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NOVEMBER 1969

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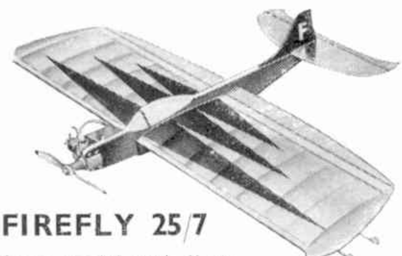

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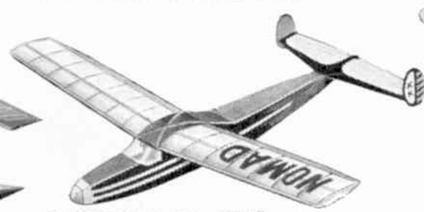

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MECCANO® Magazine

NOVEMBER 1969 VOLUME 54 NUMBER 11
Meccano Magazine, founded 1916.

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MAP HOBBY MAGAZINE

FRONT COVER
Our little "Cracker" is ready! Gordon Blackwell, editorial assistant on *Meccano Magazine* proudly holds our single channel aircraft, built from the plan which forms this month's free supplement, in the "Radio 4-2" series. Details of how to fly the model were included in last month's magazine, so to those of you then undecided whether to have a go or not, we're sure having seen our model in a completed state, that you will waste no more time and get started!

NEXT MONTH
To ensure that the modern motor car is as safe as is practically possible, many car firms deliberately crash-test new vehicles to determine how they would break up. In his feature "Crashing Cars to save lives" Arthur Gaunt looks at this necessary aspect of motor car development and describes just how these tests are made.
Still on a Transport theme Arthur Nettleton describes and illustrates the new breed of motorway transport: the "Gas Turbine Powered Truck" a means of propulsion still in its early stages, but one which is destined to play an increasingly important role in the near future.
For Meccano Enthusiasts, two simple models for the youngsters; a Bridge Laying Tank and a Bulldozer. For the more experienced, a car ramp constructed from a No. 3 outfit, and for the advanced builder an operating live steam tractor. Many other features are naturally included in the issue, plus all the regulars.

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CONTENTS

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Grand Prix
BY
Lambretta

Tension at fever pitch - crowds cheering - bands playing - hooters blaring - loud speakers counting away the seconds - last minute panic in the pits - starter on the rostrum - marshals scatter - up goes the flag - engines roar like angry lions - flag down and the best that the world's engineering brains can create disappear in a haze of smoke and burning rubber. This is real Grand Prix excitement.

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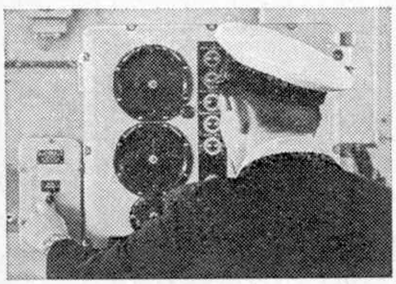

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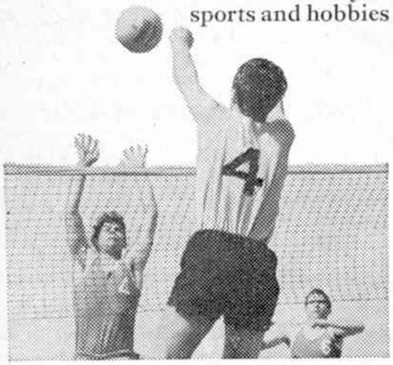

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MAP **The Finest Range of Model Technical Books in the World!**

133 AEROMODELLER ANNUAL 1969–70

This is the 22nd year of continuous publication! Lucky the modeller with a full set! Laurie Bagley has provided a grand cover once again with his R/C scale model Whirlwind in bright yellow livery. To tie in with this Dieter Schlueter's fine article on Model Helicopter Technology. (Dieter was winner of 1st International R/C Helicopter Event—also reported in this Annual), John Burkham, of U.S.A. (who won *their* first 'Copter event), adds comments. Other articles include Tubular Fuselages from Balsa; Contest Model Performance Prediction (not to be taken too seriously!) Beginners Only Please; Facts About Propellers; Glider Construction Suggestions; Navy Carrier Event and What It's All About; Fuel Control. Fifty model plans—all scaled and with main dimensions shown—from the year's best, most interesting, curious, screwball, intriguing, different designs that have appeared in the world's aeromodelling magazines.

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142 BRITISH AIRCRAFT CARRIERS

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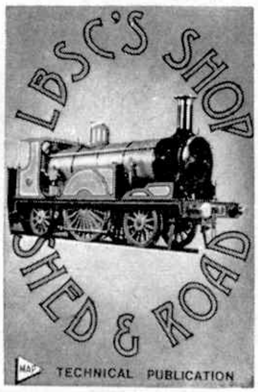

141 LBSC'S SHOPSHED & ROAD

This famous book of LBSC first appeared in 1929 and established him in the forefront of miniature steam locomotive experts for all time. It later appeared under the title of *The Live Steam Book*. We have now reproduced it once again, under the editorship of Martin Evans, with added chapters from "Curly's" later writings, with the diagrams completely redrawn, and with a new set of plates illustrating most of the locomotives that he built over the years. It is a complete course in locomotive building—fit companion to his *Tich* book published last year, and something of a tribute to, and a memento of, a great and much-loved contributor.

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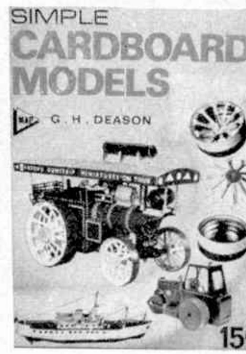
132 SIMPLE CARDBOARD MODELS



G. H. Deason

Originally published under the title of "Cardboard Engineering with Scissors & Paste" this magnificently illustrated book deals with *working* models of Rollers, Road Engines, Ships, Cars, Tracklaying Vehicles, Rail and Tramway models and other working models. Typical of the versatile nature of card are the author's models of *RMS Scillonian* and the *Ruston Bucyrus Excavator*. Suitable for all ages and all skills, for home, school or hobby projects.

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120 INTRODUCTION TO BATTLE GAMING

Author Terence Wise is a master of his subject and introduces the newcomer to the many facets of this fascinating hobby in twelve chapters and numerous appendices. Subjects include Origins of battle gaming; choosing an era; basic field layout, adding realism; organising an army; rules for ancient warfare; rules for horse and musket era; rules for modern warfare; variations of the game; ideas for advanced players; making model soldiers; final touches.

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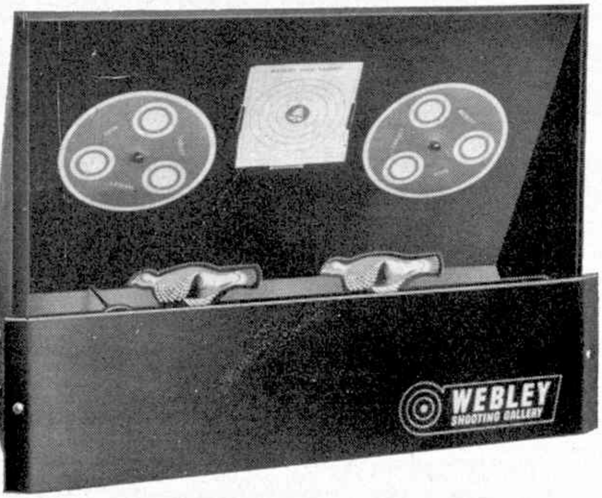

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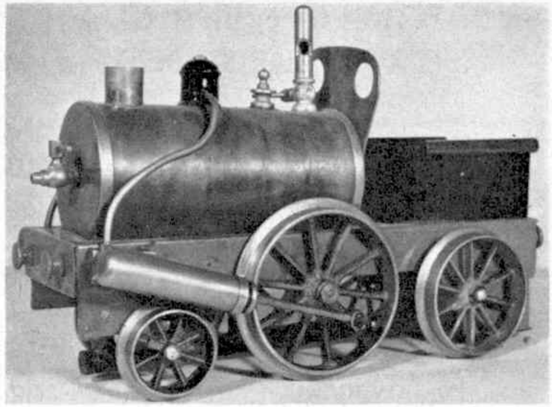

First of a series on Low Relief Modelling by Giles Barnabe. Derby Museum O gauge layout, described by D. A. Bell. Making realistic fishplates for gauge O. Scale drawings of L.S.W.R. coaches by Les Darbyshire. "Baptism of Fire"—the story of an unfortunate antique steam engine by L. W. Bromley. Wagon building in 4 mm. scale using Plastikard.

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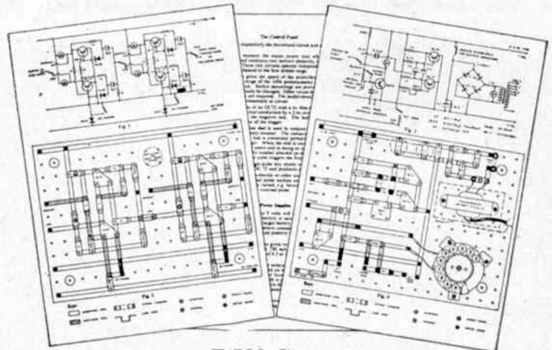

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WORKBENCH

Wildlife Competition

A special class for junior sound recordists has been included this year in the Wildlife Sound Recording Competition organised by the 3M Company, manufacturer of Scotch magnetic tape, in association with the Wildlife Sound Recording Society. Carrying a prize of a Bush TP 60 portable cassette recorder, complete with microphone and carrying case (value 26 gns), plus a supply of Scotch cassettes, the section is open to anyone resident in the British Isles, including Ireland, up to 17 years of age on the contest's closing date November 30, 1969. Any wildlife sounds are eligible providing they are recorded without provocation or disturbance to the subject—which may be a bird, mammal, insect or any other wild and free creature (recordings of domestic animals or pets are not acceptable). There is no limit to the number of recordings that may be submitted, and entry is free. Full details and entry forms are available from W. R. Bowles, 3M Company Ltd., 3M House, Wigmore St, London W1A 1ET.

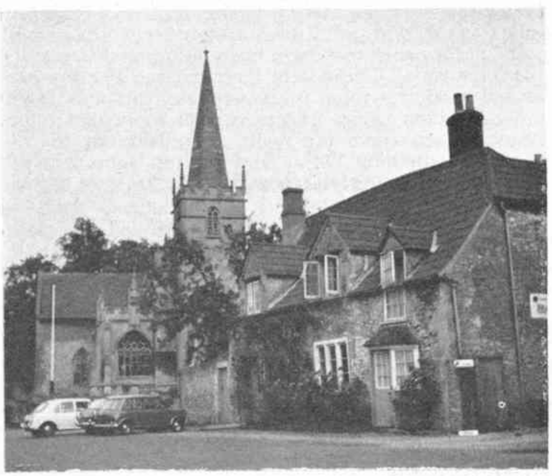
Photography Competition

Last month in Workbench. I stated the fact that closing date for our competition would be the 29th August. Since the publication of that issue we've lost count of the letters from readers protesting at such an early closing date, with the result that we've decided to let our Photography Comp' continue for at least a further two months. The closing date now (all being well!) will be 29th Dec, so carry on sending in your snaps.

Entries for this month's contest have reached a record number. No less than twenty-six readers sent in one or more snaps, and our Judges have been hard pressed to select winners from a very high standard of entries. However, winners had to be chosen, and the best two photographs are reproduced on this page and show very clearly that when it comes to good photographs Meccano Magazine readers are amongst the best.

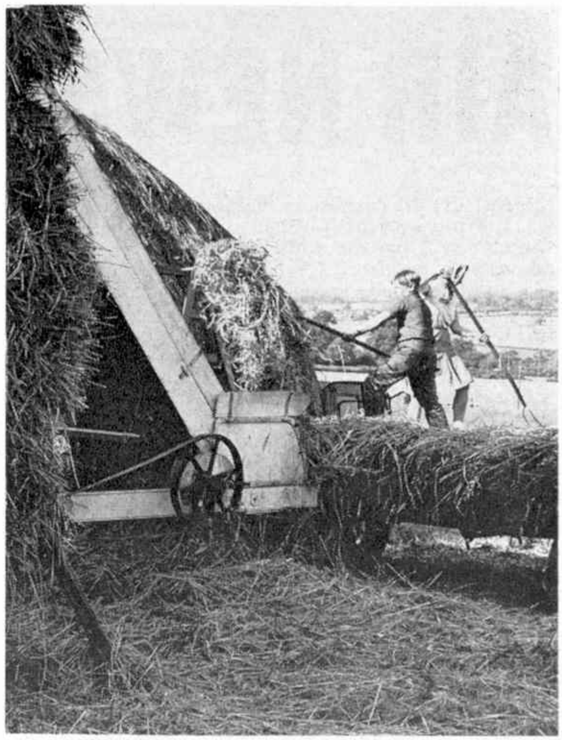
For the interest of those of you who haven't yet entered, full details were published in our June issue on this page.

COMPETITION WINNER
CLASS I



Winner of Class I, this month is Michael Smart of Bristol who took the photograph reproduced above. Runner up in this class was Miss G. Ford of Edinburgh with her entry of a photo of The Custom House at Crail.

COMPETITION WINNER
CLASS II



This magnificent photograph wins £2.2.0 for reader E. Goddard of Ringwold, Hants in Class II. Runner up was James Mackie of Tannay, Switzerland who wins 10/6d for his photograph of a climber taken on Mont Blanc.

Grand Prix

Alert readers will have noticed a new advertisement on Page 533 of this issue, announcing a new Scooter from the Lambretta Company. The scooter referred to is the Grand Prix, and just what it is we're keeping secret for the time being.

Meccano staff have recently had one on loan for test, and our report will appear, under the heading "On Two Wheels" in our January issue, however there is a way to find out more about the machine in question much sooner, just fill in the coupon included in the advertisement and send it to Lambretta, at the moment we're saying nothing!

AIR NEWS

JUMBO'S and TIGERS!

by John W. R. Taylor

SHARP-EYED spotters in the London Heathrow area will probably have caught their first glimpse of a "jumbo-jet" by the time this edition of *Meccano Magazine* is published. Pan American World Airways plan to open a daily service with 362-passenger Boeing 747s between New York, London and Frankfurt on 15 December. Before that, they will almost certainly operate some proving and crew training flights over the route.

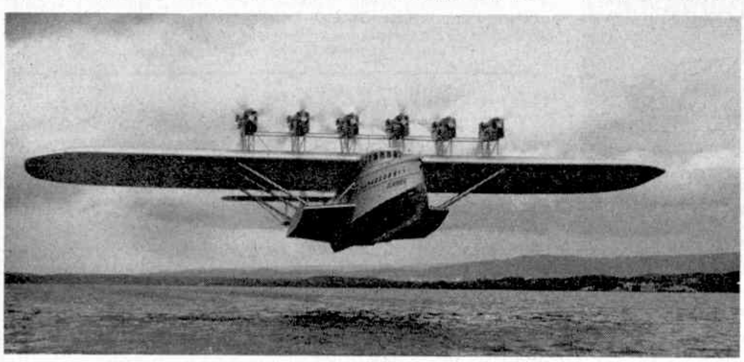
Pan Am was the first airline to order the 747 and will have 25 of these "jumbos" in service by next August, followed by eight more by mid-1971. Before the end of this year, it will be running 42 transatlantic 747 flights each week, with morning and evening flights daily between New York and London and daily services between New York and Paris. Operations across the Pacific, from San Francisco and Los Angeles to Honolulu, will start in January 1970, extending to Tokyo in February and Hong Kong and Bangkok in March. San Juan and Montego Bay in the Caribbean, Bermuda, Lisbon and Barcelona will all be handling "jumbos" by the spring.

It will be interesting to see how the airports at these places cope with the sudden arrival of hundreds of passengers in a single aircraft. At the moment fewer than 100 people disembark from the average big jet-liner; yet there is nothing new in the idea of a passenger-packed "jumbo."

Forty years ago, on 21 October 1929, a Swiss-built Dornier Do X flying-boat took off from Lake Constance for an hour-long flight with 169 persons on board. There should have been 160, made up of ten crew and 150 passengers, but nine stowaways also made the historic trip, which set a record for the greatest number of people to fly in one aircraft up to that time.

The Do X set several other records. With a wing span of 157 ft. 5¾ in., length of 131 ft. 4¾ in. and take-off weight of about 51 tons, it was the biggest aeroplane built up to that time. (By comparison, the Boeing 747 has a span of 195 ft. 8 in., length of 231 ft. 4 in. and weight of 317 tons). Engines were so low-powered in 1929, that the Do X had to be fitted with no fewer than twelve 525 h.p. Siemens Jupiters, in tandem pairs. Even then, it could climb to a height of only 1,375 ft. with a full load, and cruise at 108 m.p.h.

Its performance may have been unimpressive, but its interior wasn't. There were three decks. The top one housed a control room for two pilots, captain's cabin and navigation room, engine control room and radio cabin. Then came the main deck, laid out for 66 passengers on long flights and 100 on shorter trips. They sat in comfortable armchairs, in roomy cabins,



Our heading photograph shows one of the Canadian Air Force *Tigers*. Left: The Swiss-built *Dornier Do X* flying boat pictured 40 years ago taking off from Lake Constance. Top right: The Pan-American *Boeing 747*, America's new "Jumbo" aircraft. Bottom right: Unloading cars from a mock-up of the *DC-9* jet-liner.

with flowered wallpaper, carpets, tables, curtains at the windows and full galley service. The lower deck housed stores and freight, as well as tanks for more than 3,500 gallons of petrol.

Originally, the Do X had an auxiliary top wing, just below the pylon-mounted engine nacelles. After a time this was removed to save weight, and the engines were changed for twelve 600 h.p. Curtiss Conquerors. This raised the ceiling to over 1,600 ft. and the Do X was considered good enough to tackle a transatlantic flight, which was still quite an adventure at that period.

Leaving Friedrichshafen on 2 November 1930, the big flying-boat cruised majestically to Amsterdam and on to Calshot, where it was piloted for ten minutes by H.R.H. the Prince of Wales (now the Duke of Windsor). But the rest of the trip was less successful. At Lisbon the wing was damaged by fire; during take-off at the Canary Islands the hull was damaged. So it was not until 27 August 1931 that the Do X alighted in New York, after visiting Rio de Janeiro.

The prototype Do X ended up in the German Air Museum in Berlin, where it was destroyed in a wartime bombing raid. Two more, with 550 h.p. Fiat engines, were built for the Italian airline SANA in 1931, but never entered passenger service and were eventually dismantled.

EXPORTING CARS BY AIR

Britain pioneered the carrying of motor cars by air on a regular basis when Silver City Airways made their first vehicle ferry flights over the English Channel in July 1948. The sturdy old Bristol Freighters used for the service offered such low fares that soon they were carrying thousands of export cars each year as well as those belonging to holidaymakers and businessmen. But few car manufacturers have yet considered seriously the possibility of air-freighting their products over the Atlantic.

Lockheed Aircraft Corporation believe that all this will change if their L-500 freight-plane enters airline service. Bigger than a Boeing 747, with a payload of over 140 tons, this is a civil version of the USAF's C-5A Galaxy, the largest aeroplane ever flown.

In a recent demonstration at its Atlanta, Georgia, factory, using a Galaxy mock-up fuselage, Lockheed showed how the L-500 could carry 52 'king-size' American cars in two rows, each three cars deep, inside its enormous cargo-hold. Up to 120 smaller cars, like the British Triumph Herald, would pack into the same space, offering a quick and economical way of shipping European export vehicles to the States.

BEWARE OF THE AEROPLANES!

Back in the 1920's, London's airport at Croydon boasted the first level crossing for aeroplanes. The hangars were on one side of Plough Lane and the airfield on the other side. Whenever an airliner taxied between the two, a gate was closed to stop all road traffic.

Such goings-on seemed to be part of aviation's early years, before everything became organised and highly professional. It was, therefore, quite a surprise to receive a photograph from McDonnell Douglas Corporation showing their 500th DC-9 jet-liner being towed across the main Lakewood Boulevard in Long Beach, California, with the traffic halted by red lights.

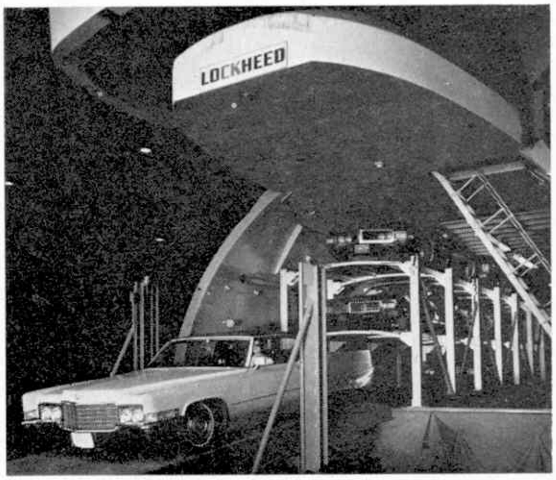
During the day, this Boulevard bustles with speeding cars and lorries. Fortunately for Douglas, who have to move their aircraft across the road from the assembly 'shops to the flying field, Lakewood carries very little traffic at night. So, the DC-9's make the crossing in the early morning hours—causing little inconvenience except, perhaps, to midnight revellers trying to explain that they are late home because they were held up by a jet airliner on Lakewood Boulevard.

TIGERS IN BRITAIN!

Since 1969, the nine Tiger squadrons of the North Atlantic Treaty Organisation have held an annual gathering with the objective of maintaining a close degree of co-operation. This year it was held at R.A.F. Woodbridge, Suffolk, between August 4th and 8th, the host being the 79th Tactical Fighter Squadron U.S.A.F., based at Woodbridge. Six other Tiger squadrons were represented, including 21 Sqn., Italian Air Force, Cameri; 31 Sqn., Belgian Air Force, Kleine Brogel; AG52, German Air Force, Leck, West Germany; 431 Staffel, German Air Force, Oldenburg; 439 Sqn., Canadian Armed Forces, Lahr, West Germany; and the 53rd Tactical Fighter Squardon, U.S.A.F., Bitburg. The French and British Tiger squadrons were unable to attend this year.

During the meet, pilots and ground crews are able to discuss common problems, fly several sorties on a team basis and then terminate the week with a public display of their prowess. One of this year's attractions included the oldest Tiger Moth (G-ACDC): one of this year's surprises was a Canadian CF-104 which sported yellow and black tiger stripes overall, as well as a tiger's head below the cockpit.

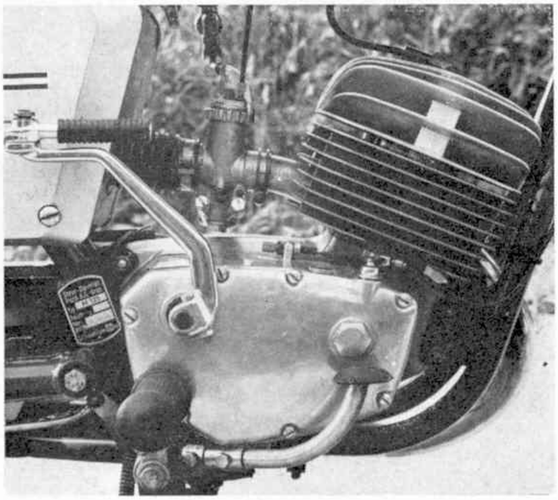
It seems that the Canadian pilots were kept well occupied while, at the dead of night, the remainder of the aircrew suitably "decorated" their colleague's aircraft: its striking appearance may be seen in the heading picture.



ON TWO WHEELS

Meccano Staff test Scooters, Mopeds, and Motorcycles

THERE CAN BE no doubt about it: the Puch M125 is decidedly an enthusiast's machine. Clean sharp lines, a freedom of any gadgets, and sparkling



Above: Offside view of the *Puch Powerhouse*. The kickstart was positioned rather high on the engine: shorter riders may find this rather awkward. Below, right: Attention to finish is the keynote throughout, the clean lines of the rear end of the machine back this up.

performance make this, the first proper motorcycle in the series, a true sports machine. For its modest engine capacity (125 ccs), acceleration and top speed are remarkable. From a standing start 40 mph is reached in 7 seconds and 60 mph in 15 seconds. Top speed is around the 70 mph mark.

For everyday use the M125 is happy at low speeds as encountered when driving in the town, although it is far happier on the open road. Flooding the carburettor with the tickler and depressing the semi-automatic choke, followed by a firm prod on the kick starter soon had the Puch's powerful engine running.

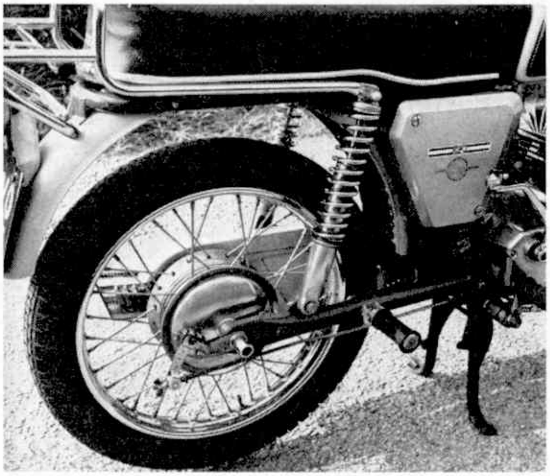
Roadholding is superb under all conditions, and bringing the bike to rest is rapidly achieved using the excellent brakes. Carrying a passenger surprisingly made far less difference to the performance than we at first anticipated, and the very long dual seat still left enough room for the rider to change his riding position on a longish journey.

