full flight with its wings spread out. Left: The sleek Duesenberg Town Car by Monogram, which is made up of 143 highly detailed parts in black, white, clear and chrome plated plastic.



develops a pinpoint flame of 3,500 degrees) and soldering attachment, which allows delicate and intricate soldering jobs to be carried out. Two gas cartridges are included with the display pack, each charger giving approximately 45 minutes continuous burning.

Full instructions for use are printed on the reverse side of the display pack. The cost of this worthwhile little gadget, which incidentally should be a part of every handyman's tool kit, is only 35/-.

Eagle's Non-slip Rulers

One of the most popular precision rulers on the continent has been introduced to the United Kingdom by the Eagle Pencil Company Limited.

Linex Super Rulers, as they are called, are made from clear acrylic plastic. Their unique and most useful feature is their non-slip property which is achieved by rubber strips which are countersunk on the underside of the rulers.

The rulers are available in four sizes: 8 inch, 12 inch, 16 inch and 20 inch. The 8 inch and 12 inch rulers have one rubber strip and one acrylic rib. The acrylic rib enables the ruler to be slid along without leaving the paper. The 16 inch and 20 inch lengths have, however, 2 rubber strips which allow a firmer grip that is necessary with these lengths.

Linex Super Rulers are fully bevelled and have both metric and inch (to 1/16) measurements. The prices are: 8 in.—5/6d.; 12 in.—8/0d.; 16 in.—11/7d., and 20 in.—15/3d.

Corgi's Chevrolet SS 350 Camaro. Price 9/0d.

The latest Corgi model to be released with the Golden Jacks wheel-changing system is the Chevrolet SS 350 Camaro. Very much a sportsman's car, the Camaro's special features include concealed headlights and air intakes in the bonnet to feed the 4-barrel carburetter of the 295 h.p. V-8 engine.

Both these details are reproduced in the model. The headlight covers are operated by levers mounted below the front bumper and the air intakes are silver plated.

The nose of the car is emphasised by a black stripe, known to Chevrolet owners as a " front accent band ". The detachable black hood, which incorporates the rear window, attaches neatly to the top of the windscreen and the luggage shelf behind the rear seats.

Two opening doors are provided to give easy access to the tipping front seats, also silver plated gear lever and, of course, the Golden Jacks.

" Fighting Planes of the Thirties " by Monogram

Monogram has announced the addition of three unique bi-planes to their line of 1 : 72 scale military aircraft.

These three aircraft, the Curtiss Hawk P-6E, the Boeing F4B-4 and the Curtiss Goshawk, are probably the most famous planes flown by the U.S. during the 1930's.

The Curtiss Hawk was the last of a series of planes that once flew in the Schneider Trophy races. Used by the Army Air Corps, it carried two .30 calibre machine guns and had a maximum speed of 198 m.p.h.

The Boeing F4B-4 was the last biplane built by Boeing and was used by the Navy until shortly before World War II. Its armament was two .30 calibre machine guns, and had a top speed of 184 m.p.h.

The Curtiss Goshawk served in the famous " High Hat " squadron aboard the carrier U.S.S. Saratoga from 1933 to 1938. With a wing-span of only 31 feet, the Goshawk had a top speed of 198 m.p.h. Its armament consisted of two .30 calibre machine guns and a 500 lb. bomb.

Each of these three Monogram biplanes have their wing struts and main landing gear moulded complete with the fuselage halves for ease of assembly and alignment of parts. All of these kits are complete with detailed pilot figure, colourful decals and display stand.

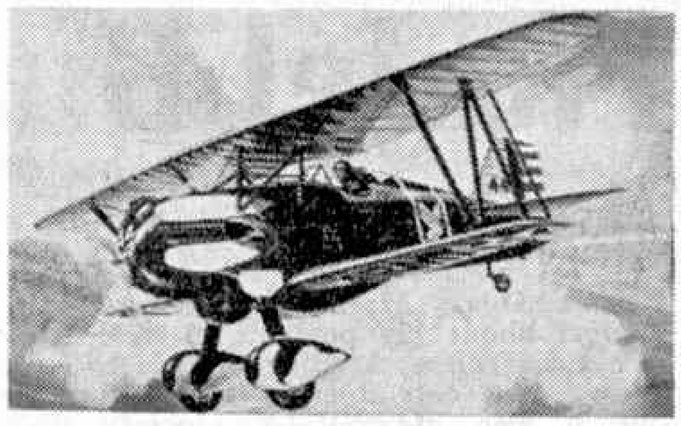
As well as buying these individual kits, Monogram has created a 3-in-1 combination kit of these planes called " Fighting Planes of the Thirties ".

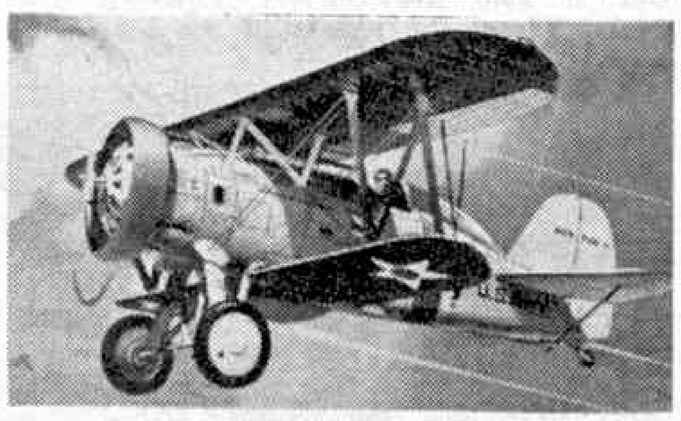
Oberg Files

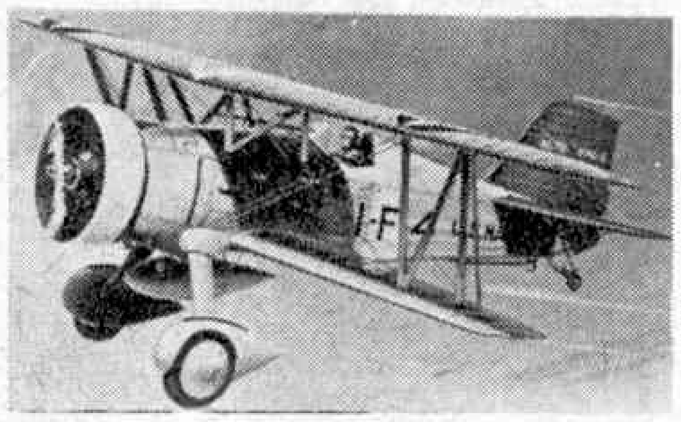
New from the Oberg range are three files specifically designed to make filing easier. Each file has a course side, for fast and easy cutting, and a fine side for making a smooth finish. A specially designed plastic handle is bonded to the file for life and fits comfortably in the hand of the user.

The file at the top of the picture is specially for working with laminated plastics and costs 8/6d. The middle one is primarily for woodworking and costs 7/6d., and finally the bottom one which is intended for use with metal also costs 7/6d.

We have used all three files extensively on model making and household tasks, and find them most satisfactory. The plastic handle is very comfortable, and the blades remain sharp even after constant use.







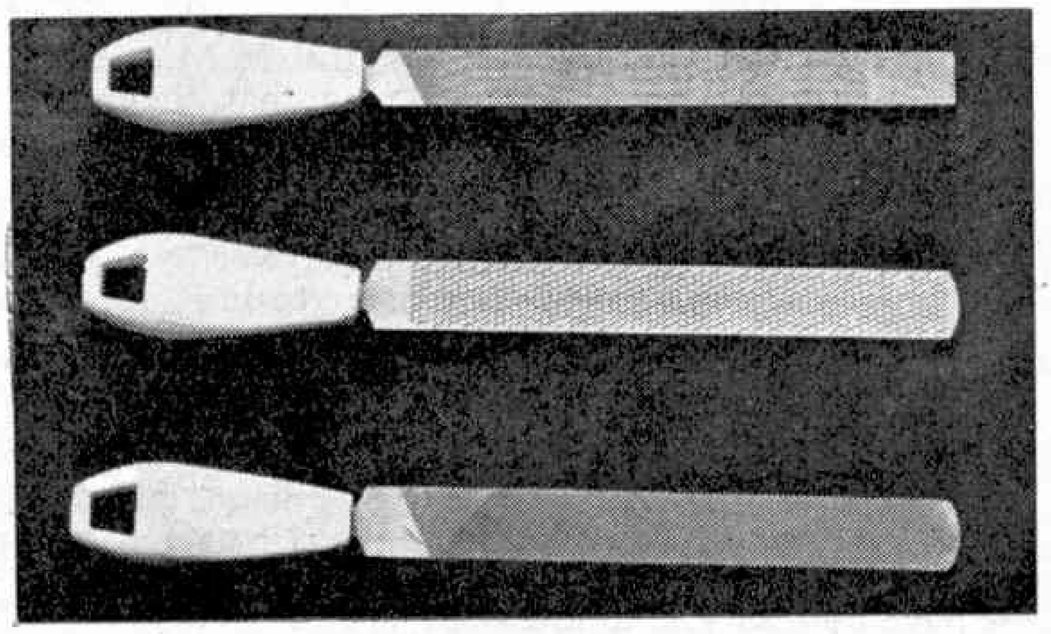
The Boeing S.S.T. by Monogram

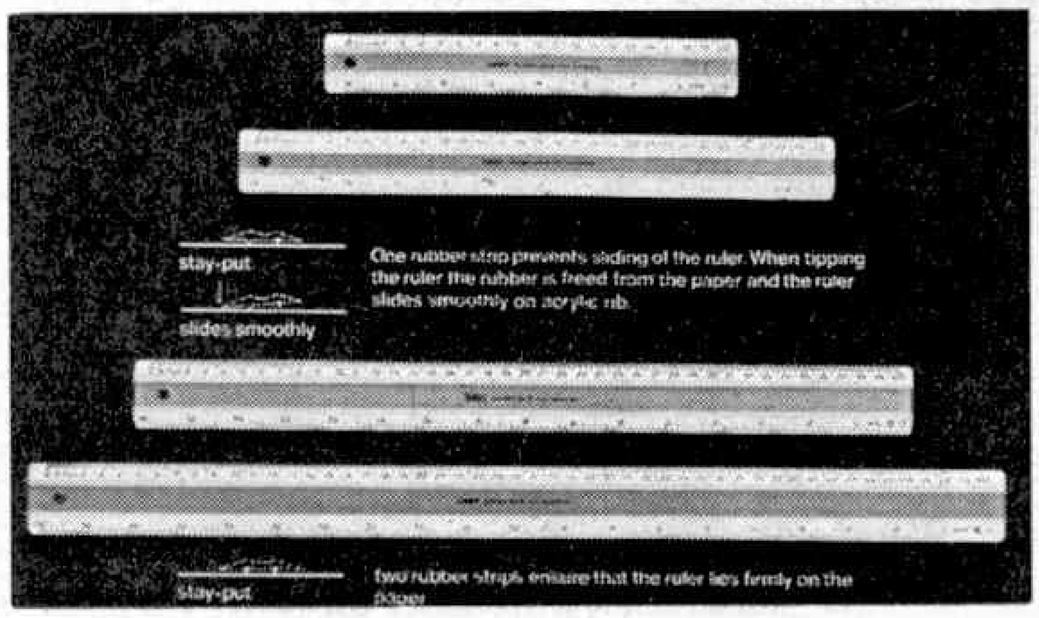
Boeing's S.S.T. supersonic jet, the most talked about aeroplane of the decade, has been made into a 1 : 400 scale kit by Monogram. Based on the latest Boeing specifications, Monogram's S.S.T. kit is the only one to feature the forward stabilising canard wings just aft of the cockpit and the new elongated tail.

Monogram has, in close co-operation with United Air Lines, designed the decal markings after the S.S.T.'s that United will fly in the mid-1970's.

As expected from a Monogram kit, there is a high degree of detailing. Also featured in the model is a sculptured display stand and movable main wings to resemble both low speed and high speed configurations.

Top left: The Walter Kidde Jet King Blowtorch which has a soldering attachment, is the multi-purpose tool for every handyman. Above: The Curtiss Hawk P-6E, the Boeing F4B-4 and the Curtiss Goshawk by Monogram, each costing 10/11d. Bottom left: The three new Oberg files used for working plastic, wood, and metal. Below: All four sizes of the Linex Super Rulers, describing their non-slip qualities.

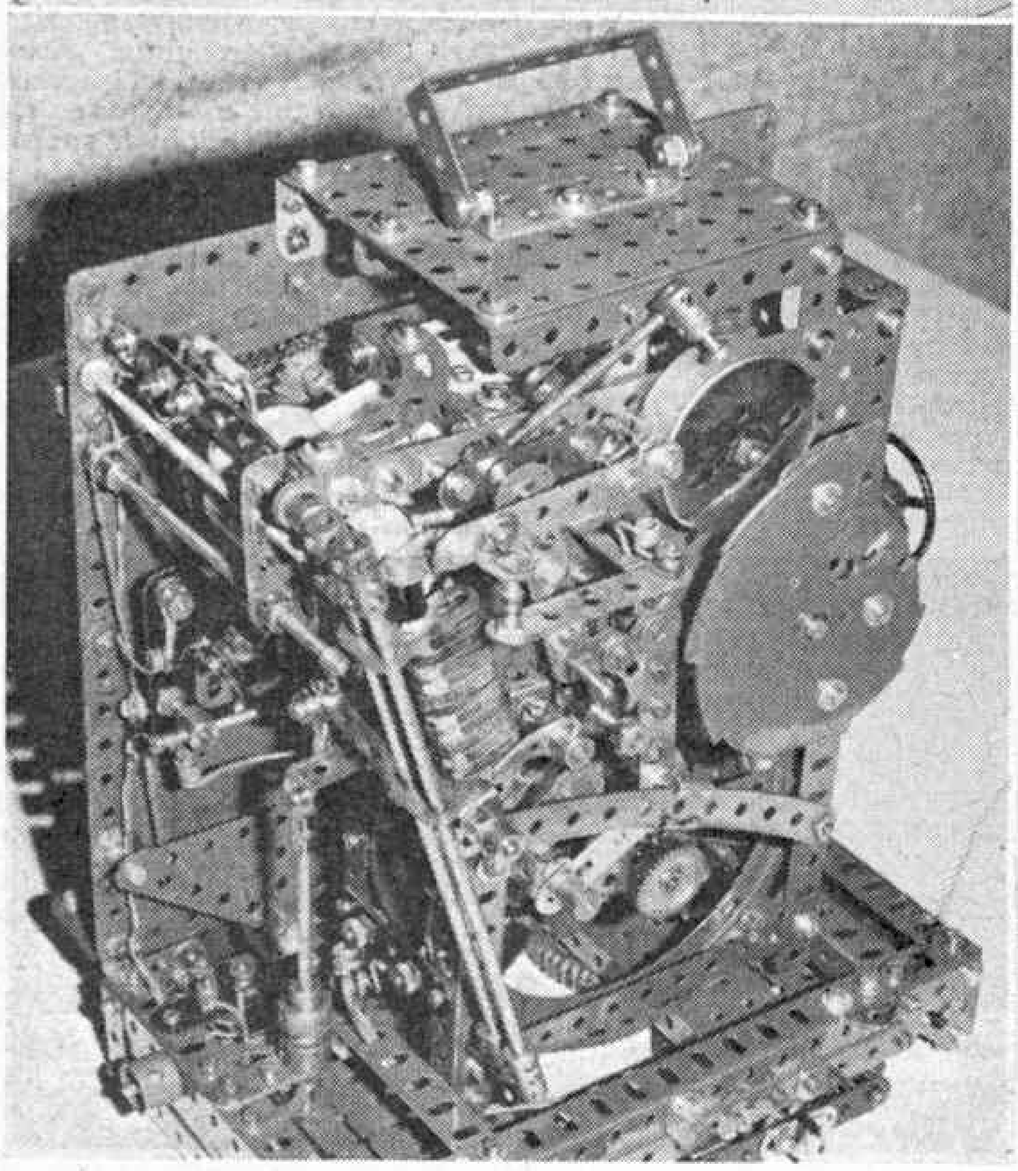




Model Builders of Distinction

by Spanner

Below: Doug McHard of Meccano Ltd. talking to Leslie Dougal about his portable electric Astronomical Clock. This is a masterpiece, keeping as perfect a time as A.C. mains will allow. Not only does it show local time by the main hands, but it also incorporates separate dials showing Greenwich Mean Time, the phases of the moon and the state of the tide. In addition, it strikes the hour and half-hour and includes a special "night cord" which, when pulled, causes the clock to strike the nearest hour. (That's for people who wake up in the night and don't want to put the light on to find out the time!) Some idea of the intricate mechanism inside the Clock can be obtained from the close-up view, below left.



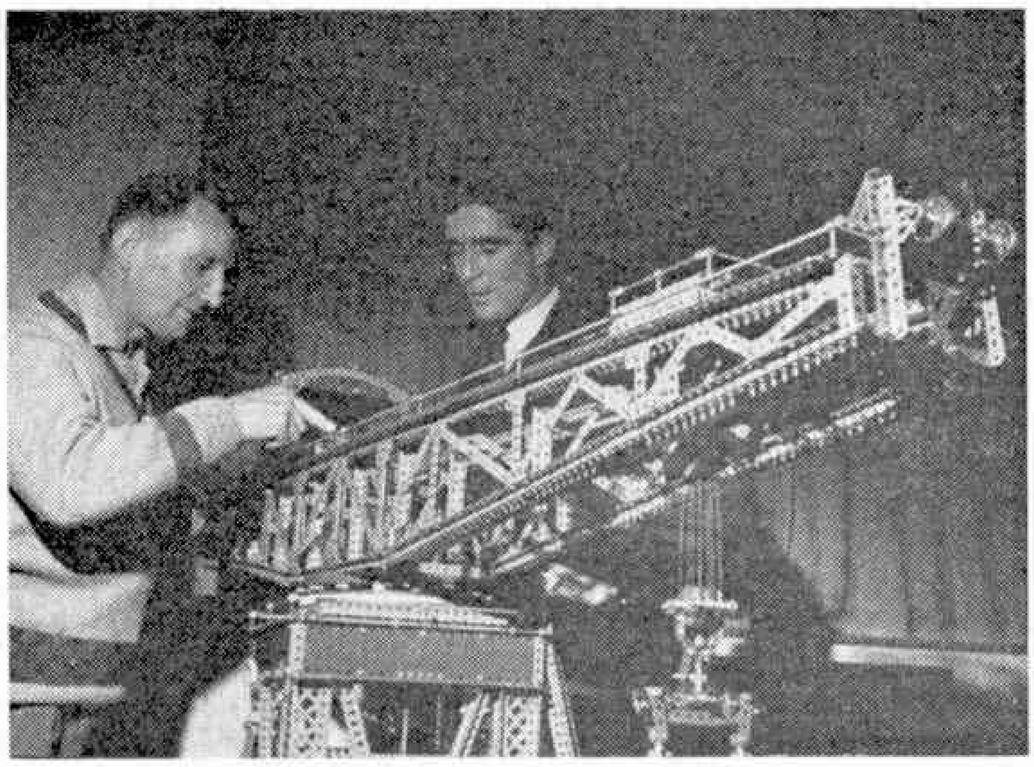
ON SEPTEMBER 28th, I was privileged, together with John Franklin, our Editor, and Doug. McHard, Marketing Manager of Meccano Ltd., to attend the First Annual General Meeting of the Midlands Meccano Guild, held in the St. John's Ambulance Brigade Hall at Stratford-upon-Avon, Warwickshire. Although we have mentioned the Midlands Meccano Guild in the M.M. on several occasions, this was the first time I had actually attended one of its functions or met any of its members, other than the hard-working Guild Secretary, Mr. Bert Love of Birmingham. Looking back, I can truthfully say I was delighted that my colleagues and myself accepted the Guild's invitation to go along. We had a thoroughly enjoyable day, met a host of interesting people, were well-fed by a team of top-flight caterers (co-opted wives of Guild members!) and, perhaps most important from my point of view, had the opportunity to study a vast selection of Meccano models built by members and transported—over considerable distances in some cases—to Stratford to be exhibited.

"Interest"—this is the word which typifies the Midlands Meccano Guild. All its members or, at least, all those whom I met at Stratford, are keenly interested in the Meccano system. They show a genuine interest in Meccano models of all types and they are, of course, deeply interested in their own Guild. Judging from the models on display at the Meeting, they are also expert model-builders. In fact, I was amazed not only by the wide variety of models exhibited, but also by the skill with which they had been built, as well as by the engineering problems that had been met and ingeniously overcome.

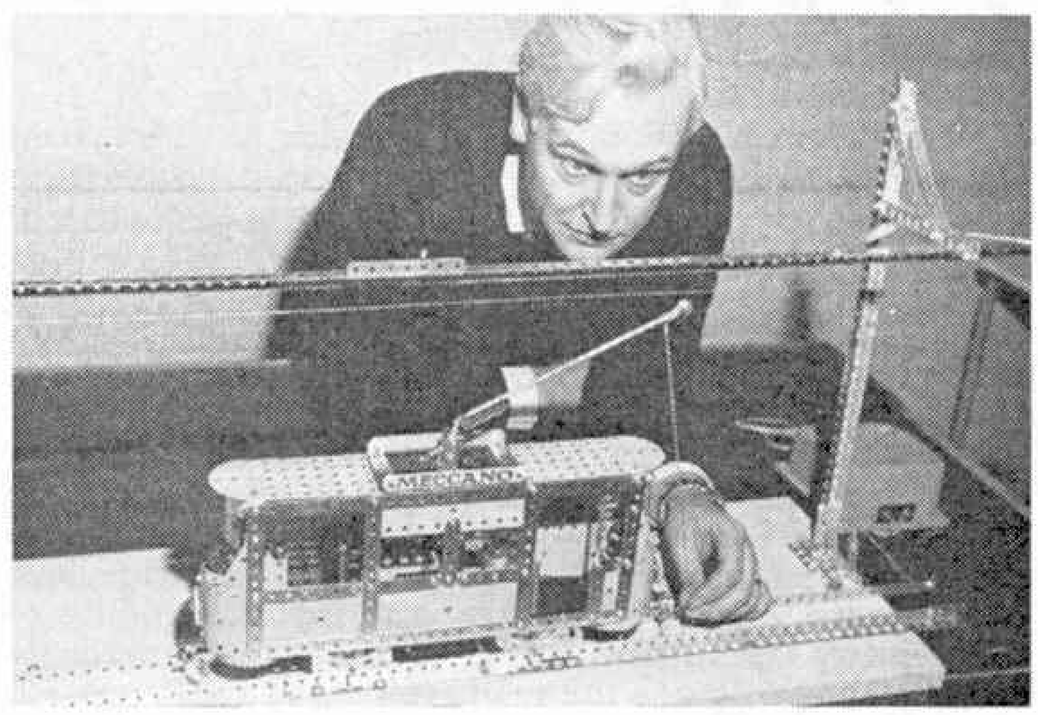
Some of the photographs we took at the meeting are reproduced on these pages, but these show only a few of the many models that were present. One of those which is not shown was a model of a 1903 Tram as used early this century by Bradford City Tramways. This was of special interest to me as it was built from building instructions I wrote for the June and July 1968 issues of the M.M. and it proved that our building instructions can at least be followed.

You may be wondering why this should be of concern, yet the fact is that, while I must have described literally thousands of models for the M.M., hardly any readers have ever let me know that they have successfully built a model from the details given. Mind you, hardly anyone has ever written to say that they were *not* able to build a model, either!

At this point I should mention other worthy models not illustrated, but to do so would require far more space than I have available. Just about every other model displayed at the Meeting falls into the "worthy" category and so, as it would not be fair to mention some and not others, I must content myself with congratulating all exhibiting members of the Midlands Meccano Guild on their—take it from me—excellent constructions and with apologising to those deserving members we have been unable to mention.