Controls are simple and well laid out. The clutch is operated by the left hand, and is smooth and light in operation. A small switch controls the lighting on/off, dip/main beam and engine cut-out. Lighting from the sealed beam headlamp unit is excellent, a wide penetrating beam on main, which is sharply cut off when the dip switch is operated. The speedometer unit (mounted in the headlamp top) is illuminated, but could do with being brighter. On top of the lighting switch is the horn button, operating a pathetically weak sounding device located under the headlamp unit! The right hand controls the throttle and front brake.

The Bodywork

As we stated earlier, the M125 is a very clean looking machine. The general styling of the bike is excellent, its tidy lines accounting much for the overall attractive appearance. The frame is finished in red and the remainder mudguards, tank, toolbox, etc., in metallic grey. The paint finish is to a very high standard.

The tank (holding 2 gallons) gives a cruising range of approximately 130 miles including reserve, and has a large filler cap with an oil measuring device on its underside. The dual seat is exceedingly comfortable and long: in fact almost long enough to seat three



people. A large box device situated under the front end of the dual seat contains in its centre, the air cleaner, and on either side space is provided for tools, etc. One lid at each end provides access to these.

The Engine

Large cooling fins radiating outwards on the cylinder head, rather like a fan, are the most distinguishing feature of the engine, and help to create the impression that it is far larger than it really is. The engine unit itself is rather noisy, and whines at approximately 65 mph in top gear, but this is perhaps a small price to pay for its remarkable power. The carburettor is situated immediately behind the cylinder barrel, and is fitted with a semi-automatic choke. The unit started normally on the first kick from the kickstart, which incidentally was rather awkward to operate due to its height and position. The large sports type silencer could be better; on hard acceleration the resultant noise was excessive.

The complete engine unit is very tidy and free from the normal wiring and exposed nuts and bolts found on most motorcycles, in fact, it looks at first glance to

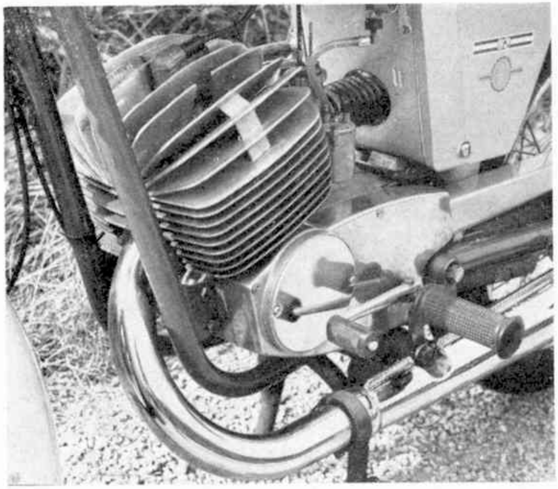
be incomplete! The crankcase is well finished in polished alloy.

The Gearbox

The four speed gearbox, operated by the left foot is first class. It is light in operation and the gear lever is well situated for easy operation. The gearbox " feel " is good and positive, although finding neutral calls for some delicate prodding.

FOR THE TECHNICALLY MINDED

Cubic Capacity:	**123.5 cc**
Maximum power:	**12 bhp at 7,000 r.p.m.**
Consumption (per gal.):	**75 miles**
Weight:	**211 lbs**
Gear Ratios	**1st—23.36 : 1**
	2nd—13.47 : 1
	3rd—8.98 : 1
	4th—7.19 : 1
Tyres:	**Front 2.50 × 17 ins**
	Rear 3.00 × 17 ins
Common dimensions:	**Length 74 in.; width 24 in.; wheelbase 48 in.; weight 211 lbs.**
Available colours:	**Red and silver.**



Above: Freedom from ugly wiring is evident, particularly on the engine unit. Note the large cooling fins.

Opposite: Sleek, fast and sturdy, sum up the *Puch M*.125.

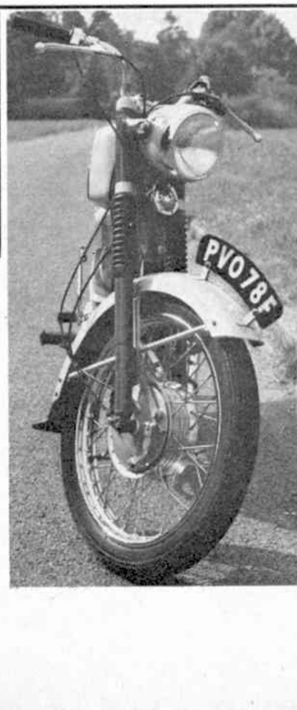
Summary

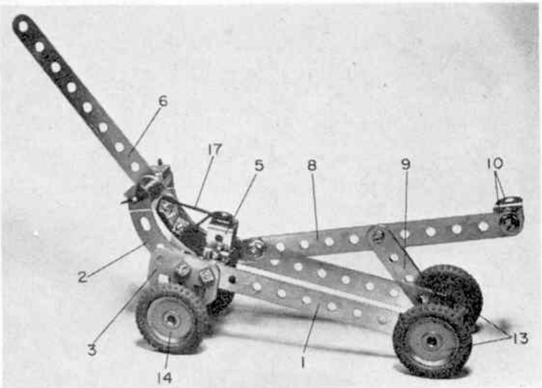
For the youngster who wants his machine to be rather more than a means of getting to work the M125 has a great deal to commend it. Good looks, performance and power with low tax and insurance plus reliability, (this same machine was taken on a test ride to Austria and back last year without trouble) put it well to the front for serious consideration. Without exception we liked it. The only criticisms were its noisy exhaust, and almost noiseless horn !

Price of the Puch M125, including purchase tax is £179.19.0.

Accessories

Carrier £3.5.0.





HEAVY DUTY JACK

DESCRIBED BY "SPANNER"

CAR-OWNERS, the world over, would be the first to agree that one of their most essential motoring tools is the car jack. We are all familiar with the small screw-type and hydraulic-type jacks carried by the majority of motorists, but such small examples are not of course the only types of jacks used in the motoring world. Far more popular with garages, for instance, is the trolley jack—a heavy-duty hydraulic unit incorporating its own set of wheels to enable it to be moved easily and positioned with the minimum amount of trouble. Illustrated here is a simple Meccano model, based on a trolley jack, which was the idea of M.M. reader D. H. Ellison of Warrington.

The model does not actually operate hydraulically, as hydraulics are not included in the Meccano system, but it does work rather well on a lever principle. As Mr. Ellison himself writes, " After several experiments with car jack designs, I arrived at the type shown in the photographs as the most successful. It was easy to build, fairly small in scale and, most important of all, it worked."

Having built up the model myself, I can confirm Mr. Ellison's comments, particularly the one about it being easy to build. The chassis consists of two similar members, each built up from a 5½ in. Strip 1 extended at one end by a 2½ in. Stepped Curved Strip 2, the securing Bolts also fixing a Flat Trunnion 3 to the outside of the Strip and an Angle Bracket 4 to the inside of the Strip. The two members are joined by two ½ in. Reversed Angle Brackets 5, bolted together and to Angle Brackets 4.

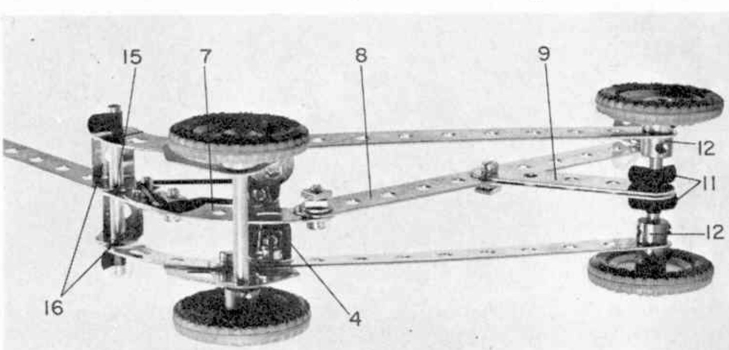
In the case of the lever unit, a 5½ in. Strip 6 is extended three holes by a 2½ in. Stepped Curved Strip 7, to the end of which another 5½ in. Strip 8 is lock-nutted. The connection must allow the Strip and Curved Strip to hinge, but not too loosely and it is advisable to position a Washer beneath the fixing bolthead and another beneath the lock-nuts. Lock-nutted through the sixth hole of Strip 8 are two 2½ in. Strips 9, while two Angle Brackets 10 are fixed to the end of the Strip.

Now journalled in the forward ends of Strips 1 and the free end holes of Strips 9 is a 2 in. Rod carrying two Spring Clips 11 and two Collars 12, the Rod being held in place by two 1 in. fixed Pulleys with Motor Tyres 13. Note that the Spring Clips are positioned one each side of Strips 9, while each Strip 1 is held between one of the Collars and the respective 1 in. Pulley with Tyre. Two further 1 in. Pulleys with Motor Tyres 14 are mounted on the ends of another 2 in. Rod journalled in the apex holes of Flat Trunnions 3.

PARTS REQUIRED

4—2	3—17	10—37b	2—111c
2—5	4—22	3—38	2—125
2—11	4—35	2—59	2—126a
4—12	14—37a	3—90a	4—142c
			1—186

Last of all, Strip 6 is pivotally mounted on a final 2 in. Rod 15 held by Spring Clips in the end holes of Curved Strips 2, two Double Brackets 16 also being mounted on the Rod to hold Strip 6 in a central position. The Rod passes through the ninth hole from the upper end of the Strip. This Strip, by the way, serves as the jack handle and movement of it controls the movement of the lifting " table " supplied by Angle Brackets 10. The knuckle action of the handle is assisted by a 2½ in. Driving Band 17 hooked over the head of the Bolt joining Reversed Angle Brackets 5 and the shanks of the Bolts joining Strip 6 to Stepped Curved Strip 7, as shown.



Above: A simple Trolley Jack designed by M.M. reader D. H. Ellison of Warrington, Lancs., for use with Meccano motor vehicles.

Left: An underside view of the jack showing the layout of the axle assemblies.

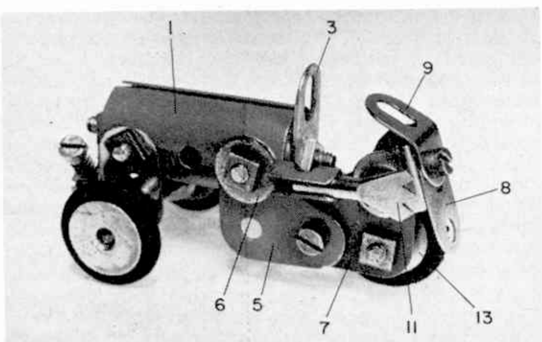
AMONG THE MODEL BUILDERS

with "SPANNER"

IN THIS article it is customary to steer clear of complete models and deal more with mechanisms, hints, suggestions and matters of general interest to modellers. I have long thought, however, that life would be pretty dull if everyone always followed custom implicity, without breaking away from "the usual", at least on odd occasions, and so this month I make no apologies for featuring in full the delightful little "simplicity" model illustrated here. Vaguely reminiscent of the old Morgan 3-wheeler, it was sent to me by Roger Le Rolland of Stoke-on-Trent, whose Steam Carriage is described elsewhere in this issue, and it appealed to me immediately. These tiny little models, built with the smallest possible number of parts, always do, you know!

It consists of a Sleeve Piece 1, in each end of which a Chimney Adaptor is fixed by Nuts on a 1 in. Screwed Rod, each Adaptor first having bolted to it a Fishplate

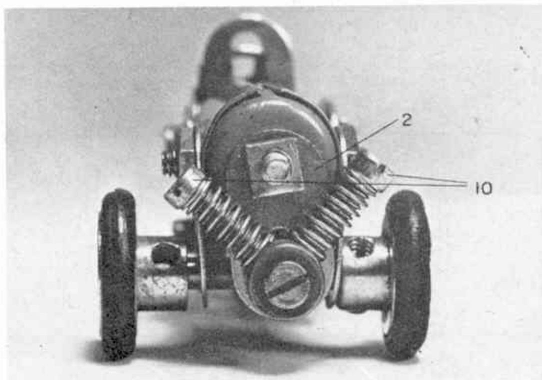
Below: A delightful little "simplicity" model, reminiscent of the old Morgan 3-wheeler, designed by Roger Le Rolland of Stoke-on-Trent.



2 or 3, as the case might be. Note that the front Fishplate 2 points vertically downwards, while that at the rear points vertically upwards to represent the windscreen.

Held by the Nuts fixing the front Adaptor to the Sleeve Piece are two more Fishplates 4, whereas the Nuts fixing the rear Adaptor hold two 1 in. Corner Brackets 5, the left-hand Nut also holding a Rod and Strip Connector 6 in place. Bolted to each Corner Bracket 5, but spaced from it by a Washer on the shank of the securing Bolt, is another 1 in. Corner Bracket 7, these Brackets at each side being joined through their upper holes by a Double Bracket, to the back of which a Fishplate 8 and an Obtuse Angle Bracket 9 are bolted.

Now fixed to the lower end of Fishplate 2 is the

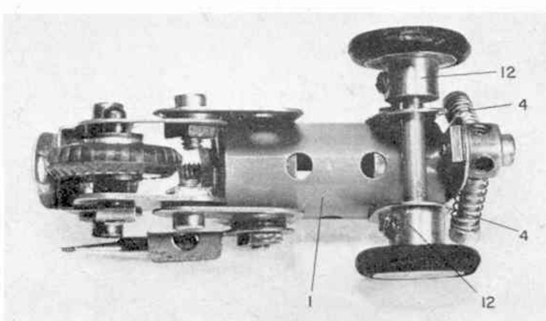


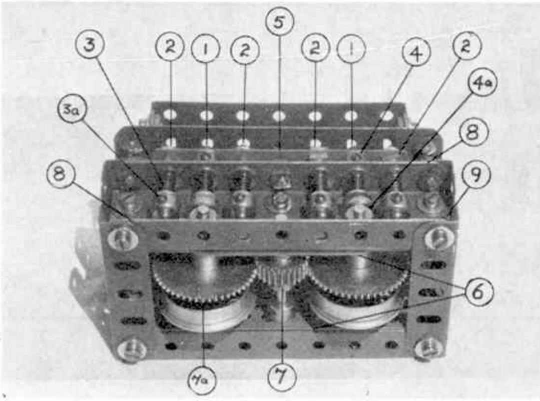
"spider" from a Universal Coupling, in adjacent holes of which are screwed two $\frac{1}{2}$ in. Bolts 10, each carrying a Compression Spring on its shank. These Bolts, with their Springs, represent the engine cylinders, an exhaust pipe subsequently being represented by a Centre Fork 11, held in Rod and Strip Connector 6.

Finally, the wheels are fitted, those at the front consisting of $\frac{1}{2}$ in. Pulleys with boss 12, mounted on a $1\frac{1}{2}$ in. Rod journalled in the free holes of Fishplates 4, while the single rear wheel is a $\frac{1}{2}$ in. Pulley without boss 13 mounted, along with three spacing Washers, on a Threaded Pin fixed in left-hand Corner Bracket 7. If available, suitable Dinky Toy tyres should be fitted to all the Pulleys to improve realism.

Above: The famous V-2 motor cycle engine at the front of the car is realistically represented by Compression Springs mounted on Bolts. The tyres are off an old Dinky Toy.

Below: An underside view of the 3-wheeler showing the wheel arrangement. Note the use of a Threaded Pin for the rear axle.





A heavy-duty Crane Bogie designed by Swiss reader Ulysse Bachelard of Zurich. It is best used as one of a pair under operating conditions.

PARTS REQUIRED

5—10	2—23d	2—82	1—140y
1—11	13—37a	2—111a	1—163
1—12c	7—37b	1—111c	2—164
1—18a	5—38	2—120b	1—212
1—23	1—65	4—133a	3—Dinky Toy Tyres

Crane Bogies

Returning, now, to true mechanisms, we have a couple of extremely interesting items which advanced crane-builders will find invaluable—a pair of heavy-duty crane bogies designed by Ulysse Bachelard of Zurich, Switzerland. The units are first class and a credit to Mr. Bachelard's skill, but, as Mr. Bachelard cannot speak English, my thanks also go to Bert Love, Secretary of the Midlands Meccano Guild, for supplying me with the following descriptions of the bogies as well as the accompanying photographs.

Both bogies are fully sprung with helical springs and they exploit to very good advantage the elongated holes which are found in Angle Girders and Flat Girders. This principle has been utilised in previous Meccano mechanisms, of course, but their combination with helical or coil springs is somewhat unique. The first mechanism is a two-wheeled unit, which is best used as one of a pair, joined by a sturdy cross member at the base of a dockside crane. General construction is apparent from the illustration and consists of 4½ in. Angle Girders for the framework, these being cross-joined by 2½ in. Angle Girders. The essential feature of this type of suspension lies in the equalising beams which consist of 3½ in. Narrow Strips 5, which are mounted on both sides of the bogie and which carry four Long Threaded Pins 2, lock-nutted to the Narrow Strips. Each Threaded Pin passes down through the top of the upper Angle Girder 8 and is then fitted with a Compression Spring 3 sandwiched between two Washers, which are held in place by a Collar 3a at the end of each Threaded Pin. Both driven Gears, carried on 2½ in. Axle Rods, mesh with a ¾ in. Pinion 7 which, in turn, is driven by a ¾ in. Contrate Wheel mounted on a vertical shaft, not shown. Each of the two 50-teeth Gears 7a, together with its associated Flanged Wheel, serves to hold its Rod in place, the external Collars 4a being loose, as they form pivot bearings for the last section of the suspension. Each Narrow Strip 5 receives two more Threaded Pins 1 which are screwed into the floating Collars 4a at the end of the Axle Rods. Again, each Threaded Pin carries a Compression Spring sandwiched between two Washers, but, in this case, each Threaded Pin is spaced with two Washers before being screwed into the Floating Collars 4a to prevent the axles from binding. The upper ends of Threaded Pins 1 carry thrust Collars 4 which bear against Narrow Strip 5, being spaced from it by one Washer.

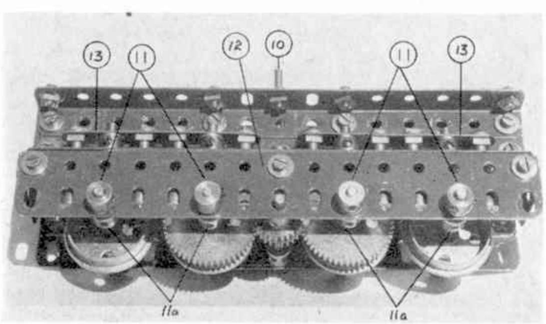
Construction of the lower parts of the bogie is very important since it relies upon accurate location of slotted holes in a pair of 4½ in. Flat Girders 9, bolted at each side of the bogie frame to a pair of 4½ in. Angle Girders 8. It is important to make sure that all elongations match up exactly so that the two Axle Rods carrying the Flanged Wheels may ride vertically under load. To maintain constant mesh between the Driving Pinion 7 and the two 50-teeth Gear Wheels, 7a, they are linked via a pair of 2½ in. Perforated Strips 6 which are also free to ride up and down the movement of the suspension. The upper portion of the bogie is reinforced by further 4½ in. Angle Girders, joined by 2½ in. Angle Girders, while a 3½ × 2½ in. Flanged Plate forms the top of the bogie at the same time providing a bearing for the central drive shaft. This drive shaft, which carries a ¾ in. Contrate Wheel, is also provided with a Compression Spring to keep the Contrate in constant mesh with Pinion 7 under all suspension conditions. In each case, the Compression Springs may be "doubled up" for additional load carrying.

In the case of the second bogie, the overall width has been reduced to 1½ in. from the first unit's 2½ in. width, but the equalising beams are doubled, being supplied by two 3 in. Narrow Strips, 13, in which the arrangement of Long Threaded Pins can be clearly seen. All suspension units are mounted internally and location of the Flanged Wheels and Gear Wheels are obtained by external Collars 11. The internal Collars 11a on each Axle Rod form the floating bearings as employed in the smaller unit.

In the accompanying illustration, the floating action provided by the elongated holes in the 7½ in. Flat Girders is evident and, again, the gearing at the centre—which drives the inner two wheels only—is linked by a pair of 2½ in. Perforated Strips. The Drive Shaft 10 is also mounted vertically as before, and passes on the travelling motion via a ¾ in. Contrate Wheel to the ¾ in. Pinion in the centre.

Either of Mr. Bachelard's travelling bogies is suitable for many of the wide variety of dockside cranes or other

Another heavy-duty Crane Bogie from Mr. Ulysse Bachelard, this one longer, but considerably narrower than the first example.



rail-mounted heavy equipment. In fact, it will be of interest to older Meccano readers to learn that the early and very heavy Titan Blocksetting Cranes employed a similar system of suspension over a large number of travelling wheels which were individually sprung by large and heavy coil springs. Unfortunately, no parts lists for the mechanisms are available as Mr. Love only managed to photograph them and make some notes during a recent visit he received from Mr. Bachelard. He did not have time to list the parts used in them, therefore we must do without on this occasion —Sorry !

New Meccano Club

Before closing, this month, I am pleased to report the formation of another new Meccano Club, the Stevenage Meccano Club, founded in mid-year by Mr. Dennis G. Higginson of 7 Buckthorn Avenue, Stevenage, Herts. At the time of writing, membership includes Andrew Oumey, Mark Lawrence, Graham Dulley, Kevin Taylor, Gary Artis, Peter Walton and Peter Brown, all of Stevenage New Town, plus Mr. Higginson's nephews Terry and Michael Higginson, of Martins Wood in Hertfordshire. Members meet for model-building and discussions at the above address, which is the present headquarters of the Club, and Mr. Higginson reports the keen interest of all in both the Club and the hobby. New members are welcome and Mr. Higginson will be pleased to hear from anybody interested in joining. We on Meccano Magazine wish the Club every success and all the members years of enjoyment.

LIGHTS AT SEA

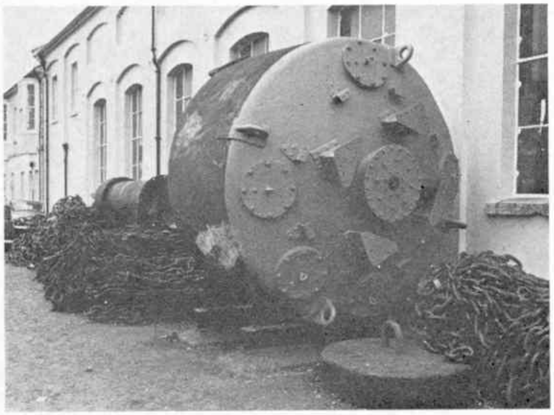
by Edith Harper

MOST TRAVELLERS on land like to have well lit roads at night to help them on their way but for those travelling at sea, lights can mean danger.

Well out at sea, darkness usually means safety, with no fear of collision or stricking rocks etc. Once nearer the coast however, when odd lights stabbing the darkness mean that hidden perils exist, rocks, sand banks, submerged wrecks can all bring disaster to shipping and often did so before warning lights were placed nearby.

In olden days monks often kept beacon fires or lights burning on dangerous stretches of coast. This they did as an act of good faith to help others but there was no systematic warning and many ships were lost.

Henry VIII was a practical man and in many ways a wise King. He decided to start an organisation to set up regulated warning lights to help sailors and those at sea.



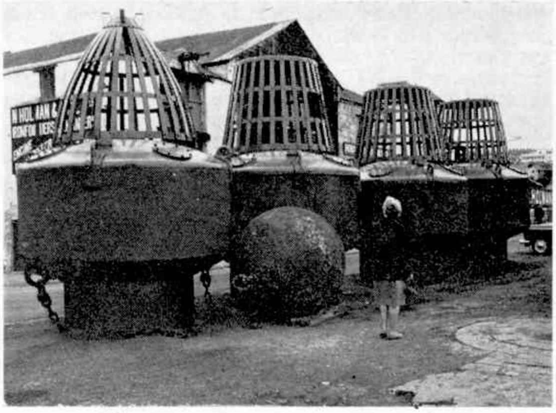
Above: There's nothing temporary about a Lighthouse. Types such as the Eddystone one are immensely strong and built to last for many years. Opposite: All Penzance depot buoys are overhauled prior to re-siting.

He not only did so but did so " in the name of the Holy Trinity". In time this became shortened to Trinity House and today Trinity House is the headquarters of the Trinity House Brethren, whose chief function is " the safety and well-being of the mariner."

Naturally the Brethren are specially picked men with wide experience of ships and life at sea. Their powers cover a wide area. In fact, most of the chief sea routes are guarded by British lighthouses or lightships.