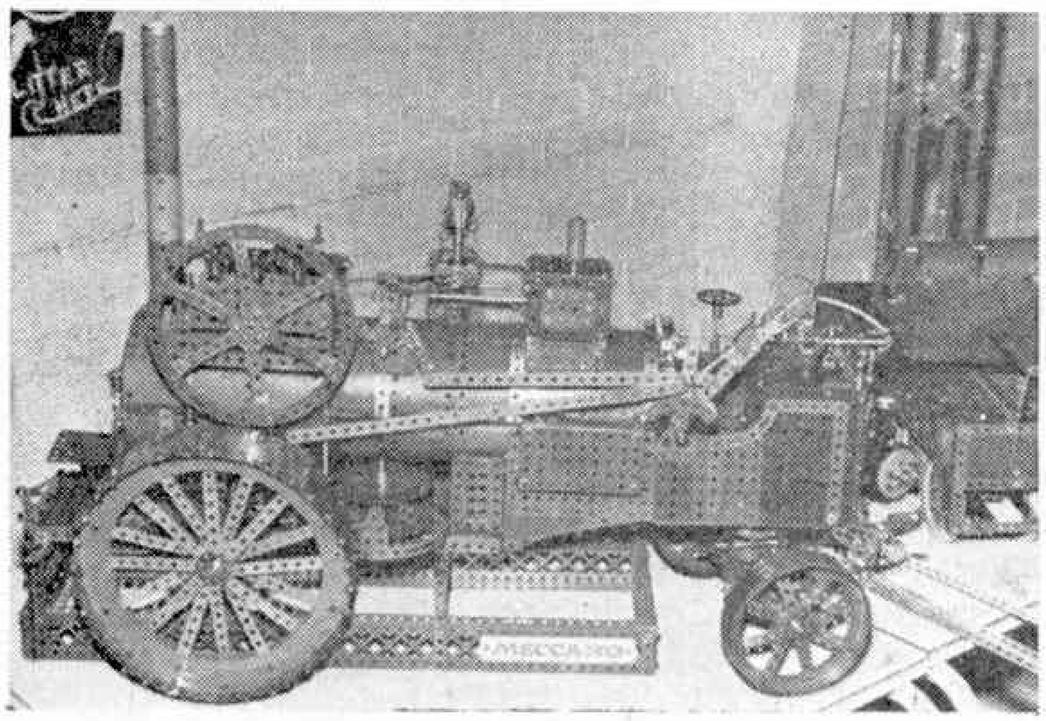


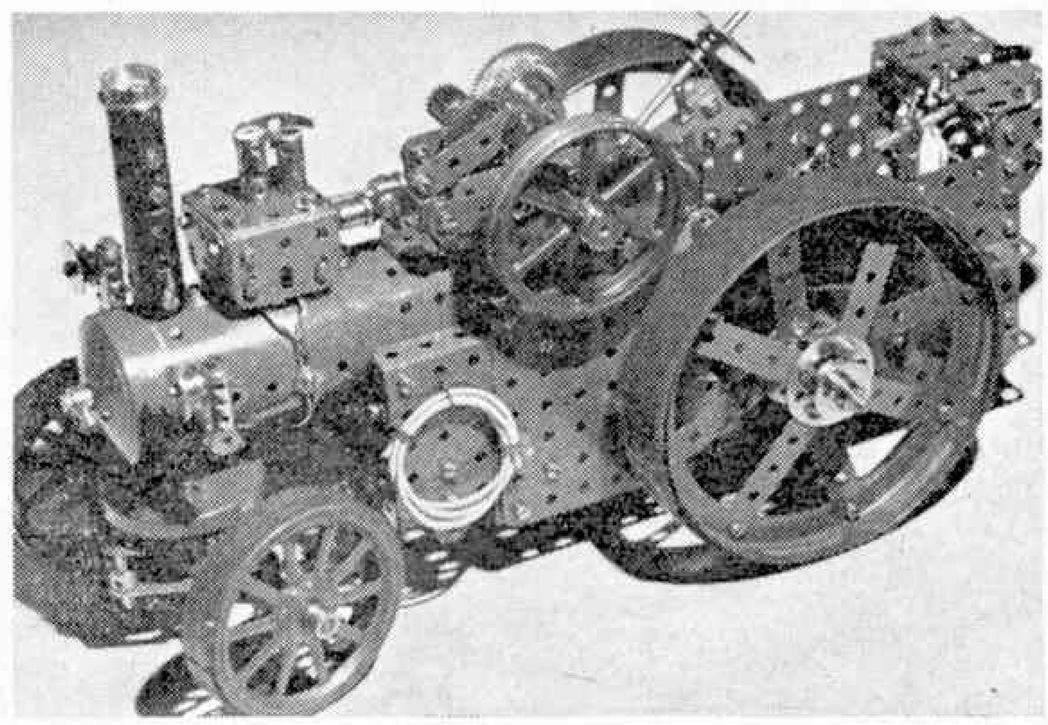
One of the star attractions of the Midlands Meccano Guild A.G.M. was a Giant Blocksetting Crane built by Dennis Perkins of Rugby. A modified and much-improved version of the model featured in pre-war Super Model Leaflet No. 4, it really is enormous with a boom well over 5 ft. in length and a drive arrangement which enables it to correctly perform all the movements carried out by the full-size prototype. Dennis is showing the Editor one of the model's many points of interest.



While the Midlands Meccano Guild will not accept, for display, models built beneath a certain constructional standard, they do not prohibit Outfit models or even Manual models. Here we see Guild Secretary, Bert Love with a splendid little tram produced from the contents of the Junior Power Drive Set. The model is fully operational, drawing its power from an overhead electrified wire. The wire, of course, as well as its supports and the rails, is not in the Outfit.

Steam-powered machines have always been popular with model-builders. Alf Hindmarsh based his 3 ft. long Steam Ploughing Engine model on a 19th century prototype and described how engines of that period had the main driving wheels and flywheel at the smoke box end of the boiler, being steered from the fire-box end. They incorporated two large powered cable drums, the ploughing implement being slung from a cable which ran from one drum, round a pulley situated at the opposite side of the field to the engine, and back to the other drum.





The beautiful and highly detailed traction engine on the right was constructed by Dennis Perkins. This model drew special attention because of the intricate detail and all of the brass parts being well polished. This model moved very realistically and was only one of Dennis's exhibits at the Guild meeting. Our photograph at the top of this page shows Dennis's other model—the Giant Blocksetting Crane Super Model.

MECCANO ELECTRIC PENDULUM CLOCK

by L. R. Dougal, M.B.E., M.T.A.I.

DURING THE first half of the nineteenth century clock-makers began to turn their attention to the electric clock and many electrically-driven pendulum clocks were produced. A very simple electric clock was devised by Hipp in 1842 and, by the middle of the century, these were being produced commercially at Neuchatel to grace the mantelpieces of the Victorian era. Very few indeed of these interesting timepieces remain, but an excellent example can be seen at the South Kensington Science Museum, while a first class reproduction was displayed recently at the Chichester Model Engineering Exhibition.

An article on electric pendulum clocks appeared in the Meccano Magazine early in 1925 when the method of operation of the Hipp clock was explained in detail, but it was not until 1935 that the first Meccano Clock operating on the Hipp system was shown to be possible. Since then, Hipp-type clocks in Meccano have appeared, although not too frequently, and I have myself produced the example featured in the accompanying illustrations. Relatively few parts are required to build the model, but some care is needed in its construction and adjustment.

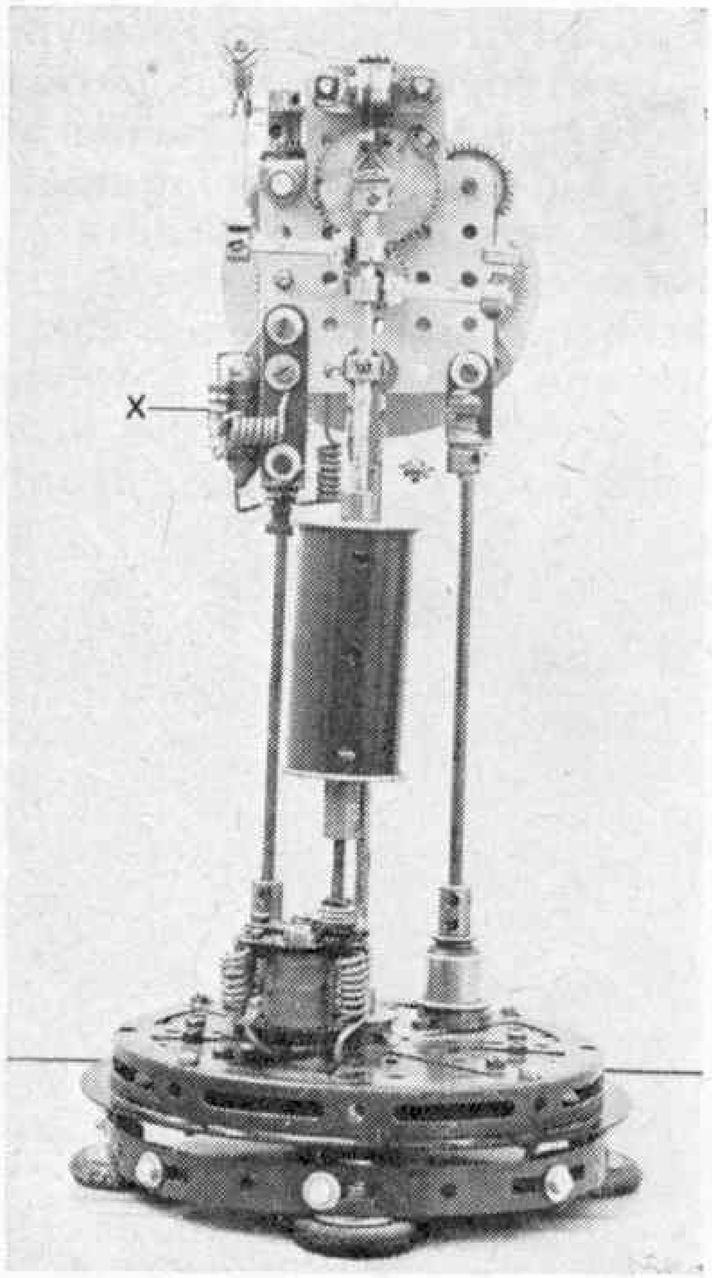
The base is built up on a 6 in. Circular Plate 1, towards the edge of which four Threaded Bosses are attached by Angle Brackets. Four 1 in. Pulleys with Motor Tyres are secured, one each, on four 1 in. Screwed Rods held in the Threaded Bosses by Grub Screws, these four Pulleys forming the feet of the Clock and serving to level it. A Hub Disc 2 is now completely filled in by 2½ × 1½ in. Flexible Plates, then, to the underside of the resulting construction, three Bush Wheels are fixed, one at the centre and two at positions immediately below the two front pillars, as shown in the illustrations. Three 8 in. Rods 3 are clamped in the bosses of the Bush Wheels, each front Rod being fitted with a ¾ in. Flanged Wheel 4, a Chimney Adaptor 5, a ½ in. Pulley without boss 6 and a Short Coupling 7. At their upper ends, these front Rods are fitted with Worms for decoration purposes.

Next, two Elektrikit Cylindrical Coils 8, fitted with Cores, are bolted to a 1½ in. Insulating Flat Girder 9 and the whole assembly is secured to Hub Disc 2 as shown, a Collar on the shank of each securing Bolt acting as a spacer.

At this point, the Hub Disc is clamped to the Circular Plate by four ¾ in. Bolts 10, then seven Formed Slotted Strips 11 are bolted together and fitted loosely round the Pulleys to mask the feet and so give a better appearance.

In the case of the gear train, the front and back plates providing the Rod mountings are identical, each consisting of a 2½ × 2½ in. Flat Plate 12 extended by a 1½ × 1½ in. Flat Plate 13. The lower corners of Plates 12 are joined by a unit 14 consisting of a Coupling in which an Adaptor for Screwed Rods is held. Note that the front Plate is attached by a Bolt passed through the Plate into the Coupling where it is held by the Coupling's Grub Screw. At the top, the Plates are joined by a 2 in. Screwed Rod 15 and by a Double Bent Strip 16, overlayed by a 1½ in. Strip, both being attached to the Plates by Angle Brackets. The Plates are now fitted to the pillars, the front pillars being inserted into the Couplings of units 14, while the centre pillar is fitted with a Rod and Strip Connector 17, bolted to rear Plate 12.

Next to be attached is the pendulum support 18 which consists of two Angle Brackets held by two 1⅛ in. Bolts locked to the top of rear Flat Plate 13. The pendulum is supported by a pendulum spring supplied by a small piece of razor blade a little over an inch in length. This pendulum spring is carefully produced by clamping a razor blade between two 2½ in. Strips and removing both cutting edges with a pair of pliers.



A general rear view of Mr. Dougal's Pendulum Clock. Note, the interference suppressor shown at X is not essential.

The ends of the blade are removed in a similar manner.

The gear train itself is now produced. Mounted on a 2 in. Rod 19, journalled as shown in Flat Plates 13, are a Ratchet Wheel 20, boss outwards, a Worm Gear 21 and a Collar. The Worm engages with a 57-teeth Gear 22 on a 1½ in. Rod mounted in Double Bent Strip 16 and its 1½ in. Strip. This Rod also carries a ¾ in. Contrate Wheel 23 which meshes with a ¾ in. Pinion 24 on a 2 in. Rod also carrying a 7/16 in. Pinion 25, this latter Pinion engaging with a loose 60-teeth Gear on the minute hand shaft which is a 2½ in. Rod carrying at its rear end a ¾ in. Pinion 26 and, at the front end, a 57-teeth Gear 27, loosely mounted. A Collar on the end of the minute hand shaft is separated from loose Gear 27 by a Washer. Note that the 60-teeth Gear on the minute hand shaft is held between a Collar and a 1 in. Pulley with Motor Tyre, thus providing a simple clutch.

In mesh with Pinion 26 is a 50-teeth Gear on a 2 in. Rod also carrying a 1 in. Gear. This Gear engages with a similar 1 in. Gear 28 on another 2 in. Rod that carries a ¾ in. Pinion which engages with a second 50-teeth Gear 29 on a Rod carrying a ½ in. Pinion 30. This last Pinion engages with Gear Wheel 27 to complete the 12 : 1 hour hand drive.

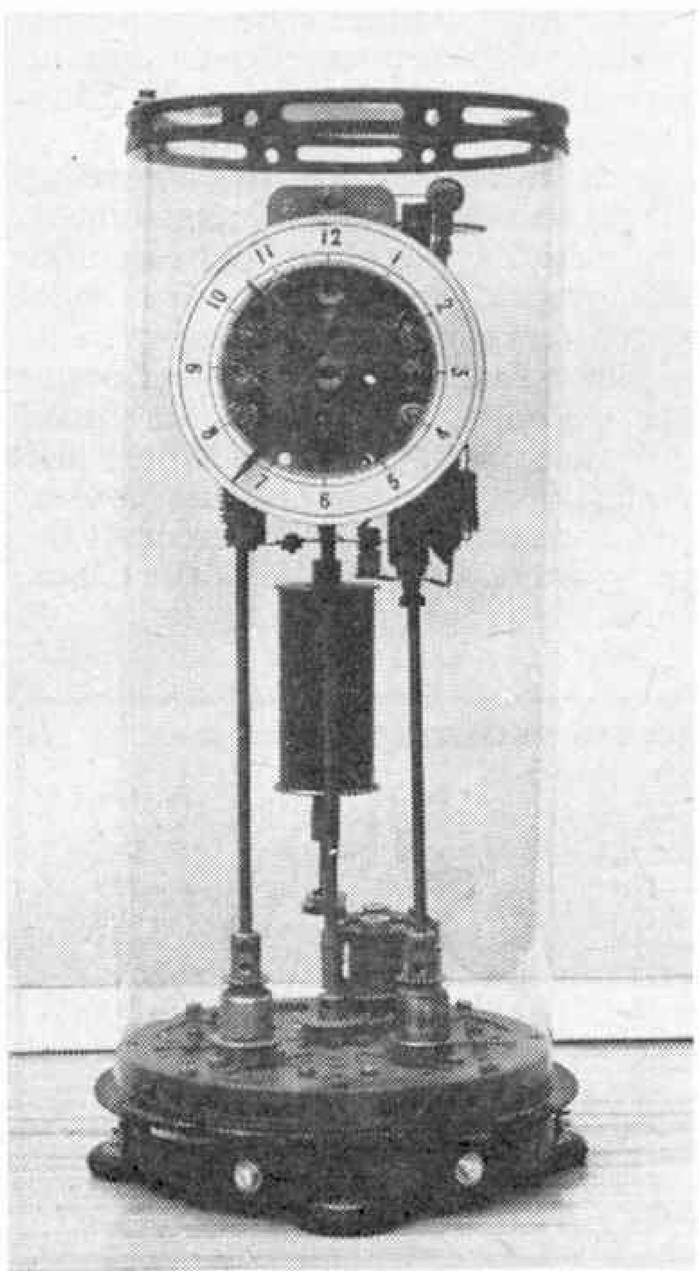
Four Reversed Angle Brackets are now bolted to front Plate 12, than a simple cardboard face is fixed to their free lugs with impact adhesive. Two hands are cut from stiff card, the hour hand being fixed to the boss of Gear Wheel 27 and the minute hand to the back of a Collar holding the Gear in place, impact adhesive again being used in both cases.

At this stage, the electrical connections should be made. Coils 8 are connected in series, one lead going to the source of supply, the other being taken up the central pillar to an Elektrikit 1 in. Wiper Arm 31, insulated from the frame and projecting towards the back of the clock. The model illustrated uses some pre-war Meccano electrical parts, but Elektrikit parts are easily substituted. A 2 in. Bent Wiper Arm 32 is now fitted to a 1 × 1 in. Angle Bracket, earthed to the frame of the clock, the other side of the source of supply also being connected to the frame.

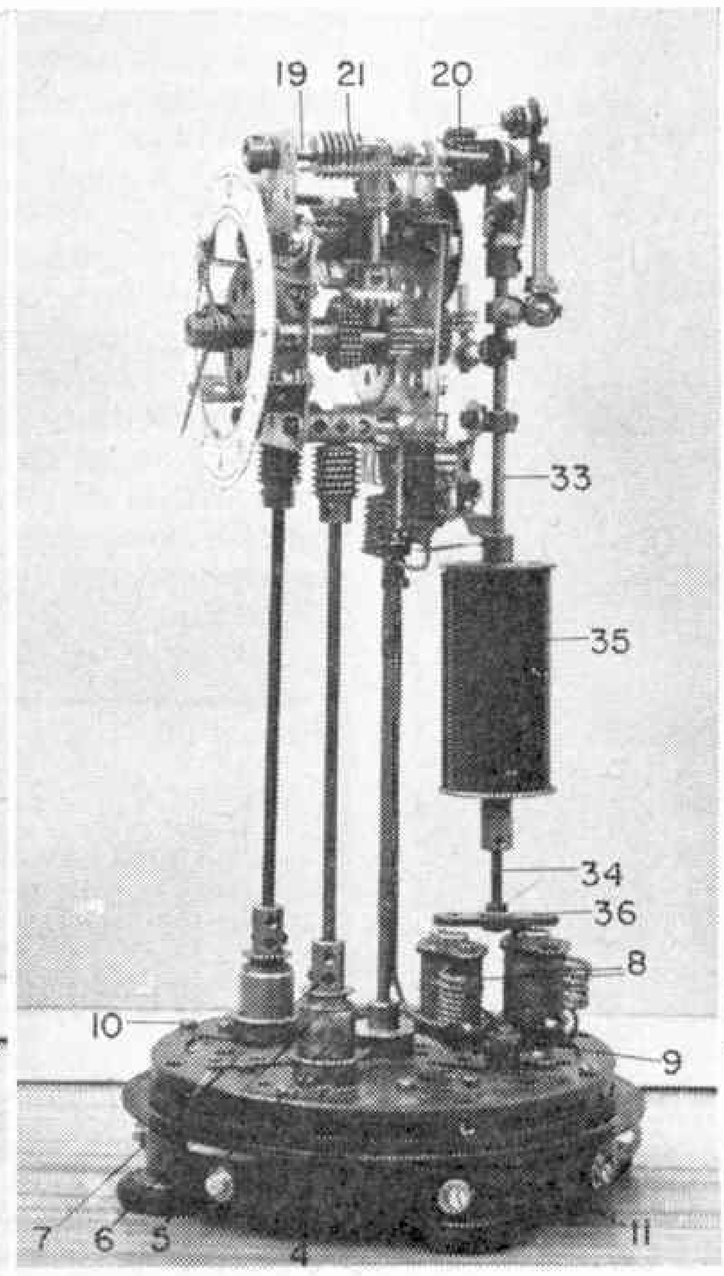
The pendulum consists of a 5 in. Rod 33, connected to a 2 in. Screwed Rod 34 by means of a Threaded Boss and Rod Socket. The pendulum bob is a 2½ in. Cylinder 35 fitted with 1⅛ in. Flanged Wheels. A sheet of lead is formed into a sleeve and slipped inside the Cylinder before fitting, care being taken to ensure that the whole bob runs freely on the pendulum. The bob can be raised and lowered by means of a Threaded Boss mounted on Screwed Rod 34. Mounted on the lower end of the pendulum is an armature built up from three 1½ in. Strips 36 fixed with lock-nuts to Screwed Rod 34. The air gap between the armature and the Cores should be as small as possible.

At its upper end, the pendulum is now fitted with three Collars and an End Bearing 37, the latter being bolted to the earlier-mentioned pendulum spring, the other end of which is clamped between Angle Brackets 18 with Washers being used for packing purposes. Screwed into one threaded bore of each of the two upper Collars on the pendulum is a Long Threaded Pin on the end of which a Collar is mounted. In one case, this Collar is fitted with a Small Threaded Pin 38 upon which Washers are placed to balance the pendulum,

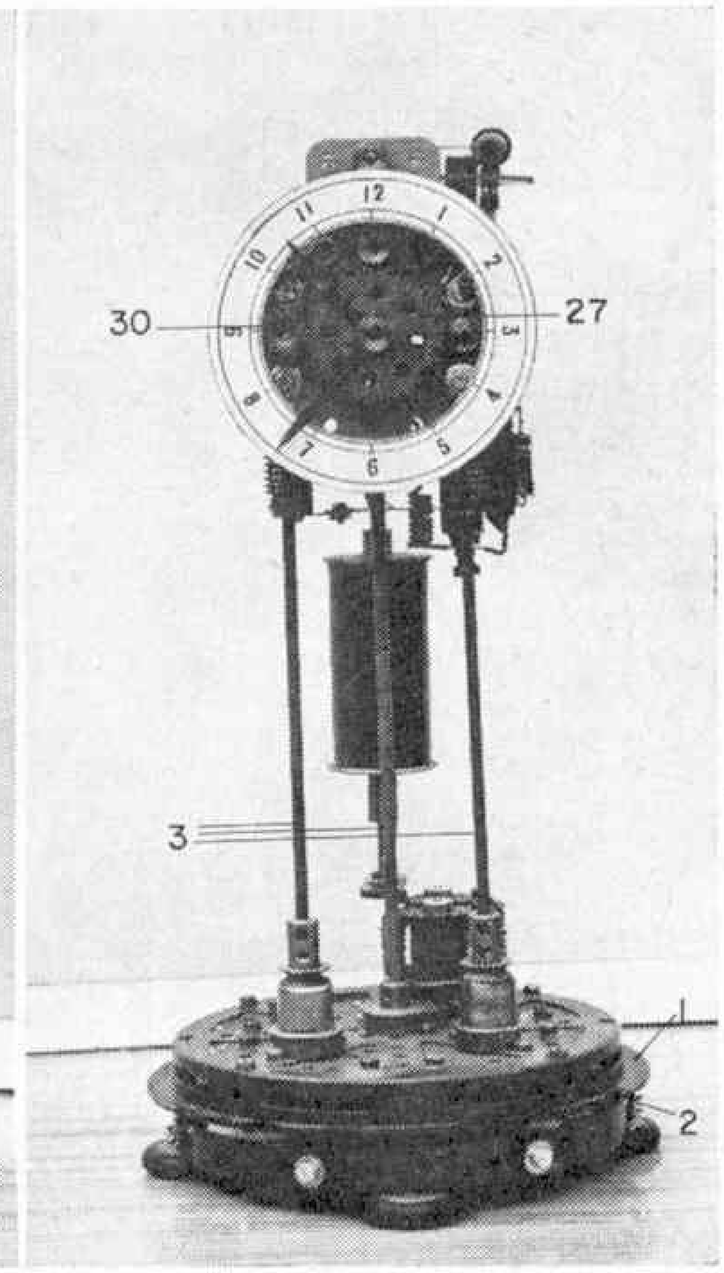
This overall view of the model clearly shows its comparatively simple construction.