Modern lighthouses have advanced considerably since early days. An ancient Roman Pharos or light tower can still be seen at Dover on the cliffs by Dover Castle. Modern examples such as the Needles Lighthouse and Eddystone have been built and re-built over the years but the chief function of any such edifice is the light.

Trinity House has nearly 90 lighthouses and lightships under its control. Electricity and vaporised oil-burners have replaced earlier forms of lighting, such as



Above: Not all Lighthouses are out at sea, as the photograph of Southsea Lighthouse shows.

Upper right: The size of these buoys can be judged by comparison with the woman in the foreground.

Below: At sea in all weathers necessitates the use for the immense chain used to anchor them by.

Below right: The cage at the top of buoy can be used as a refuge by anyone unfortunate enough to be in trouble and have to leave a sinking boat.

coal, wood or candles. The most up to date lights have devices to make sure that even if certain parts cease to function, the light will still send out its warning beam.

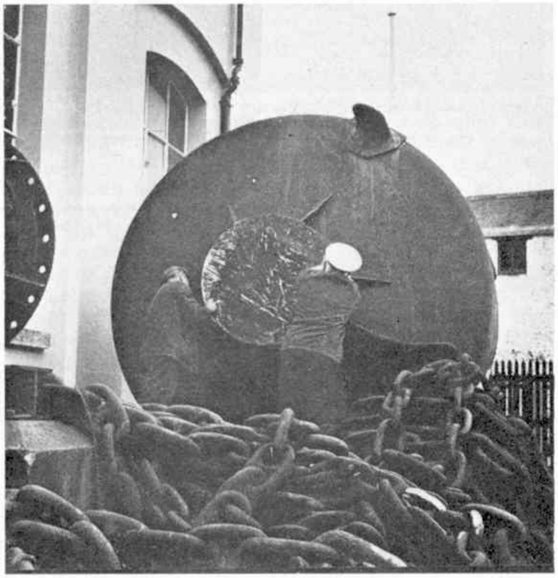
Every light works to a different pattern of beams, flashing and turning at set intervals. The pattern of the Eddystone Light is 0.3 seconds flash, 2.2 seconds dark, 0.3 seconds flash, 7.2 dark. By this means the navigator at sea can tell which lighthouse he is near and set his course accordingly. Though the actual light may be small, possibly the size of a football, powerful lenses through which it passes magnify the beam to reach miles out to sea. Today, glass lenses are sometimes replaced by plastic ones which are cheaper. This is one result of constant research carried out by Trinity House.

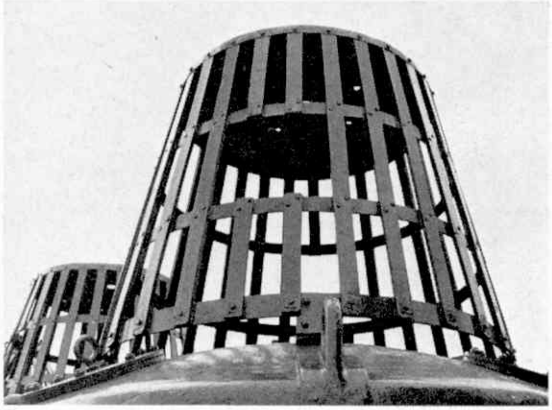
As well as a beam of light, during fog, the lighthouse booms out its fog signal too and is equipped with the latest radar and radio arrangements.

We have progressed from the days, not so very long ago, when it was not unknown on some coasts, for false lights to lure ships on to the rocks where waiting parties of ' wreckers ' looted and sometimes killed.

Lightships are moored near dangerous spots and are usually painted red. The first British light vessel was on duty in 1732 at the Nore. They can be as big as 600 tons, are usually steel built and carry their electrically worked light on a central ' mast ' or trestle column. A pendulum system ensures the light shining steadily, no matter how much the ship rolls.

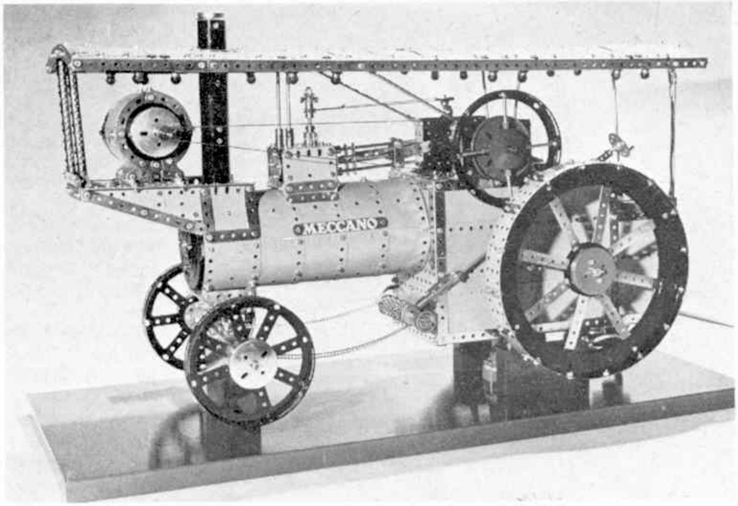
All round our coasts, lights from lighthouses and buoys burn to guide the sailor and give his ship safe passage—thanks to the Brethren of Trinity House.





AT LAST!

Meccano Ltd's much requested display model described for readers by 'SPANNER'



THE SHOWMAN'S ENGINE

EVER SINCE we showed it on the front cover of the very first issue of the new M.M. way back in January, 1968, readers have asked for details. Modellers at large have seen it in dealers' windows and have asked for details. Even people who have not seen it have asked for details. Details of what? The large Showman's Traction Engine produced for display by Meccano Limited in Liverpool.

Meccano Limited, at their factory in Liverpool, have a special Model-building Department with a small but expert staff whose primary function is to produce a set range of interesting models exclusively for dealer display purposes. The Traction Engine is one of the models in the range—one of the most successful, which is no doubt why we have had so many requests for building instructions, but we have been unable to oblige. The problem is that all the display models are copied direct from original models used as patterns, and because of this, printed building instructions or plans are unnecessary therefore none have ever been prepared—until now, that is. In view of the continued interest in the Traction Engine we have at last written building instructions specially for Meccano Magazine and the first part of these appears here. Lack of space prohibits us from printing the complete instructions in one issue, however, and so they will be concluded next month.

The model, itself, is big—some 2½ ft. long by 1¼ ft. high by 1 ft. wide—but it is not really complicated. In fact, if built in the sections produced by Meccano's Model Department staff, it is not difficult at all.

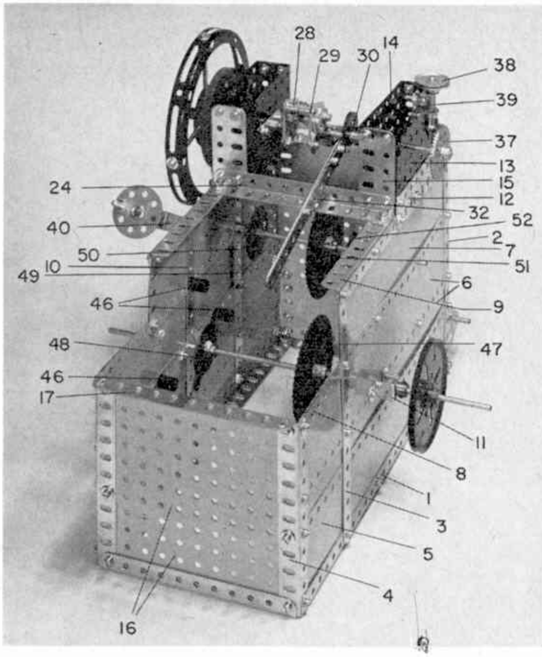
Body

The body section is perhaps the most complex part of the whole Traction Engine to build as it incorporates the crankshaft, but it still does not qualify as being particularly difficult. Each side consists of a 12½ in. Angle Girder 1, to which are bolted in the positions shown, a 7½ in. Angle Girder 2, a 7½ in. Strip 3 and a 5½ in. Angle Girder 4, the securing Bolts fixing a 12½ × 2½ in. Strip Plate 5 in place. Two similar Strip Plates 6 and a 9½ × 2½ in. Strip Plate 7 are added to enclose the side then a 3½ in. Strip 8 is bolted between Strip 3 and the top of Girder 4, while a 9½ in. Angle Girder 9 is bolted between the top of Strip 3 and the top of Girder 2.

Inside the Plates, another 7½ in. Strip 10 is secured between the sixth hole from the rear end of Girder 9 and the corresponding hole of Girder 1. The ninth hole from the top of this Strip will later serve as one of the bearings for the main axle of the model, an additional bearing being supplied by a Double Bent Strip 11, bolted to the outside of upper Plate 6.

Attached by a 3½ in. Flat Girder 12 to Girder 9 is a 3½ × 2½ in. Flanged Plate 13, to the flanges of which a similar Flanged Plate 14 is secured by 2½ in. Flat Girders 15. Both sides of the body are then joined together, this being effected at the rear by two 5½ × 3½ in. Flat Plates 16, overlapped three holes, and a 5½ in. Angle Girder 17, all bolted between Angle Girders 4. At the front, the sides are joined by another 5½ in. Angle Girder 18, a 5½ × 2½ in. Flexible Plate, a 5½ × 3½ in. Flat Plate 19, another 5½ × 2½ in. Flexible Plate, to the lower edge of which a 4½ in. Strip 20 is attached by Rod Sockets 21, and a 5½ in. Angle Girder 22 to the centre of the vertical flange of which another Rod Socket is secured. Angle Girder 22 is also bolted between the forward ends of Girders 9, these being further connected by a 5½ × 1½ in. Flexible Plate, overlaid by a 5½ in. Strip 23, and by another 5½ in. Angle Girder 24, this Girder also being bolted to rear Flat Girders 15. A 1½ in. Strip is attached, as shown, to the front of Flat Plate 19 by a Bolt and a Rod Socket 25.

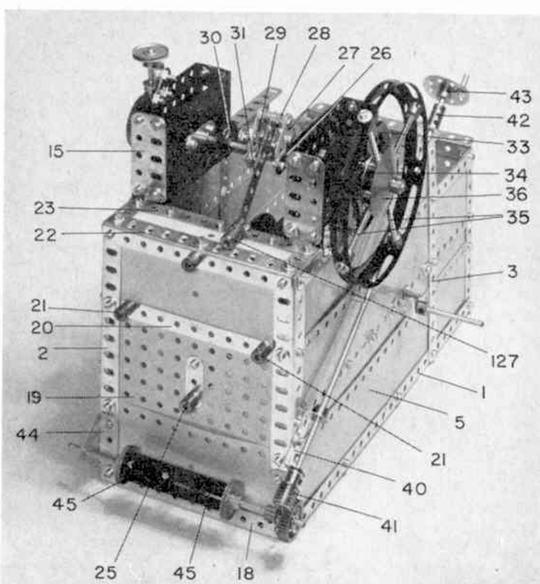
At this stage, the crankshaft can be added. This consists of two separate 4 in. Rods, each journalled in one set of Flanged Plates 13 and 14, two 1½ in. Strips first being bolted to each Plate 14 to provide extended bearings for the Rod. Mounted on the inside end of the left-hand Rod is a Collar followed by a Double



A rear view of the body section of the model showing the overall construction and the layout of the internally-mounted drive Sprockets.

Arm Crank 26 to which a Flat Trunnion 27 is bolted. Bolted, in turn, to this Flat Trunnion is a Crank 28, the boss of the Crank coinciding with the apex hole of the Trunnion. Another Crank/Flat Trunnion/Double Arm Crank arrangement 29 is built up and mounted on the in-

A front view of the body section showing construction of the crankshaft and the first stage of the steering gear.



side end of the right-hand 4 in. Rod, along with a Single Throw Eccentric 30 and a Collar, then the bosses of the Crank and Crank 28 are connected by a 1 in. Rod, a $3\frac{1}{2}$ in. Strip 31 being mounted on the Rod between the Cranks. This Strip will later form part of the piston connecting rod, while two $5\frac{1}{2}$ in. Strips 32, placed one on top of the other and bolted to the arm of Eccentric 30, later serve as part of the valve gear linkage. The Collars on the 4 in. Rods, by the way, hold the crankshaft in place.

Now fixed on the left-hand end of the crankshaft is a 3 in. Pulley 33, followed by the flywheel. This latter is produced from an 8-hole Bush Wheel 34, to which four Threaded Bosses are attached, these being connected by 2 in. Screwed Rods 35 to four further Threaded Bosses bolted to the rim of a $5\frac{1}{2}$ in. Circular Girder. Clamped by a Collar against the flywheel is a Conical Disc 36.

Fixed on the opposite end of the crankshaft is a $1\frac{1}{2}$ in. Bevel Gear 37 which meshes with a $\frac{1}{2}$ in. Bevel on a 2 in. Rod held by a 1 in. Pulley 38 in a Double Bracket, three Washers spacing the Bevel from the Double Bracket. The Double Bracket, itself, is spaced by another three Washers from a 1 in. Corner Bracket 39 to which it is attached by a $\frac{3}{8}$ in. Bolt, the Corner Bracket being bolted to Flanged Plate 13.

Also mounted on the body section while still in its separate form is the first stage of the steering mechanism. Two $1\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips 40 are bolted one to left-hand Girder 2 and the other to Girder 9 to serve as bearings for an $11\frac{1}{2}$ in. Rod held in place by a Collar and a Worm 41, the upper end of the Rod being extended by a Coupling 42, carrying a 1 in. Rod on the end of which an 8-hole Bush Wheel 43 is fixed to serve as the steering wheel. A Threaded Pin is held in the face of the Bush Wheel.

In mesh with Worm 41, on the other hand, is a 1 in. Gear mounted on a $6\frac{1}{2}$ in. Rod, journalled in two Trunnions 44 bolted one to each Girder 2. Mounted on the Rod is the drum which later carries the steering chain. Because this particular Traction Engine is a special display model however this does not actually control the movement of the chain, but is simply allowed to revolve on its Rod, thus avoiding the danger of damage to the steering gear being caused by visitors "testing" the steering. It is produced simply from two Sleeve Pieces 45, on Chimney Adaptors, carried between two 1 in. Pulleys, but, if working steering is required, the 1 in. Pulleys could be replaced by $\frac{3}{4}$ in. Flanged Wheels or, perhaps better still, the whole thing replaced by a Wood Roller.

Three Elektrikit Insulating Spacers 46 are now bolted to the left-hand side of the body in the position shown, then the main axle, supplied by an $11\frac{1}{2}$ in. Rod, is mounted in place, being held by Collars. Fixed on the axle are a 3 in. Sprocket Wheel 47 and a Commutator 48, the latter situated about half an inch from the Insulating Spacers. Although not shown in the accompanying photographs, three 2 in. Wiper Arms are secured to the inside ends of the Spacers, the upper Wiper engaging with the continuous contact area of the Commutator and the two remaining Wipers both engaging with the outer half-contact area of the Commutator. The Wipers will later be wired to lamps fitted in due course to the model.

To complete the body section of the model, two additional vertically-positioned $7\frac{1}{2}$ in. Strips 49 are bolted one to each side, these Strips providing bearings for a $6\frac{1}{2}$ in. Rod held in place by Collars. Fixed on the Rod are a $1\frac{1}{2}$ in. Sprocket 50, a 3 in. Sprocket 51 and a 1 in. Sprocket 52.

Boiler Section

We come next to the boiler section of the Traction Engine, this also including the cylinders, chimney and generator. Four formers are first produced, the two side examples 53 each from two $9\frac{1}{2}$ in. Strips overlapped seventeen holes, the upper example 54 from two $9\frac{1}{2}$ in. Angle Girders overlapped seventeen holes and the lower example 55 from one $9\frac{1}{2}$ in. Angle Girder and one $9\frac{1}{2}$ in. Strip also overlapped seventeen holes. At the front, formers 53 are connected by a $4\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip 56, a similar Double Angle Strip being bolted between formers 54 and 55, then twenty $4\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates, curved to shape, are bolted around all four formers, as shown, to form the main cladding.

The cylinder unit is built up from two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flanged Plates 57, to the flanges of which two $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 58 are bolted, Threaded Bosses being used in place of Nuts with the upper Bolts. Note that the Bolts are screwed into the transverse bores of the Bosses, while fixed to the top of the unit by Bolts screwed into the longitudinal bores of the Bosses, is a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 59, to which two Threaded Couplings 60 and a Double Bent Strip 61 are bolted. Another Double Bent Strip, vertically-mounted, is secured to the inside of rear Flanged Plate 57, being held by Rod Sockets 62, these Sockets also fixing a 1 in. Corner Bracket and an 8-hole Wheel Disc 63 to the front of the Plate. The Corner Bracket, positioned beneath the Bush Wheel, is arranged so that its apex hole coincides with the centre hole in the Wheel Disc. Because of this, it is held only by upper Rod Socket 62, its other corner being fixed by a Bolt.

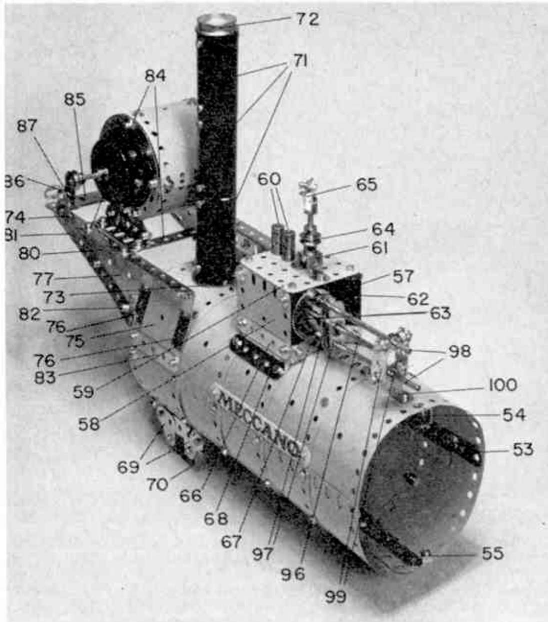
Another 8-hole Wheel Disc is bolted to the front of forward Flanged Plate 57, then a $2\frac{1}{2}$ in. Rod is held by Collars in Double Bent Strip 61 and Flat Plate 59. Fixed on the upper part of this Rod is a $\frac{1}{2}$ in. pulley 64 and an imitation governor 65, represented by an End Bearing to which two Rod and Strip Connectors are bolted.

Now fixed to the inside of each Flexible Plate 58 is a $2\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strip, the securing Bolts also fixing a $2\frac{1}{2}$ in. Strip 66 to the outside of the Plate. The lugs of the Double Angle Strips at each side are connected by a $2\frac{1}{2}$ in. Curved Strip 67, then the lower parts of Plates 58 are bent to shape, overlaid by a $2\frac{1}{2}$ in. Strip 68 and bolted to the top of the boiler.

Bolted beneath the boiler, at the front, are four Obtuse Angle Brackets forming the anchoring points for the perch bracket which later holds the front axle. The perch bracket, itself, is built up from a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flanged Plate to each flange of which two 1 in. Corner Brackets 69 are bolted, these Corner Brackets being joined by a $2\frac{1}{2}$ in. Strip. Two $2\frac{1}{2}$ in. Angle Girders 70 are then fixed one to the forward edge and one to the rear edge of the Flanged Plate, two Fishplates being bolted to opposite ends of the vertical flange of each of these Girders. A $2\frac{1}{2}$ in. Curved Strip is bolted between each pair of Fishplates.

The Bolts fixing Girders 70 to the Flanged Plate also secure a Double Arm Crank to the inside of the Flanged Plate, the boss of the Crank coinciding with the centre hole in the Plate. Held by Collars in this boss and projecting downwards through the Plate is a $1\frac{1}{2}$ in. Rod on which the front axle will in due course be pivoted.

In the case of the chimney, three Cylinders 71 are fixed together by two $7\frac{1}{2}$ in. Strips bolted down the inside of the Cylinders. The upper and lower pairs of securing Bolts each hold a $2\frac{1}{2}$ in. Strip, curved between them to allow it to fit, these Strips providing bearings for an $11\frac{1}{2}$ in. Rod fixed in a Collar secured inside the middle Cylinder by two $\frac{1}{2}$ in. Bolts. A $1\frac{1}{8}$ in. Flanged Wheel 72 is secured on the upper end of the Rod, which is then mounted in an 8-hole Bush Wheel 73, bolted to the top of the boiler, and in the longitudinal bore of a Threaded Coupling bolted to former 55, but spaced from it by a Collar on the shank of the securing Bolt.



The entire boiler section of the Traction Engine complete with the cylinders, chimney, generator and perch bracket. Construction is not as complicated as it looks.

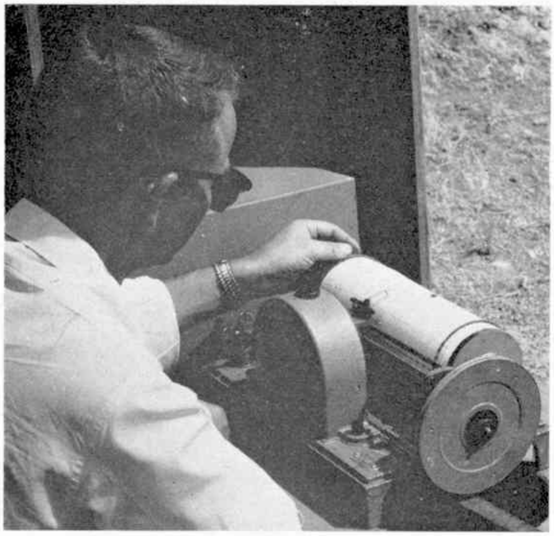
Generator and Bracket

Projecting forward from the front of the main boiler section is the generator bracket, each side of which consists of a $7\frac{1}{2}$ in. Angle Girder 74 to which are bolted a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plate 75, edged by two $2\frac{1}{2}$ in. Strips 76, a $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plate 77, a $3\frac{1}{2} \times 1\frac{1}{2}$ in. Triangular Flexible Plate 80 and a $5\frac{1}{2}$ in. Strip 81, the last attached to Plate 77 by a Fishplate held by Bolts 82. The Plates and Strips are curved slightly to shape, as can be seen, then Strips 76, with Plate 75, are bolted to the boiler, the securing Bolts also fixing another $2\frac{1}{2}$ in. Strip 83 in place.

Girders 74 at each side are connected through their fifth and ninth holes from the front by two $4\frac{1}{2}$ in. Strips 84 and, at the front, by a $3\frac{1}{2}$ in. Angle Girder 85, secured to Girders 74 by $1 \times \frac{1}{2}$ in. Angle Brackets. Fixed to each end of Girder 85 is a right or left-hand Corner Angle Bracket 86, depending on the end, and a Threaded Coupling 87, the latter holding the Corner Angle Bracket in place.

The generator, itself, is built up from two circular arrangements consisting of four $2\frac{1}{2}$ in. Stepped Curved Strips 88, bolted together, the securing Bolts also fixing four 1×1 in. Angle Brackets in place. Bolted to the horizontal lugs of these Angle Brackets are two $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 89, while fixed by a Nut in the end hole of the protruding vertical lug of each bracket at one side is an ordinary Bolt, shank pointing

(Continued on page 578)



Earthquakes as far distant as India and Israel were detected at the Hanford Atomic Plant reservation in America by sensitive water level recorders in wells and recorded on graphs. In the photograph, a member of the Earth Science Unit at Hanford (USA) checks data at one of the well sites.
Photo courtesy General Electric Company of USA.

NEW LIGHT ON EARTHQUAKES

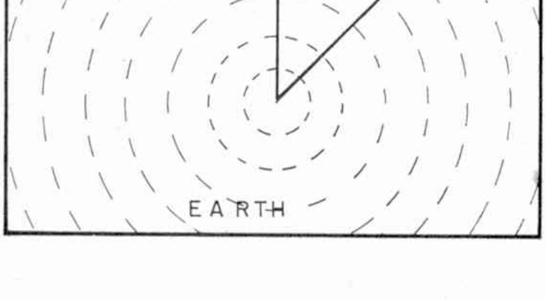
by Charles A. Rigby

MUCH MORE has been learned about the earth's make-up and earthquakes in recent years. Of the nervous tremors, 300,000 which occur each year, only 60,000 earthquakes have sufficient force to alert the registering seismographs or seismometers. Nevertheless, since the beginning of this century earthquakes have on an average killed over 15,000 persons each year and caused great damage. Some countries such as China and Japan, Chile and Peru, Italy, Greece, Turkey and Iran, have suffered more heavily than others.

An earthquake is a more or less violent to and fro or vibratory movement of the rocks of some portion of the earth's crust, produced by the passage through them of a wave of 'elastic compression' which takes its origin at some place within the crust and spreads outward therefrom in ever widening circles of diminishing intensity, like the rings produced on the surface of a pool of water when a stone is thrown into it. During the passage of the wave, all parts are affected by it, and first driven forward away from their original position and then back to it again, the distance to which they move to and fro depending upon the violence of the shock.

FIG. 1.

SHOWING THE CENTRE OF AN EARTHQUAKE KNOWN AS THE CENTRUM (O), AND THE EPICENTRUM IMMEDIATELY ABOVE. (P).



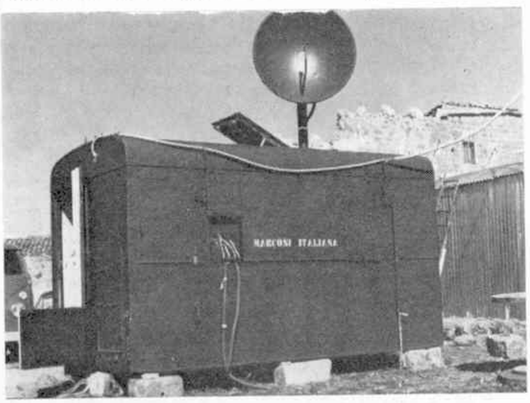
As will be noted in the diagram, the place or focus in the earth's crust from which the waves proceed is called the 'centrum' or seismic focus, while the line drawn from this at right angles to the surface is called the 'epicentrum' or seismic vertical. The shock, of course, is felt at greater distances on the earth, as at 'L' (figure one). Earthquakes that bring utter desolation and death occur mainly in regions where the earth's crust is weak or subject to the greatest strain, and quite often are registered on seismometers thousands of miles distant.

The interior of the earth is gradually cooling. The heat that it is losing is partly the relic of the original heat possessed by the earth when it was formed, and partly heat generated by radium and other radioactive substances. As the interior cools it contracts and places a great strain on the more solid part of the earth, the upper crust. For possibly thousands of years the strain can be resisted, but eventually, there must be a sliding and crumbling of the rocks, and it is such a subterranean movement that causes an earthquake. Such shifting of gigantic pieces of rock, sometimes of whole subterranean mountain chains, starts a resettlement of part of the earth and a whole series of dreadful shocks occur.

This is particularly so when the movements occur near the crust of the earth. Sometimes they happen 300 miles deep into the solid outer mantle. These deep-down, often occur in May, for records show that this is the month when there is frequently trouble in the earth's granite layer, which is 12 to 18 miles thick, or in the even deeper down basaltic foundations. Nobody has yet found the reason. It is usually at the end of the year that the upper crust shocks, causing the so-called tidal waves, shake cities in unexpected parts of the world into dust. This occurred when Shohsueco, a 7,440 ft. Andes volcano erupted during May 1960, burying whole villages in molten lava, and causing an earthquake and tidal waves up to 20 ft. high in Hawaii, Tahiti, New Zealand, and also North America.

Earthquakes are undoubtedly produced by some sudden blow or shock administered to the rocky crust at the place or focus from which the waves of 'elastic compression' proceed. The cause or origin of the shock is not for certain known, but the close connection which obviously exists between volcanic phenomena and earthquakes, points to the conclusion that they have a common origin, and indicates that the force which expels the various materials with so much energy from the mouth of the volcano, administers to the rocks the blow or shock which is transmitted outwards in all directions as the earthquake wave. Hence, the rapid generation and expansion of high pressure steam is believed to be one of the chief causes in the production of earthquakes.

Another cause, believed by some to be responsible for them is the sudden snapping and displacement of strata due to the contraction which must of necessity take place as the earth cools. This was evidently the cause of the great Alaskan earthquake of April 1964, when deep in the earth, a huge slab of rock hung taut as an auto spring. Then for some unknown reason it bent a little more and snapped with the force of 100 megaton hydrogen bombs. The recoil laid waste to Alaska and sent huge waves tumbling down the west



During the recent earthquake in South Western Sicily a fully equipped mobile radio shelter was set up in Santa Margherita Bellice, a village in the centre of the disaster. The photograph shows the shelter, containing radio link and telephone multiplex equipment with damaged buildings in the background.
Photo courtesy The Marconi Company Limited.

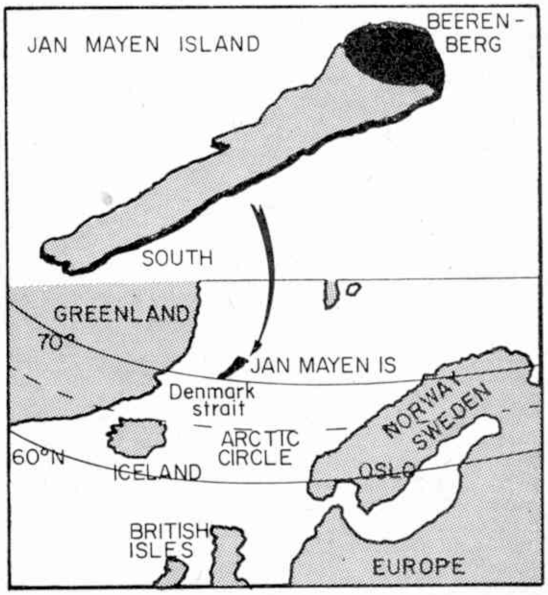
coast of North America and out into the heart of the Pacific Ocean.

There are now over 400 observatories installed in different parts of the world and from the study of the immense amount of data obtained, the pattern of distribution over the earth has now emerged quite clearly. Besides, some insight has been gained into their causes which are probably linked with the slow convective movement of material in the earth's mantle. From the practical point of view, even more interesting results come from the study of the distribution of earthquakes within certain limited regions such as Southern Europe, Central Asia, or California.

While every part of the world is subject to earthquakes, in general, it has been noted that they tend to occur in certain well defined zones stretching around the world. The first of these is the Circum-Pacific zone which extends all around the shores of the Pacific Ocean from Chile to New Zealand. The second is the Mediterranean-Alpine zone which stretches from Morocco in the West, through the Mediterranean and along the mountain chains of the Caucasus, the Hindu

FIG. 2.

MAP SHOWING POSITION OF JAN MAYEN ISLAND, ALSO THE LARGE VOLCANO KNOWN AS THE 'BEERENBERG' (7470 ft.) IN THE NORTH.

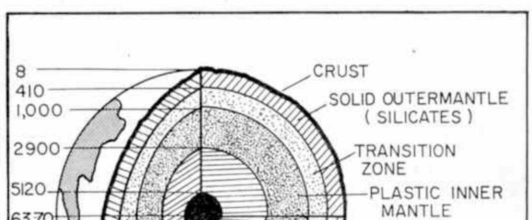


Kush, the Karakoram and the Himalayas into China, Burma, and Indonesia.

Regarding the connection of volcanoes with earthquakes, Dr. Dollar, Head of the Department of Geology at Birkbeck College, believes that Jan Mayen Island lying between the North Cape of Norway and Greenland, can and does bring reaction in places like Hawaii, the Philippines and the Atlantic. This dumb-bell shaped island has some 900 volcanoes steaming and erupting from its 34-mile long and nine-mile wide surface. Each year since 1947, a team of London

FIG. 3.

CUTAWAY DIAGRAM OF THE EARTH SHOWING THE CHIEF LAYERS, AND THE DEPTHS. COUNTING THE CRUST AS ONE LAYER, THERE ARE 6 IMPORTANT LAYERS.



University students have gone to Jan Mayen Island during June to uncover the secrets of the immense convulsions which bury cities and kill thousands.

The 'Beerenberg' volcano in the extreme north has an interesting central vent or chimney from which from time to time, lava and cinders are flung. In association with this volcano are the 900 others, all of which lie in parallel lines and have stretched the earth's crust. And the importance of these lines of volcanoes is that the island lies on the Great Central Atlantic Ridge. This starts on the Siberian river Lena, cuts across the Arctic Ocean, turns down into the Atlantic Ocean and sweeps up into the Indian Ocean, a giant undersea ridge which from base to peak is as high as the Himalayas.

Instruments for measuring earthquakes are called seismographs or seismometers. To a brilliant Chinese mathematician, astronomer and geographer, named Chang Heng (78-139 A.D.) goes the credit for producing the ancestor of all seismographs. This primitive instrument consisted of a pendulum to register the movements of the earth. Look at figure 4 showing the principle of a seismograph, many different types of which are now in use. Note the various parts, particularly R, the rigid support contacting the post with a free moving sharp point at J, and D, the recording drum revolved by clockwork and the marker which extends from W (the weight) to D. When the ground shakes, the suspended weight due to its inertia scarcely moves but the shaking motion is transmitted to the marker which leaves a record on a drum.

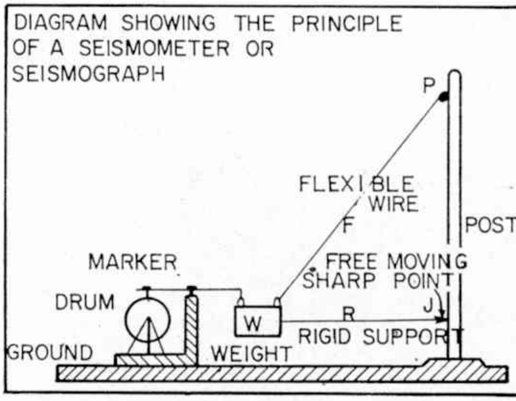
In this simple type a delicately balanced horizontal pendulum is attached to a mast. From the heavily-weighted end an arm attached to the pendulum magnifies and records the movements of the pendulum to a revolving drum or chronograph which automatically registers both the time and magnitude of the shock.

Another method of detection with water level recorders in wells, was tested at the Hanford Atomic Station in America during 1956. The well recorders were installed to provide scientists there with a continuous record of water table fluctuations. Earthquakes as distant as India and Israel were detected.

In recent years, seismic recordings have been much improved by arranging the instruments in arrays for great precision in determining the direction and strength of the waves. They are also buried in deep holes. Eventually, geologists hope to be able to predict earthquakes, thus saving lives and valuable property.

FIG. 4.

SIMPLE DIAGRAM SHOWING THE PRINCIPLE OF THE SEISMOMETER OR SEISMOGRAPH.



DINKY TOY NEWS

HOSE DOWN!

Chris Jelley describes the new Dinky Fire Tender

DINKY HAVE done it again! I wouldn't have thought it possible, but they have. Those back-room boys at Meccano have come up with yet another brand new, never-before-seen feature for a die-cast model—a working water pump for a fire engine! Yes, a water pump which really squirts water and, what's more, they've introduced a striking new fire appliance specially designed to incorporate the pump, No. 285 Merryweather Marquis Fire Tender, built on an A.E.C. chassis.

Dinky Toy fire engines, or, to use the correct expression, fire appliances, have always been highly popular with collectors, but I have no doubt that the Marquis will break all records. It's quite the best model of its kind ever to roll off the production lines at Binns Road: big, solid and a beautifully-detailed, feature-packed scale reproduction of a magnificent real-life vehicle. Even without the water pump, it would be a hit, and so having the pump must make it a smash!

The pump, itself, with its water tank, is enclosed in the main body of the model, behind the cab and is actuated by a small, spring-loaded button projecting from the top of the rear body section. When the button is pumped, water is forced out, under considerable pressure, from a special outlet " cock " at the back of the model. Under operating conditions, of course, the water is not simply sprayed out of this outlet. If it was, it would defeat the whole object of the Tender. No, real fire engines are equipped with hosepipes and, in the same way, the Dinky model comes complete with a length of tough hose, brass nozzled, which is designed to be coupled up to the outlet pipe. When not in use, this hose is carried in an opening storage locker built into the left-hand side of the model. The filler cap for the water tank, by the way, is situated on the roof just behind and to the side of the pump button.

No self-respecting fire tender would be complete without a ladder and so, true to form, the Dinky is equipped with a two-section extending ladder, mounted on the roof and held in place by a special quick-release catch which engages with two spigots on the lower section of the ladder. To release the ladder, this catch is simply pressed down, allowing the ladder to be slid out of its mounting and it must be removed to allow access to the water pump button. The ladder, itself, is extended by hand, as are full-size ladders of the type on which it is based.

Unlike the old open fire engines of years gone by, most modern appliances carry their crews undercover, inside, in a special compartment immediately behind the driver's seat. This compartment, as well as the main cab, is faithfully reproduced on the model and has the added attraction of being fitted with an opening door. Inside both the crew compartment and the cab, full seating is supplied, the cab moulding including a dashboard representation. Windows and steering wheel are fitted as standard, of course, while other features include twin bells and simulated blue light on the cab roof, jewelled headlamps at the front and, on the top of the body, an imitation rotating floodlight. The Tender is also fitted with full suspension, which is rather unusual for a model of this size.

All these features, so far, are things which could be described as being " fitted " to the model, but I must say that the basic casting, alone, incorporates tremendous fine detail such as two recessed pump consoles, one each side of the body, sporting a host of wheels, dials, outlets, etc. Also shown are a couple of simulated small-bore-hose reels, one on the roof and one in its own recess in the left-hand side of the body, plus various lockers, toe-holes and such-like. Even the fuel filler cap is shown in beautiful detail deep inside one of the recesses!

Colour finish is in an eye-catching polychromatic red with silver base, the consoles, simulated hose reels, opening door, main lockers, and the back of the body also being silver, as well as the " dimpled " lower forward sections of the sides of the body. The ladder and its quick-release catch are silver too, while the interior moulding inside the model is white. " Fire Service " emblems, with crests, appear on the main locker lids. The overall effect is great, which word just about sums up the model as a whole!

Mobile Mounties

Released with the Merryweather Marquis Fire Tender is Dinky Toy No. 252 Pontiac R.C.M.P. Car. Admirers of the famous Canadian " Mounties " will know that the initials " R.C.M.P." stand for " Royal Canadian Mounted Police " and the new model is simply their equivalent to our own police patrol cars. The Mounties of course gave up using horses for day to day police work a long time ago, when modern conditions made it necessary, and are now as much an up-to-date, mechanised force as any other in the world. In fact, because of the huge areas under their control, they are probably much better mechanised than most!

There has been an R.C.M.P. patrol car in the Dinky range for a number of years, now, and quite frankly, it's getting more than a little out of date. This new model, therefore, is produced as a replacement for the old example and serves to modernise the situation. It is based on the Dinky Pontiac Parisienne, introduced a few months ago, but has been given the correct blue-grey colour finish with white door of the real life vehicle, plus a simulated red roof light and a driver resplendent in the Mounties' renowned red uniform. The R.C.M.P. crest also appears on both white door panels.

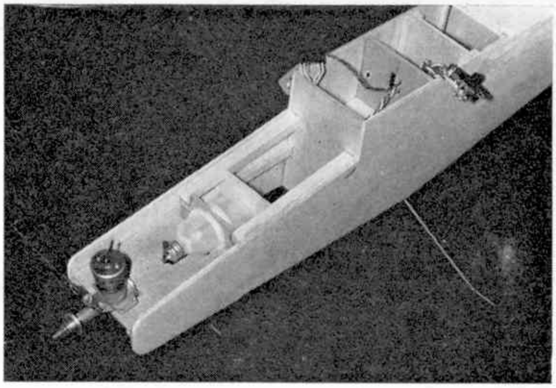
As a matter of interest, the Mounties' tunic is no longer red, but brown. However, as most people throughout the world associate a Mountie with a red uniform, they do still wear them on ceremonial occasions. It was because of the red association that Meccano " dressed " their driver in this colour.

As regards the model, itself, its most appealing features are its twin retractable radio aerials in the rear wings, controlled by sliding buttons in the base, and its Speedwheels which are surely the ideal things for crime-prevention in these days of high-speed criminals! Fitted in addition, however, are windows, seats, steering wheel and American-style number plates, the windscreen moulding incorporating rear-view mirror and windscreen wiper representations. It's a good model and an ideal replacement for the old R.C.M.P. Patrol Car.

RADIO 4-2

CONSTRUCTIONAL NOTES ON

'CRACKER'



ALTHOUGH THIS model is fairly typical of simple rudder-only R/C aircraft, it has a number of features designed to simplify construction and flying and to make it economical to build while still retaining an attractive appearance. As an example, apart from the ribs, cabin front and fin top, there are no curves to trace—everything is straight lines and any other "softening" curves are sanded in. The structure is strong but light, in order to keep flying speed low but survive rough landings, etc. The target weight for the prototype was 26 ozs. all-up; with an empty fuel tank it came out at 25½ ozs. but the model will still fly well at 32 or even 36 ozs. Although intended for simple rudder-only control, it can be built or converted to rudder and throttle or rudder, throttle, and elevator by builders with a little experience.

Construction is quite straightforward and any puzzling points from a study of the plan should resolve themselves as building proceeds. A building sequence is given on the plan, but these notes amplify one or two points. Each fuselage side is a 4 in. sheet with the corners sliced off and one butt-joined on the top edge; the joint line is shown on the drawing. Cut the sides to shape, then add the $\frac{1}{16}$ in. sheet inside from F4 forward, grain vertical, using contact cement, PVA glue, or balsa cement. Make sure one is left and one right. The notes on the plan cover assembly, but note that the engine bearers are tapered at the front to tilt the engine mounting plate downward; saw and/or plane this taper before assembly. The inside details of the nose are shown in the photographs.

Use soft ¼ in. sheet balsa for the blocking around the nose area and the cabin front, and cement all pieces in place before carving and sanding down to the pleasantly curved appearance shown in the pictures of the finished model. Fuel-proof the inside as you go, to prevent later oil soakage weakening the nose.

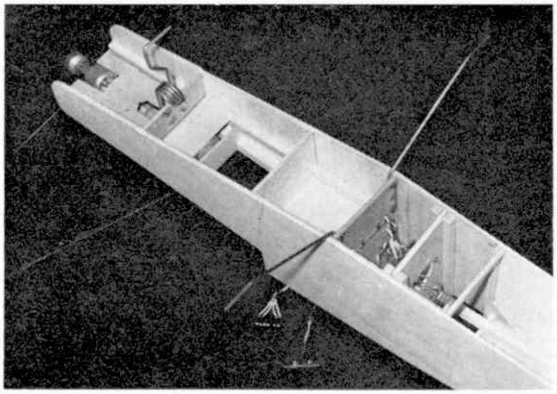
One point—fret out a little hole in F3 (as in one of the pictures) to enable the plug from the escapement to pass through to the receiver. The size will depend on the equipment harness used, but in any event it should be sawn before assembly.

The wing is built around the ply dihedral brace, so make sure this is accurate. One wing panel is drawn, and the second can be built over the same drawing, as shown by the dotted lines and italic lettering, by just putting the centre-section at the other end.

Rudder hinges are strips of silk or nylon or cotton tape, crossed as indicated, i.e. that glued to the port side of the fin pokes through and glues to the starboard side of the rudder and vice versa. Keep the cross-over bits free of cement or dope or the rudder will be too stiffly held to move. The trim tab is held by soft iron wires or tabs of thin aluminium so that it can be bent to trim the model to fly straight.

The prototype was covered all yellow, heavyweight Modelspan on wing and tailplane and lightweight clear dope on the fuselage and fin. After two thorough coats of clear dope the decor was put on by cutting up a thin plastic film self-adhesive black number plate, Letraset letters, and fin transfers, after which the fuselage was given a thin coat of fuel proofer. Help on covering and other constructional matters can be found in Plans Handbook No. 1, or ask your library for our book "All about Model Aircraft."

Use soldered washers each side to retain the wheels, complete the radio installation (see last month and notes on plan) and the model is ready for tests. Check balance point with the fingertips ¼ to ½ in. behind the wing mainspar and check that wing, tail etc. are free of warps. Check radio. Glide tests can be made into tall grass or weeds or the model can be flown on a short motor run (15-20 secs) with the motor running as slowly as possible (very rich). Adjust trim tab as necessary; raise wing l.e. with up to $\frac{1}{16}$ in. packing if model tends to dive or lower tailplane t.e. with up to $\frac{1}{16}$ in. packing if there is a tendency to stall. If more adjustment than this seems necessary, add ballast to nose or tail. Gradually increase motor speed and length of run. Try not to apply rudder until model has climbed to a safe height, until you know the effect of the rudder. Later you can change the rattler (if an Elmic escapement) and/or increase the rudder area. Fly with care and you will enjoy many happy hours.



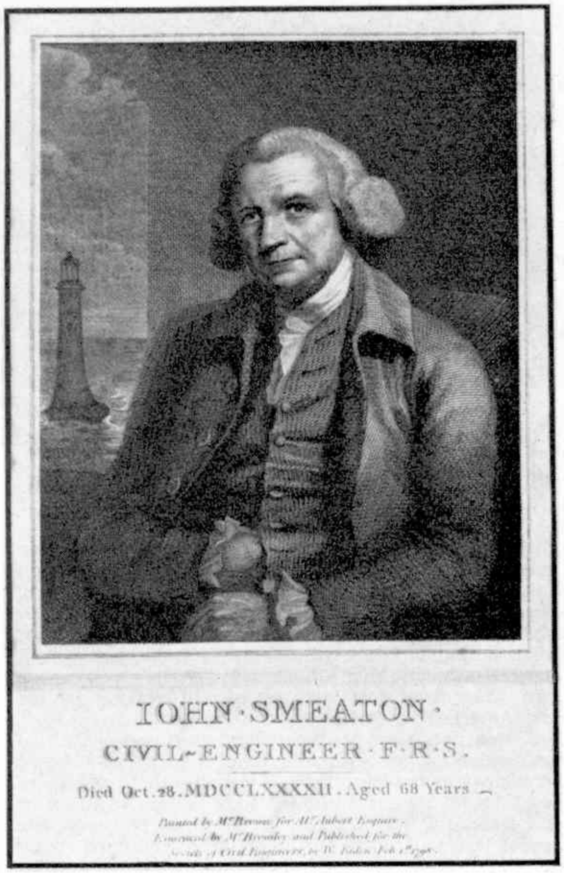
The heading photograph shows the engine, fuel tank and the radio compartment bulkheads installed.

Right: Another view of "Cracker", but this time showing the under carriage and rudder linkage. The wiring harness can also be seen on the rear of the second cabin bulkhead.

GREAT ENGINEERS—No. 22

JOHN SMEATON (1724-1792)

by A. W. Neal



JOHN SMEATON had a great advantage over many of his engineering contemporaries, both in upbringing and education. He also had money. He was born at Austhorpe Lodge, near Leeds, his father being a successful attorney in that town.

His basic education was given by his mother, and it was at this early stage that he showed a strong leaning towards mechanics. At the appropriate age he was sent to Leeds Free Grammar School, his best subjects being geometry and arithmetic. All of his spare time was, however, spent in the workshop his father had furnished for him some years before.

At the age of 16 he entered his father's office, and later was sent to London where he attended the Courts of Westminster Hall, but young Smeaton could not generate any kind of liking for the Law, and his father wisely allowed him to follow his own inclinations.

He trained as an instrument maker and, at the same time, supplemented his scientific knowledge by attending meetings of the Royal Society. At the age of 26 years he had gathered sufficient knowledge to present a paper to the Society, and in this he described his and a Dr. Knight's improvements in the mariner's compass. Then followed other scientific papers, and in 1759 he was awarded the Society's Gold Medal for his paper "An Experimental Inquiry concerning the Natural Powers of Water and Wind to turn Mills and other Machines depending on a Circular Motion."

In 1742 he travelled through Holland and Belgium inspecting dykes, canals, docks and harbours, all of which proved of great advantage when he returned the following year.

Eddystone Reef, about 13 miles from Plymouth, lay across the path of Channel shipping, and on this unhappy and angry spot there had been two lighthouses, both of which had untimely ends. Trinity House then placed a Light Vessel to guard the position as a temporary measure, and early in 1756 approved the design for a new tower by Smeaton. He decided on the use of stone (the former towers were of wood), although there were some objections to this. He chose the trunk of a tree for his model, the tower having a broad base, diminishing in a curve to the lantern at the top. The stones he had prepared were accurately cut and dovetailed. They were all fitted together before being sent by ship to the site. In this way the work on the rock, some of which was under water at times, was reduced to a minimum. Smeaton also carried out many experiments in cement, and the formulae he evolved are still used. Eight courses were completed during the first season, after which the work was easier. The new light was first shone on October 16th, 1759. In the 1870's cracks were observed in the rock on which the tower stood, and a new one was begun in 1878 on a nearby rock. The stump of Smeaton's lighthouse still stands, and the upper part has been re-erected on Plymouth Hoe.

Then followed many other achievements in civil engineering. He schemed improvements to navigation of a number of rivers, and was consulted on the drainage of the Fens. He strengthened the old London Bridge in 1777, and designed new pumping machinery beneath one of the spans. He built a bridge at Perth, at Coldstream and another at Banff, and yet another at Hexham. The last named, however, met with disaster; it was his only failure. He commenced building the Forth and Clyde Canal. More of his work may be seen at the harbours of St. Ives, Cornwall and Ramsgate, Kent.

His biographers depict him as a typical professional of his period, blunt in manner and straightforward in all his dealings. None could dispute this. Now he rests with his forefathers in the parish church of Whitkirk.