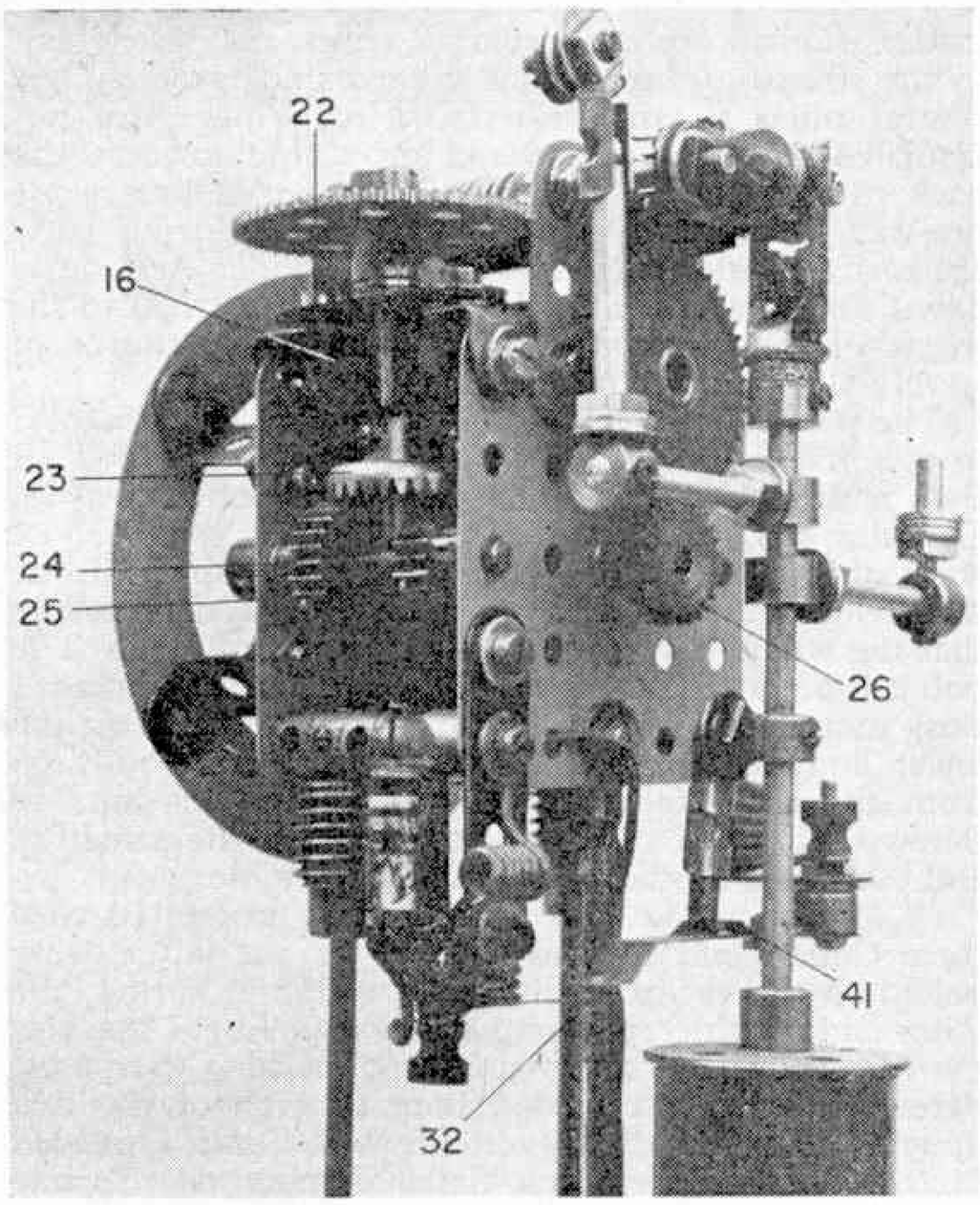


Another view of the Clock showing construction of the base and elevated mechanism supports.



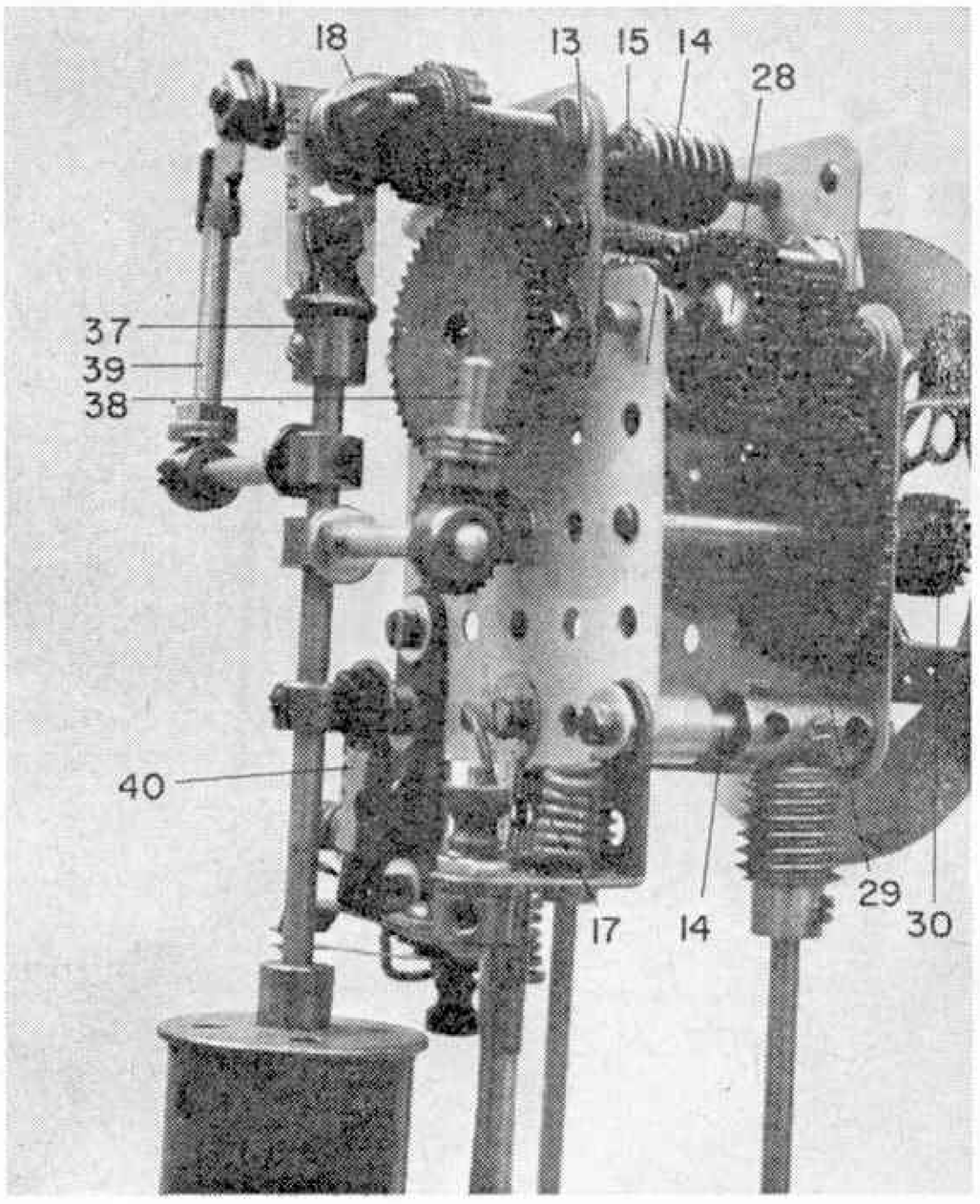
A small but accurate electrically-driven Pendulum Clock, working on the Hipp system, designed and built by L. R. Dougal M.B.E., M.T.A.I.





A close-up view of the drive gearing and pendulum connection.

Another close-up view of the Clock showing the initial drive gearing and the electrical contacts controlling the solenoids.



while, in the other case, the Collar is fitted with a second Long Threaded Pin 39, to which a Rod and Strip Connector is attached. A thin " L "-shaped piece of wire is attached by a lock-nut to this Rod and Strip Connector to rest on the upper teeth of Ratchet Wheel 20. Thus, when the pendulum is vibrating, the Ratchet Wheel is advanced tooth by tooth.

Another Rod and Strip Connector 40 is loosely fitted to the lower of the three Collars at the top of the pendulum and, in it, is fixed a small length of Axle Rod brought to a sharp edge with a file. A small piece of Flexible Plate ¾ in. long by ¼ in. wide is formed into a " bridge " 41 and bolted to 2 in. Bent Wiper Arm 32, then the Collar carrying the Rod and Strip Connector with its sharpened Rod is lowered until the Rod rests on one side or the other of the bridge. (A Centre Fork could be substituted for the sharpened Rod, if available.)

The whole clock is now levelled fore and aft and side to side using a spirit level. With the pendulum at rest, the armature should be in the position shown in the illustrations. When the pendulum is swung, the sharpened Rod should travel backwards and forwards over bridge 41 and, as the amplitude of the swing decreases, the time will arrive when the Rod fails to clear the bridge, but rests on top. On its return beat, the pendulum will cause the Rod to press downwards on the bridge, closing the contacts, energising the solenoids and attracting the armature. As the pendulum passes dead centre, the contacts should open and this action must take place before the armature reaches the edge of the solenoid Cores.

Being mounted on the Insulating Flat Girders, the solenoids are capable of slight adjustment as they are fixed to Hub Disc 2 by the centre elongated hole. The sharpened Rod can also be adjusted by rotating the Collar slightly one way or the other and the Clock is re-levelled by adjusting the feet until satisfactory operation is achieved.

The Clock will operate from an A.C. or D.C. source of between 6 and 9 volts, although A.C. voltages of up to 13 volts are quite permissible. Once adjusted, the Clock is most reliable, will keep excellent time and call for no attention. The Clock shown in the illustrations has now been operating for more than 18 months. A spark quench circuit (suppressor), consisting of a condenser and resistor have been incorporated, but this is a refinement which is not altogether essential.

In one of the photographs you will see the model enclosed in a transparent case. This was simply made from double glazing clear plastic which can be bought at most ironmongers. A tube is formed and joined with Sellotape, then bolted to a Circular Girder, also fitted with a disc of clear plastic. The case, of course, serves to keep out the dust and moisture present in the atmosphere, thus greatly increasing the life of the Clock.

PARTS REQUIRED

1—6	1—26c	2—72	2—164
4—6a	2—27	2—74	1—166
7—12	2—27a	2—81	2—173a
1—12a	1—27d	4—82	1—179
3—13a	1—29	4—111	8—188
1—15	2—31	4—111a	3—212
1—16a	3—32	2—111d	7—215
6—17	82—37a	1—115	1—216
1—18a	60—37b	3—115a	1—502
2—20	60—38	1—118	2—542
3—20b	1—45	4—125	1—508
5—22	12—59	5—142c	2—522
2—23	2—63	1—143	2—528
3—25	2—63a	1—146	1—531
1—26	6—64	1—148	1—533

Martin Luther King On Stamps

by James A. Mackay

MARTIN LUTHER KING was born in Atlanta, Georgia, on January, 15th 1929 of a familiy in comparatively easy circumstances. His father was a Baptist clergyman and his mother was a school-teacher. He was educated at Morehouse College and Crozer Theological Seminary and, following a post-graduate course at Boston University, was awarded a doctorate of philosophy. He spent some time in India where the life and teachings of Mahatma Gandhi made a profound impression on him.

In 1954 he was appointed pastor of the Baptist Church in Montgomery, Alabama, a town in which the Negro population were virtually denied basic human rights. He soon became involved in local politics and organised a Social and Political Action Committee with a view to inducing his parishioners to take an interest in the problems of the Community. The following year he began his long, yet pacific, struggle for " the peaceful conquest of the right of living as human beings," as he put it. He organised a boycott of Montgomery's segregated buses and, after 382 days, the civic authorities gave way. Overnight Dr. Martin Luther King was hailed as a hero by American Negroes.

His next move was to organise " sit-ins "—non-violent demonstrations and the peaceful, though systematic, occupation of establishements resorting to racial segregation. Marches and demonstrations went on successively, culminating in the great Civil Rights demonstration of August 28th 1963 when a quarter of a million people, including 60,000 whites, gathered in front of the Lincoln Memorial in Washington. Dr. King delivered his most memorable speech, stating, " I dreamed that my four children shall live in a country where they will no longer be judged according to the colour of their skins, but according to their deserts; that one day the sons of former slaves and former enslavers shall sit together at the same table, fraternally."

Later in the same year the United States Congress passed the first law concerning Civil Rights and on December 10th Martin Luther King was awarded the Nobel Peace Prize—the youngest man ever to receive it. In his speech of acceptance he said, " Non-violence is a weapon unprecedented in history, that cuts without wounding, and ennobles the man using it."

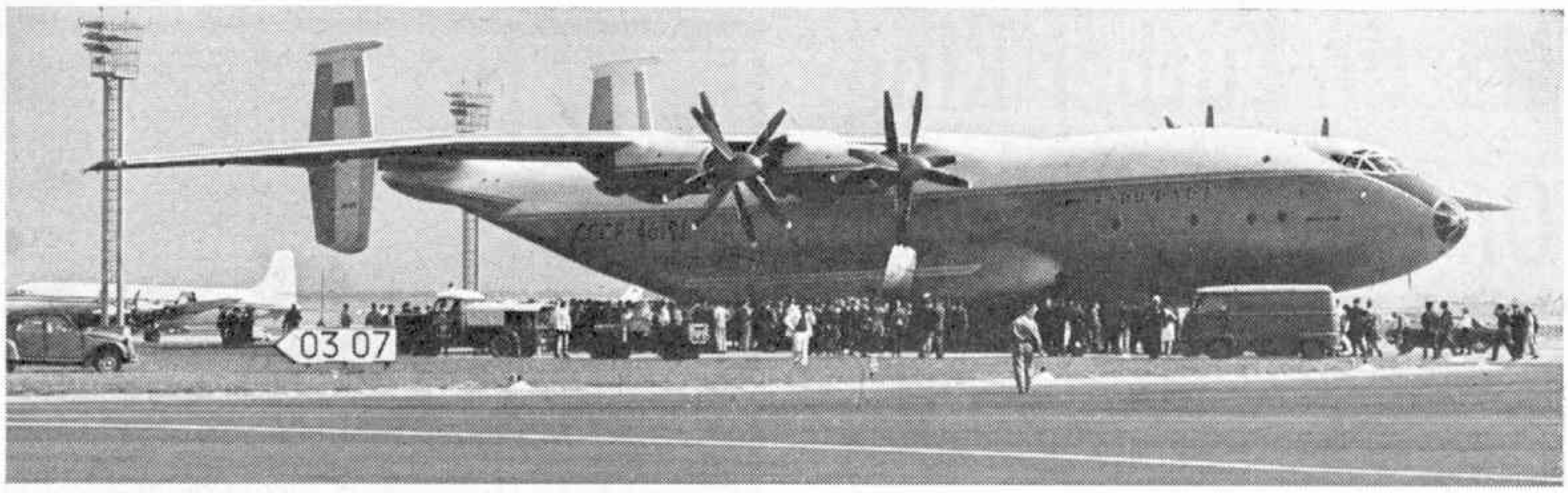
The Civil Rights Act of 1964, however, proved to be insufficient to improve the lot of the Negroes and other under-privileged sections of the American community In 1966 he took his crusade for racial equality to the North On July 10th he marched at the head of a procession to the Chicago City Hall where, in the manner of his illustrious namesake, Dr. Martin Luther, at Wittenberg 450 years earlier, he nailed to the door his demands for housing, welfare, education and jobs reforms.

At the end of 1967 he announced that he was preparing for a mammoth Civil Disobedience Campaign to oblige Congress to ensure work and a steady income for all. By his moderation, Dr. King was beginning to alienate the Black Power extremists, but he had also incurred the hatred of fanatical racists and he knew that, sooner or later, an attempt would be made on his life. In a speech at Memphis Tennessee on April 4th 1968 he said, " Like everyone I would like to have a long life, but this matter does not disturb me much. I want to be the instrument of the Will of Providence who has allowed me to climb up the mountain. From that height I have seen the Promised Land. It may be that I shall not be able to reach it with you, but I want you to know that our black people shall reach the Promised Land. That is what makes me happy, and causes that I fear nothing." A few hours later, at 6 p.m., he was shot down by a sniper outside his hotel and died shortly afterwards.

At his funeral thousands lined the streets to pay their last respects to this man of peace and many of the world's leaders were among those who escorted the coffin, on a humble mule-cart, to its burial place. Among those present was Senator Robert Kennedy, a prominent Civil Rights worker, who was soon to die by an assassin's bullet himself.

World reaction to Dr. King's murder was dramatic and spontaneous. Many of the emergent nations of Africa and Asia have issued stamps in the past few months, ironically publicising Human Rights Year, but also honouring the memory of Martin Luther King. Perhaps the finest of these stamps was the 100 frs. recess-printed in black, which was issued on July 29th by Rwanda. The stamp is printed in a miniature sheet containing, in French, a famous quotation from one of Dr. King's speeches, " A man who isn't ready to die for something, is not capable of living."

Several countries in the British Commonwealth have issued stamps bearing his portrait. They range from India and Nigeria to Western Samoa. In the West Indies straightforward portrait stamps were released by St. Lucia and St. Kitts-Nevis. The three stamps from the Turks and Caicos Islands show a procession, with banners headed " Work," " Freedom " and " Justice," with King's portrait in the foreground. The two stamps of the Virgin Islands depict a Bible, with a knight's sword and gauntlet, as well as his portrait. St. Vincent's three stamps feature a profile of Dr. King, with a view of Negro cotton-pickers in the background.



THE JUMBOS ARE COMING

by John W. R. Taylor

BOEING'S MODEL 747 "jumbo jet", the largest passenger airliner ever built, will begin its flight trials round about the time that this issue of *Meccano Magazine* is published. The target date of December 17 is the 65th anniversary of the first-ever powered aeroplane flights, by Orville and Wilbur Wright. Like their frail wood-and-canvas biplane, the 747 opens a completely new chapter in man's conquest of the air.

No existing factory was big enough to house it. Before Boeing could begin to manufacture the prototype, they had to cut down a pine forest at Everett in the State of Washington, U.S.A., and erect the world's largest building on the site. The prototype began to take shape within the 160 million cu. ft. workshops even before they were finished, and was completed a mere 2½ years after Boeing decided to produce it.

The 747 is beautifully proportioned and so like the 707 in appearance that it is difficult to appreciate at first glance just how big it is. The passenger cabin is 185 ft. long, which is more than 1½ times the length of the first of Orville Wright's historic 1903 flights. Its width of over 20 ft. permits ten-abreast seating without making passengers feel like human sardines in a can, because there are two aisles and the ceiling is as high as that in the average modern house.

The four Pratt & Whitney JT9D-3 turbofan engines that power the 747 are equally impressive. Each gives 43,500 lb. of thrust for take-off (more than twice the output of the most powerful engines fitted in the 707), and swallows two-thirds of a ton of air every second—enough to fill all the rooms of a large, double-fronted two-storey house. The air intakes of these engines are so big that a tall man can stand inside them with room to spare.

Such an aircraft is, inevitably, a statistician's delight. Seventy-five thousand design drawings were used to produce the prototype, which contains 4½ million parts if we include the rivets. There are well over 100 miles of wire in a 747, and its tail is as high as a five-storey building. Yet it can be guided automatically through any weather to any point on Earth, with no outside radio contact, by an electronic navigation system smaller than the drawer of a filing cabinet and about the same weight as a standard electric typewriter.

Each 747 delivered to an airline will cost about $20,000,000, or £8,330,000, and a lot of people must wonder if any aeroplane is worth that much. The answer must be "Yes", or Pan American would not have been so eager to be first in the queue with an order for 25; nor would B.O.A.C. have asked the British government for permission to buy eleven at a time when we are so short of dollars.

The reason why 26 airlines have so far put down deposits on a total of 157 Boeing 747s was well summed up by Pan American's former chairman, Juan Trippe, when he said that he expected each of his company's 747s to carry annually four times as many passengers across the Atlantic as did that great ocean liner the *Queen Mary*. It is a measure of the work being done by airlines today that Pan Am requires an initial fleet of 747s equivalent, on this basis, to 100 *Queen Marys*.

Up to 490 passengers can be carried by a single 747; in addition, the below-deck holds are big enough to accommodate about 38 tons of baggage and freight, equivalent to 3,400 average pieces of luggage—all of which can be loaded or unloaded in under seven minutes. More usually, the 747 will be equipped to carry 363 passengers, made up of 57 first class and 306 economy class, with a separate eight-seat lounge.

Passengers will board the 747 through five double-width doors on each side of the fuselage. From the main cabin, a spiral staircase leads to the upper deck, at the front of which is the flight deck for a crew of three or four. All kinds of bright ideas have been put forward for utilising the space on the upper deck aft of the crew accommodation. There is room for one or two private staterooms, with beds, or a "flying boardroom" for businessmen, or for the kind of office found on a ship, in which officials can check passports and other documents during the journey to save time at the destination.

This is only a start, for there is so much room on the main deck that some airlines are already investigating the possibility of installing a small cinema or theatre, children's playroom or super-luxury lounge. All these things are possible in an aeroplane which is 231 ft. 4 in. long, with a wingspan of 195 ft. 8 in. and loaded weight of 710,000 lb. (317 tons).

Despite its huge size, the 747 can operate from runways no longer than those needed by the present generation of jet-liners and should be less noisy. It needs only the same number of flight crew to operate it and will fly even faster than the big jets of today, with a maximum cruising speed of about 625 m.p.h. Most important of all from the airlines' viewpoint, its operating cost per seat-mile (the cost of flying the aircraft one mile divided by the number of seats) will be about

At left: The giant An-22 as seen at the Paris Air Show.
Above: The huge Boeing 747 at its first public showing.

30 to 35 per cent lower than that of the latest 707.

This does not mean that all fares will drop by a third when the 747s enter service. Fares are fixed by international agreement and airlines unable to afford 747s would soon be put out of business if they had to cut their fares to match those of operators who can equip with "jumbos". Initially, therefore, the reductions may be limited to operations such as charter flights and inclusive holiday flights, where the passenger makes a single payment for his fare and hotel accommodation.

If all goes according to plan—and there's no reason why it shouldn't—Pan American should be able to introduce 747s on their transatlantic routes in the autumn of 1969. Air traffic controllers will be pleased, because a single 747 will do the job of two present-day jet-liners. This will relieve slightly the growing congestion in the skies around major airports, which has led to delays of several hours for aircraft waiting their turn to land at places like John F. Kennedy Airport, New York.

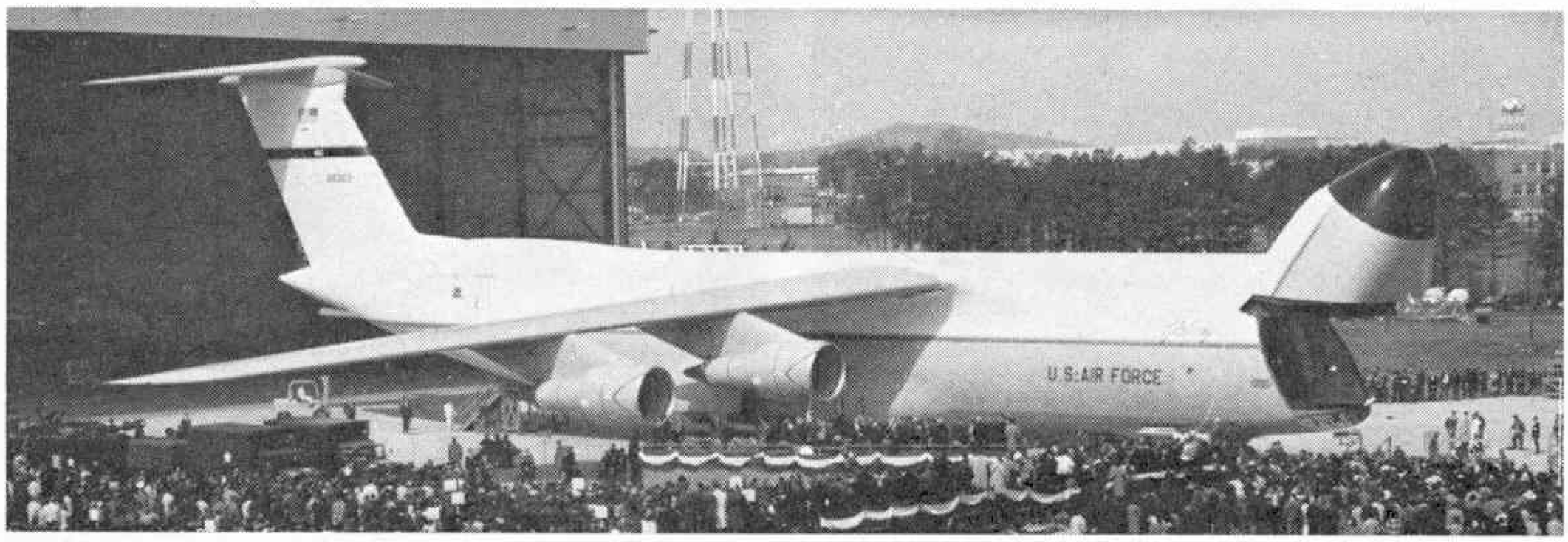
Does this mean that we shall see even bigger "jumbos" within a few years? The best answer is, perhaps, that some airlines have already cancelled orders for cargo-carrying versions of the 747 and are likely to order instead a commercial version of the Lockheed C-5A Galaxy, the largest aeroplane ever flown.