POLARISED LIGHT

by V. F. Bignell

Department of Mechanical Engineering, City University

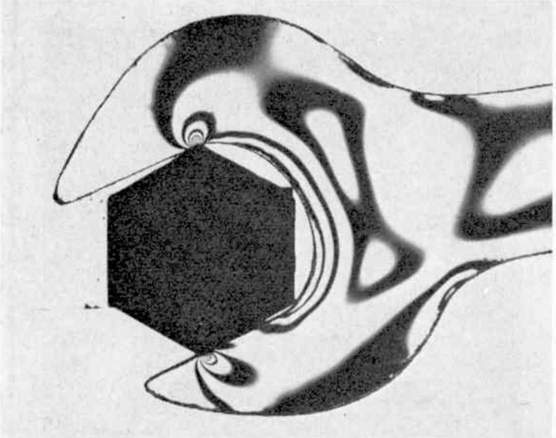
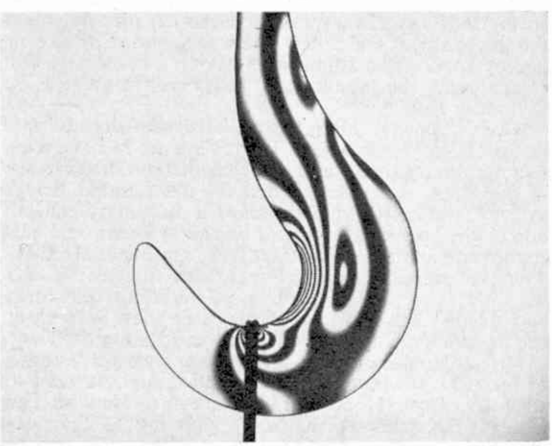


Figure 3. The stresses in this model of a spanner are evenly distributed except at the contact with the nut. Photoelasticity can measure these stresses.

IT WAS in the year following the Battle of Waterloo that Sir David Brewster addressed the Royal Society on the subject of a strange effect he had observed in glass. He had found that pieces of glass which had been quenched showed coloured patterns when seen by polarised light. Glass was the only suitable transparent material available then, but today the same colours are seen when engineers use transparent plastics in the application of photoelasticity to their work.

We do not know yet what light itself consists of, so we cannot explain polarised light, but we can devise an analogy or model to help us visualise light. Thus we begin by saying that although light is seen to travel in one direction, it consists of local vibrations across the line of travel. In ordinary light these vibrations are in random directions but at a polarising sheet all vibrations are removed except those in a certain direction, the polarising direction of the sheet. It is rather as if a taut rope were shaken at one end, and then a slotted board placed over it. Only vertical movement of the rope is possible beyond the board. If a similar board is placed with its slot parallel to the first, the motion of the rope is unchanged. If however the slots are at right angles, the motion allowed by the first will be entirely stopped by the second. Light does just this. If it is polarised by one polariser, it will be unchanged in its polarisation by a second parallel polariser but stopped if the second polariser is crossed relative to the first.

Figure 4. In a scale model of a crane hook, the lines produced in this photoelastic test join points having the same maximum shearing stress. The next figure shows how this data can be used.



Light can be polarised by many things; air molecules scatter the sun's rays so that part of the sky emits polarised light. Bees and other insects use this effect for navigation. Also, nearly all smooth, non-metallic

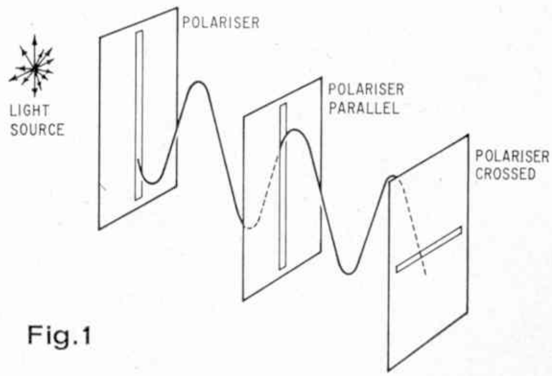


Fig.1

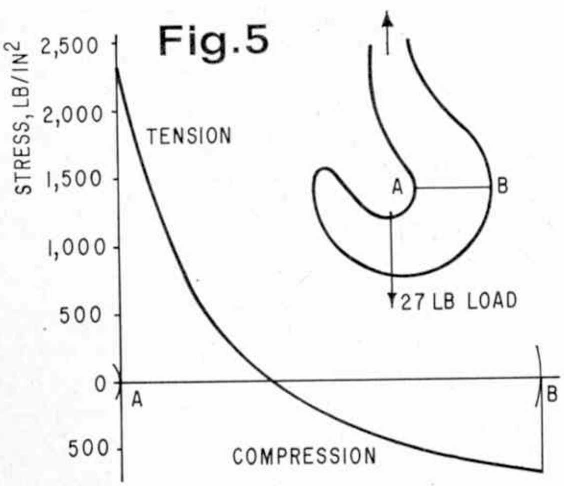
surfaces polarise some of the light they reflect, and because it is this polarised light which causes glare, so objectionable to motorists and holiday-makers, polarising sunglasses are made containing a polarising element crossed with respect to the glare, and thus eliminating it. Such glasses polarise, using a piece of material containing dichroic crystals or molecules.

Of this same type are the polarisers available from many technical and hoppy shops, and the phenomenon of the crossed polariser is easily arranged. When however a piece of plastic material is placed between the crossed polaroids it will itself act as a polariser, a double polariser in fact, changing the speed of different components of the light.

When this kind of light emerging from a piece of plastic or glass is viewed through the second polariser, the effect visible is a network of lines, black, white or coloured, crossing the piece of material. This effect is what Sir David Brewster saw in 1816, and since then it has been proved that just as a mountain range may be described by contours on a map, the patterns in the arrangement just detailed show the internal stress or strain pattern in the plastic. The line patterns are called photoelastic patterns.

Internal stress can arise from two causes. Firstly, when some plastics are fabricated, the process of moulding or pressing produces flow lines and quenching effects. These are of little importance to engineers. More interesting to us is that if we make a transparent plastic model of a machine part, and apply a scale load to it, we can gauge the internal stresses and strains which will occur in the real thing. This preliminary photoelastic test can help the designer to choose his shapes, sizes and loads wisely. Figures 4 and 5 show how the photoelastic pattern is used to find the peak stress in a crane hook model. At the inside of the hook the peak stress is some ten times the stress calculated from dividing load by area. The same multiplying factor would apply in a real, full size hook.

The engineer's polariscope for photoelasticity consists firstly of an intense source of light, either white or monochromatic yellow or green. In front of this is a polariser. Next in the light path the model under examination is placed, and finally the second polariser, usually in the crossed position. Sheets of mica are interposed to remove unwanted effects, and lenses are added to form a projection system or help photography of the model. Using this kind of apparatus the photographs illustrating this article were taken. If a coloured picture is desired, white light is used but for many



measurements the monochromatic light source or a monochromatic filter must be employed.

In a polariscope all transparent materials will show some photoelastic fringes, but engineers choose sensitive epoxy resins, polycarbonate and polyurethane plastics for their work. Polystyrene and PVC are more readily available materials, the former showing heavy injection strains and little effect under deliberate load. PVC is recommended for simple demonstrations (figure 7); it commonly occurs as transparent tubing and may be flattened to a sheet by heating.

The equipment described enables a flat model to be examined, but if the object under study is thick and has a complicated shape, the photoelastic effect may be frozen in by heating and cooling the plastic model while under scale loading, The model can be cut into slices and the stress conditions for each slice examined separately.

In a further application the sensitive plastic in sheet form is cemented to a metal surface using a silvery reflective adhesive. Polarised light is shone on to the plastic layer and the reflection observed through another polariser. When the underlying metal is strained the plastic is strained with it and the familiar patterns are seen. In this way information is obtained on the behaviour of the actual component under real loads during service conditions.

Together with strain gauges (see Meccano Magazine July 1968), two powerful tools are thus available to the engineer wishing to know more about the stresses and strains which may cause damage to machines and structures.

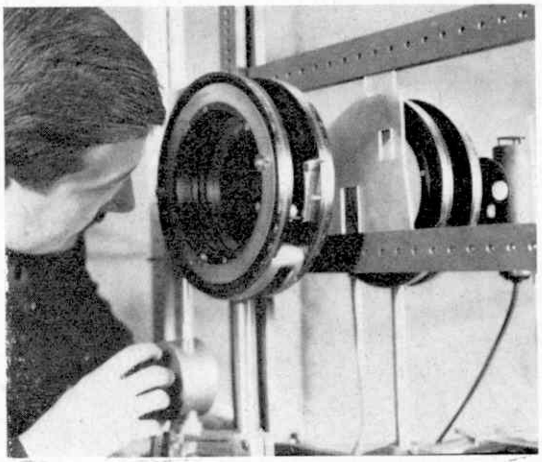
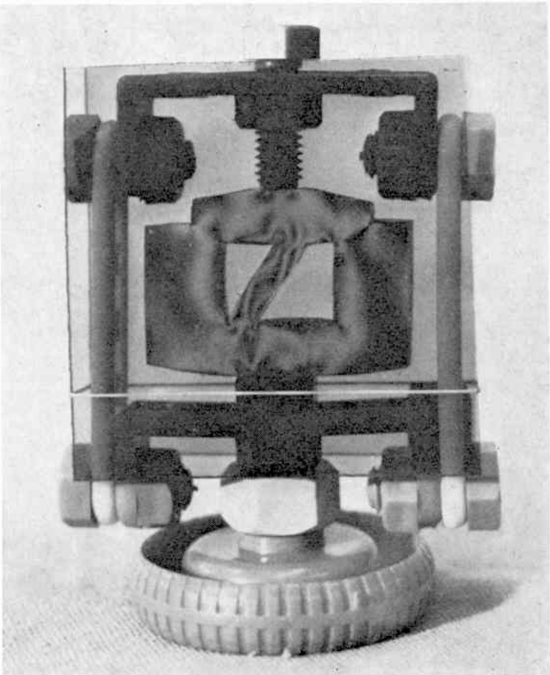
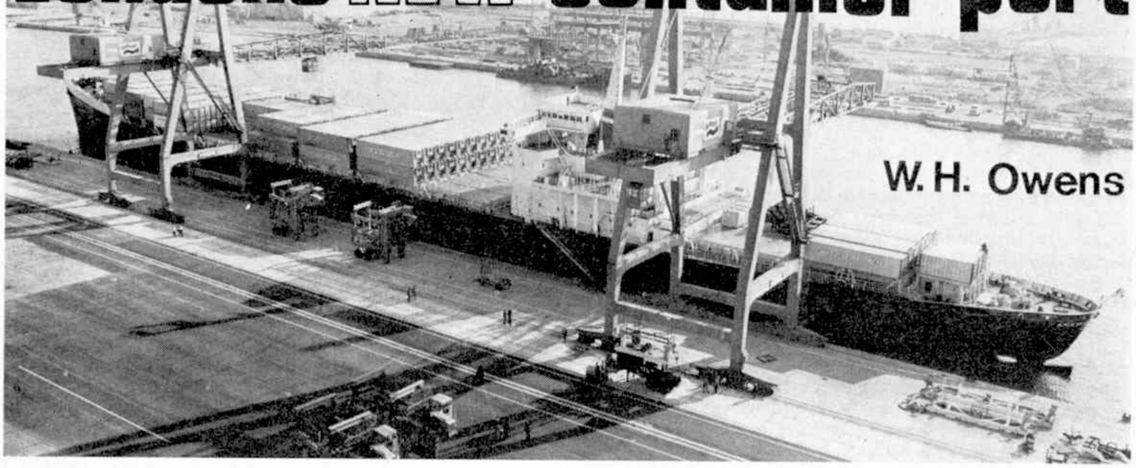


Figure 6. A model of the wall of a building, under examination in a polariscope.

Figure 7. Plastic Meccano and flattened PVC tubing between two 'Polaroid' sheets make a simple polariscope.



Londons NEW container port



W. H. Owens

ABOUT 60 MILLION TONS of cargo a year—more than a third of Britain's total imports and exports—pass through the great dock systems of the Port of London, which extend for over 20 miles down the lower Thames from the Tower to Tilbury. The river tideway is one of the busiest commercial waterways in the world used today, as for centuries past, by ships of all the maritime nations.

In the last few years the container method of shipping goods overseas has been transforming the pattern of general cargo handling in the London Docks, as in other world ports. To put London in the front rank of international container handling ports, the Port of London Authority has just established the first British containership terminal at Tilbury. Large deep-sea vessels of this kind can be discharged and loaded here many times faster than conventional ships in the other docks.

Below is a photograph of "Berth No 40", in the Port of London Authority's new dock extension at Tilbury. This berth is equipped with two 30 ton capacity Paceco-Vickers Portainer cranes, each costing some £200,000.

The Tilbury Docks extension, which has cost nearly £30 million, is London's largest new dock development since the King George V Dock in the Royal Group was opened in 1921. It has added two miles of deep-water quay and 13 shipping berths to Tilbury's existing facilities. The new berths include six container berths, three berths for packaged timber and pulp, two roll-on roll-off berths, and to conventional cargo berths with modern single-storey transit sheds.

This dock is now handling the big transatlantic containerships from east coast ports of the United States, which carry up to 1,000 containers per voyage, as well as short-sea container and drive-through freight and passenger/car ferry services on the Continental and Scandinavian routes.

Ocean containerships require about 35 ft. of water for berthing and up to 20 acres of parking land alongside—compared with the average three to five acres cargo space of a conventional berth. Such land was only available at Tilbury. To construct the new dock, rows of huge concrete monoliths, each measuring 30 ft. square and 50 ft. deep, were sunk into the marshland. There are 231 of them forming the quay walls, and they were sunk at the rate of about 10½ ft. per week. The deeply embedded monoliths provide a very firm foundation for the heavy container handling cranes and the mechanised parking and stacking operations.

Once the concrete monoliths were in position, the area between the quay walls was dredged out by bucket dredger, assisted with grab dredgers to clear alongside the walls. Some of the excavated material was dumped in the Thames estuary, and some pumped ashore on to new reclamation areas down river.

Since Tilbury's existing impounding station could not provide the volume of water required for the new dock, a new one was built—designed not only to increase the water intake but also to reduce the inflow of river silt. The four pumps of the new station, driven by 560 h.p. electric motors, have a total capacity of 1,200 cubic ft. of water per second. They are programmed on punched tape to operate automatically for a four-hour period from 2½ hours before high water to 1½ hours after, but only when the water in the dock falls to a predetermined level.

Special cranes are required for the fast loading and discharge of standard 20 ft., 30 ft. and 40 ft. international containers which weigh up to 30 tons each when loaded. At Tilbury two 30-ton capacity Portainer cranes, which cost some £200,000 each, are working on the quay of No. 40 berth where the regular transatlantic all-container service of United States Lines is based. These powerful machines have a very high operational capacity. Loading and discharging containers simultaneously, they work in a rapid one-on one-off time cycle of about 2½ minutes.

Mobile straddle carriers move containers from the quayside to the container park, and vice versa, or deliver directly to or from lorry or rail wagon. These carriers can also stack 20 ft. containers three high and 40 ft. containers two high and, like the portainer cranes, their operating rates are fast. The carrier can be positioned over a container at the quayside and pick it up in 18 seconds, and can release the container in a park and move clear in only 42 seconds. Total time for the complete operation depends on the distance between quay and park, but straddle carriers travel at speeds from 10 to 20 m.p.h.

With such modern high-speed machinery in use, there is an enormous saving of time and labour in the dock handling process. Container export loads are packed at the factory, picked up from there by road vehicles, and delivered either by road or rail freightliner to the Tilbury dock, where straddle carriers and portainer cranes take over and ensure a fast turnround of the ship.

The other development at Tilbury is the new £5 million Riverside Grain Terminal, completed and put into operation early in 1969. This up-to-date terminal provides London with one of the fastest and most efficient grain unloading plants in the world, capable of discharging bulk carriers at a rate up to 2,000 tons an hour. The grain can be discharged into the 105,000 ton capacity silos, or immediately into barges at the same rate for transfer to mills higher up the river.

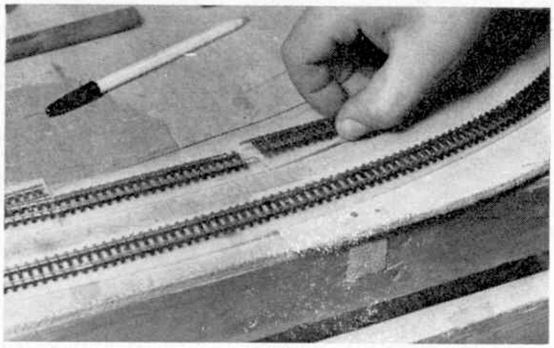
This grain terminal consists of a 950 ft. long river jetty with mooring dolphins, and two discharging towers 180 ft. high. The system of discharge is quite new to this country, but based on methods used in Canada. The discharging towers are equipped with bucket elevators which take up the grain from the ship's hold, and there are pneumatic hose elevators for the final cleaning up of the corners where buckets cannot reach. From the towers the grain is carried on conveyors to the silos or other discharge points. For the present the riverside jetty will take bulk grain ships up to 35,000 tons, but provision has been made to take vessels of 45,000 tons and over after dredging.

Although the Tilbury developments have naturally overshadowed all else, the modernisation and re-equipment of Britain's leading port has continued steadily ever since the end of World War II. Everywhere in the Port of London the new dock facilities have been designed to speed up and simplify cargo handling, and allow a faster turnround of shipping. More and more cargo operations have been mechanised. Old and obsolete warehouses have been replaced by modern transit sheds of clear-span type, which permit the free movement of fork-lift machines handling palletised cargo at high speed. New dock approach roads and quayside parking areas have been provided for the huge increases of road vehicles which deliver and collect cargoes.

Above is an ariel view of the Port of London Authority's West India and Millwall docks (Millwall docks in the foreground).

A new £1 million three-storey shed at South Dock, in the West India and Millwall group, has cargo transit facilities at ground and first floor levels, with warehousing on the top floor. A special feature is the elevated roadway for direct lorry access to the first floor transit area. Ships alongside the berth can discharge cargo simultaneously to ground and first floor levels. Four overhead electric cranes are used for moving cargo from the warehouse to road vehicles at first floor or ground level and to rail transport.

The P.L.A.'s new £30 million grain terminal is shown above, whilst below is an ariel view of the "Royal" group of docks.



Filing down sharp corners and inside edges on the rails makes *fish plating* much easier.

BUILDING AN 'N' GAUGE LAYOUT

by

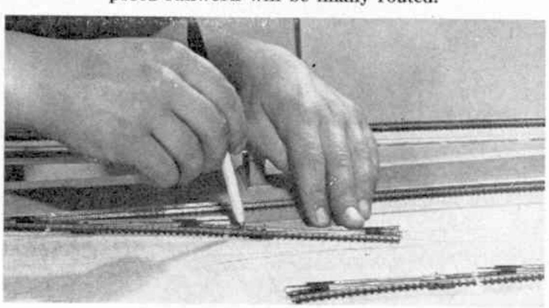
P. Tomlinson

Part V: TRACK LAYING

THE KEY to good trackwork—apart from the gauge which is taken care of by the manufacturers—lies in getting it dead flat. Twists and bumps derail rolling stock and another virtually essential aid to good running, particularly in as small a scale as " N," is to file off the sharp corners at the sides and tops of the rail ends with a fine file. Particular attention should be given to the inside edges where the flanges of the wheel bear against the rail This also makes *fish plating* much easier.

Most people use a foam plastic underlay or inlay for ballasting their track. This has the distinct advantage in disguising the necessarily overscale thickness of " N " gauge sleepers as well as producing a sprung track for good electrical contact and quiet running. Peco recommend that their inlay be fitted to the track before it is curved and laid in place. The ballast strip can then be glued down to the baseboard and the track will automatically be held in place by the ballast. Unfortunately, the glue method means that the ballast cannot be used again if a change of track plan is required. I prefer to pin the track down, but three points have to be watched. First, drill the sleepers a good clearance size for the pins you are using. It is unnecessary to drill the holes closely together, and in fact the fewer pins you use the better, providing that the track is held firmly in place. Secondly, leave the heads of the pins " proud " of the sleepers so that the ballast strips are not compressed at all. If they are too tight the track will end up in a series of humps rather like a switch-back, which is useless for good running. Frequent use of a straight edge on the rail surface will soon show up any irregularities. Get rid of them all, even if a couple of test wagons seem to negotiate the section successfully. Finally, there must be no kinks in the track. Check this by looking directly along the top of the rails, or if you cannot get your head down low enough, use a small mirror. Although you may have used proper templates and straight edges to align the rails, it is still possible to produce dog-leg joints, especially on curves. These joints are bound to produce bad running but can be eliminated by pinning through the second and fourth sleepers from the end of each section of track, at the same time holding the joint in alignment.

Using track as a template gives a clearer idea of where proposed railwork will be finally routed.



The easiest way to start laying your track is to begin at a terminus or hidden sidings, working your way gradually round the baseboard. Fix the point at the throat of the terminus in position first, and then lay the track and subsequent points towards the buffer stops. Remove the moulded chairs or rail fastenings on the end sleeper of a length of track to allow the rail joiners or fishplates to slide over the sleeper. Push the other ends of the rail joiners over the point rails and pin down the track, making sure that the point is aligned correctly. Fix down the rest of the track length, and continue laying the remainder of the trackwork, following as closely as possible the layout plan drawn out on your baseboard. Where two or more points are situated close together, as in a station, the sensible routine is to locate the points first and then bend and cut the track to fit. Use a fine-toothed saw for cutting the rails, and file the cut edges smooth.

Curving flexible track calls for more than just a quick bend of the track. While large radius curves can be judged by eye, anything lower than 12 in. radius in " N " gauge is best laid with a template cut from stiff card or hardboard, measuring 2 ft. to 3 ft. long. Mark this out with care, and when laying a curve longer than the template, only move it forwards for half its length, keeping the rest up against the part previously laid, and taking particular care to avoid bad alignment at points.

The appearance of the finished trackwork can be greatly improved by painting. A realistic track colour is available from the recognised model paint manufacturers and this should be used as a basic colour greatly thinned down with white spirit. Do not forget to paint both sides of the rail, wiping the top surfaces clean before the paint has time to dry. This painting can be carried out with a coarse brush using a dabbing motion. After this basic colour has dried, further applications of different colours can be used to create greater realism. The main line ballast will probably look newer and fresher than that in goods and locomotive yards. There will be patches of dirtier, darker colour on the ballast where locomotives have stood in station areas, and by coal stages the track bed will consist mainly of coal dust, so you will have to use your powers of observation and imagination to reproduce this sort of effect in miniature.

TRANSPORT TOPICS

by Mike Rickett

A RAIL trip of a very different kind, designed amongst other things, to help boost Britain's exports to the U.S.A., is now being undertaken by the famous "Flying Scotsman" which sailed for Boston on the "Saxonia" recently. Accompanied by Mr. Allan Pegler, owner of the locomotive, the train will run a 2,200 mile trip round the United States lasting about 38 days. She will have with her four Pullman coaches, two of which—"Lydia" and "Isle of Thanet"—were used by Sir Winston Churchill during the war. These were shipped to the U.S.A. on the "Ivernia" in September. The remainder of the nine coach train—four exhibition coaches and an observation coach—set sail on the "Parthia" on September 4. Accompanying the train will be Pipe Major Robert Crabb, formerly of the Scots Guards, who, complete in dress uniform, will be playing his pipes on the train from Hartford to New York, Philadelphia to Baltimore, and from Washington to Atlanta and on to Dallas.

Amongst the firms participating in the venture are British Rail, who will be showing in their display some of the latest developments in railway technology in which Britain has established a world lead. They will try to persuade more American tourists to visit and see Britain for themselves—by rail of course!

One of our photos this month gives an impressive view of a Hawker Siddeley "Harrier" landing on the flight deck of the cruiser "H.M.S. Blake" during trials over the weekend of 2nd and 3rd August. The result of a directive from the Ministry of Defence for

the Navy to study the use of the "Harrier" for operations from ships in the 1970's, the aircraft was flown from Dunsfold airfield in Surrey by the Chief Test Pilot of Hawker Siddeley Aviation Ltd. H.M.S. Blake was operating just South East of the Isle of Wight and this was the first occasion that the "Harrier" had landed on a Royal Navy cruiser.

For the trials, the "Harrier" performed thirty-four vertical take offs and landings, whilst H.M.S. Blake was steaming at speeds varying from 10-25 knots and with a rolling action of up to five degrees. Throughout the trials the "Harrier" was unaffected by gusts, and operated with the ease of a helicopter. H.M.S. Blake—10,000 tons—has a flight deck of 117 feet long by 56 feet at its widest point, normally carries a squadron of four Royal Navy Mk 3 Wessex helicopters. It will carry four Sea King helicopters when these aircraft come into front line service.

Readers may remember in a recent "Transport Topics" that we mentioned the disastrous fire in the Alcock and Brown Exhibition at Manchester Airport which succeeded in severely damaging the flying replica of the Vickers Vimy. It returned to Wisley on August 4 to start a four month repair operation and it is hoped to have the Vimy flying again before the end of the year. Due to the gallant action of firemen and ground crew, a total loss was averted by preventing the flames from reaching the fuel tank. It is believed the fire was caused by reflected sunlight being concentrated on the wing fabric.

1968 was British Rail's 21st Anniversary as a nationalised industry and under the 1968 Transport Act they now have tough but realistic financial objectives. Tough because the Act has now ended the system of deficit financing, which means that from now on B.R. are on their own: there will be no government subsidy to help them. The Act is however realistic in that it does not expect B.R. to pay for those lines that do not pay for themselves. It instead lays down that the cost of these services be met by the community.

Despite their economic difficulties however, a great deal of development work has been going on and B.R. are already well advanced in designing the next generation of diesel and electric locomotives. Designs for new style Inter-City coaches are also now taking shape and these will have a high degree of insulation as well as double-glazed windows and pressure ventilation or air conditioning. One important result of research carried out by the back-room boys is an improved type of lubricating oil to cut down the number of hot axle boxes on freight trains and also the development of a hot box detector which can sense a temperature rise in a hot axle box as a train passes by. After the few accidents of last year, prospective passengers will also be pleased to hear that more staff has been trained to detect rail flaws using 60 new pulse-echo flaw detectors—portable electronic machines which give visible and audible warning of hidden defects.

MAHATMA GANDHI ON STAMPS

by James A. Mackay

IN 1869 there was born in the town of Porbandar in the Indian state of Kathiawar, a Hindu of middle class parents. The boy's name was Mohandas Karamchand Gandhi, though later in life his followers were to confer on him the title of Mahatma or Great Soul. It is not so much what he achieved as what he stood for, that Mahatma Gandhi is remembered today and in this, his centenary year, stamps are being issued in his memory all over the world.

One of the countries which is currently celebrating the centenary of Gandhi's birth is Mauritius, the Indian Ocean island with a large Hindu population. Indians came to Mauritius as indentured labourers in the nineteenth century after the negro slaves were emancipated. Gandhi visited Mauritius in 1901 and spent some time with the Indian community there, and this accounts for the great interest shown by Mauritius in him.

Mauritius has issued a set of six stamps which bear different portraits of Gandhi, outlining landmarks in his career. At the age of 19 he came to England, studying for a time at University College in London before being called to the bar by the Inner Temple. The 2 cents stamp in the Mauritius series portrays Gandhi as a student, looking very smart in his wing collar and bow tie. He returned to India and practised law in the Bombay High Court, building up a successful and lucrative practice.

In 1893 business took him to South Africa and there he was appalled by the conditions in which the Indian community were living. He gave up his Bombay legal practice and threw himself wholeheartedly into a long and sometimes bitter struggle for the civil rights of his fellow Indians. It was in the course of this movement that he formulated the doctrine of Satyagraha (literally, insistence on truth) or non-violent non-co-operation with the authorities as a means to securing civil liberties. The 50 cents stamps of Mauritius depicts the young Gandhi as a *Satyagrahi*, during the period when the Indian community resorted to civil disobedience to gain their rights and liberties. Gandhi also established an Indian colony near Durban in Natal. He was arrested on several occasions and often subjected to great indignities and persecution but he remained steadfast in his aims of establishing a multi-racial community in South Africa. On three occasions he demonstrated his fundamental loyalty to the Government; during the Boer War he raised and commanded a Red Cross unit, he organized a plague hospital when an epidemic broke out in Johannesburg, and he led a stretcher-bearer party during the Zulu rebellion in Natal in 1908. In connection with the last of these events he is portrayed on the Mauritius 15 cents stamp, in military uniform and ' basher " hat. The 1 rupee stamp shows Gandhi at the time of his visit to Mauritius in 1901.

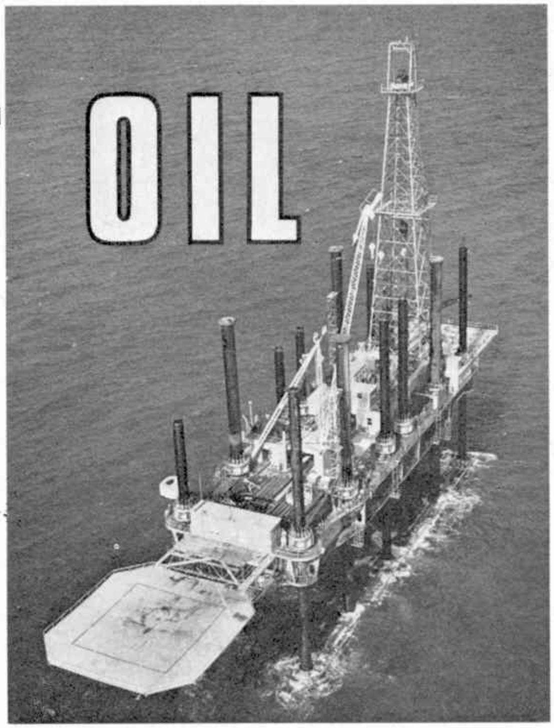
In 1914 a commission of enquiry eventually examined the grievances of the Indians and the worst abuses were subsequently removed. Satisfied with the results of his work in South Africa Gandhi then returned to India to organise the Indian home rule movement. The rest of his life was spent in opposing the British and trying to unite the Hindu and Mohammedan communities to work together for a free India. His ideals of non-violent passive resistance to injustice were adopted by millions of people and although they were only partially successful in India they have since been taken up in many other parts of the world, especially by the American Negroes led by the late Dr. Martin Luther King in their struggle for civil rights.

The Indian National Congress elected him as their leader in 1921. The common people of India regarded him as a saint and it was at this time that he came to be known as the Mahatma. During the 1920s and 1930s Gandhi was sent to prison on several occasions. Nevertheless his influence on India continued to be very strong and in 1931 his discussions with the Viceroy led to the Delhi Pact, the basis on which India eventually became self-governing. In the same year he returned to Britain for the Indian Round Table Conference. He made a great impression in London by appearing in the simple robes reminiscent of a beggar rather than of the leader of a great nation. The portrait of him in these humble garments on his visit to 10 Downing Street, appears on the Mauritius 60 cents stamp, and has also been adopted by Malta for its commemorative stamp. The top value in the Mauritius series shows Gandhi in old age. The caption on this stamp—Apostle of Truth and non-Violence—symbolises the saintliness of Gandhi in his last years. After the Second World War he was revered as the father figure of India which he lived to see become independent. It is ironic that, in January 1948, he should have been shot down by a Hindu fanatic. India released four stamps in mourning for him and in 1961 the United States issued two stamps bearing his portrait, in the Champions of Liberty series. Several countries last year chose Gandhi as the subject of their stamps marking International Human Rights Year, but now the centenary of his birth is being celebrated globally. On August 13th Britain released a stamp portraying Gandhi—the first occasion on which a person other than a native Briton has been thus honoured.

The STORY OF OIL

by Trevor Holloway

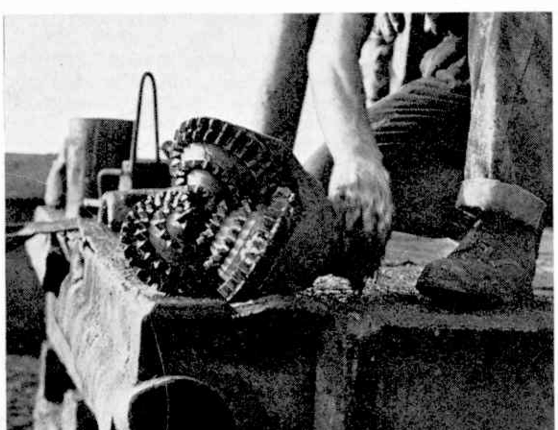
Rightly called the life blood of the 20th Century, oil plays an increasingly important role in our modern world



"Mr. Gus", a 1½ million pound offshore drilling platform designed to operate in 100 ft of water in the Gulf of Mexico. The derrick platform (background) is connected to the service platform by a cat-walk, which contains the supply store, crews quarters and (foreground left) the built in helicopter port. *A Shell photograph.*

THE FARMERS and lumbermen of Titusville were convinced that Edwin Drake was an eccentric crank. In fact, he had become a standing joke in the district. Their amusement lay in the fact that Drake actually expected to obtain oil by means of the bore-hole he was drilling with great difficulty in the iron-hard rock on the outskirts of the town. He had been labouring away for nearly a year and all he had to show for his efforts was a hole in the ground.

A typical drilling "bit", used for hard formation rock drilling.



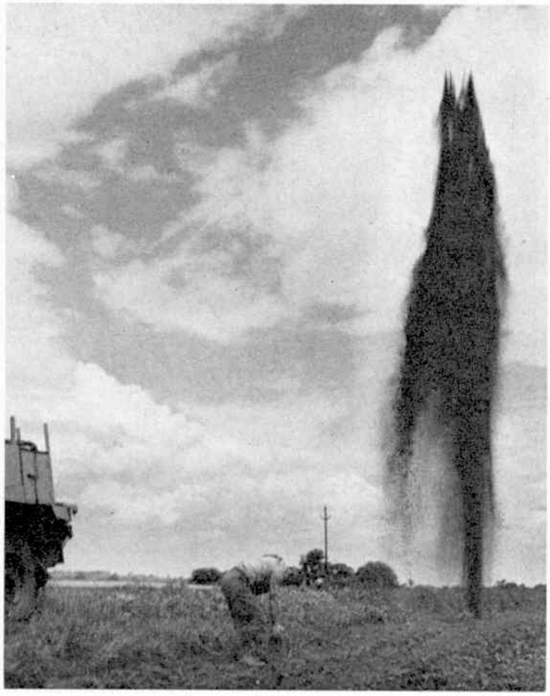
The scoffers laughed loud and long and were not backward in letting Drake know their opinion. Drake said nothing, but just went on drilling. One day, he felt sure, he would silence their laughter in no uncertain manner.

Sure enough, that day came. On the afternoon of Saturday, August 27th, 1859, Drake struck oil at a depth of only 69 feet and by the following afternoon his well was three parts full of oil.

But even Drake himself did not fully realize the importance of his achievement. He could not see mirrored in the dull gleam of the green-black liquid the images of cars, aircraft, motor ships and all the other innumerable power units of transport and industry which were to spring from the use of petroleum as a fuel. At the time he saw only oil—oil for lamps and oil for lubricating machinery.

Some of the very men who had scoffed at his idea took one look down the well then saddled their horses and rode off at break-neck speed to buy up mineral rights in the area. They needed no telling that oil spelt money—big money if there was plenty of oil below their feet.

Immediately the stirring events of Titusville became known to the world outside, the stampede to the oil territories was similar to the Californian Gold Rush of ten years previous. Some struck it rich and others lost their all, but a gigantic new industry had been born—an industry that was to change the pattern of life the world over. Man had discovered yet another of Nature's long-buried treasures.



Above: A mud and water plume rises high into the air as a 20 lb charge of gelignite is fired in a shot hole to make a miniature earthquake. *A B.P. photograph.*

Below: Two men are shown lowering a drill pipe into position. *A B.P. photograph.*

Today, on the very spot where Drake drilled his historic well, stands a huge stone on which is a plaque which reads: "This native boulder marks the spot where through the foresight, energy and persistence of Edwin L. Drake the first well was drilled for oil. On August 27th, 1859, oil was found at a depth of sixty-nine feet. This great discovery inaugurated the petroleum industry."

In 1859, production of petroleum was about 1,000 tons. Today it is being produced in about 50 countries, with a total production of around 36,589,000 barrels per *day* !

Although the oil industry itself is only a little over a hundred years old, the use of pitch, or bitumen—produced by the weathering action of sun and wind from crude oil which had seeped to the surface—dates from earliest times.

The "eternal fires", for instance, which played such an important part in the religion of the ancient Persians on the shores of the Caspian Sea, were simply burning seepages of petroleum gas and oil which had become ignited on escaping from the ground.

What exactly *is* oil ? For many years scientists held two different theories. Some believed it was of organic origin, whilst others argued it was a purely chemical process. The organic theory is now generally accepted as being the most probable.

This theory suggests a slow accumulation, beginning anywhere between 13 and 400 million years ago, of fragments of plant and animal life in the mud and silt of ancient seas and lagoons. The main source appears to have been microscopic marine life called plankton. Countless billions of these minute organisms died, sank to the bottom of the water, and were there sealed in the mud before they were decomposed.

Here a certain type of bacteria worked on them and eventually the pressure of the water above converted the mud into shale, and the source-material of oil was finally imprisoned. So it remained until some disturbance in the earth's crust brought a tremendous pressure to bear upon the shale, and the oil was squeezed out. Some found its way to the surface, but the greater part became trapped by rock formations, there to remain imprisoned, awaiting the day when the oil prospector's drilling bit should locate it.

In the early days of the oil industry, new wells were often drilled merely because some prospector had a 'hunch' that oil would be found ! Nowadays, the search for oil is carried on with the assistance of the skilled geologist and geophysicist, and the element of chance has been considerably reduced. Even so, it is still the driller's bit that finally proves the existence of oil.

Aerial photography has speeded up preliminary survey work enormously. Tens of thousands of square miles of country can be photographed in a matter of weeks, thus saving months or even years of work, especially in areas of swamp or tropical rain forest. The surface features indicated by the photographs are studied by the geologist and these give him a clue as to the most likely areas to search.

One of the most successful means of obtaining information on the nature of underground rock strata is the *seismic* method. Small artificial earthquakes are created by firing charges of explosives. The resulting shock waves are recorded by instruments known as seismographs, and from these readings the skilled geophysicist can gain a good idea if the sub-strata is likely to be oil-bearing, and at what depth it lies.

Until recent times, wells were drilled by the 2,000-year-old 'percussion' method, whereby a heavily-weighted chisel-shaped tool was raised and lowered and made to punch its way into the ground. The majority of modern wells are now sunk by rotary drilling, which makes use of a rotary cutting head working on much the same principle as the carpenter's brace and bit.

For drilling a deep well a 23-inch bit is normally used for the first few hundred feet. As the well deepens, progressively smaller bits are used. A well drilled in California was completed with a 3½-inch bit at a depth of 17,754 feet. Actually, drills have reached depths of more than 25,000 feet.

Some of the world's richest oilfields lie under the sea and special drilling techniques have been developed to tap this submarine wealth. Some wells in the Gulf of Mexico are thirty miles out to sea. Drilling is far more complex and hazardous than well-drilling ashore, for the derricks have to be erected on huge platforms built up on caissons driven deep into the sea bed. These island platforms are self-contained units, housing derrick, pipe racks, mud pumps, offices and sleeping accommodation for a crew of 50 men. They are built to withstand waves of 30 feet and winds up to 125 m.p.h.

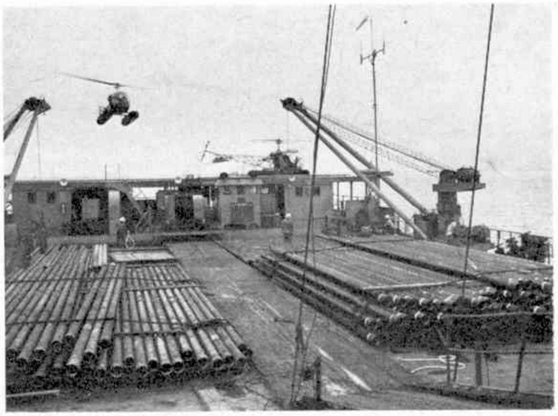
An exploration well situated 13 miles from Timinoun in the Algerian Sahara Desert. *A Shell photograph.*

Modern pipelines are marvels of engineering. Actually, the pipelines, in a primitive form, are an ancient mode of transport. The inventive Chinese are believed to have used bamboo pipes for transporting water as much as 7,000 years ago. Probably the first oil pipeline used by the oil industry was constructed in Pennsylvania in 1861, only two years after the successful completion of Drake's historic well. It was made of wood and was about six miles in length.

Sometimes oil will flow through a pipeline by force of gravity alone, but normally it requires pumping, or 'boosting', to keep it moving. The great trunk pipelines of America, as intricate as any freight railway network, are serviced by pumping stations whose controls are as numerous as those of a main-line signal box.

In these stations, operators, by means of valves, can regulate the oil streaming through hundreds of miles of pipe and divert it to storage tanks, refineries or ports, just as a signalman can switch a train to whatever siding, track or marshalling yard is required.

Different consignments of different oils follow each other through the trunk routes like so many wagons in a goods train, but the pumping station operators can ensure delivery of each consignment as accurately and easily as though it had a pipeline entirely to itself. Separate batches of oil in a pipeline can also be successfully marked by inserting radio-active tracers between them, thus allowing rapid switching to be made at the receiving end.

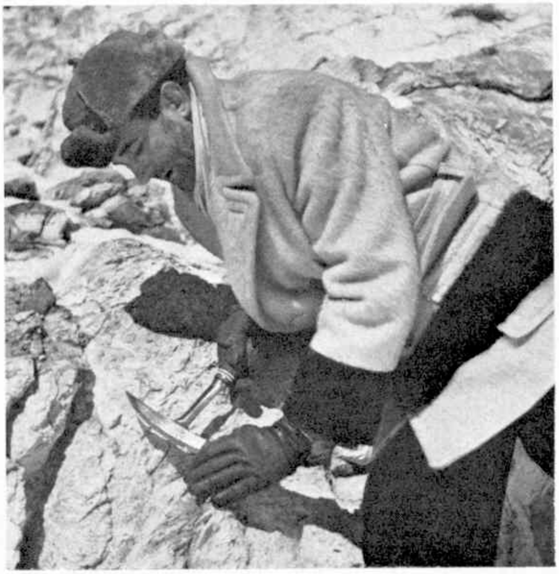


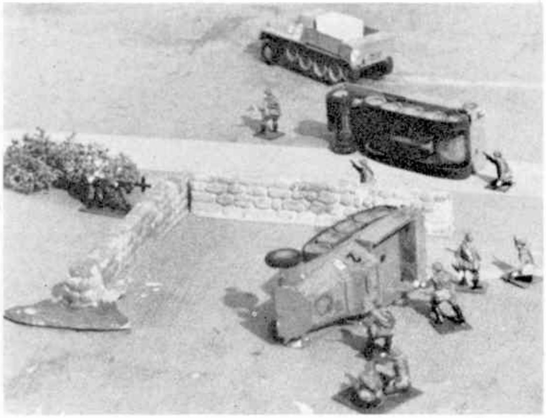
A helicopter landing on a drilling platform operating on Lake Maracaibo, Venezuela.

The 1,067-mile long Trans-Arabian pipeline linking the oilfields of the Persian Gulf region with a Mediterranean shipping point, has six pumping stations along its route. Each station cost about £2 million to build and is equipped with refrigeration plant, a laundry, swimming pool, cinema, hospital and other modern amenities.

In view of the vastness and importance of the oil industry today it is probably true to say that the well Edwin Drake drilled at Titusville in 1859 was the most important hole in the ground ever made by man.

A geologist in Canada taking a rock sample.





BATTLE
Part X1X
Artillery Organisation
by Charles Grant

GUNS HAVE to be organised in units and there is no reason why, in doing so, we should not adhere to the traditional unit, the battery. Obviously, what we are going to describe will not contain nearly as many pieces of artillery and transport vehicles as its real lift prototype, but our wargame battery will be scaled down to a size compatible with what we earlier decided was to be our infantry unit—the ' battalion ' of three infantry groups and a headquarters company. Experiment and much practice have shown that, in the scale we are using, the handiest unit for artillery is a battery built around two guns. This is so in two ways, in fact, first, as regards the relative volume of fire the battery delivers, and second, as far as it relates to the amount of space it occupies on the wargame table, both when actually engaged in firing in ' battery position ' and in the process of moving from place to place in column of route.

Although we are initially considering in this context a field battery, it might be as well to note that the organisation we shall detail applies generally to any other type of artillery, medium, heavy, or anti-tank. One further point before we continue—although this will become obvious—is that we are talking about towed artillary, self-propelled and assault guns coming in a different category.

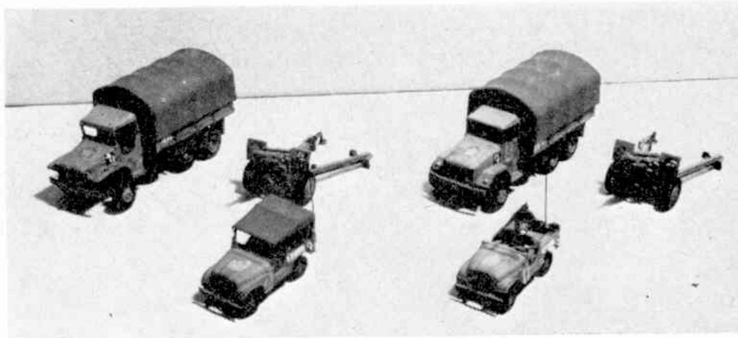
As to the actual guns we use, several different types are available, and if I have chosen to employ those produced by one particular manufacturer, it is not to say that there are not other firms which make any number of excellent models. They do, but of them all, probably the Minitanks range is the most widely known, although it does have its limitations, particularly with regard to British ordnance—the celebrated 25-pounder being completely absent, for instance. If, however, the wargamer is prepared to stretch a point, he won't cavil too much if he finds that the opposing sides in a wargame are equipped largely with the same artillery material (these arms merchants have positively no scruples !). Indeed, if this be the case, no finger can be pointed at a player whose equipment, a defeated opponent might allege, has unfair advantages in the realms of power or range. So with this in mind we can make a start by saying that our field battery will be composed of the 105 mm. howitzer, an admirable gun in every way, and one which any army can employ without being tremendously anachronistic. Besides, the Minitanks version—this really is not a ' plug '—is a fine model in every respect.

It might be as well here if I say that I shall simplify matters by dealing with the organisation of one particular kind of unit, to be specific, my own field battery. This will be simply, because I know it best, and I must confess, it works a treat ! This basic setup will be suitable for any sort of kindred unit; simply substitute one's own guns—if they are other than those I employ, in fact—or different prime movers or towing vehicles—and one gets a standard sort of thing to suit one's own army with little, if any, alteration to the personnel.

So, given two 105 mm. howitzers ready for action, we have to provide them with crews. Now, it is obvious that the eight to ten men required to make the actual field gun operational will have to be scaled down, so, without going into a lot of detail, we do this simply by allocating to each gun a crew of four men. If desired—and this could, I suppose, be pretty important—one could be given the rank of N.C.O. or gun commander. This is a personal preference, but the man who really is essential, from the wargame point of view, is the battery commander, his presence having a very significant effect for two separate reasons, one—the effectiveness of the battery in action, and two—the consideration of morale, the vague quality which has such an effect on the performance of troops under fire, and of which we shall have much to say later. If the wargamer wishes, the battery commander will have his own command car, but rather than multiplying unnecessarily the number of vehicles in the battery, I may perhaps be forgiven a little economy if I accommodate him in the battery radio truck. This is not really illogical, as he would have to be in closest possible contact with the information being relayed to him by his Forward Observation Officer. The radio car could be the same type as that used for the Headquarters Company of our infantry battalion, but I don't think that such elaboration is strictly necessary. After all, the main radio channels in use are but two in number, that used by the F.O.O. and the one affording contact between the battery commander and the infantry with which he is associated, the infantry in fact to whom he affords artillery support. However, if the wargamer wants to have the ' pukka ' job and have a radio truck as such, then it's up to him. It could be said, of course, that, in addition to the two radio links just mentioned, a third—connecting with higher authority—might be necessary, but for the moment though let us stick to the two-channel command jeep which will then have, as personnel, the inevitable driver (fixed, of course), the radio operator and the battery commander.

Next, we have another very important part of the organisation—the Forward Observation Officer and his transport. Again we cannot do better than use a jeep for the latter—rather a different type this time, as one can see from the photograph. I have chosen to mount

The Ambush! The heading photograph shows a close-up of the Panzerfaust attack detailed in the recent "Action at Twin Farms". Right: The guns and vehicles of the field artillery battery. Note the machine gun mounted in the Forward Observation Officers' jeep.



a machine gun on it. This might be considered a bit of personal idiosyncracy, of course, and has no real justification other than the theory that the F.O.O. is probably going to be called upon to go zooming ahead into pretty close contact with the enemy, and might well need a little protective firepower. The M.G. operator could be a sort of co-driver, and the third occupant would naturally be the great man himself, the F.O.O. in person. It is doubtful whether a fourth man, say a reserve operator, could be accommodated in the jeep, much of which will be pretty well occupied with radio equipment. Furthermore, the F.O.O. in addition to the radio installed in the jeep, would certainly have his own portable transmitter. In many cases he would have to leave his transport concealed somewhere and carry on on foot, climbing to the top of a church tower or to the upper branches of a convenient tree to get a good view of what he was hoping to direct his guns on to, or lurking about the edge of a wood to the same end, to give but a couple of examples. All this plus the fact that his contact with his guns must be close and immediate and the fewer intermediaries the better—it is appallingly easy to make errors in the transmission of messages, even on the telephone and the closer the connection between the people who are transmitting or receiving the more efficient must be the communication. Thus, in the F.O.O.'s jeep, equipped as we see, with the antenna showing its function, we have the F.O.O. in person, the driver and the M.G. operator, all more or less lumped together with the mass of W/T apparatus.

So, to the jeeps and, of course, the guns we have to add only the gun tractors, the prime movers. There is a pretty wide range of vehicles we can employ in this role, and, as the photograph shows, my own choice is the 2½-ton truck. These serve a double purpose, in fact, to tow the guns and to carry ammunition and the crew. That the vehicles are soft-skinned need not cause great alarm—they are unlikely to come into close contact with the enemy with any frequency, and they have to stand the chance—not really very great—of being hit at long range by enemy counter battery fire.