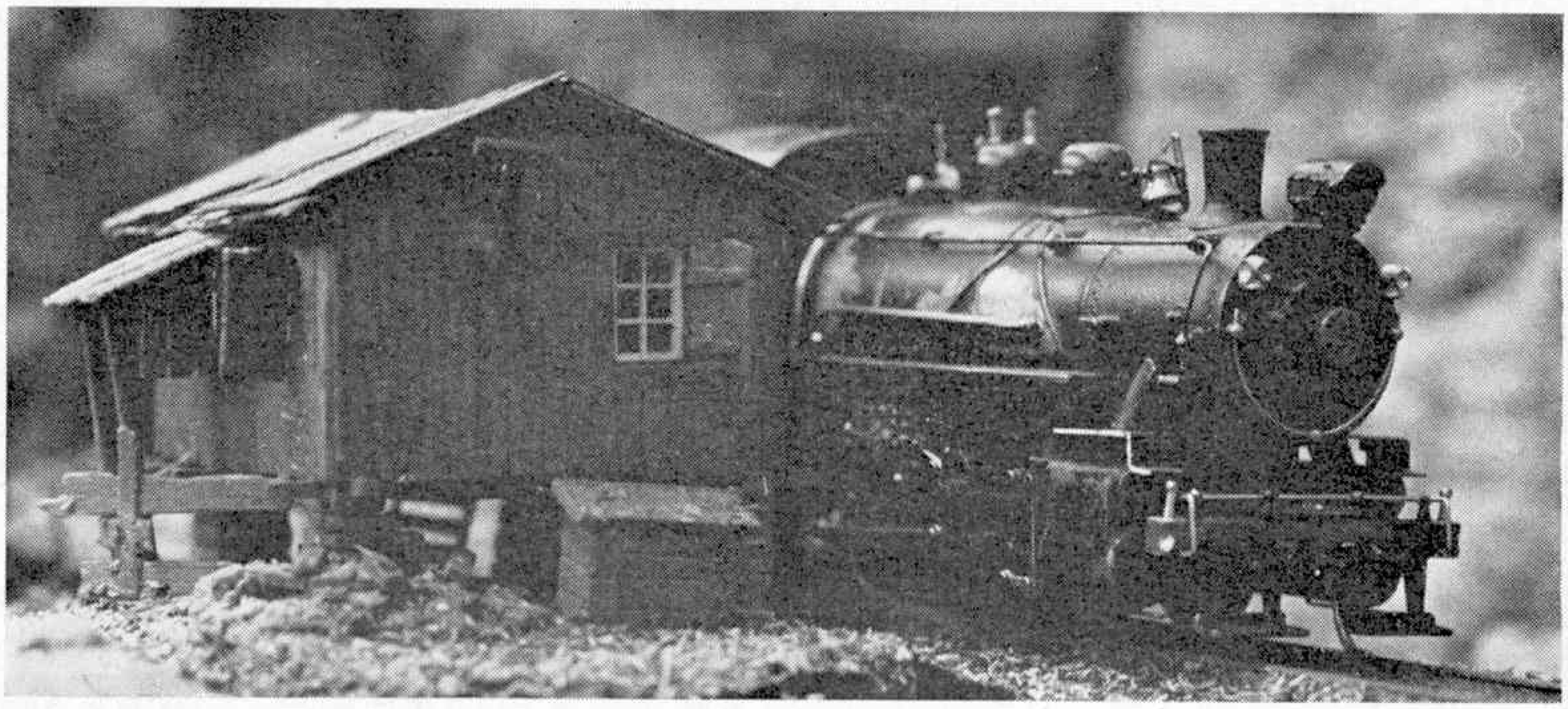
The prototype Galaxy made its first flight on June 30, 1968, and dwarfs even the 747, with a span of 222 ft. 8½ in., length of 245 ft. 11 in. and take-off weight of 764,500 lb. It carries over 118 tons of cargo and, in addition to the usual rear loading doors, has a unique upward-hinging "vizor" nose-door to speed loading and unloading. A true double-decker, it can fly over 7,000 miles with a reduced payload of 40 tons. Its undercarriage consists of a four-wheel nose unit and four separate main units, each with six wheels, making a total of 28 wheels.

Russia's biggest aeroplane at the moment is the Antonov An-22 Antheus, spanning 211 ft. 4 in. and 189 ft. 7 in. long, with a loaded weight of 551,160 lb. This makes it smaller than the 747 and Galaxy; nevertheless, one cannot help being impressed with the size of an aeroplane which is entered via a door in the undercarriage fairing!

Since Igor Sikorsky built the world's first four-engined aeroplane in Russia, in 1913, that country has always been in the forefront in the design of giant aircraft and there is no reason to believe that the An-22 will remain their largest for many more years.

The huge Lockheed C-5A Galaxy emerges for the first time.
Note the unique nose doors and the size of spectators!

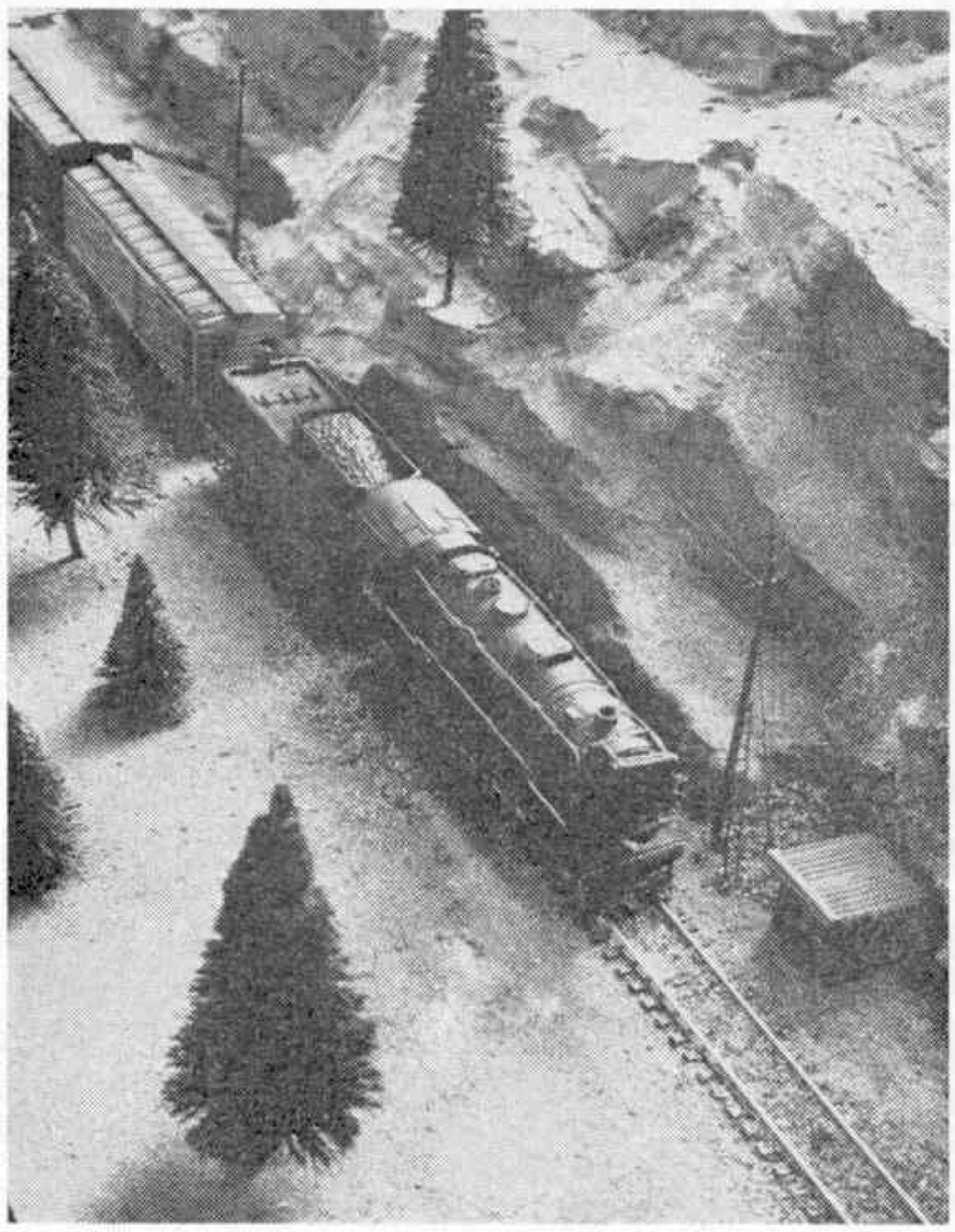




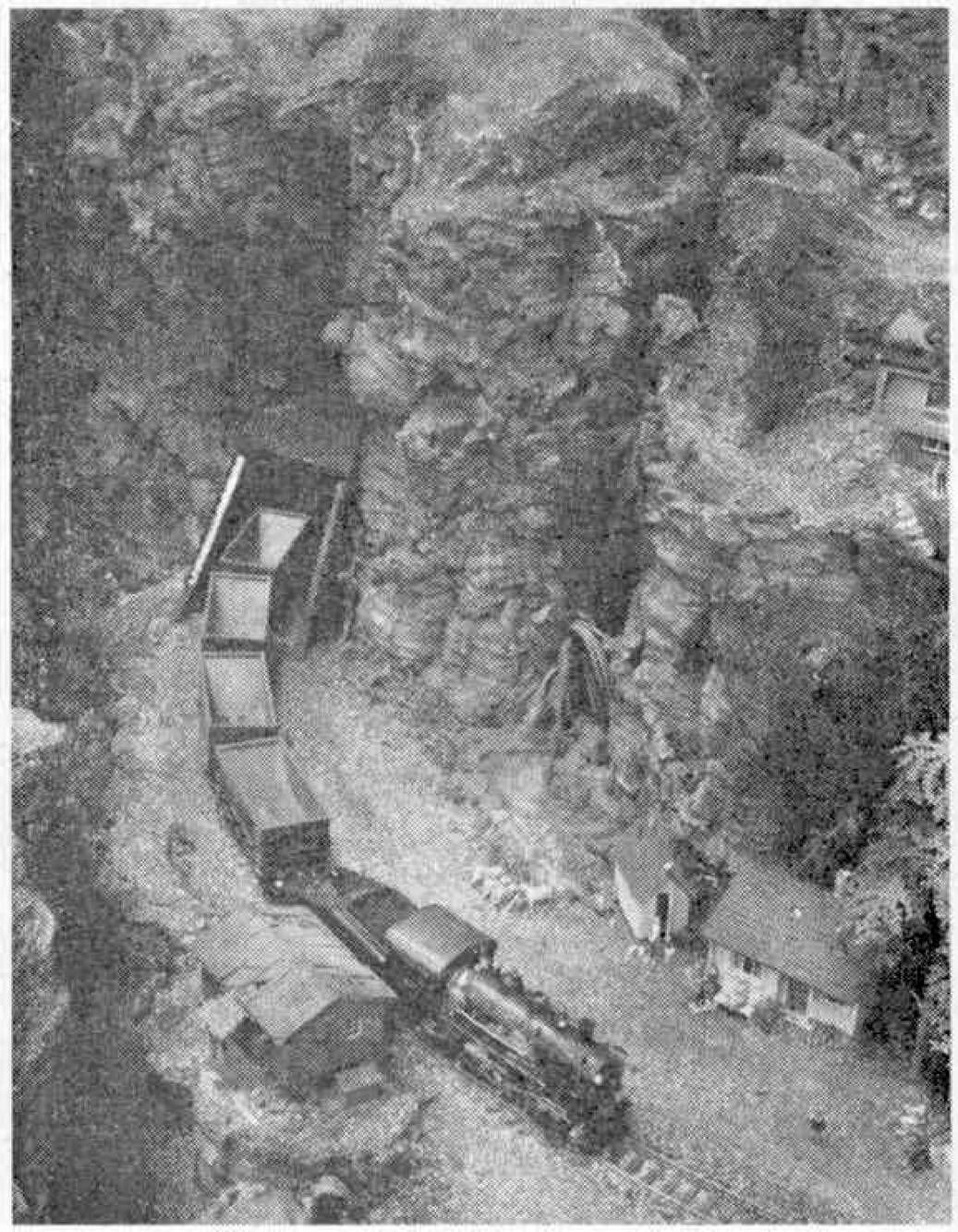
LET'S GO AMERICAN RAILROAD MODELLING

A special photo-spread feature by **Brian Monaghan**

Below: A Rivarossi 0-8-0 Heavy Switcher shown on the layout exhibited by Francis DeLez of Sheffield. The trees are made from twisted wire and bristle, at a rough cost of 1d. each! Running track is Peco, scenery is a mixture of plaster and fine chippings.



Below: The Lakeside and Midland Railroad of H. D. S. Clarke (Macclesfield M.R.C.). Picture shows a Tyco Big Six Switcher hauling a load of empty mineral trucks along the lines through typical mountain scenery. Scenery is a mixture of Cork Bark, Plaster and Flock.



A VISITOR to any of the big railway exhibitions held this year anywhere in the country will come away with two things. (a) tired aching feet, (b) a firm conviction that the American Railroad side of the hobby is growing fast.

The reasons for this increasing interest are basically threefold:—(1) the single track working of the prototype lends itself admirably to the modeller. (2) the challenge of something different in Locomotives, Rolling stock, Buildings and Scenery. (3) railroad scenes shown on the cinema and television. One might add that the very high quality of proprietary items available to the modeller would make a valid fourth reason.

Certain Model Railway Clubs are almost wholly 'American's for example, the Capitol MRRC of London and in the provinces the Blackpool & Fylde MRC. Others such as the South London Club at Norwood or the Sheffield Model Railway Enthusiasts have very good American sections. If you are interested in this subject why not see what a club has to offer? If there is nothing doing at the moment why not start something? There is nothing quite so infectious as enthusiasm, except perhaps the Measles.

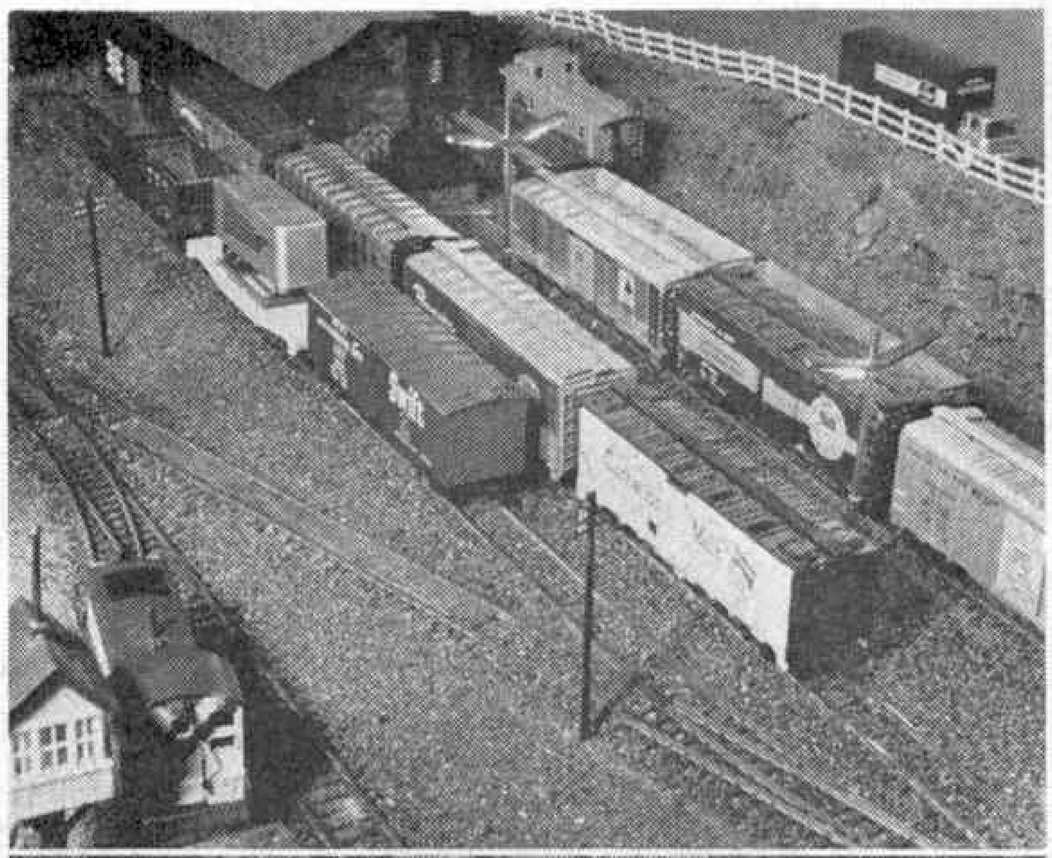
For someone starting off in this section of the hobby there are a wealth of books and periodicals to do the necessary researching into, and at the same time a whole new railroad vocabulary to learn. Do not forget your local library before you start to buy however.

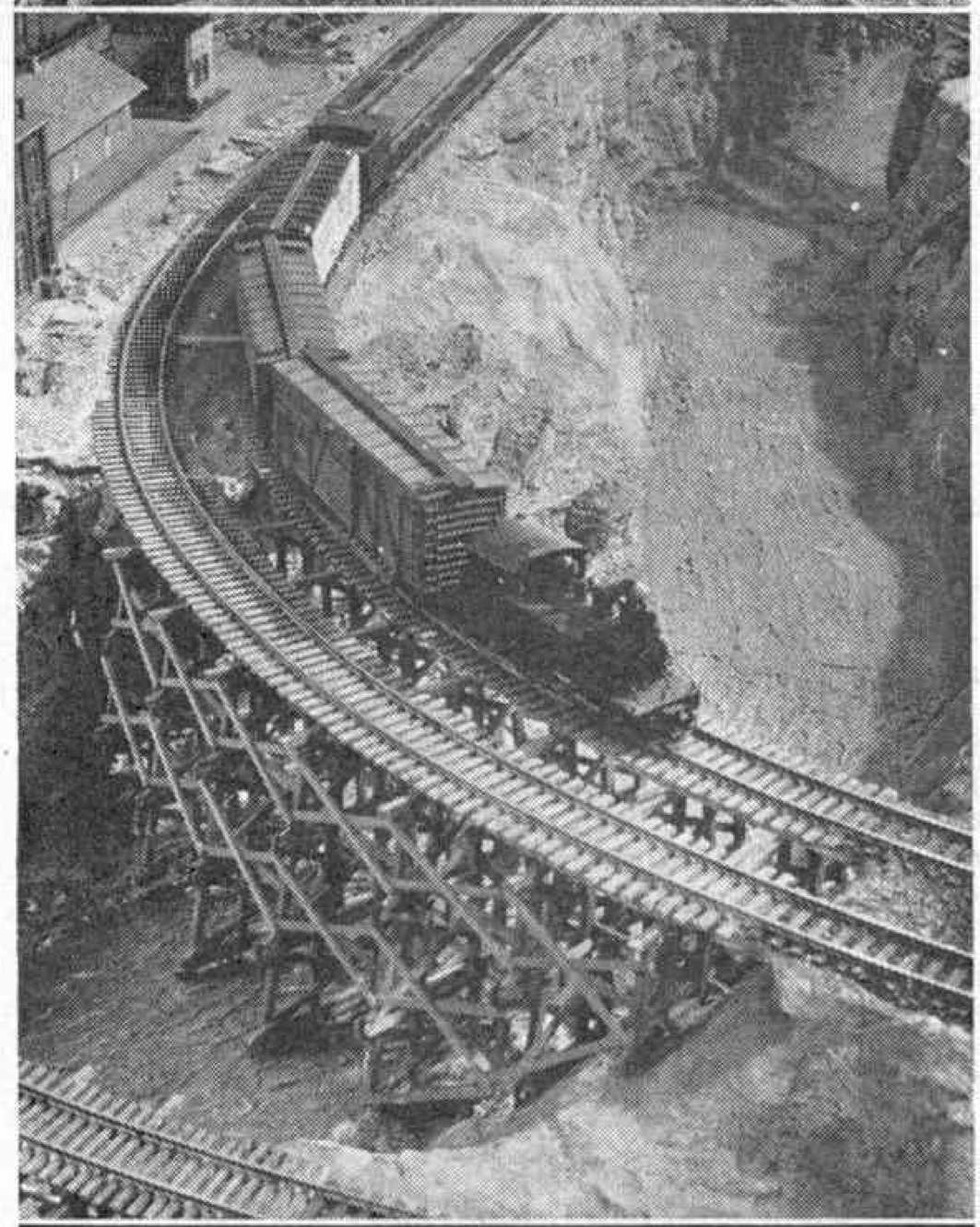
There are a number of dealers who specialise exclusively in railroad equipment, while the big model mail order houses can also supply many of the enthusiasts needs. This is important became most items are imported and cannot always be picked up from the corner shop. Japan makes some really superb metal kits of American Locomotives, indeed the larger ones retail at well over a hundred pounds. But, you do not have to start off with one in this price range, even the poorest of us are well catered for (thank goodness).

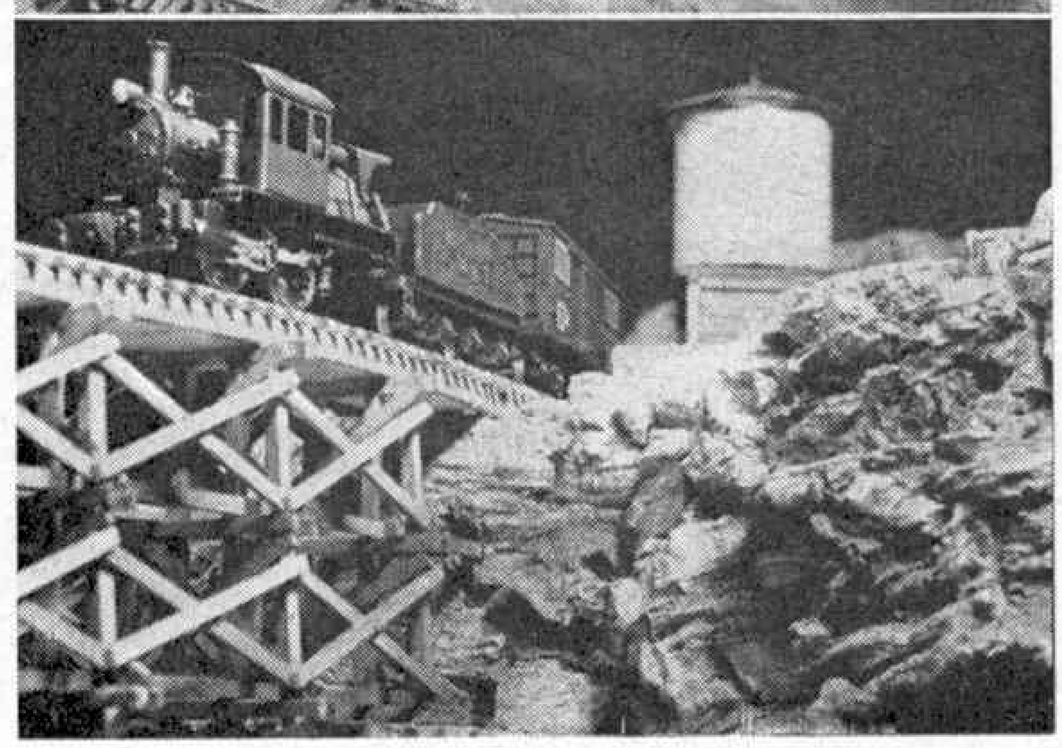
Unless you have a big area for your layout some of the larger Locomotives with a scale length of 15 in. could be an embarrassment since obviously they are going to need a fairly large radius to get round. For this reason the beginner might well consider one or other of the smaller switch engines available, perhaps a Tyco Big Six switcher or a Lindberg SW7 Gen. Motors Switcher, the choice is yours.

Have you thought of buying rolling stock second hand? It can save money and give you something to work with at an early stage. One of the big advantages of being in a model railway club is that you get to hear about bargains and can swap and trade with the best of 'em.