The next point to be considered is the question of the mechanics of operating the guns and how long it takes to get them into action—the process, that is, of unlimbering and limbering up. This, even for a substantial piece of artillery such as a field gun, is a fairly rapid operation when carried out by a well-drilled crew, and naturally enough all of ours have been trained to a high degree of efficiency! Take the unlimbering process first—with its gun bumping along behind it, the truck comes bombing up to the designated point where it is going to come into action, the gunners leap out, 'unhook'—for want of a better word—the gun from the truck, swing it into position, get a round of the appropriate type into the breech and await the gun layer's directions (it really is a more complicated business in actual fact—this is a description of the barest essentials and we assume that the battery commander has already a rough idea of the direction of fire—he merely awaits the accurate directions of his F.O.O.). All this would take a minute or less, and thus we consider it to occupy a complete move, and the unlimbering sequence might be as follows:

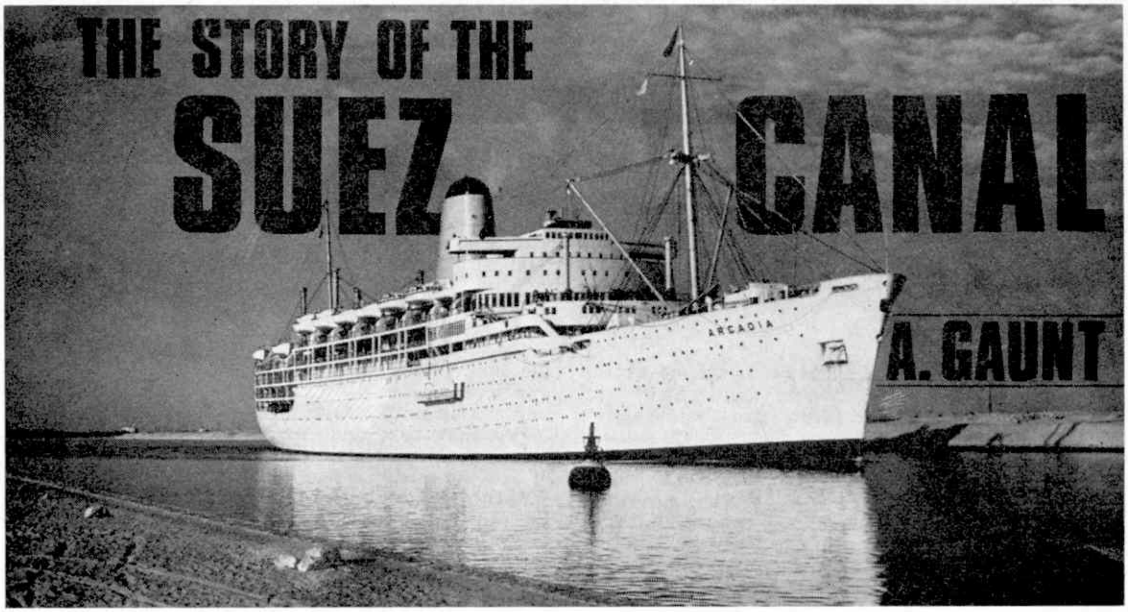
Move 1—Tractor moves up with gun to battery position.
Move 2—Gun unlimbered, in position.
Move 3—If directions available, gun opens fire—of course, if the target is visible, no radio directions are necessary.

The reverse also holds good.

Move 1—Tractor comes up to the gun.
Move 2—The gun is limbered up.
Move 3—Tractor moves off with gun.

We know the road and cross-country move for trucks, but this will naturally be affected by the weight of the gun which is being towed. Let us say then that a third of the normal speed is lost when the truck is acting as prime-mover and is towing a field gun. By this token, the moves are therefore: overland—4 in.; on roads—16 in.

Let us conclude with one very important point. This is the question of how many men are basically necessary to fire the gun. It is hardly necessary to point out that even the minimum requirement involves quite a number—the shells must be carried from truck to gun, the charge selected, gun controls operated and so on. Casualties to the crew can reduce it to a point where there is not enough personnel to maintain the piece in action. Let us say then that to man the gun requires an absolute minimum of 50 per cent of the normal establishment, that is, in our wargame, two men. But with two men only, the gun would naturally be served more slowly than with the full complement, so we enact that in such circumstances, i.e., with but half the ordinary crew, the gun may fire only every other move. With less than two men, sad to say, it has to remain silent. There has to be a further restriction in that two men are required to carry out the limbering-up or indeed the unlimbering, but here it is fair to allow non-technical assistance. If the crew is reduced to one, and it is decided to limber up and get the gun away to a healthier spot, this may be done with the assistance of a passing infantryman, or anyone else who might happen to be about. When things are absolutely desperate and the battery is in dead trouble, no less a personnage than the battery commander might be called on to lend a hand. After all, it's a dreadful disgrace for gunners to lose their guns!



One hundred years ago this month the Suez Canal was opened, thus creating a passage between the Mediterranean and the Red Sea

THIS MONTH (Nov. 1969) is important in the history of ocean shipping routes, for its brings the 100th anniversary of the ceremonial opening of the Suez Canal, the 101-mile man-made waterway linking the Mediterranean and the Red Sea. As a short-cut for vessels plying between Europe and India, its only rival for boldness in conception and construction is the Panama Canal—and that example is only half as long.

The turbulent story of the Suez route since its nationalisation by Egypt in 1956 reflects earlier controversies relating to it. Britain vigorously opposed the enterprise when it was first mooted, declaring disquiet for a scheme that would give France and other countries easier access to the Indian Ocean and enable them to expand their overseas commercial interests. Britain, indeed, proposed the substitution of a railway instead, no doubt expecting that the use of this line would be limited, entailing trans-shipment of cargoes and inconveniencing passengers. George Stephenson Jnr., son of the railroad pioneer, actively supported the idea of building a Cairo-Suez railway. He was so much against the provision of a canal that he publicly questioned the honesty of France in backing it. The affront so angered the leader of the French scheme, Ferdinand de Lesseps, that he challenged Stephenson to a duel! Lord Palmerston and a number of other British statesmen considered it impossible to construct a canal capable of accommodating ocean-going ships. Politicians pointed out that if one *could* be provided, it would imperil Britain's mastery of the seas. The project was described as a French ruse to extend that country's maritime power in the East. Nevertheless, de Lesseps got a concession to form a company that would finance and create a Suez Canal without British approval or help.

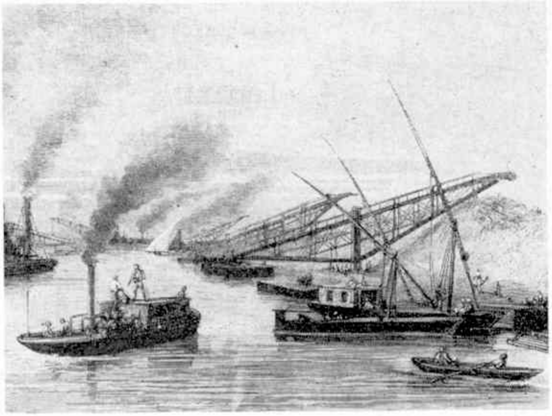
Camels were used to carry some of the materials needed in constructing the 101-mile channel for seagoing ships, between Port Said and Suez.

The first sod was cut in 1855, and large numbers of navvies were recruited to dig the channel. Although steam power was in its infancy, the contractors brought "mechanical devices of great originality and power," as records describe the machines. Dredges of three sizes were used, the largest being run by a 75 h.p. steam engine. More than 100 ft. long and 27 ft. wide, this mechanical giant could raise its scoop 48 ft. One reporter stated that nobody who had seen an ordinary dredger working in an English river could imagine the bold way in which the same principle was being applied to excavating the Suez Canal. The civil engineering operations pioneered a number of ideas widely but wrongly attributed to our present century. Thus the modern movable containers introduced by British Railways, for transporting bulk consignments more quickly and more easily, had their counterparts in the Suez Canal equipment. Dredgings needed for embankments and other purposes were lifted from the cutting and allowed to drop into boxes with a capacity of four cubic yards. Seven of these boxes fitted into a barge moored below the spout of the dredger. When all the capacity was filled, the barge was floated under a steam-driven crane which lifted out the boxes and transferred them to trucks running along a tramway. At their destination one end of the boxes was opened on hinges, and the contents were readily deposited. Nevertheless much of the excavating was done by hand labour. Over 12,000 navvies were enlisted at wages from 1s. 6d. to 2s. 6d. a day, plus free meals. The most critical stage in the canal development arose when the route had to cross Lake Menzaleh to Kantara, a distance of about thirty miles. The Lake had a depth of only 5 ft., and the bed was merely mud. Opponents of the whole enterprise expected that, when a deep channel was scooped out, the bottom would not hold water. The mud (it was believed in some quarters) would soak up everything.

The problem was solved by adapting a method used by tribesmen on the shores of the lake. Their time-honoured system was to scoop up masses of the soggy material and press these against their chests to squeeze out the water. The lumps were then laid one on another to form a narrow channel.

The civil engineers of a century ago had a channel of this sort made for them. Then they used mechanical dredgers to deepen it and bring up clay from a lower stratum. The slob was allowed to bake in the sun before being discharged on to the canal banks, thus forming shores high enough to contain the waterway. The simple expedient of allowing the material to dry before each new layer was added created cohesion and solidarity, and the water allowed to fill the channel did not drain away as the pessimists predicted. The blistering sun baked the banks so effectively that they were used as roads for heavy transport, as well as containing the waters of the canal between them. A useful circumstance was that no locks were needed anywhere along the 101-mile route, the water of the Mediterranean and the Red Sea being at almost the same level. In addition to running along the edge of Lake Menzaleh the Canal was constructed to incorporate other lakes. Even so, the whole job took more than ten years and cost nearly £30-million, double the original estimate By October, 1869, however, this great artificial channel for carrying ocean-going ships across the Isthmus of Suez was ready for navigation. At the beginning of that month a French steamer the *Louise-et-Marie* made maritime history by voyaging along the entire route from Suez to Port Said.

The official opening ceremony took place on November 17, and the occasion presented a unique spectacle. Never before or since the event has there been such a gathering of royalty and heads of state in maritime surroundings. More than 80 vessels, including 50 warships, massed at Port Said, and all the flags of Europe were flown. The guests included men of eminence in various branches of endeavour—statesmen, artists, scientists, musicians, men-of-letters, and businessmen. Tens of thousands of sightseers flocked to the Isthmus to witness the *Aigle*, the Imperial yacht



Giant excavating equipment was used in digging the channel and enclosing it between high banks.

of the French Empress Eugenie, leading the unusual fleet along the Canal. Lesseps, the genius of this sea-to-sea masterpiece, was among the illustrious people invited by the Empress to be aboard her ship. His presence there was a deserving honour, and was an outstanding reward for his creation of a new and shorter route from Western Europe to the East. Great Britain was represented in the procession by the Admiralty yacht *Psyche* and a couple of fighting ships acting as escorts.

From 8 a.m. onwards the vessels forming the procession passed into the Canal at regular intervals, and the last one did not join the fleet until evening.

Ismalia, used as a halting-place on the route, put on a gala appearance for the distinguished visitors, and the night sky was made brilliant by displays of fireworks. Oddly, when the fleet dropped anchor at Suez on November 20, accommodation for the important personalities woefully inadequate, although the port was in festive mood and triumphal arches had been built to welcome them. The festivities lasted several days, and did not end until the most distinguished visitors had left for home. Most of them went back by overland routes, leaving their ships to make the trip along the Canal with only a few passengers. After its auspicious opening the waterway had to adopt its real purpose as a commercial enterprise, financed by shareholders who got dividends from levies imposed on ships using the route.

Sightseers flocked to see the Canal being officially opened a century ago.

A fleet of eighty ships took part in the opening celebrations of the Suez Canal in 1869.

The Suez Canal has undergone some physical changes since it was opened, these measures including deepening the channel so that bigger ships can go along it. Its original depth of 26 ft. was increased to allow ships drawing 34 ft. to use it. New suction dredgers were introduced to speed up the deepening and widening operations before the crisis with Egypt in 1956 put the route out of service. How the Canal came under British control, as a result of the secret acquisition of more than half the shares by Disraeli, in 1875, is now well-known. Less widely realised is that the deal was prompted by the editor of a newspaper in London who revealed to Disraeli that the Khedive of Egypt was hard up and would be willing to sell his shares.

Perhaps the most interesting point about the Canal today is that plans to replace it have been seriously put forward. Not even an enlarged Suez Canal could cope with the 400 million tons of cargo expected to be available each year, for transportation between the Mediterranean and Afro-Asia, by the end of the present century. Already there are giant oil tankers that could not pass along the 101-year-old waterway. Whenever that short-cut is completely freed for international shipping, the huge tankers must continue to go round the Cape, unless a deeper and wider artificial waterway is provided to supplement or replace the Suez Canal.

The proposed new canal, from Eilat on the Red Sea to Ashdod on the Mediterranean, would be able to take ships up to 150,000 tons. Civil engineers who have surveyed the route point out, too, that a branch could run to the Dead Sea, which is nearly 400 metres below the level of the Red Sea. A hydroelectrical station could be built to take advantage of this circumstance. Investigations have revealed that the project could be completed by 1981—or sooner if nuclear devices were used for excavating the channel. The use of controlled nuclear explosions for delving is already undergoing scientific examination by American experts, as part of a scheme to open a new route bypassing the Panama Canal. But wherever ship canal enthusiasts and maritime historians meet, Ferdinand de Lesseps will long be remembered as the imaginative Frenchman who linked the Mediterranean with the Red Sea a century ago.

A statue of Ferdinand de Lesseps, the French engineer who conceived the Suez Canal, and who supervised the constructional work, overlooks the entrance at Port Said.

HAVE YOU SEEN ?

Monogram's Tijuana Taxi

This model was actually released before the Bathtub Buggy (reviewed last month), but it somehow managed to get pushed to the back of one of our cabinets, and it wasn't until a couple of weeks ago that we finally dug it out. So, if you have already seen this model in the shops and don't know whether to buy it or not, we hope this review will help you to make up your mind.

As you have, no doubt, already guessed by the title, the model is another of Monogram's "Instant Fun Cars". There are, as usual, plenty of chrome parts, and many amusing accessories such as a fighting cock in a chicken coop, ornamental bullhorns, and a foot-shaped accelerator pedal. The long, automatic gear lever and shaped driver's seat are very unconventional, but then all these Monogram models are !

The Taxi's engine is enough to make any young racing fan's eyes light up, among its many chrome parts are "dual quad" Weber carbs, and long flowing exhaust pipes.

The model is moulded in what Monogram call "Hot Orange", which blends very sickly with the suggested colour scheme of purple, tan, black, red, white and ivory. It's a shame you can't see the colours in our photograph.

A variety of amusing transfers complete the model, which we think is the most delightful in the series to date.

Weller Marksman Soldering Pencils

Every modeller must at one time or another, have had to do a job that requires the use of a soldering iron, and no matter what type of soldering this is, this company produce an iron to suit every requirement.

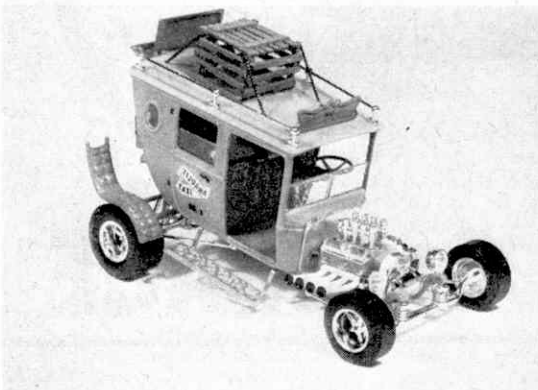
The Marksman series, as they are called, come in six sizes, 15 watt, 25, 40, 80, 120 and 175 watt. All six are for 220-240 volts power supply but can also be obtained from the company for a 120 volt A.C. system, if required.

The large variety of interchangeable Wellertips are all pre-tinned, nickel-plated copper for prolonged life. This eliminates tip dressing and ensures a clean application each time it is used.

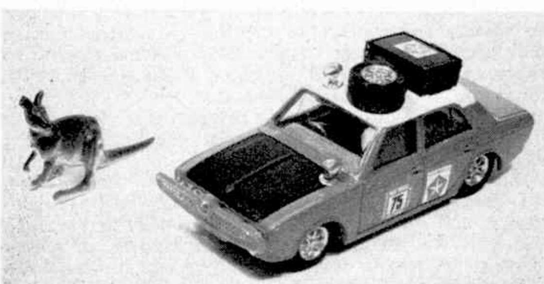
The slim shape and light weight of the Marksman ensures maximum control, and for only £1.12.0. we think this is pretty good value for money.

Included in the pack are two Weller tips, a coil of multi-purpose resin-core solder and a handy soldering aid tool. The whole pack costs £2 2. 0.

Below: Monogram's new "Instant Fun Car" complete with racing Drag Slicks, fighting cock in the crate and large flowing exhaust pipes. There is even a set of bull horns on the radiator!



Below: The London to Sydney marathon winner has now been brought out by Corgi. The Hillman Hunter has many features of the full size car including chromed tools in the tool box on the roof, spare wheels, revolving spot lamps and of course the "Kangaroo bar". A little bonus is the inclusion of the Kangaroo as shown in the photograph.



Above right: The Ford 3-Litre G.T. now available from Airfix stockists. Below right: The new "Marksman" soldering iron manufactured by Weller.

Corgi Marathon Car

A really handsome model of the London to Sydney Marathon winning Hillman Hunter, is one of the new releases from Corgi. The model is finished in blue with a white roof and black bonnet. This paintwork is quite good apart from the edge of the white roof, which tends to be a little uneven.

All features on the model are very authentic. Two spare wheels are mounted on the roof along with a swivelling spotlight and a toolbox that opens to reveal chrome plated spanners, a monkey wrench, brace and screwdriver. A "Kangaroo bar," that distinctive feature

of Marathon cars, is fitted at the front of the model in front of the four jewelled headlamps. A jewelled spotlight is also incorporated in the bar.

The imitation magnesium wheels, all individually sprung, can be removed by the "Golden Jacks" system. At the back of the car two step plates have been fitted, along with a jewelled reversing lamp.

To add to its authenticity, the model has representations of the bucket seats actually used in the winning car.

Included with the car is a sheet of decorative transfers that can be applied to the model at the owner's wish, and to complete the set is a model of a kangaroo complete with Junior in its pouch ! Price of this attractive model is 10/6d.

Airfix Ford 3 Litre G.T.

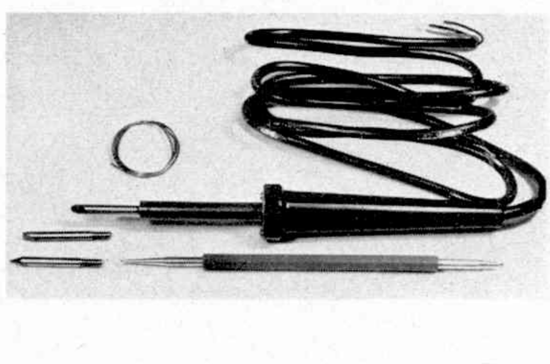
One of the new kits from Airfix is the new 3-litre Ford G.T. The full size prototype, designed by Ford's Len Bailey and developed by Alan Mann, made its racing debut at the B.O.A.C. 500 meeting at Brands Hatch in April of last year. The car has an exceptionally low frontal area and the Ford patented "Vortex" developing tail, increases the road holding qualities of the car.

However, this is quite a simple model to build, comprising of only 53 parts. The most difficult parts encountered during the construction were the suspension units, although there should be no problem if attention is given to details on the plan.

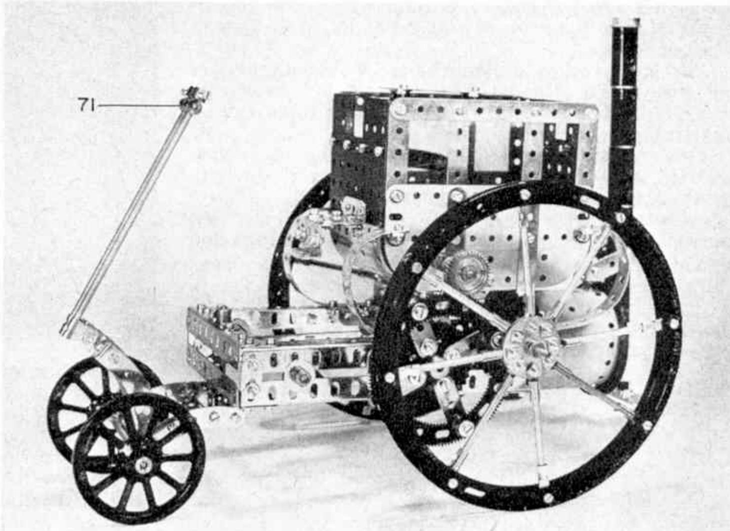
The colours of the various parts are red, gold, black and silver, although these, of course, can be altered to the requirements of the builder.

The model is actually already moulded in red, but this is rather on the pale side and a coat of Humbrol Gloss Red would do much to enhance its appearance.

The finished model measures 5 inches long, is quite good looking, and its simple construction, as we have mentioned earlier, makes it ideal for the young modeller who has 3/9d. in his pocket.

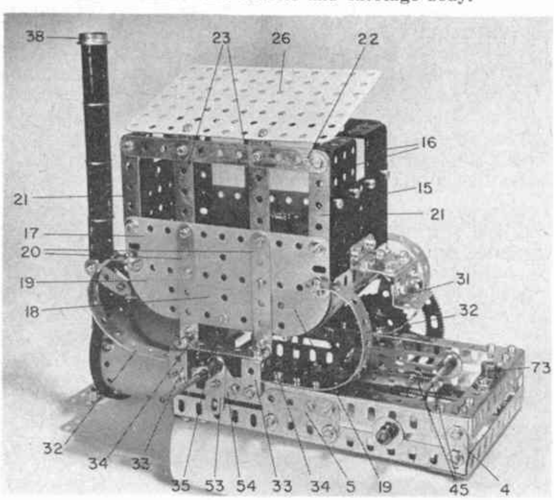


'SPANNER' describes a reader's fascinating model of a "new"... HORSELESS CARRIAGE



WHEN SELF-PROPELLED vehicles first appeared on the roads of Britain, they immediately received the distinguished and, in my opinion, rather stuffy title of "horseless carriages." This, no doubt, was to distinguish them from the horse-drawn vehicles of the time, but I must confess that I have always thought the title a bit of a misnomer. I wasn't around at the time, of course, but all the pictures of early motor cars I have seen have shown vehicles of quite different appearance to any "carriage," as I understood carriages of the day to look. Imagine my surprise, therefore,

In this view of the Steam Carriage, the rear wheels as well as the complete front wheel assembly have been removed to show construction of the chassis and carriage body.



when I saw the model, featured here, of Richard Trevithick's first steam carriage, built in 1801. This model, the work of M.M. reader Roger Le Rolland of Stoke-on-Trent, Staffordshire, shows the original vehicle to be a real "horseless carriage" in the true sense of the term. In fact, it looks from the model as if it might well have been a horse-drawn carriage, to which a large and rather cumbersome, steam engine had been fitted, and with a long steering handle to replace the shafts. I do not know if this is actually so, mind you, but it certainly looks that way!

Mr. Le Rolland's model is undoubtedly different to the usual type of Meccano models we receive, and I was particularly interested to learn how he came to build it. "During the Christmas period" he tells me, "I made a few demonstration models for Meccano dealers and I was asked if I could produce in Meccano the first known mechanical road vehicle in Great Britain. A trip to the local library was most helpful as I found a book entitled "Commercial Road Vehicles" by Cornwall (now out of print) and published by B. T. Batsford Ltd., London. In it was a picture of Richard Trevithick's Road Carriage of 1801—the prototype for my model."

The fact that Mr. Le Rolland found the necessary information for his model in the local library should be of great significance to Meccano modellers on the look-out for subjects to model. No end of useful material can be had by browsing through books in libraries and all modellers should, therefore, make full use of any library within visiting distance if they are able.

But to get down to construction of the model, itself, it is best to start work with the chassis, as usual. Two rectangular structures are each produced from two $7\frac{1}{2}$ in. Angle Girders 1 connected together through their circular holes by two $4\frac{1}{2}$ in. Angle Girders 2, the join in each case being strengthened by a 1 in. Corner

Bracket 3. The rectangles are then joined at each side by a Fishplate 4 and a 2 in. Flat Girder 5, bolted between Girders 1, use being made of the elongated holes in the parts to ensure that the gap between Girders 1 is just sufficient to allow a Rod to slide easily in it without being so great that excessive vertical play results. Bolted to the upper right-hand Girder 1, in the position shown, is a left-hand Flanged Bracket 6, to which a 1 × ½ in. Angle Bracket 7 is fixed.