American Railroads are full of character, colour and excitement, and there is still plenty of 'Steam' left for the enthusiast. Come on, how about it? Let's go American Railroad Modelling.





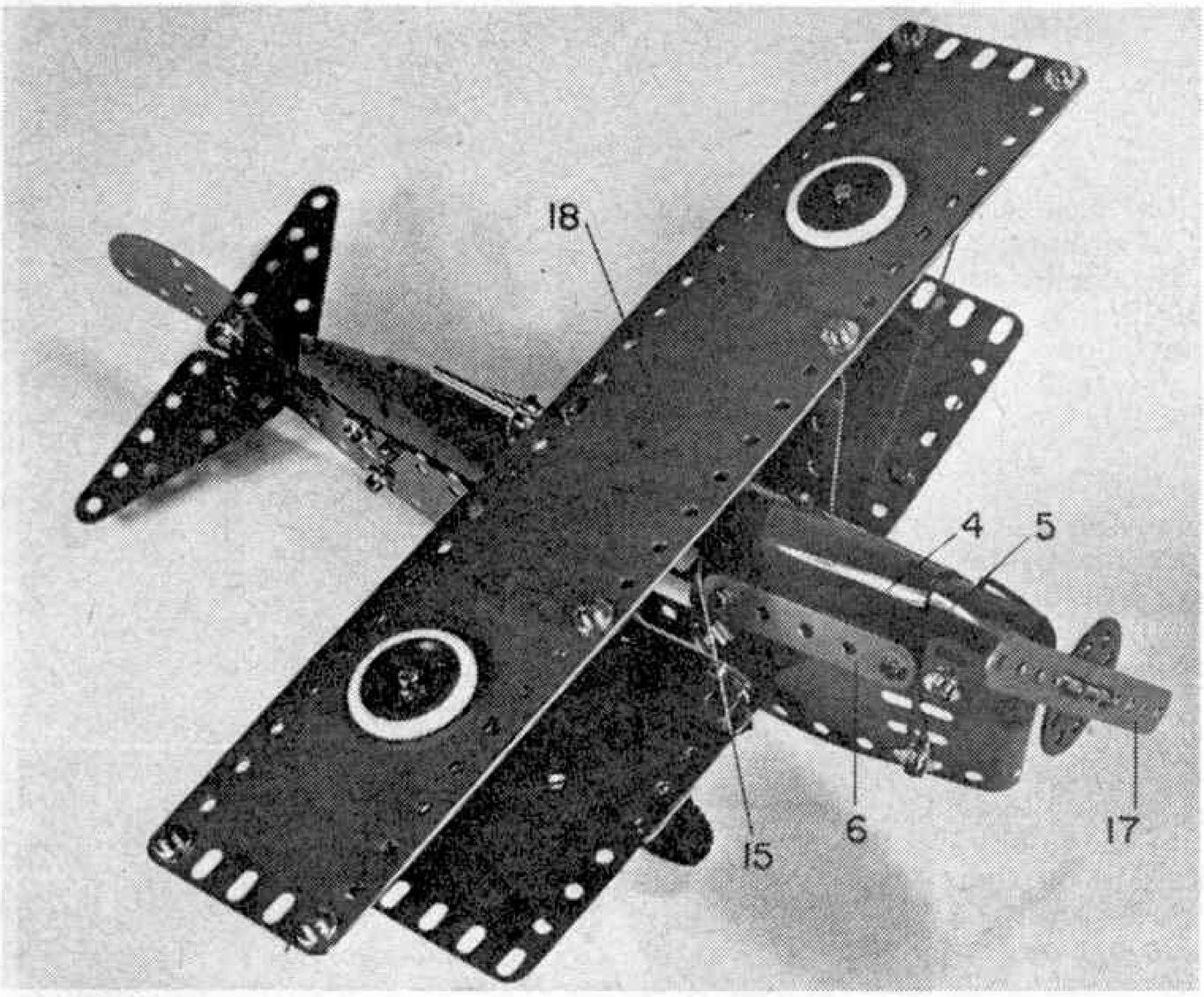


Our heading on the opposite page shows a modified Tyco Big Six Switcher passing an interesting piece of 'real estate'. Locomotive reconstructed by Arthur Brooks of the Altrincham (Cheshire) Model Railway Club.

At right, top: Part of the local freight depot of 'Tuxedo Junction' and the Midland Railroad operated by H. D. S. Clarke of the Macclesfield M.R.C. Picture shows numerous and diverse colourful freight cars and strip lighting.

At right, centre: A scene on the Sheffield Model Railway Enthusiasts 'Indian River' line. A Ken Kidder Plantation Tank engine is hauling a few box cars over a fine, well built Trestle bridge built by Eric Slater.

At right: A camel back switcher heads out over a Trestle bridge on the 'Indian River' layout of the Sheffield Model Railway Enthusiasts. The trestle bridge is scratch built, the Loco and stock proprietary, the rock face a mixture of Cork Bark and Plaster.



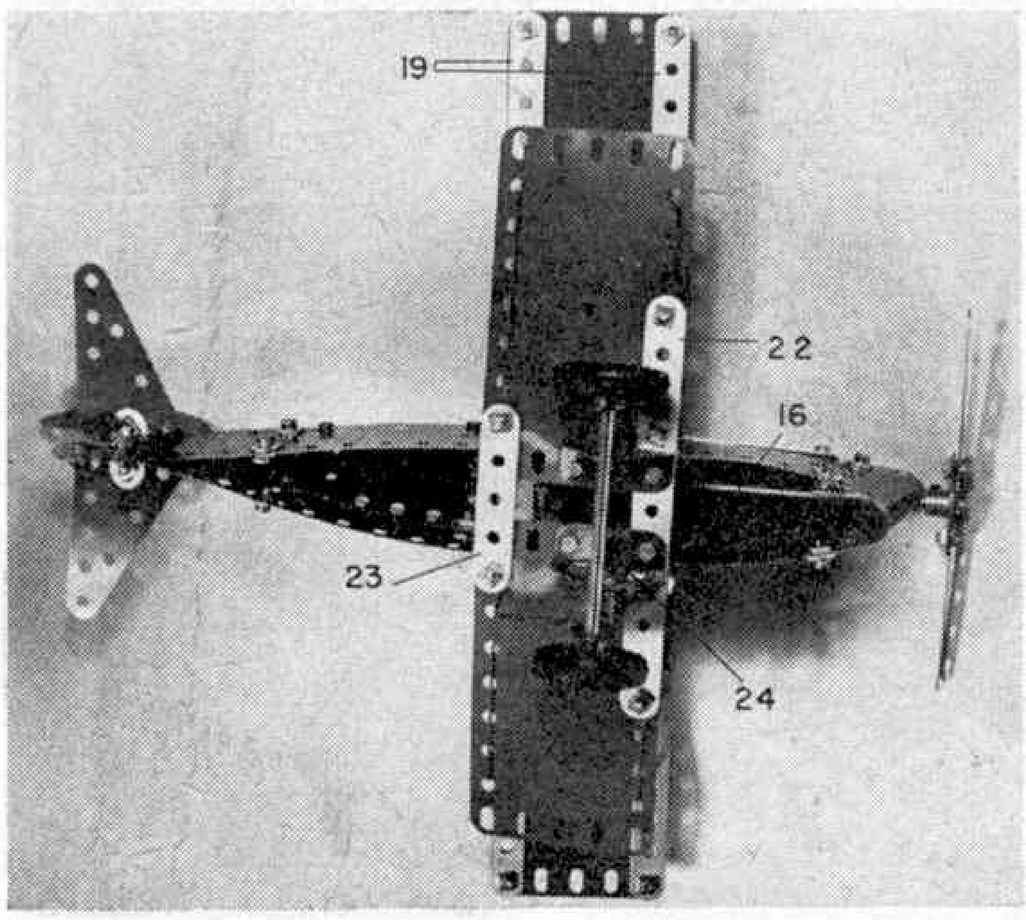
Based on a between the Wars Breguet biplane, this simple Meccano model was designed and built from a No. 3 Outfit by our associate company in France. On opposite page: Viewed from this angle, the Meccano Breguet biplane presents an appealing and realistic picture.

BIPLANE FROM FRANCE by Spanner

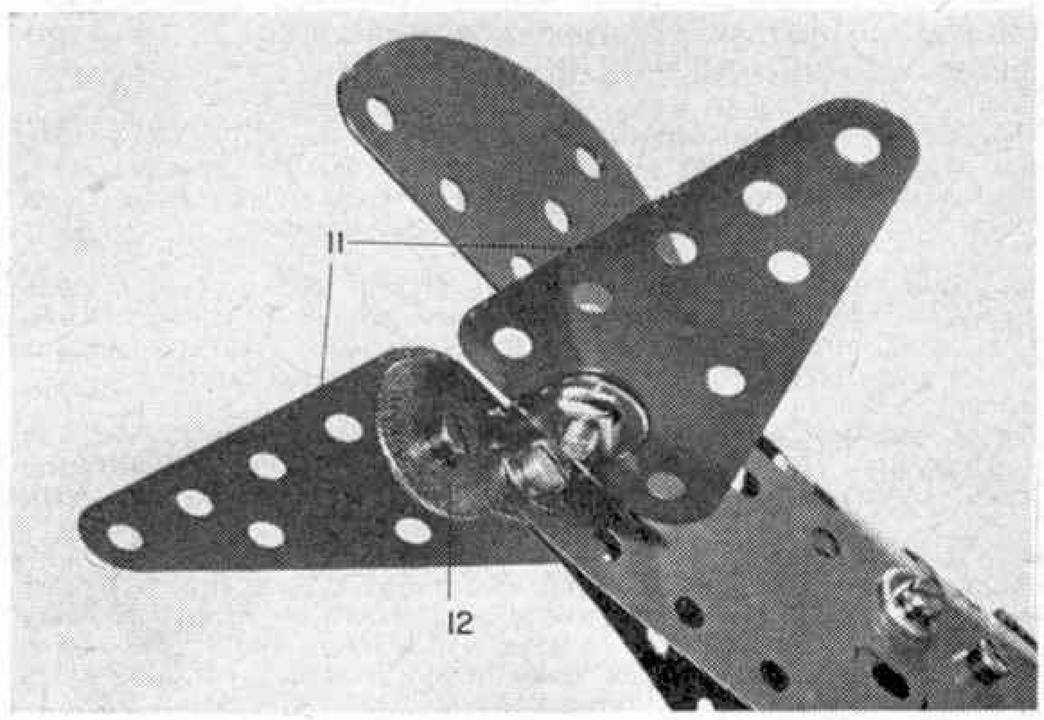
An overseas Meccano model built with Outfit No. 3

MECCANO, AS a product, is completely British having been invented by an Englishman and manufactured in Liverpool since the very beginning of its existence in the early nineteen-hundreds. This does not mean, however, that Meccano has always been made *exclusively* in Liverpool and nowhere else. On the contrary, it has been produced in no less than three other countries around the world: by a subsidiary company in America; by an associate company in France and, under licence, by a separate company in Spain. As far as America is concerned, the manufacturers, The Meccano Company Incorporated, went out of existence in the 1920's, but the French and Spanish manufacturers are still very much in business.

Although the full standard Meccano range is produced by our French associate company, the company operates entirely independently of the Liverpool concern. The two companies, however, co-operate fully with each other and the model featured in this article is just one example of such co-operation. Based on a between-wars Breguet biplane, it was sent over to Liverpool recently by Meccano-Tri-ang, as the French company is now called, for possible publication as a No. 3 Outfit model. As far as I am concerned, it is well worthy of publication, especially as it captures more than a few of the lines of a very difficult original subject.



Below, left: This underside view shows construction of the lower wing. Below: A close up of the fin and tailplane assembly as seen from beneath. Note the tailwheel construction.



It is best to begin construction with the fuselage, each side of which consists of a 2½ × 1½ in. Flexible Plate 1, a 5½ × 1½ in. Flexible Plate 2 and a 2½ × 2½ in. Flexible Plate 3. Bolted between Plates 3 at each side is a 2½ × 2½ in. Plastic Plate 4, extended by a 2½ × 1½ in. Plastic Plate 5, the joins between Plates 3 and 4 being overlaid in each case by a 2½ in. Strip 6. The nose is completed by a vertically-mounted U-section Curved Plate 7 bolted as shown between Plates 3. Plates 1 and 2 at each side are connected, as shown, by a 2½ × 1½ in. Plastic Plate 8 and a 2½ × 2½ in Plastic Plate 9, and also by a Fishplate attached to Plates 2 by Angle Brackets held by Bolts 10.

At the rear of the fuselage, Plates 1 at each side are joined directly together, the upper securing Bolt also fixing a Semi-circular Plate in position to represent the fin, while the lower securing Bolts hold two Angle Brackets in place as well as a Fishplate, the latter angled rearwards. Two 2½ × 1½ in. Triangular Flexible Plates 11, serving as the tailplanes, are bolted one to each of the above-mentioned Angle Brackets and a ¾ in. Washer 12 is lock-nutted to the Fishplate to act as the tail-wheel. A machine gun is represented by a 2 in. Rod 13, held by Spring Clips in the lugs of a Double Bracket bolted to the top of Plastic Plate 9.

If everything has so far been correctly built, a space should remain in the fuselage for the cockpit. Fixed by Angle Brackets inside this space are two Flat Trunnions 14 and 15, the former positioned at a slight angle in the centre of the cockpit, and the latter mounted vertically against Plate 4. Journalled in the apex hole of Flat Trunnion 15 and in Plate 4 is a 4½ in. compound rod, built up from one 1 in. and one 3½ in. Rod joined by a Rod Connector 16 and held in place by a Spring Clip and an 8-hole Bush Wheel. A 5½ in. Strip 17 is bolted across the Bush Wheel to serve as the propeller.

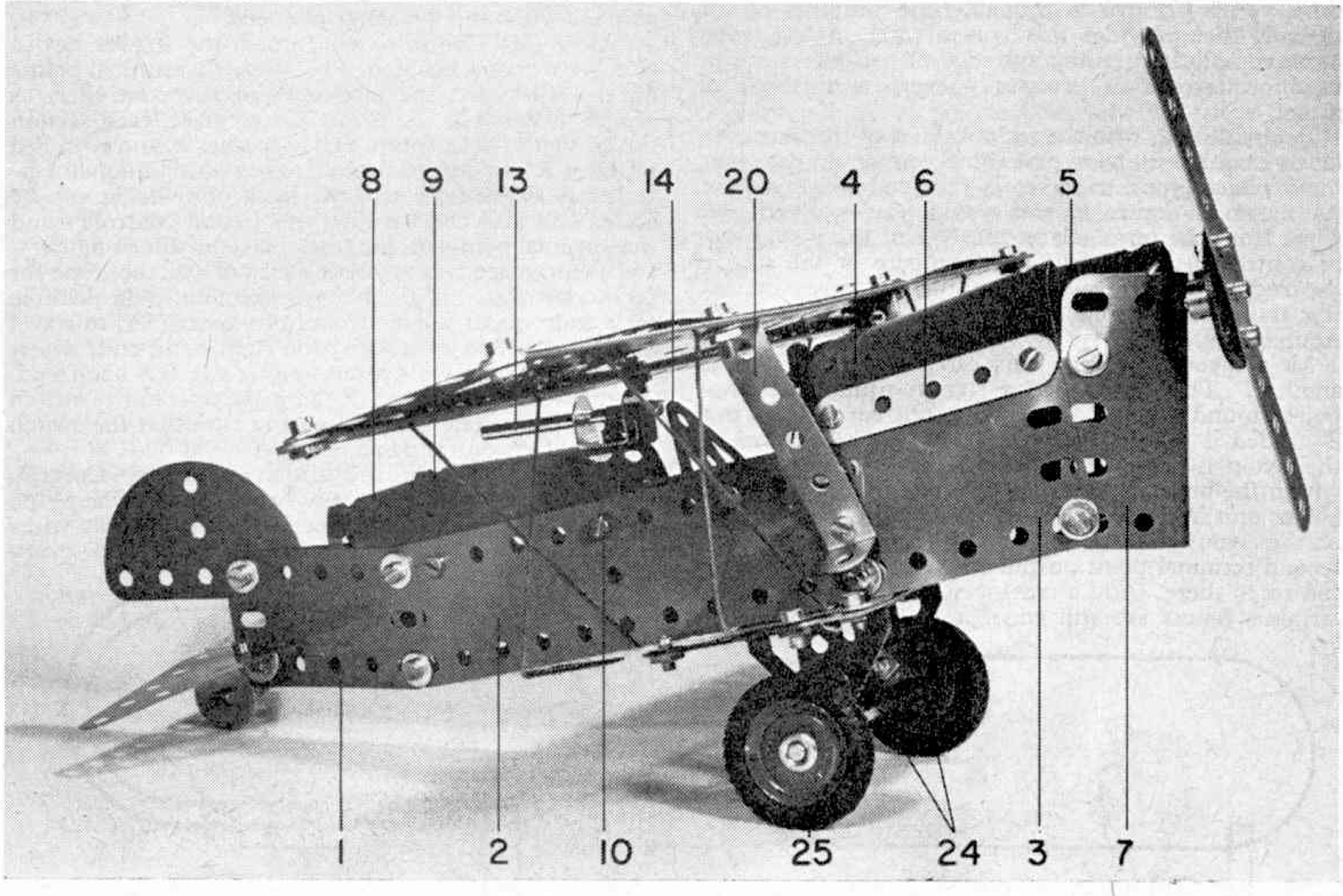
PARTS REQUIRED

2—1	2—22	2—48a	2—190
2—2	2—22a	2—111c	3—191
3—5	1—24	2—125	2—192
2—10	3—35	2—126	2—193
1—11	57—37a	2—126a	2—193a
10—12	55—37b	2—142c	1—199
2—16	17—38	2—155	1—213
1—17	1—38d	2—188	1—214
1—18a	1—40	2—189	1—221

Being a biplane, two wings are of course fitted to the model. The upper wing consists of a 12½ × 2½ in. compound flexible plate 18, obtained from two 5½ × 2½ in. Flexible Plates joined by a 4½ × 2½ in. Flexible Plate. Both the leading and trailing edges of the wing are strengthened by 12½ in. Strips 19, bolted to the underside of the compound plate, bracing struts being provided by two 2½ × ½ in. Double Angle Strips 20 fixed between the fuselage and front Strip 19. Two 1 in. Pulleys without boss, each carrying a Rubber Ring, are bolted to the top of the wing to represent identification roundels.

The lower wing consists of two 4½ × 2½ in. Flexible Plates, joined, with a distance of one hole separating them, by a 5½ in. Strip 22 and a 2½ in. Strip 23. Note that Strip 22 is positioned beneath the leading edge of the wing and that two of the securing Bolts help to fix two Trunnions 24 in position. Two ½ in. Reversed Angle Brackets are fixed one to the apex of each Trunnion to provide bearings for a 3½ in. Rod held in place by two 1 in. fixed Pulleys 25 fitted with Motor Tyres, serving as the undercarriage.

The finished wing is attached to the fuselage by Angle Brackets then, finally, bracing wires, arranged as shown between the wings, are represented by Meccano Cord.



Why Not Try Cab Control on Your Railway Layout

by Mike Rickett

NO MATTER what sort of model railway you own, without reliable, trouble-free wiring, it would be about as much use as the proverbial white elephant. Admittedly, model railway systems like Tri-ang Hornby, Trix or Fleischmann, will provide a reliable track system with equally reliable, foolproof, wiring that anyone can understand. If however, you are an enthusiast with a model railway that uses flexible track, or if you are thinking of building such a layout, then it is necessary for you to understand at least the basic principles of wiring as applicable to model railways. Eventually, to improve the range of movements you are able to arrange for your trains, you will want to know about a wiring system that provides the means for you to operate more than one train at a time, whether it be on the same oval of track or in the same station.

Ultimately, this is where a system like Cab Control comes in, for with this system you can add an almost indefinite number of controllers, enabling you to operate an equally large number of trains at the same time. Cab Control is probably the simplest system there is that provides this control and, unlike other more complicated wiring systems, Cab Control can be used on layouts of practically every size, shape or gauge.

Before dealing with the technicalities of this however, let us examine the very first thing you would do when, for instance, your train set is removed from its box. As shown in figure 1, you would simply attach two wires from the terminals at the rear of the power unit or controller to a similar two terminals at the side of the track. No matter which way the wires are attached, the train will operate hour after hour without any trouble at all.

Most layouts fall into this category in one way or another. They may have a station situated at some point around the oval, or a siding, but basically all that is needed is the one terminal point—as it is called. If the layout is enlarged by the addition of a second oval within the other, as in figure 2, you still only need one power unit in order to operate one train over any point on the layout. You do admittedly require an additional second terminal point on the inside oval so that power can reach there. Add a crossover, as at X, and the two terminal points are still adequate. You may need an

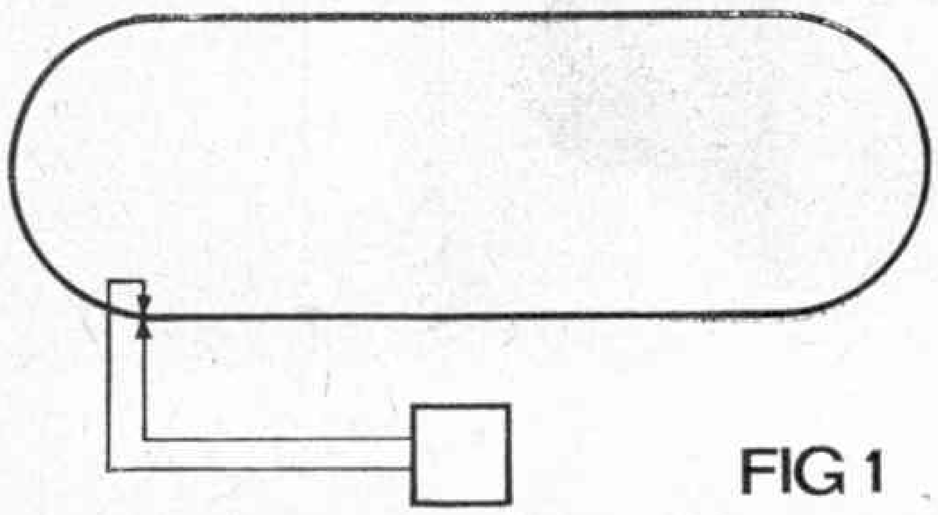


FIG 1

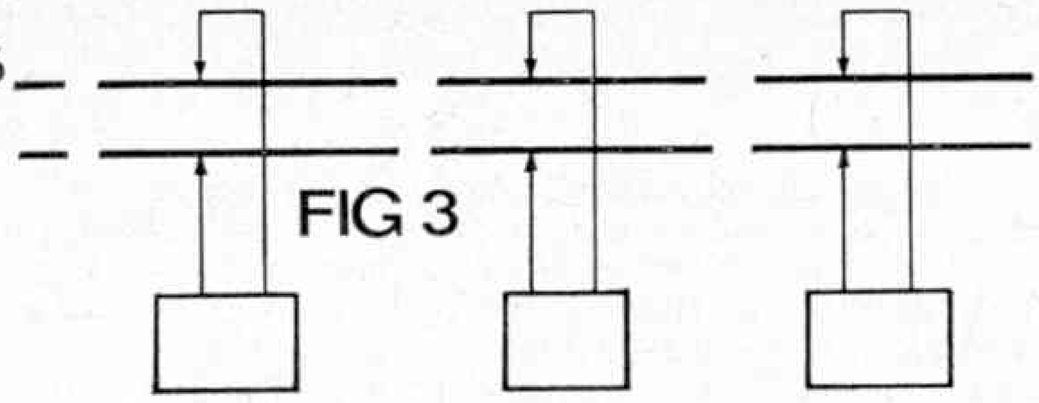


FIG 3

extra terminal to enable power to reach the more inaccessible points on the layout, but this is easily done by finding out where the power does not reach and then adding an additional terminal point. It doesn't matter in the least if you have too many terminal points, providing all the connecting wires are attached the correct way round, but it does matter if there are too few. Simple isn't it ?

Basically, wiring as described above is all you need to operate one train over nearly every type of layout, and this is equally true for flexible track or Tri-ang Hornby. Where Cab Control wins is when more than one train is involved, for then the layout can be sectionalised as shown in figure 3. For simplicity, I have shown the layout in the form of just a straight section of track, with gaps in both rails cut at intervals with a fine tooth saw. Each section is then dealt with individually and a power feed and return clipped or soldered to each rail. This means that, theoretically at least, a separate controller can be wired to each section, enabling a separate locomotive to operate over each of those sections. In theory, this is all very fine, but in practice it would be most inconvenient to have to switch in different controllers as a train made its way along the track. There would be the difficulty too of keeping the train running at a consistent speed from section to section. It is obvious, therefore, that there are many distinct disadvantages to this system. Much better if each of these sections can be coupled up to EACH of the controllers, so that by using just one controller, it is possible for the train to run through each of the sections without any change of speed.

Where Cab Control is concerned, the answer lies in suitable switches positioned between the terminal points on the track and the terminals on the controller, as shown in figure 4. With the aid of these, each section can be switched on before a train reaches it, and switched off after it has passed. If therefore an additional controller is available, a separate bank of switches can be added and attached between the second controller and the terminal points on the track. I show this in figure 5, and you can see two separate banks of switches, one for each controller. With this arrangement, it is possible for a train under the control of one controller, to travel along the section of track at the right hand end, whilst a second locomotive operates along the left hand end. All that it is necessary to do is for the operator to switch on the appropriate section, making sure that the switch on the other control panel is off.

Basically, those are the principles of Cab Control. Certain rules must however be observed where the power units are concerned, for because the return wires from each section are connected directly to every

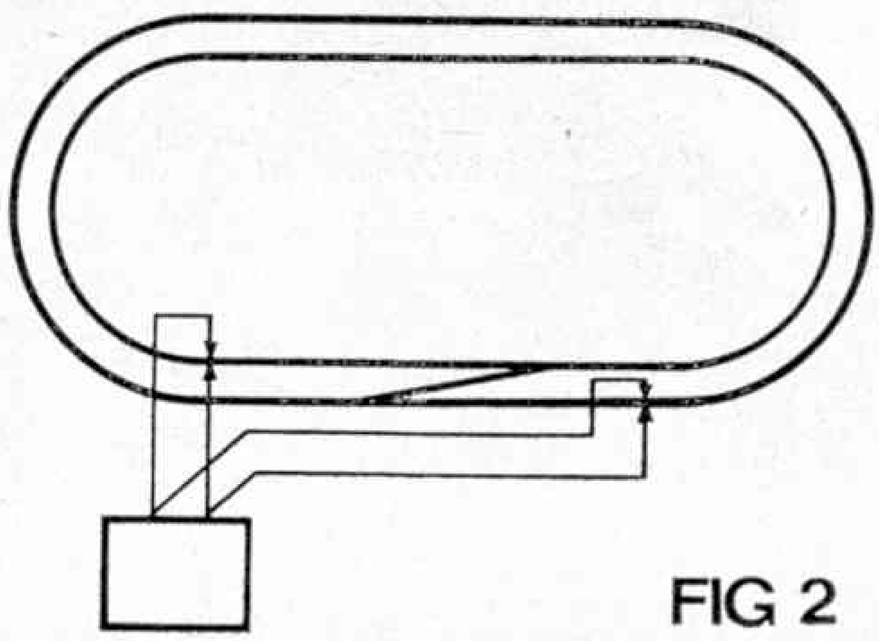


FIG 2

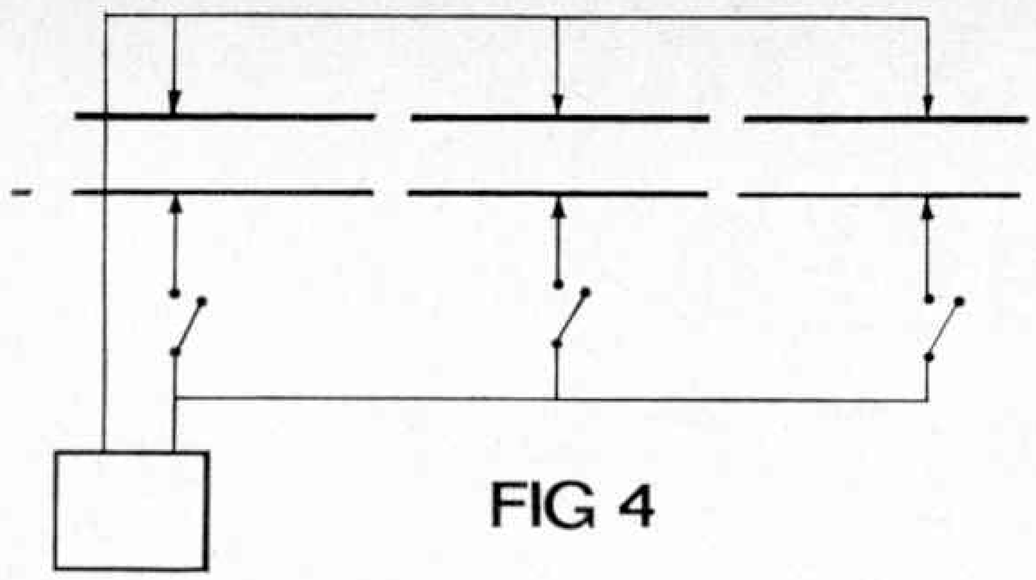


FIG 4

controller, the power units involved must be either completely separate in that they should be plugged in directly to a mains power supply and not connected to another power unit. The only circumstances where a second controller can be connected to the first unit is when this has a triple wound transformer. If you are in any doubt about this point, simply buy units that plug directly into the mains supply. Secondly, it is a good habit to see that all section switches are in the "off" position whenever they are not in use. If more than one controller or power unit is accidentally switched in to the same section, the result will be that the overload cut-out fitted to all units these days, is actuated, cutting off power temporarily.

On nearly all average size model railways, it will rarely be necessary to fit more than one controller, especially if only yourself and possibly one friend are likely to be the sole operators. Let's face it, you cannot control more than one train and operate one bank of section switches at any one time, so do try to avoid dreaming up *more* "cabs" than you think you have operators for.

Where Cab Control is concerned, you do of course have to build a control panel to go with your power unit. If the number of sections on your layout does not exceed six, then the answer may be to buy the "Powermaster" unit made by Hammant & Morgan which has, built in, a panel of six section switches. Terminals for connecting these up to the track are provided at the back of the unit, although if costs enter into the argument, it would be cheaper to build your own unit, using S.P.S.T. toggle switches, or indeed any on/off switch available from any electrical supplier. For maximum cheapness you could even use ordinary light switches, although I must admit that toggles can be bought for as cheaply as 2s. and they do give a much more professional appearance.

Our figure 6, shows how a typical section of layout would be wired, complete with controllers and two panels of section switches. Notice that it is really quite simple and nothing like as much of a problem as some people would have you believe.

Even with a commercial track system like Tri-ang Hornby, it is possible to use this system of control by dividing the track layout into individual sections, using the isolating rails included in the Tri-ang system and cutting through the other rail with a fine hack-saw or back-saw, or by using a normal piece of Tri-ang Hornby Rail and cutting both rails through. With flexible track you do have more freedom in that sections are easier to position and gaps can readily be sawn in the rail more-or-less anywhere. Flexible track does of course allow you to use curves of whatever radius you like, and also rails of whatever length you please. All

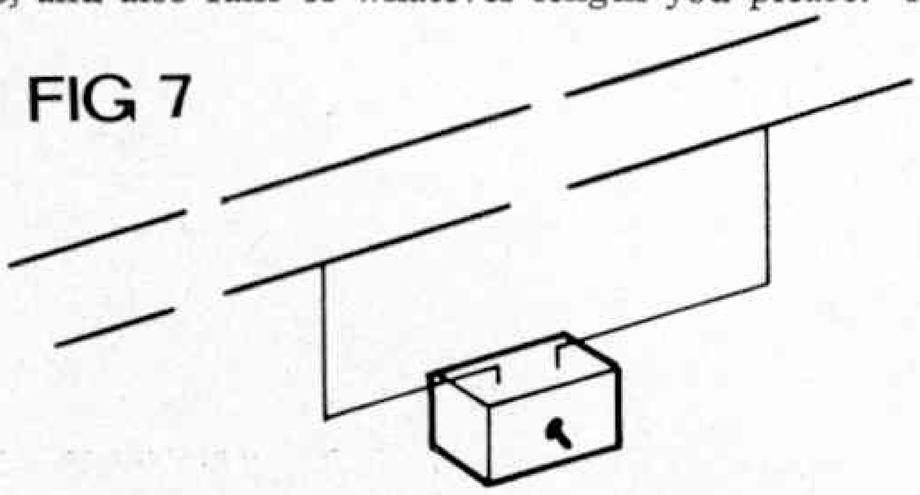


FIG 7

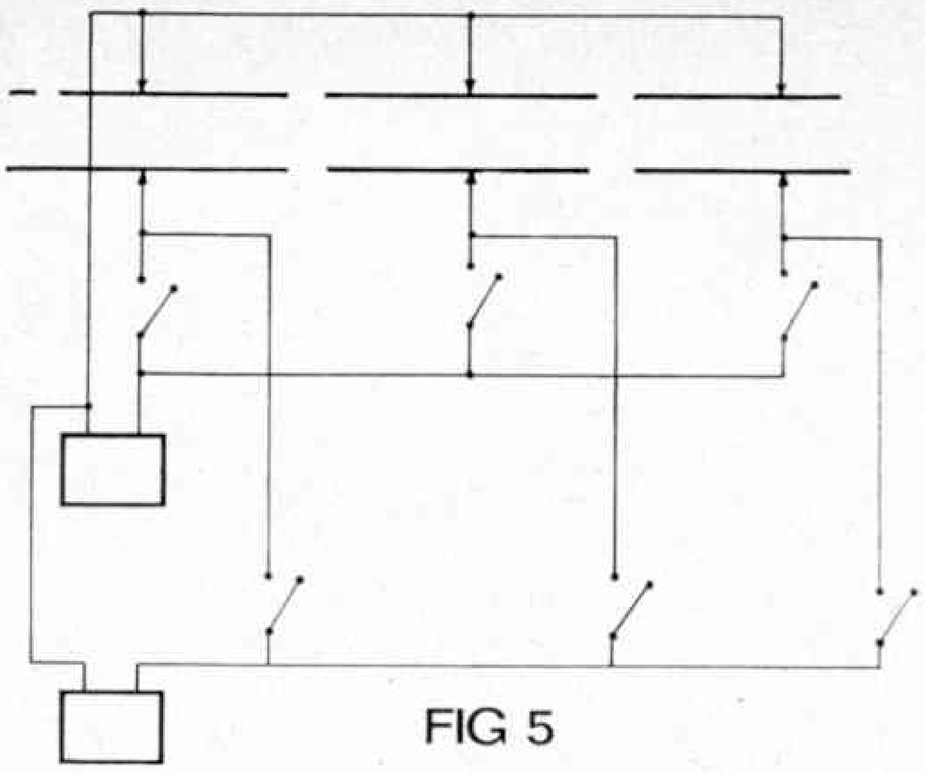


FIG 5

you have to do is to saw off the 3 ft. lengths to suit. Naturally, when you are able to do this, the design of your layout is limited only by the space available, and so to those interested in the do-it-yourself aspect of model railways, this is something really worth considering.

I said above that cuts must be made in both rails for sectioning the layout. In fact there are exceptions to this, the most important of which, as far as we are concerned here, being the dead ends which it is sometimes wise to include on sidings in, for example, locomotive sheds, or platform bays. This is easily done by cutting a single gap on either rail of the track and connecting wire from each side to an ordinary on/off switch. I show this in figure 7, and like the other wiring connections that have to be made, it is desirable to solder these if possible.

Finally, I should perhaps say a few words on the subject of points. Those readers with old Hornby Dublo points will know that these required Double Isolating Rails to avoid short circuiting when power is fed into the "frog" end of the point. A "frog", I should explain, is that section of the point that forms a "V", and this, at least on the Hornby Dublo point has caused a great deal of difficulty. If you have to use points with this type of "frog", you will need to ensure that power is not allowed to feed in at the "frog" end, by using rails with two gaps cut in them. Most commercial points today however use a different kind of "frog" that is completely self-isolating, and all that is necessary, is for the track feeds to be positioned to both ensure that power reaches every position on the layout, and also for convenience as far as the positioning of sections are concerned.

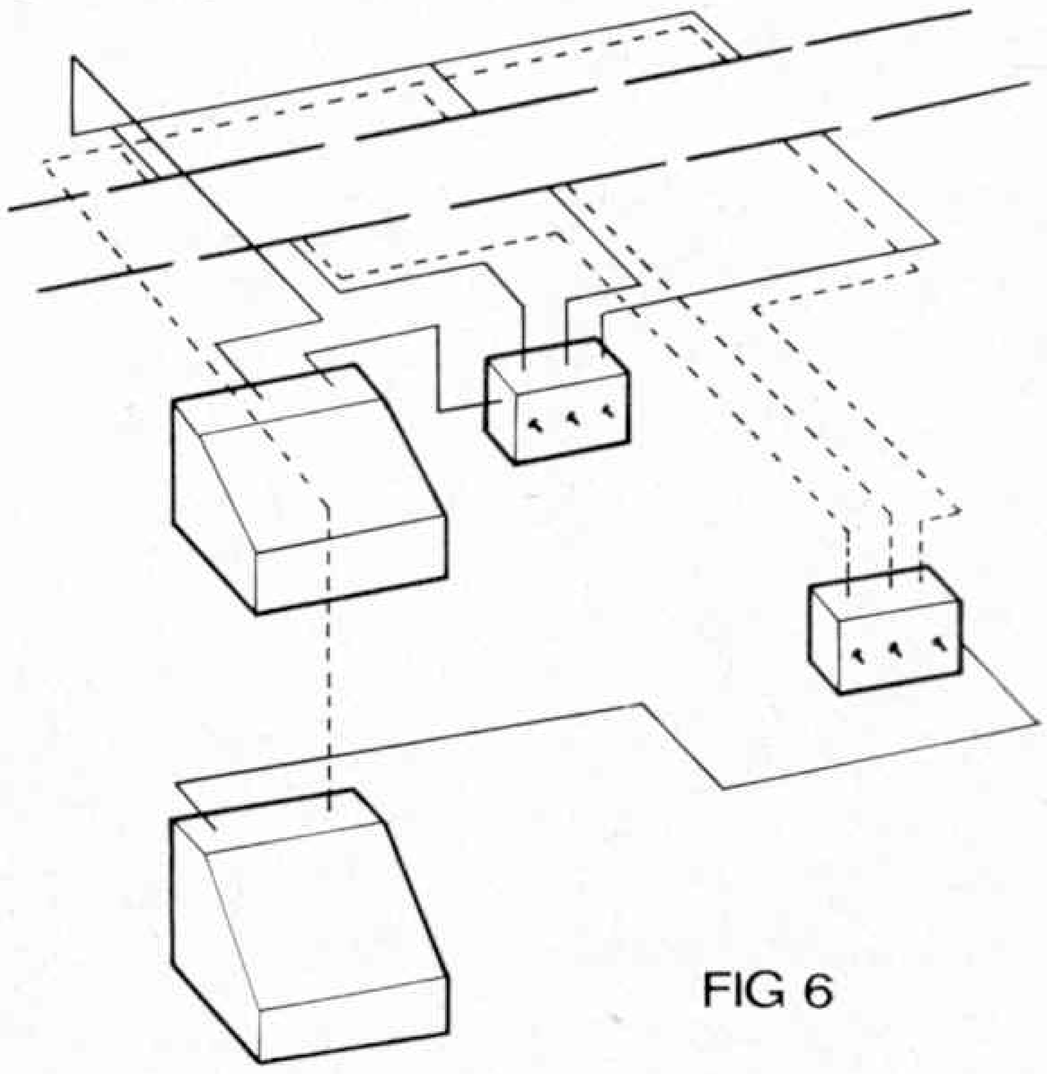
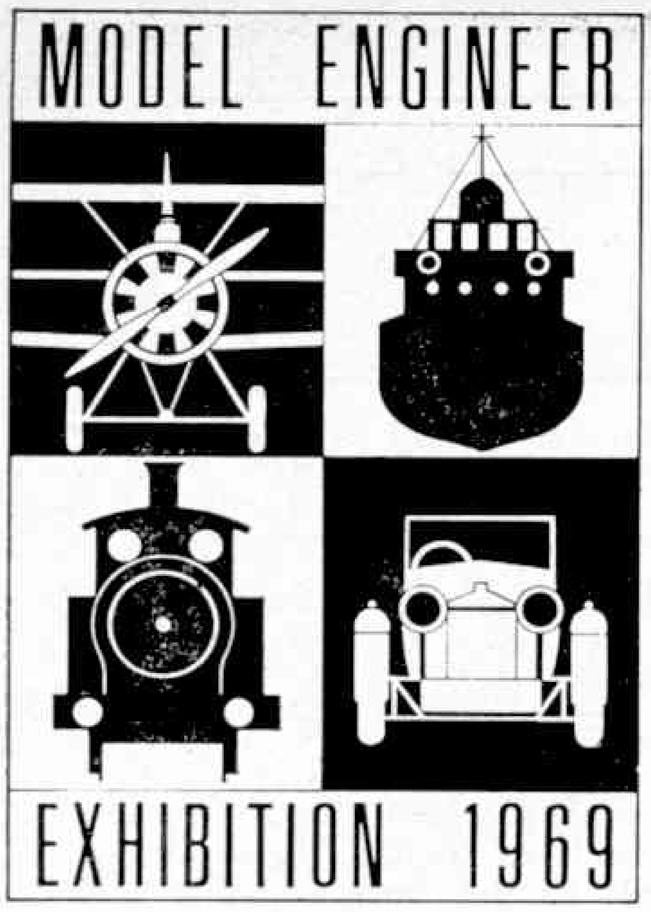


FIG 6



38th MODEL ENGINEER EXHIBITION

Seymour Hall, London, W.1.

31st DECEMBER 1968 - 11 JANUARY 1969

(Excluding Sunday) 31st December open to the Public 2.30 p.m. to 9 p.m. Thereafter daily 10 a.m. to 9 p.m. until Saturday, 11th January, closes 7-30 p.m.

SEE AND ENJOY

There will be a magnificent collection of models of all sorts shapes and sizes covering locomotives, traction engines, steam rollers, ships, yachts, cars, aircraft, in fact anything which can be modelled. These entries will be competing for a wide selection of trophies, cups and other awards as individual entries, in addition this year the emphasis will be very much on the club aspect and not only the governing bodies but some of the larger individual clubs have come together to give a composite exhibit of their efforts.

Meccano will be displayed, both working models sponsored by some of the specialist Meccano Societies and an actual contest for Meccano model entries.

WORKING MODELS

The ever popular live steam exhibit will be operated by the Society of Model and Experimental Engineers and youngsters of all ages, five to seventy, will be able to have a ride behind the steam engine. A new departure this year is to provide some space for the live steam operation of steam road vehicles, model rollers, model traction engines and the like. These will be operating alongside the railway passenger track. A further movement activity will be the new competition for the LBSC Memorial Bowl where locomotives must perform a track test to qualify for their prizes. The S.M.E.E.'s own stand will also, of course, have its usual selection of models operating under compressed air. Also showing for the first time will be a number of miniature railway layouts based on some of the proprietary manufacturers including Tri-ang, Trix and Fleischmann. We are also happy to welcome the Tramway and Light Railway Society with a working tramway exhibit.

Other special features will include an historic Dinky Toy collection alongside which will be shown the existing modern Dinky Toy range showing progress from 1934 to the present day. Another special feature will be a collection of Edgar Westbury's designs over the years. These are not E.T.W.'s own models but are representative of his designs and have been collected by well-known modeller Gerry Buck and restored by him to impeccable exhibition condition.

MODEL TRADE SUPPORT

Once again we welcome members of the model trade who will be displaying their wares and in most cases selling their products. We have Auto-Models, Beatties of London, Howell Dimmock, Kennions, Myfords, Traction Engine Enterprises, Historex, Peco Publications, Cromar White, Flying Dutchman, Lewisham Model Centre, Hugh Evelyn, Great Western Society, Richard Kohnstam and Model Racing Car Centre, in fact, there should be somebody to please the enthusiast in every angle of model making. Our own M.A.P. books will be on sale and a number of representative model governing bodies will be exhibiting including The Society of Model and Experimental Engineers, International Plastic Models Society, Model Power Boat Association, and the Model Yachting Association, all of which are National Non-territorial bodies. In addition there will be a number of club features to show what can be done.

SOUVENIR GUIDE

A very special Christmas Extra issue of Model Engineer will be coming out on 10th December. This will be the Exhibition Souvenir Handbook and Guide. It will contain Exhibition Entries, details of Stands, plus articles by experts on all aspects of modelling. Some special articles include, Clockmaking by Claude Reeve, Small Gauge Railways, Sixty Years of Model Flying, Radio Control Aircraft in Films, Approach to Model Car Collecting, Pairs Racing Model Boats, Hovercraft in Model Form, Meccano as Engineering. The Guide will be 72 pages, our usual magazine size and price 2s. 6d.

On sale everywhere and at the Show. If you cannot come get a copy and it should persuade you. If you expect to come read all about it first.

PARTIES

Many clubs will be organising parties to come. We shall be very happy to welcome them, give them reduced price bookings, also book up party lunches, teas or other meals well in advance.

Single and small number pre-booking tickets are available from these offices at Adult 3s. and Child 2s. Parties of more than ten—Adults 2s. 6d. Child 1s. 6d. Admission at the Pay-box is, Adults 4s., Child 2s. 6d. Any youngster at school is a child. Under five, admission free accompanied by an adult.

MODEL & ALLIED PUBLICATIONS LIMITED, 13-35 BRIDGE STREET, HEMEL HEMPSTEAD, HERTS.

SIMPLE HOME CHEMISTRY

ABOUT EMULSIONS

EVERYONE KNOWS that "oil and water does not mix", yet so many common substances such as milk, butter, hair creams and cosmetic preparations, paints, polishes, etc., are oil-and-water mixtures. The trick is that they are formed as stable oil and water mixtures known as emulsions, by the addition of a third substance known as an emulsifying agent.

Put a spoonful of thin oil (such as paraffin or benzine) and a spoonful of water in a test tube, cork the end and shake vigorously. The two will form a single milky coloured liquid, but if left to stand drops of oil will soon appear and grow in size and in less than a minute the water and oil will have separated out as two clear liquids again with the oil on top. You have produced an emulsion (by shaking), but it is not stable and breaks down into its two constituents as soon as it can (i.e. when you have stopped shaking it up).

Add a tiny piece of soap to the test tube and try shaking again for about ten seconds. If an emulsion has not fully formed, wait for about ten seconds and shake again. Repeat as long as necessary to produce a white mixture. This time the emulsion will be stable and not separate out on standing, although after a few hours it may appear thicker and whiter at the top. This is known as 'creaming' and is just the same as the cream rising to the top of a bottle of milk. Slight shaking will disperse the 'cream' evenly through the emulsion again.

Oil and water plus a small proportion of emulsifying agent produces a stable emulsion, so let's put this to use to make a practical emulsion say a hair cream. The oil in this case needs to be medicinal paraffin (liquid paraffin). We can again use soap for the emulsifying agent, but beeswax will be better. Suitable quantities for making an 'economy size' jar of haircream will be—

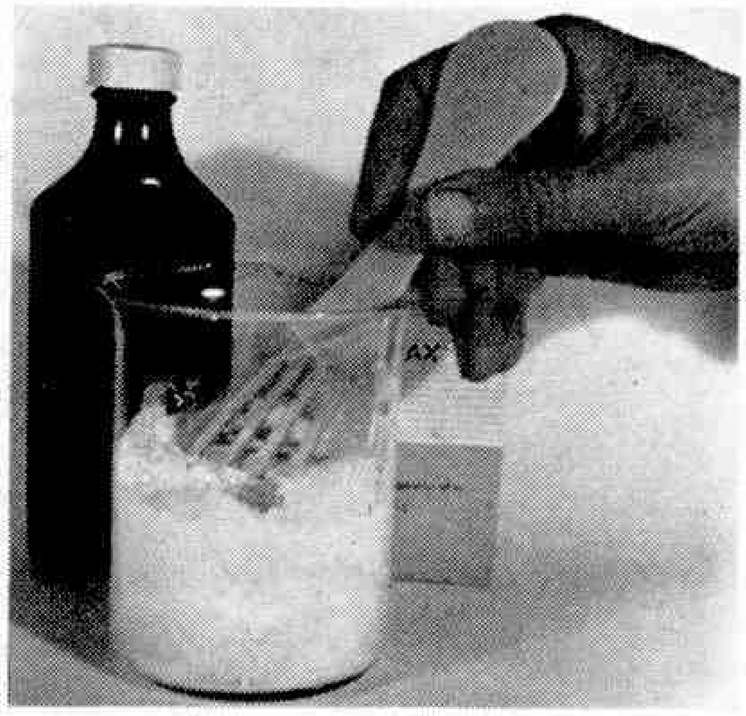
(i) one half cupful of liquid paraffin
(ii) one cupful of water
(iii) one ounce of white beeswax.

Pour the liquid paraffin into a clean beaker and stand in a pan or larger vessel partly filled with *warm* water (a temperature of 60 to 70 degrees C will be about right). Add a teaspoonful of beeswax to the paraffin and stir continuously until it is properly dissolved.

Warm a cupful of water to the same temperature and pour into another clean beaker. Now take the beaker containing the liquid paraffin and beeswax solution and pour slowly into the water, stirring vigorously all the time. Continue stirring, preferably with a beating action, to build up a creamy-white emulsion. It helps a lot if you use an egg whisk, or an electric food mixer, for this part of the job. All that then remains is to scrape out the finished hair cream as soon as it is cold into a suitable jar, ready for use.

There are some variations you can try. Thus if you want a scented hair cream, all a little scent to your choice to the paraffin after you have dissolved the beeswax. Also if the emulsion does not thicken and stiffen as much as you would like, try adding a pinch of borax to the water before mixing and stirring, or if you really want a stiff haircream, add a little gum arabic to the water.

Emulsions, once made, can be thickened or thinned by adding a further proportion of one of the constituents and re-agitating, but first you have to know the *type* of emulsion concerned. One constituent of the emulsion always forms the external or 'continuous' phase, with the other constituent distributed through it in the form of minute droplets separated from each other. Adding more of the continuous phase thins the emulsion; adding more of the 'droplet' or 'internal' phase thickens the emulsion. It is usually impossible to tell what type an emulsion is merely by looking at it, and what is more the same constituents may form different types of emulsion depending on the emulsifying agent used, or even the method of stirring or mixing.



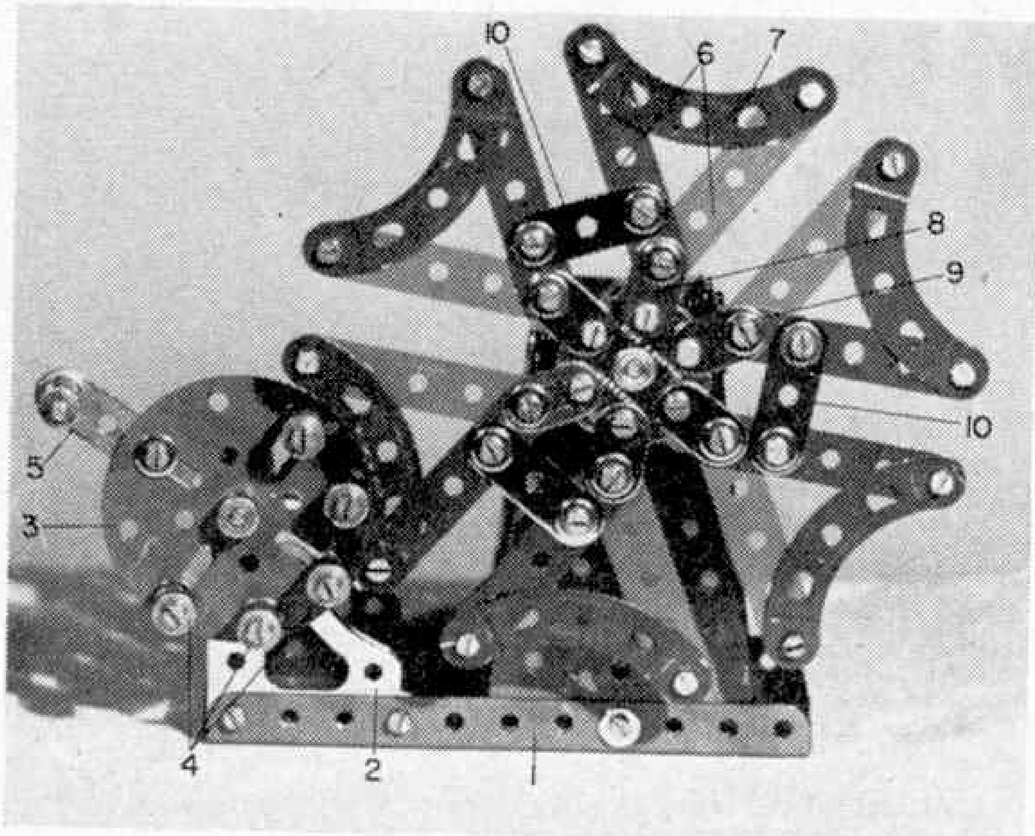
Hair cream in the making. This is only an experiment and we do not advise readers to apply this to their hair, as they may not have made the emulsion correctly.

The two basic types of emulsion are: *oil-in-water*, where water is the external or continuous phase and the oil is in droplets, *water-in-oil*, where oil is the continuous phase and the water is in droplets.

A simple test is to add a drop of water-soluble dye, or water soluble ink, to a small sample of the emulsion. If the colour blends and spreads through the emulsion it is an oil-in-water type. If not, or the colouring is speckled, the emulsion is a water-in-oil type. Most emulsions are of the oil-in-water type—which means that they can be 'thinned' with water and 'thickened' with oil. Some common emulsions, like butter for instance, are water-in-oil type. Thus remixing butter with water would actually thicken it. Try it and see!

Properly formed emulsions are stable enough and will retain their paste-like form indefinitely, but some emulsions are more sensitive than others. Emulsion paints or the so-called 'thixotropic' paints are a typical example. They are stable enough to remain as paste or even jelly-like materials, but severe agitation tends to make them break down. Never stir a thixotropic paint, for example, otherwise you will find it will tend to break down into its separate constituents. For that reason—its sensitivity to mechanical agitation—you cannot effectively 'thicken' or 'thin' a thixotropic paint.

Incidentally, one oddity of emulsions is that the internal phase may have a much greater volume than the external or continuous phase. Mayonnaise is a typical example, being an oil-in-water emulsion where the actual water content is quite small. In fact, typical proportions are, roughly, *half a pint* of salad oil (or olive oil) to a tablespoonful of water (in the form of vinegar or lemon juice). This small amount of water completely contains and surrounds the larger volume of oil dispersed through it in fine droplet form when the emulsion is produced by beating—provided you have not forgotten to add the emulsifying agent! In the case of mayonnaise suitable emulsifying agents include egg yolk, powdered mustard and paprica and have a double purpose in providing flavour as well.



An Intermittent Drive Mechanism designed and built by Andreas Konkoly of Budapest, Hungary. The unit works on the Maltese Cross principle except that six arms are included whereas a true Maltese Cross arrangement has only four arms.

AMONG The MODEL BUILDERS

with Spanner

Intermittent drive mechanism

OFTEN HAS it been said that Meccano is a world-wide hobby, transcending oceans, mountains and —perhaps significantly in this case—frontiers. Our first offering this month helps to prove the international appeal of the system as it comes, not from Britain or even Western Europe, but actually from behind the iron curtain ! To be more precise, it comes from Hungary, " it " being the Intermittent Drive Mechanism illustrated in the accompanying picture. Full credit for the idea must go to Andreas Konkoly of Budapest who is a passionately keen and extremely capable enthusiast. Unbidden, he has done a great deal to publicise Meccano in his country, appearing many times with models on television and even exhibiting Meccano Magazine before the cameras.

Mr. Konkoly's mechanism is based on the " Maltese Cross " principle, with the difference that six arms are incorporated whereas a true Maltese Cross arrangement, of course, has only four arms. The mechanism is designed to give an intermittent drive with pauses of regular lengths at regular intervals. As illustrated, it is built onto a test mounting which would naturally be dispensed with under actual working conditions in a model, but the following description refers to the unit as it appears here. The mounting consists of a $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plate 1, to the side flanges of which two Corner Gussets 2 and two Flanged Sector Plates are bolted.

Journalled in the Corner Gussets is a $3\frac{1}{2}$ in. Rod, serving as the input shaft, which is held in place by a Collar and a Face Plate 3. Fixed by Nuts in five adjacent holes around the circumference of this Face Plate are five $1\frac{1}{8}$ in. Bolts, each carrying a Coupling 4, free to rotate on the Bolt and spaced by a Washer. Also bolted to the Face Plate, diametrically opposite the centre Coupling, is a $2\frac{1}{2}$ in. Strip 5, to the end of which a further Coupling is attached by being clamped on a $\frac{3}{4}$ in. Bolt. This Coupling will later be instrumental in turning the Maltese Cross-type construction.

Actually, it is incorrect to refer to the latter part of the unit as a " cross " because of its six arms. It looks far more like a flower with six petals ! Each " petal " consists of two $2\frac{1}{2}$ in. Strips 6, joined together at one end by a $2\frac{1}{2}$ in. Stepped Curved Strip 7 and bolted at their other ends to a Fishplate 8 which is in turn bolted to a 6-hole Bush Wheel 9. The petals are joined together as shown by three $1\frac{1}{2}$ in. Strips 10, then the completed section is mounted on a $3\frac{1}{2}$ in. Rod journalled in the Flanged Sector Plates.

When the unit is in operation with Face Plate 3 revolving, Couplings 4 engage with the concave edge of the adjacent petal, thus holding the " flower " steady until the last Coupling disengages the petal, at which time Strip 5 has moved round to engage in the slot between the first and the second petal. As the Face

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This Five-speed and Reverse Gearbox comes from Ken Ashton of Brinsworth, Rotherham, Yorkshire. It is an extremely effective mechanism designed for use in fairly large vehicle models.

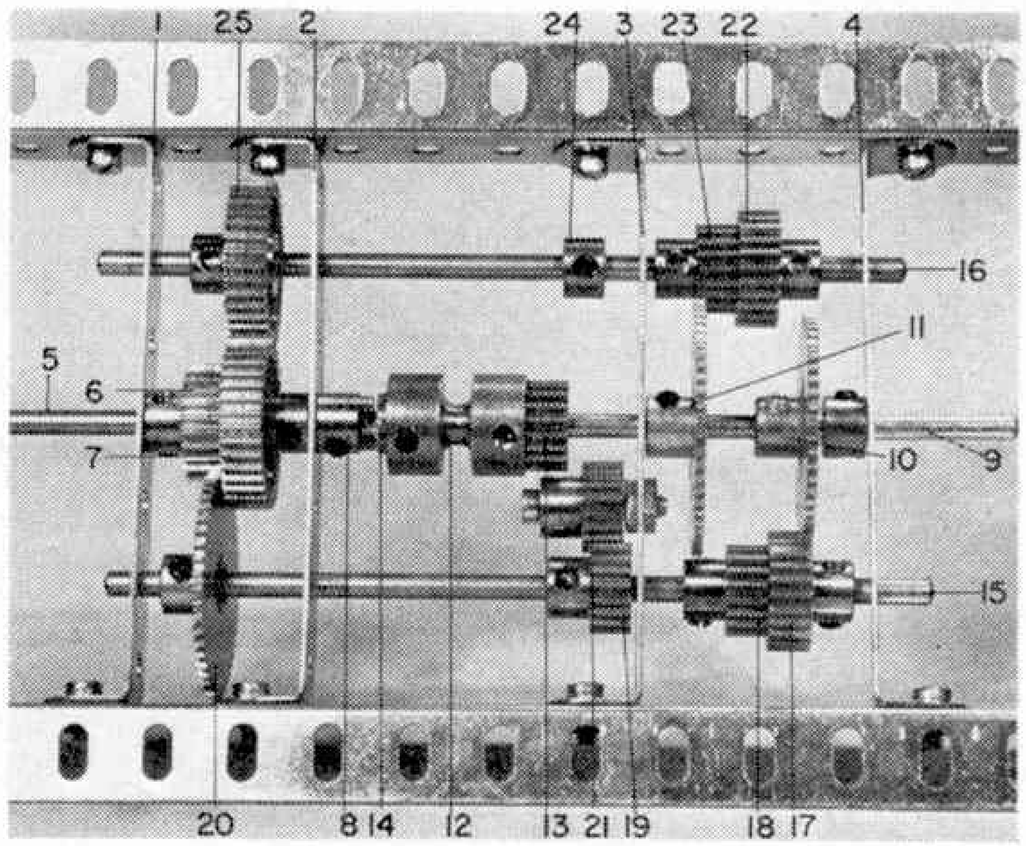


Plate continues to revolve, the Strip moves the flower round until the Strip disengages itself at the bottom of its throw, by which time Couplings 4 have moved round to hold the second petal in place. The cycle is then repeated, ad infinitum.

As a matter of interest, Maltese Cross mechanisms are widely used in movie film projectors for pulling the film through the projector in a series of intermittent movements so that each frame is allowed to pause for a fraction of a second behind the lense. If the film were pulled through in a continuous movement, the screen would present a confused series of pictures instead of the correct steady, clear picture we know.

PARTS REQUIRED

12—2	51—37a	2—54	2—108
3—6a	41—37b	2—59	1—109
6—10	13—38	6—63	1—111
2—16	1—52	8—90a	5—111d
1—24b			

Five-speed and reverse gearbox

Leaving Hungary for home, now, we have an extremely useful 5-speed and reverse gearbox supplied by Ken Ashton of Brinsworth, Rotherham, Yorkshire. Designed for use in fairly large vehicles, it is intended to fit between the main chassis members of the model, using the chassis members themselves as the side-plates of the gearbox. Construction is pretty obvious from the illustrations. Four $3\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips 1, 2, 3 and 4 are bolted between the chassis members to provide bearings for the input and output shafts, as well as for the two sliding layshafts incorporated in the mechanism. The input shaft 5 carries a $\frac{3}{4}$ in. Pinion 6, a 1 in. Gear 7 and also one half of a Dog Clutch 8 which is fixed on the Rod, but is so positioned that a sufficient length of its bore remains to receive the end of the output shaft 9—a 4 in. Rod with Keyway journalled in Double Angle Strips 3 and 4. Fixed on this Rod between Double Angle Strips 3 and 4 are a Collar, a 50-teeth Gear 10 and a 57-teeth Gear 11. Free to slide on the Rod between Double Angle Strips 2 and 3 is a Socket Coupling 12, in one end of which a $\frac{1}{2}$ in. Pinion 13 is held by a 7/64 in. Grub Screw, the other half of a Dog Clutch 14 being held in its other end. A Keybolt is screwed into one bore of Pinion 13 to engage with the keyway of Rod 9.

Two 5 in. Rods 15 and 16 serve as the sliding layshafts. Secured on Rod 15 in the positions shown are a $\frac{3}{4}$ in. Pinion 17, two $\frac{1}{2}$ in. Pinions 18 and 19 and a 50-teeth Gear 20. Pinion 19 is in constant mesh with a $\frac{1}{2}$ in. "idler" Pinion 21 mounted on a $\frac{3}{4}$ in. Bolt held by Nuts in Double Angle Strip 3, while Gear 20 is in constant mesh with Pinion 6.

Fixed on Rod 16 are a second $\frac{3}{4}$ in. Pinion 22, another $\frac{1}{2}$ in. Pinion 23, a Collar 24, to prevent the Rod moving too far, and a 1 in. Gear 25. Gear Wheels 7 and 25 are in constant mesh and note that Gear Wheels 10 and 11 should be so arranged that, when the layshafts are in their central positions, a neutral period occurs.

Operation of the gearbox is not so straightforward as a full-size vehicle gearbox, but you soon get used to it. With Socket Coupling 12 so positioned that Pinions 13 and 21 are out of mesh while the Dog Clutch sections 8 and 14 are *disengaged*, movement of layshaft 15 towards the input shaft should bring Pinion 18 into mesh with Gear 11 to give bottom gear with a 6 : 1 ratio. (Remember Pinion 6 is in constant mesh with Gear 20.) Movement of the layshaft towards the output shaft brings Pinion 17 into mesh with Gear 11 to give second gear at 4 : 1, remembering that Gears 7 and 25 are in constant mesh. For third gear, layshaft 15 should be centralised and layshaft 16 moved towards the input shaft, thus bringing Pinion 23 into mesh with Gear 11 to give a 3 : 1 ratio. Movement of the layshaft towards the output shaft engages Pinion 22 with Gear 10 to give fourth gear at 2 : 1. Top or fifth gear is obtained by centralising both layshafts and moving Socket Coupling 12 to engage the two halves of the Dog Clutch, thus giving a straight-through 1 : 1 drive. For the 2 : 1 reverse gear, the Socket Coupling is moved in the opposite direction to mesh Pinion 13 with Pinion 21 which, by the way, is in constant mesh with Pinion 19. To prevent accidental engagement of the reverse ratio, a Compression Spring can be mounted on Keyway Rod 9 between Pinion 13 and Double Angle Strip 2.

In the details of the gearbox Mr. Ashton supplied, he did not include mention of a gear-change lever as this would depend on the individual model in which the mechanism was fitted. I suspect a single gate-change lever would involve some decidedly complicated linkages, however, therefore, if you're looking for simplicity, I recommend three separate levers, one for each layshaft and one for Socket Coupling 12. The following parts list applies only to the basic mechanism, excluding the input shaft and chassis members as these would be governed by particular model requirements.

PARTS REQUIRED

2—15	1—27a	8—37b	1—171
3—25	2—31	2—59	1—230
5—26	10—37a	1—144	1—231
2—27			

Postscript

Just before finishing this month, I would like to pass on a simple little hint from J. G. Gamble of Lenton, Nottingham on a way to improve the appearance of models such as locomotives, traction engines, etc., which have brass-bound boilers. Elektrikit Part No. 530 is a thin Flexible Strip made out of brass and several of these bolted round a boiler have a very striking effect. As Mr. Gamble put it, "A very simple idea, but one which does much for the general appearance and realism of such models." He's absolutely right !

BATTLE

Part IX

More about-Anti-Tank Guns

by Charles Grant

I'M SORRY that in this Part I am obliged to inflict two more Tables on the reader, but I hasten to add that they should be about the last—as far as tanks in battle are concerned—and it won't be long before we lead our armoured squadrons into at least a relatively simple sort of action. At the outset, of course, I could have simply set out the basic rules of " Battle ", loads of tables of ranges, speeds, effectiveness and so on, and laid it down more or less arbitrarily that *this* is done in such a manner, *that* is done this way, etc., but I feel that the battlegamer is keen to know just what the reasoning is behind a particular rule, and for my part, I prefer, as I go along, to explain just how I came to some conclusion governing some facet of fire power or tactics. It does, I hope, add a measure of realism as well as encouraging the player to do his own research into the finer points of the military art.

However, to get on with the business in hand, the next consideration—having put together rules giving strike and defence values of A.T. guns—is whether, when you have fired at a certain target, the shot you have loosed off is actually going to strike home. It can only do so—and this is pretty obvious—if the target is within visibility range and can, in effect, be seen by the character firing the gun.

Now, it has generally been my experience in battle-games, and this applies not only to those set in the modern period but also to those of any other era you like to name, that vision is generally grossly exaggerated and that the keenest of eyesight just has not the powers people think it has. We are here going to deal with two types of vision—aided and unaided. The latter is not of immediate concern as we are dealing with tanks at the moment and it is reasonable to assume that tank commanders and such like people are always equipped with binoculars. For future reference, though, it might be as well to elaborate a little about vision with the naked eye.

One important point to be noted is that what we are firing at is not normally something that stands out boldly against a differently coloured background, such as a white-washed cottage against a ploughed field (this would most obviously show up at a considerable distance) but something which is specifically designed to blend with its background—in a word, camouflaged. This technique can be carried to great and most effective lengths with both men and vehicles. There is a species of army demonstration in which a body of men, marched into the middle of a field, simply cannot see a number of soldiers, cleverly camouflaged, who are sitting about at distances of as close as fifty or sixty yards—or at least not until they move. If this is the case with troops, even more so is it the case with fighting vehicles, especially at considerable distances, the art of camouflage being most highly developed. To all this add the fact that in action there will doubtless be lashings of smoke about, clouds of dust thrown up by tanks and other vehicles and probably from shell explosions, and you have also the inevitable fatigue and strain affecting the eyesight of the gunners.

I'm not going into a whole heap of figures about this—statistics prove anything, they say—but I have carried out a number of simple tests over measured distances in varying kinds of weather and I was absolutely astonished at the results—as were my collaborators. On a bright, sunny day—to give an example—a car, against a background of buildings, could be identified at about 1,500 yards, but only as a spot of reflected sunlight. With the sun obscured—well, that was that, it simply could not be located at all.

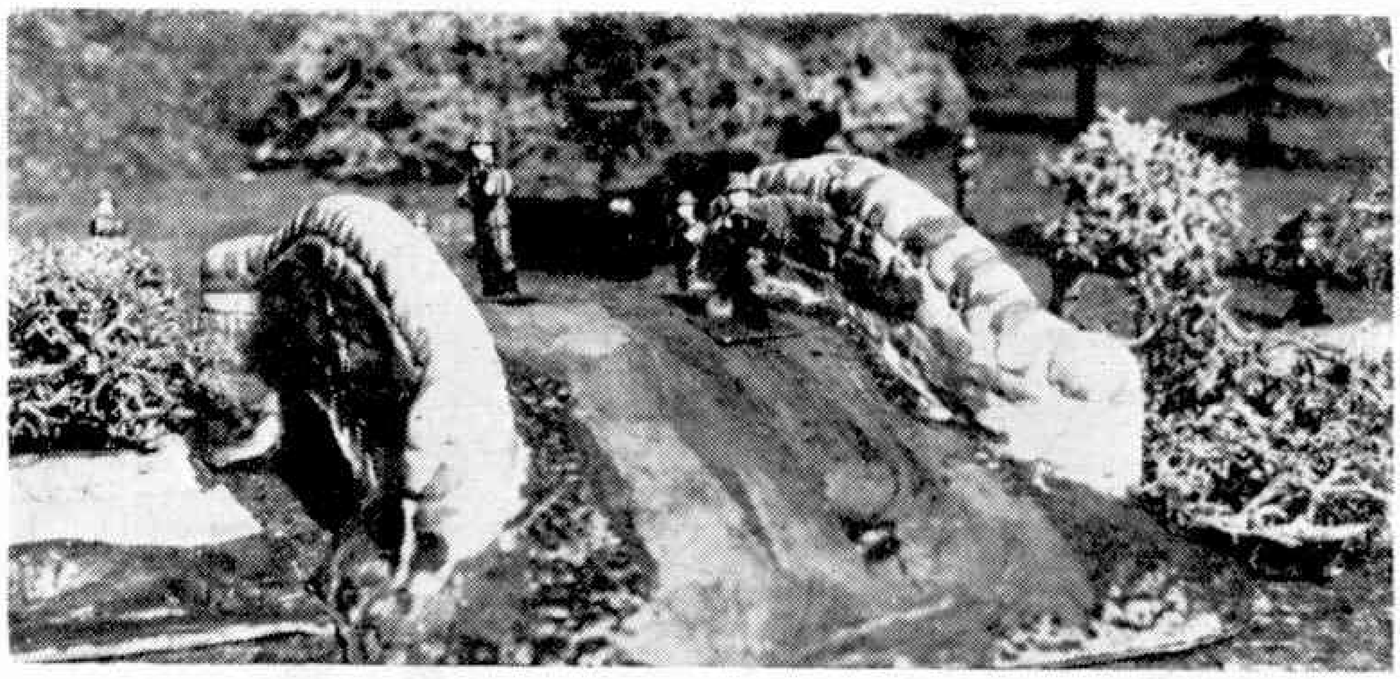
So, in studying the Table which is appended, I hope that it will be accepted as a realistic one, for the good reason that it is in fact so. As a corollary, I quote a ' tankie ' friend of mine who served in Shermans and Churchills through the World War II campaigns in Italy and Normandy—his dictum being that if you got a reasonable chance of seeing, identifying and hitting a panzer at above two or three hundred yards range you were darn lucky. This of course is not desert fighting with wide open spaces and a much clearer atmosphere than was generally likely in any European theatre of war. This is a special case, quite certainly, and if the player wants to specialise in desert warfare, a considerable increase in visibility would have to be catered for by the rules, although the added complication of what or how one could see in a sandstorm would have to be introduced !

However, let us take a look at how, for the purposes of " Battle " we determine visibility. This would naturally have to be done at the beginning of each game, or if a campaign were in progress involving fighting on successive days, at the commencement of each day's fighting. The purist might argue—and with reason if we think of our own unpredictable climate—that the weather, and consequently visibility might change quite dramatically in the course of a single day. True, indeed, but this is a refinement which can well be left to the individual player. The Table then is designed to give, as a rule, reasonable visibility, the weight being on the higher rather than the lower visibility distances, but, in point of fact, if the player wants to have an ' open ' type of game he might well choose to operate in conditions of maximum visibility all the time, particularly if fighting a single unconnected engagement (with a campaign, though, it's a different kettle of fish—one really must take weather into consideration).

Anyway, we again make use of two dice, and the Table gives the scales for aided and unaided visibility, and, for the moment, we shall be rather more interested in the former (the binoculars, you will remember !). So, taking two dice, we roll them in the time honoured fashion, and the resulting total will give visibility for the battle in which we are about to engage.

(Later on, when we come round to directing long range

Easy now!—infantry cautiously approach a bridge—not an easy crossing, obviously—very exposed.



shellfire on enemy positions, the table will come in useful for the vision capabilities of Forward Artillery Observers, usually, of course with 'aided' visibility.)

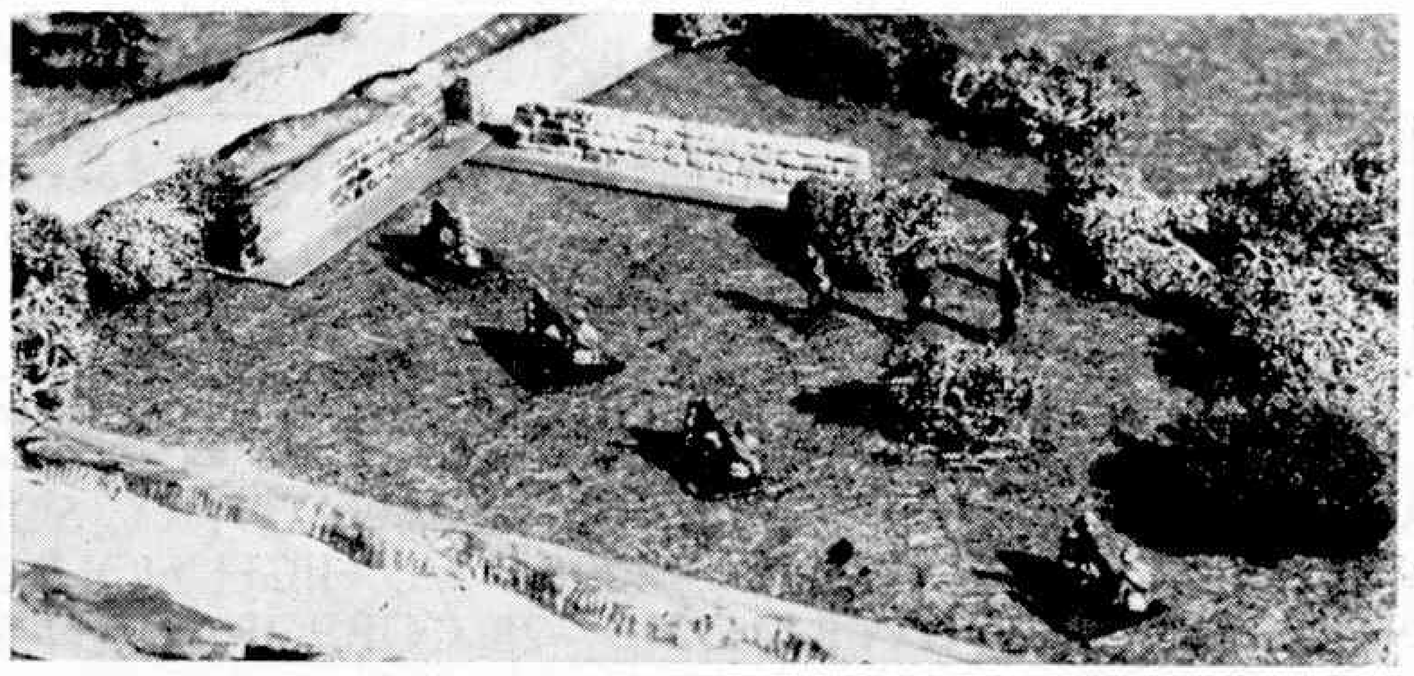
Having done this, then, we now return to our tank commander (or A.T. gunner) who is now in a position, first to see the enemy, if the latter is within visibility as per the table, and second, to draw a bead on him. Distance, of course, is the primary concern when it's a question of scoring a hit. At point blank range it will be a relatively easy matter, while at maximum range, the chances of slamming home a shot will be correspondingly decreased. One could draw a kind of probability graph for hits at different ranges but this, having regard to the basic quality of these rules, would be somewhat beyond our terms of reference, as indeed would be the table of hit possibility I had originally thought of including. This was one I have used in normal day to day battles, and was graduated in 5 in. 'steps', but on reflection it seemed to be unnecessarily subdivided. I decided to simplify it and this I did by employing the same scale as used for the Table of Strike Values, using only four stages to get up to the chance of a hit at maximum range. The reader may see the result in the second table.

Dice throw	Visibility in inches	
	Unaided	Aided
12	30	45
9, 10 or 11	25	35
5, 6, 7 or 8	20	30
3 or 4	15	20
2	10	15

Range in inches	Dice throw to score a hit
0 to 10	6 or over
10 to 20	7 ,, ,,
20 to 30	8 ,, ,,
30 to 45	9 ,, ,,

The mechanics of the operation are simple—'A' is firing at 'B' (It does not matter at the moment what 'A' is firing with or even what 'B' might be)—he throws two dice, and noting the range, the result of the dice throw shows whether or not 'A' has scored a hit (the result of course being subsequently determined by comparison of Strike and Defence Values). At what we might call point blank range, that is, up to 10 in., a hit is registered if the total of the two dice reaches only 6 (or more, of course)—this being the equivalent of 15 chances out of the possible of 21. At maximum range, however, if the target is visible, a total of nine must be thrown as a minimum, with the possibilities being reduced thereby to only six out of the twenty-one possible.

This process—I must stress—is simply to see whether the enemy has been actually hit—how effective the shot has been being decided by the second throw, that which is added to the Strike Value and compared with the Defence Value of the target vehicle. However, that we have scored a hit is sufficient for our present purpose, and although we have progressed rather in a sort of reverse direction—starting with the defence and working back to the gun firing—we have nearly reached the target, in a manner of speaking, and the next stage will see our guns not only being brought to bear but actually firing.



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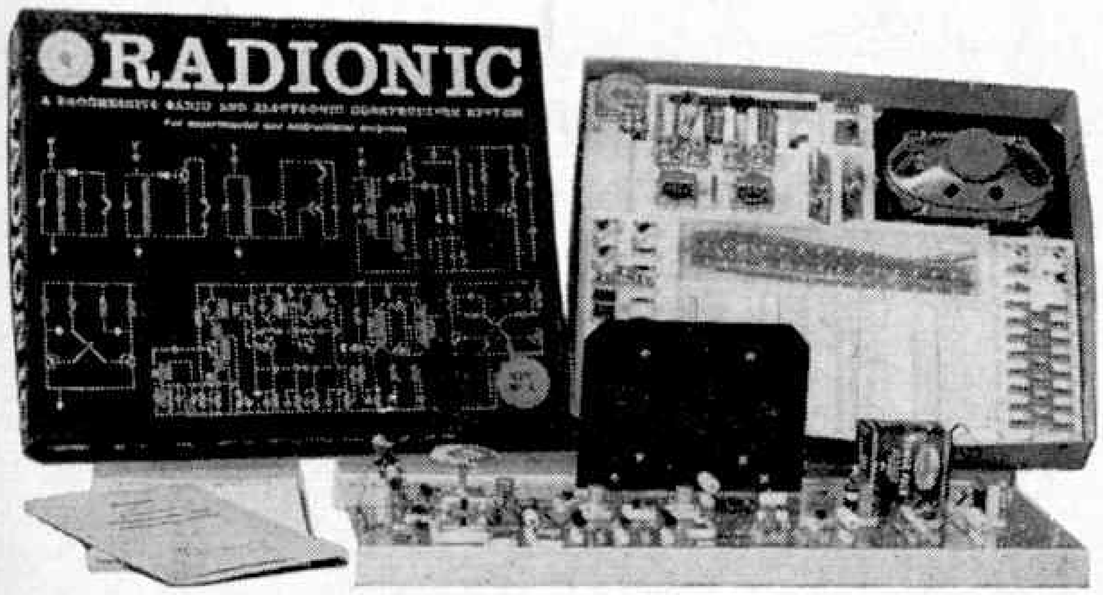

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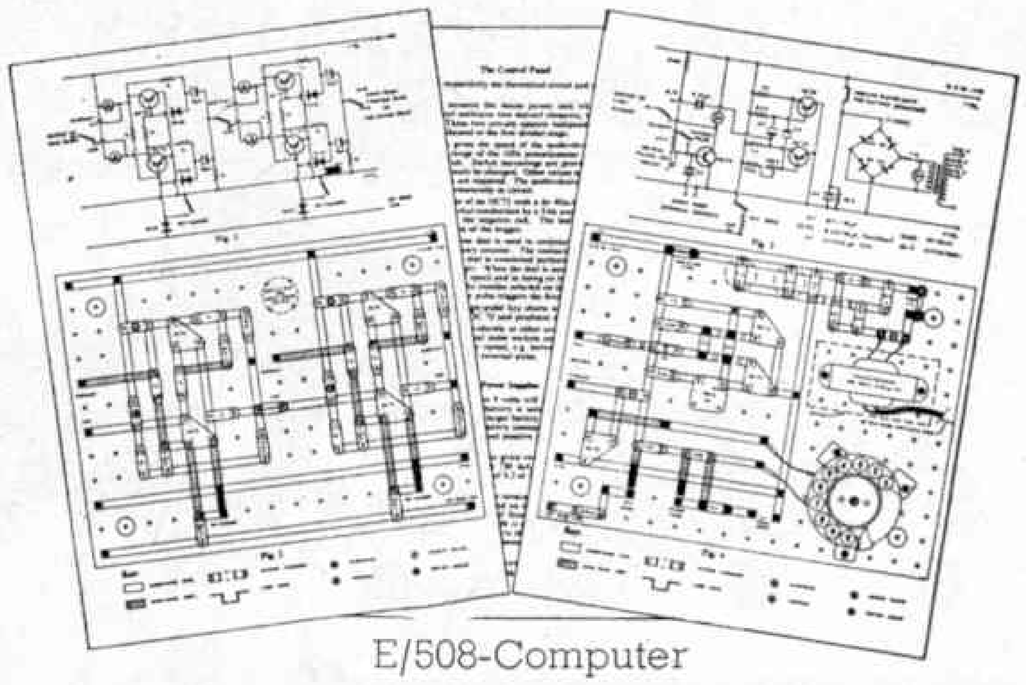

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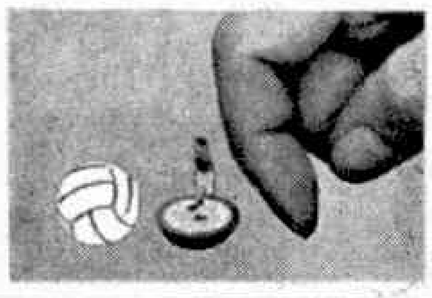

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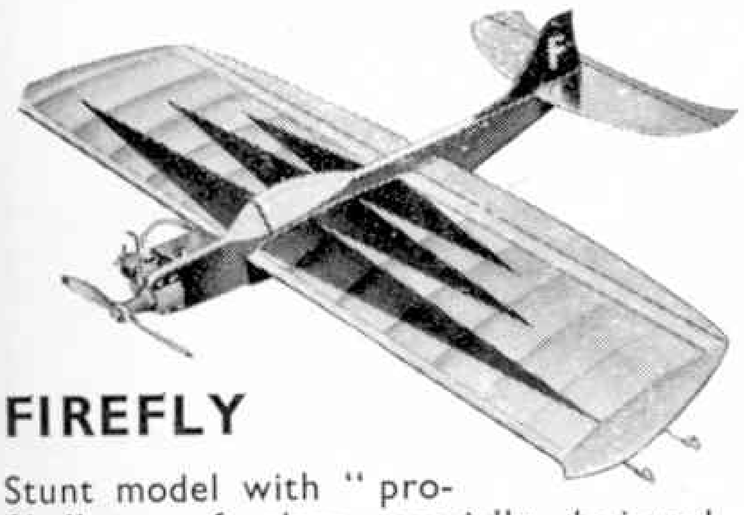

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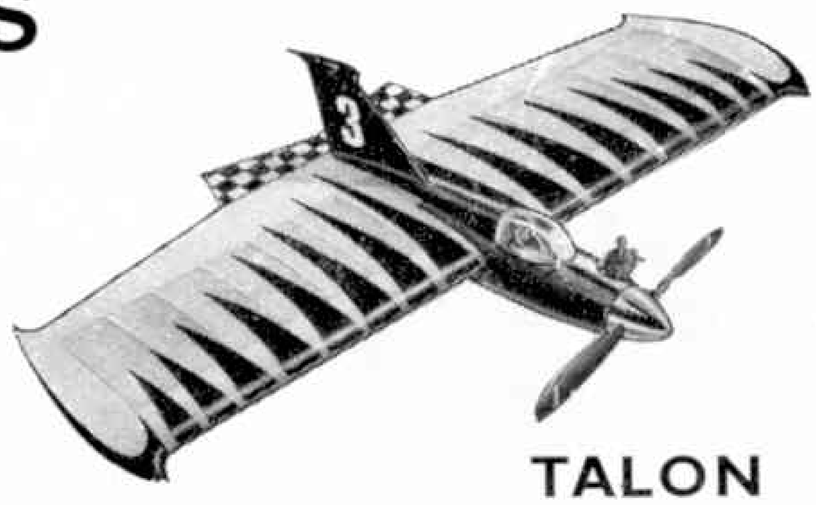

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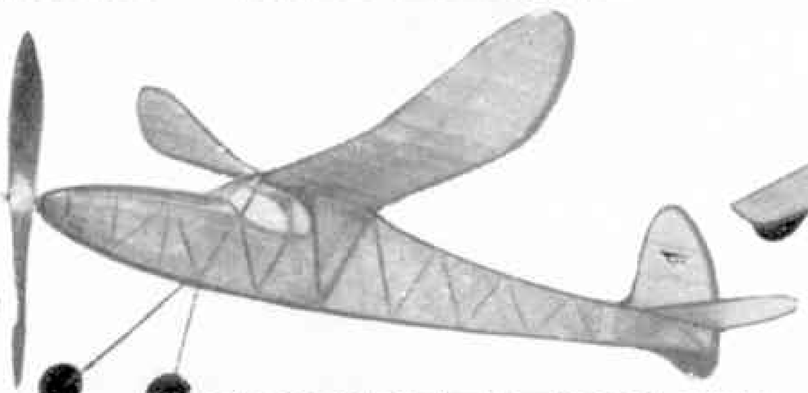

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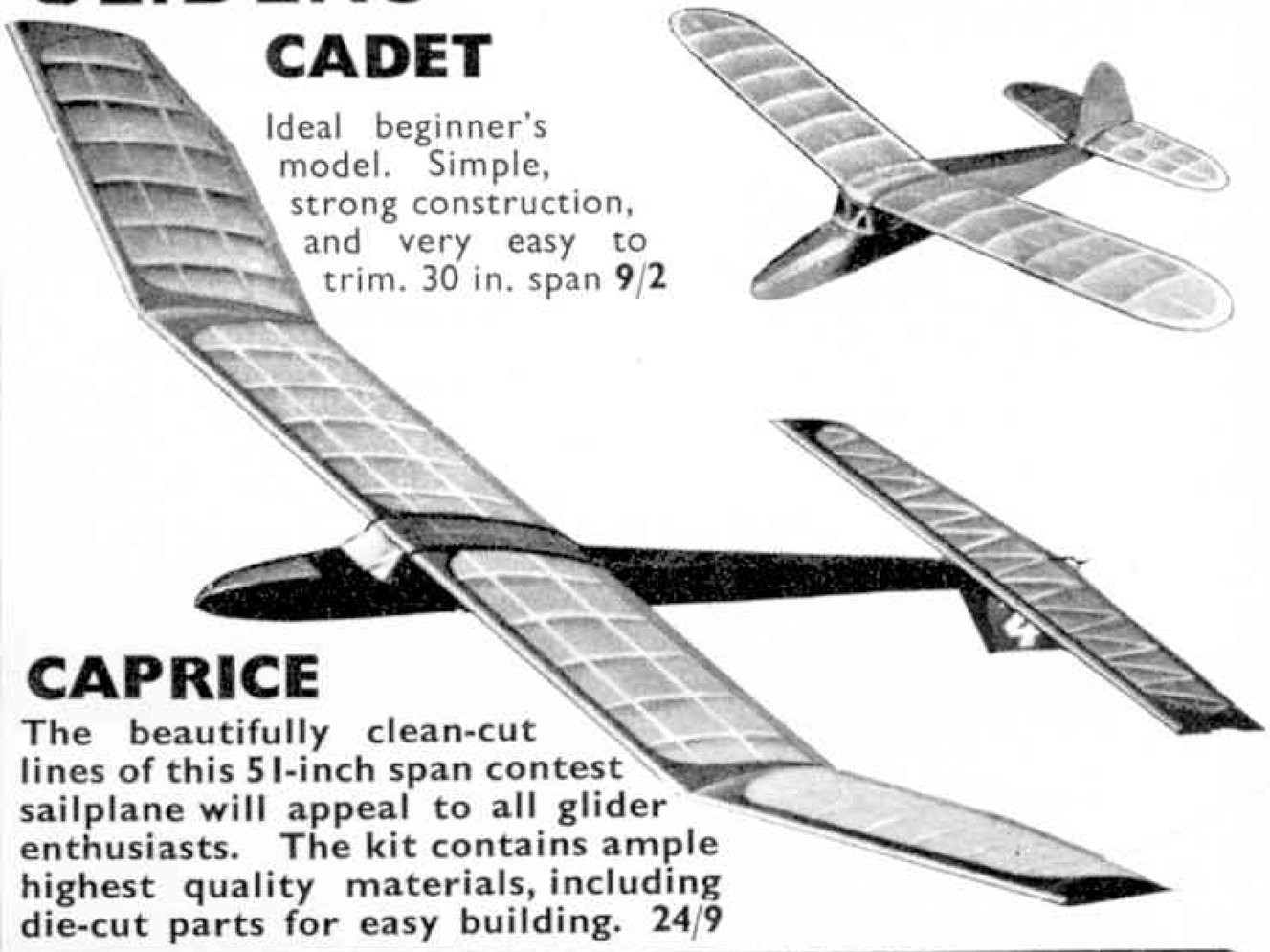

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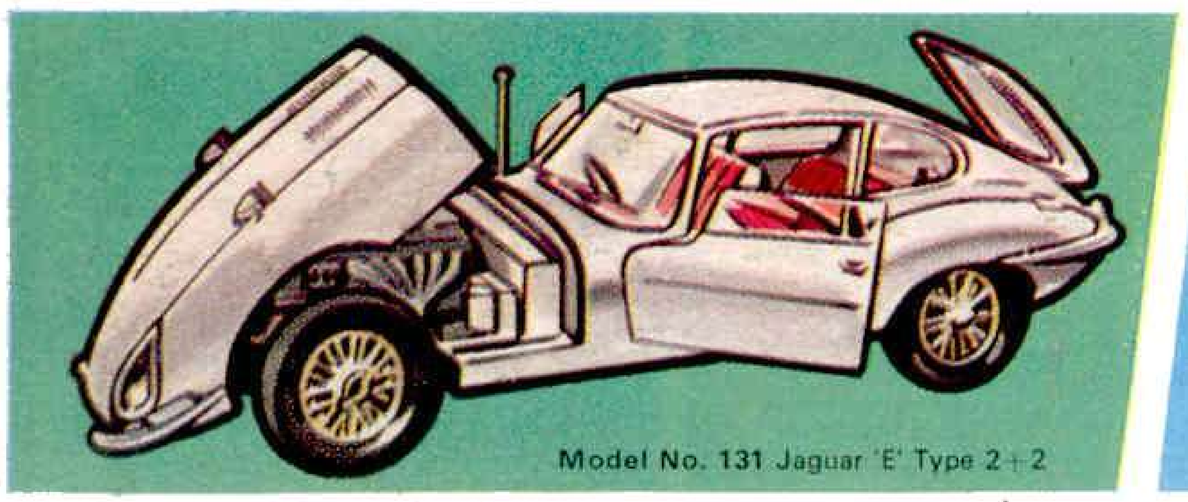

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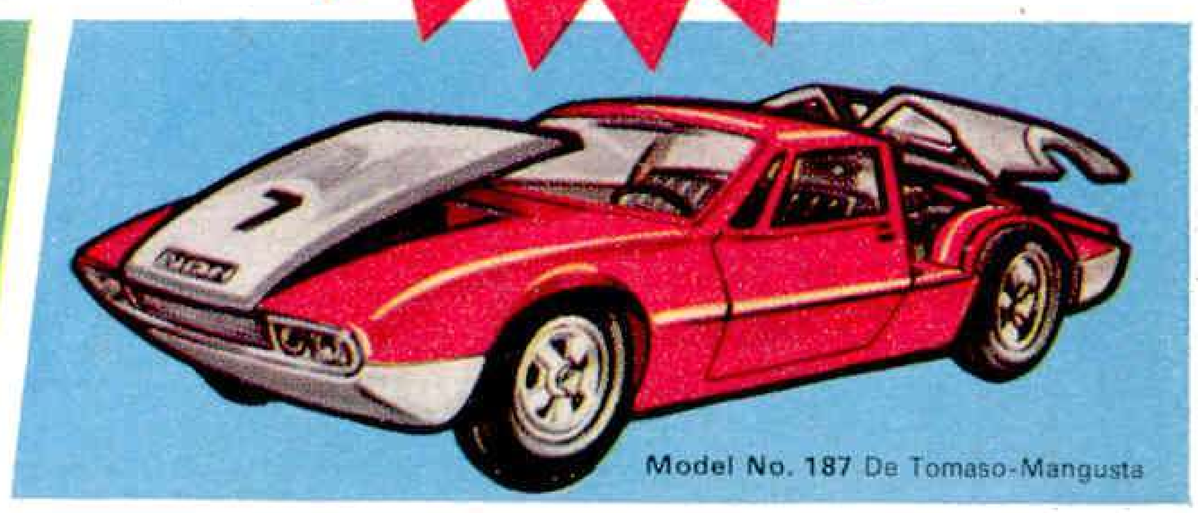

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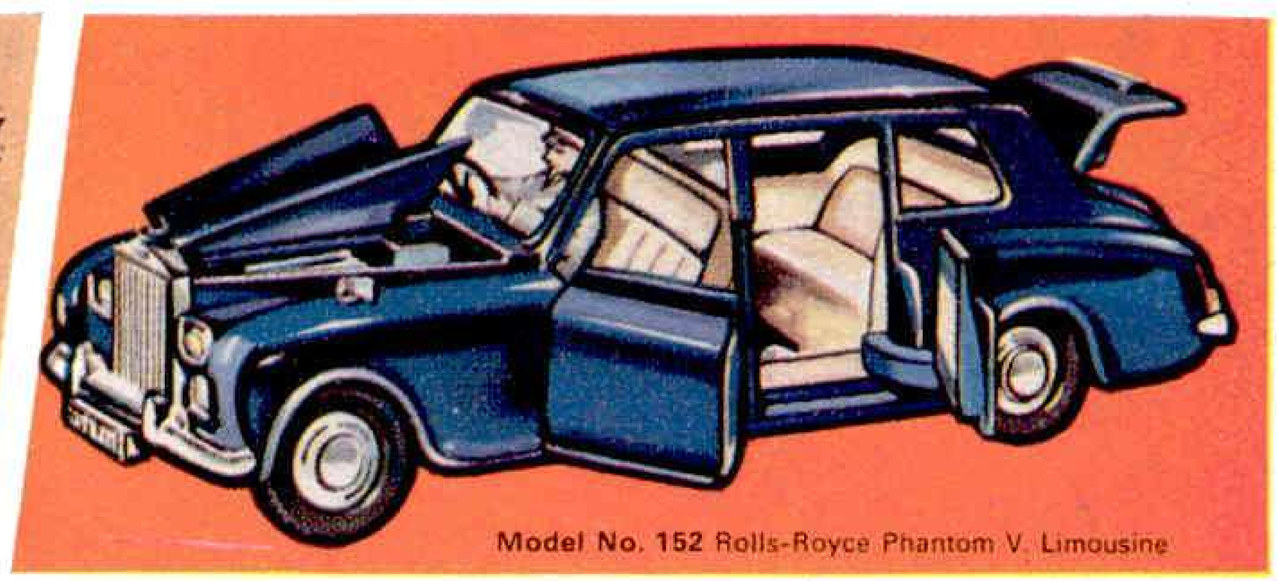

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