Before going any further, the boiler should be built onto the chassis, this being a rather tricky operation. Attached by a ½ in. Bolt to the inside of the vertical flange of upper rear Girder 2 is an Angle Bracket, the Bolt passing through the elongated hole in the Bracket and through the fourth hole from the right-hand end of the Girder. Behind Girder 2, the Bolt is fitted with a Collar, followed by a 3 in. Pulley 8, the whole thing then being tightly held by a Nut. Note that the Bolt must pass through one of the elongated holes in this Pulley.

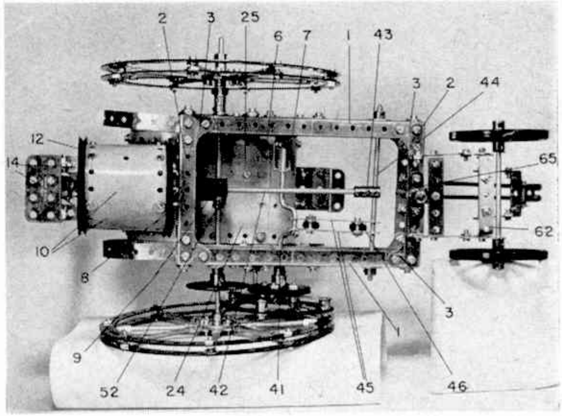
A second Angle Bracket is secured by another ½ in. Bolt to lower rear Girder 1 through its fourth hole from the left-hand end. As before, a Collar is added, the Bolt then being secured in the opposite elongated hole of Pulley 8. Fixed to the free lugs of the Angle Brackets is a Sleeve Piece 9, representing the cylinder, in the forward end of which a Chimney Adaptor is secured.

Now bolted to the rear face of Pulley 8 through the remaining opposite elongated holes are two 2½ × ½ in Double Angle Strips, to which two curved 5½ × 2½ in. Flexible Plates 10, overlapped three holes, are fixed to serve as the main boiler cladding. A ½ in. Bolt, shank upwards, is mounted in the top rear hole of upper Plate 10. A Washer is added, then it is secured by a Nut. Fixed on the remaining shank of the Bolt are two Angle Brackets 11, spaced from the first Nut by two Washers.

Next, a 1 in. Screwed Rod is fixed in the boss of a second 3 in. Pulley 12. Four Washers are mounted on the protruding end of the Rod, followed by a Nut which helps to fix a Chimney Adaptor 13 on the remaining part of the Rod. Also fixed to Pulley 12 are two ½ in. Reversed Angle Brackets 14, then the Pulley is bolted to the free lugs of the Double Angle Strips secured to Pulley 8. This is undoubtedly the tricky bit, as it can take considerable effort to fit the Nuts to the fixing Bolts inside the boiler. With patience, however, and the help of a thin screwdriver or rod to hold the Nut in place while the Bolt is inserted, it can be done.

Coming, next, to the body, both the front and the rear of this are similarly built from a 3½ × 2½ in. Flanged Plate 15, to which two 2½ × 1½ in. Flanged Plates 16 are fixed. Also similar in construction are the two sides, each consisting of a 5½ × 1½ in. Flexible Plate 17, to which are bolted a 2½ × 1½ in. Flexible Plate 18 and two Semi-Circular Plates 19, as well as two 3 in. Strips 20, the last projecting a distance of one hole below Plate 18. Plates 17 and 19 are then bolted to the appropriate flanges of Plates 15, the upper sucuring Bolts in the case of Plate 17 also fixing two 2½ in. Strips 21 in place. The upper ends of these Strips are connected by a 5½ in. Strip 22, which is also connected to Plate 17 by two 2½ in. Strips 23, these Strips lining up with Strips 20. Note that the lower Bolts securing Plate 17 to Flanged Plate 15 also hold two Angle Brackets in place.

In the case of the floor, a 5½ × 2½ in. Flexible Plate 24 and a 5½ × 1½ in. Flexible Plate 25 are bolted to the lower edge of each Flanged Plate 15, then the Flexible Plates at each end are curved under, overlapped seven holes and bolted together, also being attached to the

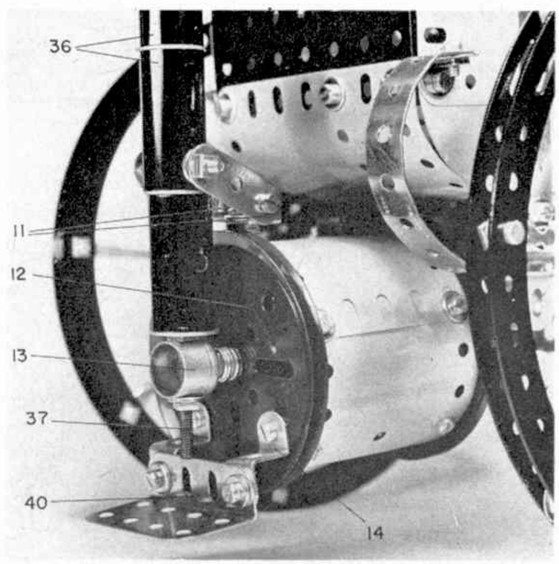


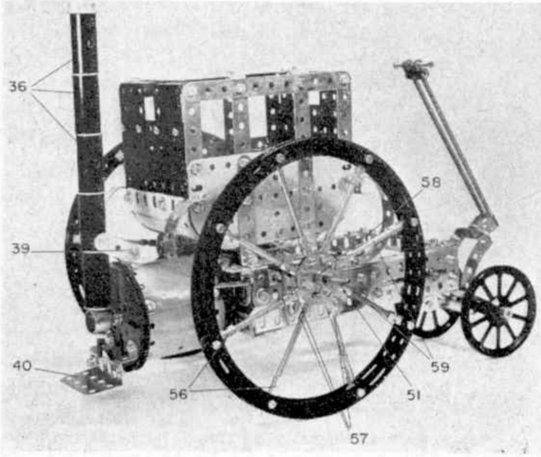
The rectangular construction of the chassis frame, strengthened by Corner Brackets, is obvious from this general underside view of the model. Note the cylinder positioned inside the chassis in front of the boiler.

centre of the lower edge of each Flexible Plate 18 by an Angle Bracket. The roof is simply supplied by a 5½ × 3½ in. Flat Plate 26 attached to Strip 22 by two Hinges. Inside the body, a Power Drive Unit is bolted to a 2½ in. Flat Girder 27 which is, in turn, bolted to the lower flanges of forward Flanged Plates 16. The output shaft of the Power Drive Unit projects through the centre vertical hole in left-hand forward Semi-Circular Plate 19.

Owing to the inaccessibility of the motor switch, an on/off control for the motor is supplied by a ¾ in. Bolt held by Nuts in the motor baseplate. Mounted on the upper shank of this Bolt is a Compression Spring and a Fishplate 28, the latter held against the head of the Bolt by the former. A Contact Screw 29, head downwards, is secured in the free elongated hole of the Fishplate in such a position that, when the Fishplate is turned on its Bolt, the head of the Contact Screw

A close-up view of the boiler showing the method of fixing the chimney in place.





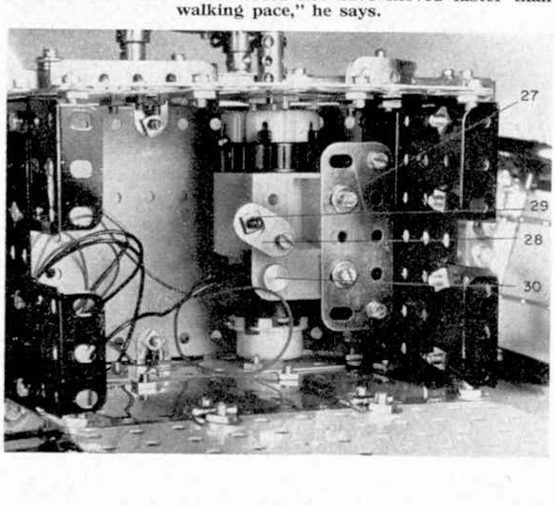
Another general view of the Steam Carriage showing the position of the boiler in relation to the chassis frame. Construction of the large rear wheels is also evident from this picture.

connects with a Contact Stud 30, fixed in the adjacent hole in the motor base.

At the front of the body, a 1½ in. Angle Girder, extended by a 1½ in. Flat Girder, is bolted to Flanged Plate 15, then another 1½ in. Angle Girder is bolted to the front edge of the Flat Girder. A final 1½ in. Angle Girder 31 is secured to the vertical flange of this Angle Girder to complete the driver's seat.

Four imitation suspension springs are now fixed to the chassis, after which the body can be mounted in position. Each spring consists of a 5½ in. Strip 32, curved to the shape shown and bolted two to each upper Angle Girder 1. The rear spring is bolted through the first and second holes in the horizontal flange of the Girder, while the front spring makes use of the sixth and eighth holes in the Girder. Bolted through the first and fifth holes in the vertical flange of each Girder 1 are two 1 × ½ in. Angle Brackets 33, spaced from the Girder in each case by two Washers on the shank of the securing Bolt. This Bolt, by the way, passes through the end hole in the long lug of the Bracket. Secured to

A view looking down into the body of the Carriage to show the Power Drive Unit mounting and on/off control switch. Mr. Le Rolland recommends the gearbox to be set on the 32 : 1 ratio as "... such a machine could not have moved faster than walking pace," he says.



the shor t upper lug of each Bracket is an ordinary Angle Bracket 34, the securing Bolt helping to fix a 2½ in. Strip 35 between the Brackets. Strips 20 in the body are bolted to the vertical lugs of Angle Brackets 34, the upper ends of the main springs at the same time being secured to the Angle Brackets bolted to the sides of the body.

CHIMNEY ASSEMBLY

This brings us to the chimney which can now be built up and secured to the back of the boiler. It consists of five Sleeve Pieces 36, each spaced from the next by a ¾ in. Washer and all slipped over a 6 in. Screwed Rod 37, on the upper end of which a Threaded Boss is mounted. The Sleeve Pieces and Washers are clamped in position by a Nut beneath the lowest Washer and a ¾ in. Flanged Wheel 38 on a 1⅛ in. Bolt screwed into the upper part of the longitudinal bore of the Threaded Boss. The chimney is secured in place by fixing Screwed Rod 37 in Chimney Adaptor 13 and it is braced by two 1½ in. Strips 39 bolted to the free lugs of Angle Brackets 11 and held by Nuts on Bolts fixed in the second Sleeve Piece from the lower end of the chimney. A Girder Bracket 40 is bolted to Reversed Angle Brackets 14.

CRANKSHAFT CONSTRUCTION

Next to be fitted are the crankshaft and connecting rods. The crankshaft, itself, is supplied by a Meccano Crank Shaft 41 held by Collars in upper left-hand Angle Girder 1 and Angle Bracket 7, while the piston rod is a 6½ in. Rod 42 sliding in the cylinder. The forward end of this Rod is fixed part way in the longitudinal bore of a Coupling 43, in the forward transverse bore of which a 5½ in. Rod 44 is loosely mounted. This Rod slides in the slots between Angle Girders 1, being held in place at each end by two Collars, one each side of the respective Angle Girders, each Collar spaced from the Girders by a ¾ in. Washer. Rod 44 is connected to Crank Shaft 41 by a specially-strengthened arrangement, built up from two 3 in. Narrow Strips 45 joined together by two ½ in. Bolts, but spaced apart by a Spring Clip 46 between two Washers on the shank of each Bolt. When the Crank Shaft is turned, Rod 44, and thus the piston rod 42, should move backwards and forwards.

Mounted on the outside end of the Crank Shaft are two 2 in. Sprocket Wheels 47, fixed together face to face by ½ in. Bolts, these Bolts also securing four Threaded Cranks 48 to the outside Sprocket, the arms of the Cranks being spaced from the Sprocket by two Washers on the shank of each securing Bolt. Bolted, in turn, to the bosses of the Cranks is a Gear Ring 49, the outside teeth of which mesh with a 1 in. Gear 50 on a 1½ in. Rod attached by a Coupling to the output shaft of the Power Drive Unit.

At this point the main axle 51 can be added. This is a composite item, built up from two 5 in. Rods joined by a Coupling 52, and mounted in the bosses of two Cranks 53, bolted, along with two 1 in. Corner Brackets 54, to upper Angle Girders 1, one at each side. The axle is held in place by a Collar at one side and by a 2 in. Sprocket Wheel 55 at the other. This Sprocket meshes with Sprockets 47 and, to enable it to do so correctly, Cranks 53 should be angled forward slightly. It is not, of course, normal Meccano practise to use Sprocket Wheels as gear wheels by having them meshing, but in this case the arrangement works sufficiently well as to be acceptable.

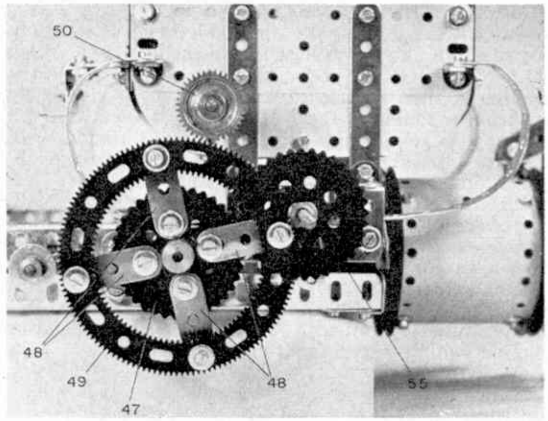
Naturally enough, fixed on the main axle are the large driving wheels, which are each produced from two 7½ in. Circular Strips, to each of which four Rod and Strip Connectors 56 are bolted, making eight in all. Another eight Rod and Strip Connectors 57 are bolted to two 8-hole Bush Wheels 58 placed face to face to form the hub, alternate Connectors being secured between the Bush Wheels and the remainder secured to the front of the outside Bush Wheel. Both sets of Rod and Strip Connectors are then joined by eight 2½ in. Rods 59, as shown. When mounting the wheels in position, note that one is fixed directly on the axle, whereas the other is loose on the axle being held in place by a Collar and a Spring Clip.

FRONT WHEEL ASSEMBLY

We are now left with only the front wheel assembly to complete, and the model is finished. Two 2½ in. Curved Strips 60, each extended one hole by a 1½ in. Strip 61, are joined by three 2½ × ½ in. Double Angle Strips 62, 63 and 64, positioned as shown. Bolted to the centre underside of Double Angle Strip 64 is a Double Arm Crank 65, while a ½ in. Reversed Angle Bracket 66 is bolted to the centre top side of Double Angle Strip 63, the hole in its free lug coinciding with a centre hole of Double Angle Strip 64.

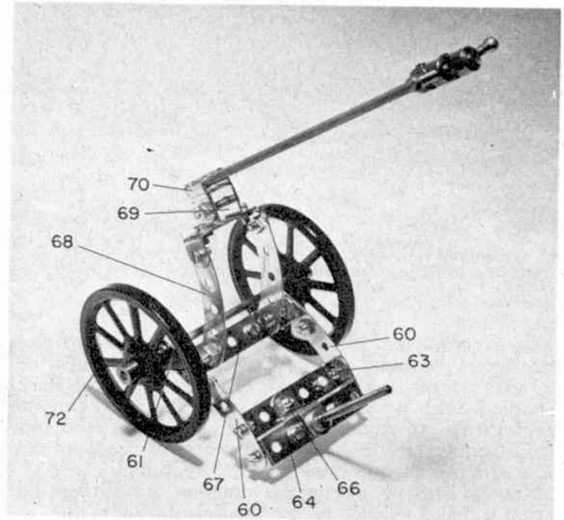
Bolted to the remaining Double Angle Strip is a 1½ × ½ in. Double Angle Strip 67, to each lug of which a 2½ in. Curved Strip 68 is fixed. The upper ends of these Curved Strips are connected by a second 1½ × ½ in. Double Angle Strip, to which a Double Bent Strip 69 is bolted. Secured, in turn, to this Double Bent Strip are two right-angled Rod and Strip Connectors 70, in each of which a 6½ in. Rod is held. These Rods are joined towards the free ends by a Coupling 71, sufficient space being left for two Collars, each carrying a ½ in. Bolt, acting as the steering handle. Two Spoked Wheels 72 are fixed on a 4½ in. Rod journalled in the end holes of Strips 61, then the finished assembly is mounted on a 3 in. Rod, secured in the boss of a Double Arm Crank 73 bolted to the centre of upper forward Girder 2. The Rod passes, free, through the boss of Double Arm Crank 65, being held in place by a Collar beneath the Crank.

This, then, completes the Steam Carriage as far as construction is concerned, but it should be mentioned in closing that the model is designed to be self-contained. It is, in other words, intended to carry its own power supply for the motor and this it does inside the cab. The original model drew its power from a small 9 volt transistor radio battery (Ever Ready PP7, or equivalent), one lead from the battery being connected to one of the motor leads and the other battery lead being connected to the ¾ in. Bolt carrying Fishplate 28. The remaining motor lead is connected to Contact Stud 30.



Above: A close-up view of the gearing which transfers the drive from the motor to the main wheels. Note that the Sprockets are used as gear wheels.

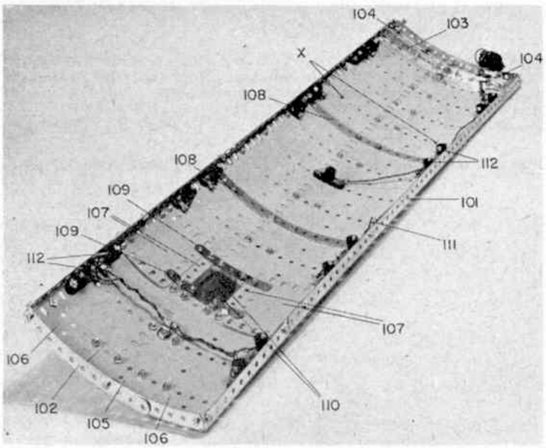
Below: The complete front wheel assembly as it appears when removed from the model.



PARTS REQUIRED

6—2	2—19a	2—62	3—125
4—4	2—19b	4—62a	10—133a
8—5	1—20b	6—62b	1—134
4—6a	4—24	4—63	1—139a
4—8b	1—31	1—64	4—145
4—9a	3—35	1—79a	1—161
3—9f	238—37a	1—82	6—163
2—10	153—37b	4—90	2—164
14—12	60—38	3—95a	1—180
5—12b	9—38d	1—103f	2—188
3—14	1—45	2—103g	4—189
1—14a	2—48	1—103h	4—192
2—15	5—48a	2—111	32—212
1—15a	4—51	27—111a	2—212a
16—16a	1—52a	20—111c	4—214
1—16b	2—53	1—111d	2—235a
1—18a	15—59	2—114	1 Power Drive Unit

(*Continued from page 551*)
outwards, this Bolt at the other side being replaced by a $\frac{1}{2}$ in. Bolt. Two 1 in. Corner Brackets 90, joined by a $2\frac{1}{2}$ in. Angle Girder 91 are bolted to each Curved Strip assembly, then a Face Plate is fixed by Nuts on the protruding shanks of the four *ordinary* Bolts held in one set of 1×1 in. Angle Brackets. At the other side, another Face Plate 92 is mounted on the shanks of the protruding $\frac{1}{2}$ in. Bolts, but note that, in this case, it is secured only by two Threaded Bosses on horizontally opposite Bolts. A Boiler End 93 is slipped over these Bosses and secured by Universal Coupling Studs screwed into the transverse bores of the Bosses. Journalled, free, in the centre hole of this Boiler End and in the bosses of the Face Plates is a 5 in. Rod held in place by Collars. A $\frac{1}{2}$ in. Pulley 94 is fixed on the protruding end of the Rod.



An underside view of the canopy removed from the model. Great care must be taken when mounting and wiring the Elektrikit Lamp Holders.

Once completed, the generator can be secured to the generator bracket by bolting Angle Girders 91 to Strips 84. Before this is done, however, a Ball Thrust Race Toothed Disc 95 is fixed by $\frac{3}{8}$ in. Bolts to Double Angle Strips 56 at the front of the boiler. A Rod and Strip Connector is bolted to the centre of the Toothed Disc to represent the smokebox door handle.

Now is also an opportune moment for fitting the piston rod and its slide bars. The piston rod, sliding in Wheel Disc 63 and Flanged Plate 57, is supplied by a $5\frac{1}{2}$ in. Rod 96 on which two Double Arm Cranks 97 are fixed. Passed through the holes in the arms of these Cranks are two 4 in. Rods 98 secured in Rod Sockets 62. Mounted towards the opposite ends of these Rods are two 4-hole Collars between which two pairs of $1\frac{1}{2}$ in. Strips 99 are fixed, the Strips being spaced from the Collars by three Washers on the shank of each securing Bolt. Fixed, in addition, on the lower right-hand securing Bolt is a $1 \times \frac{1}{2}$ in. Angle Bracket 100, the short lug of which is bolted to the top of the boiler.

Canopy

Coming, next, to the canopy, two 30 in. compound angle girders 101 are each produced from one $24\frac{1}{2}$ in. and one $5\frac{1}{2}$ in. Angle Girder, butt-jointed together by a $2\frac{1}{2}$ in. Angle Girder, then the girders are connected at each end by a $7\frac{1}{2}$ in. compound curved strip 102, attached to the girders by Angle Brackets, the compound curved strip consisting of two $5\frac{1}{2}$ in. Curved Strips overlapped seven holes. Another similar compound curved strip 103 is also attached by Angle Brackets to girders 101, through their fourth holes from the rear end, two 1 in. Corner Brackets 104 being bolted to this strip. A Rod and Strip Connector is secured to each Corner Bracket. The canopy is then covered mainly by twenty-six overlapping $4\frac{1}{2}$ in. $\times$ $2\frac{1}{2}$ in. Flexible Plates arranged as shown, but also by one $5\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plate 105, two $2\frac{1}{2} \times 1\frac{1}{2}$ in. Flexible Plates 106 and four $3\frac{1}{2} \times 2\frac{1}{2}$ in. Flexible Plates 107. Strengtheners are provided by two curved $7\frac{1}{2}$ in. Strips 108 bolted between girders 101 beneath the canopy and another two similar Strips on top of the canopy, these being bolted between the ends of girders 101.

A study of the appropriate accompanying photograph will show that the Flexible Plates in the canopy are so arranged that a gap is left for the chimney. This gap is edged, on the underside of the canopy, by two $3\frac{1}{2}$ in. Strips 109 and, on the top of the canopy, by two $1\frac{1}{2}$ in. Strips between which two $2\frac{1}{2}$ in. Stepped Curved Strips 110 are bolted. Two further Rod and Strip Connectors 111 are bolted one to each compound girder 101 through its twenty-fifth hole from the front.

Fixed to the underside of the canopy in the positions shown are seventeen Elektrikit Lamp Holders 112. Care must be taken with these, however, as one terminal of each must be properly earthed while the other must be insulated. The earthed side is simply secured in place with a standard Meccano Nut and Bolt, but, for the insulated side a thin non-Meccano 6 BA bolt is used in conjunction with a fibre washer, great care being taken to ensure that no part of the bolt touches any metal part of the model. (The Meccano Bolt must, of course, make good contact with the metal of the model to ensure proper earthing).

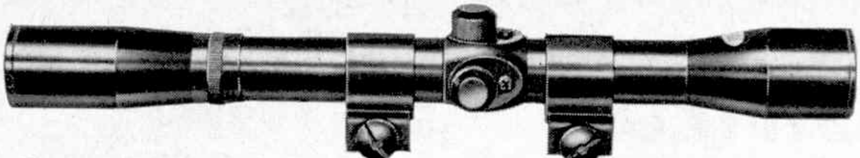
The Lamp Holders are wired together in two separate circuits, the insulated terminals of the first, third, fifth, etc., Holders being connected in one circuit and the insulated terminals of the second, fourth, sixth, etc., Holders in the other circuit. Insulated Wire is used in both cases, of course.

PARTS REQUIRED

5—1a	4—15b	3—52a	1—118
13—1b	2—16	4—53	2—126
7—2	2—16a	35—59	2—126a
18—2a	1—17	4—62	1—130a
8—3	1—18a	6—62b	12—133a
14—5	1—18b	13—63	2—136
45—6a	2—19b	1—63b	2—137
2—7	1—20	5—63c	1—143
2—8	4—22	10—64	1—154a
4—8a	2—23a	1—72	1—154b
6—8b	8—24	4—81	3—162a
7—9	2—24a	6—89	2—163
1—9b	1—30a	4—90	4—164
6—9d	1—30c	10—90a	1—166
2—10	1—31	2—94	4—167b
2—11	1—32	3—95a	1—168b
16—12	574—37a	2—95b	8—179
8—12a	545—37b	1—96	1—187a
2—12b	187—38	2—103d	38—188
4—12c	1—40	4—103f	2—189
4—13	2—45	6—109	4—190
6—14	2—48	32—111a	4—190a
5—14a	2—48c	5—111c	46—191
1—15a	3—51	1—115	4—192

2—196	1—212a	3—533	3—564
6—197	3—216	17—539	17—$\frac{7}{16}$ 6 BA bolts
10—212	2—224	1—551	17—fibre washers
			1—electric motor

TO BE CONCLUDED NEXT MONTH



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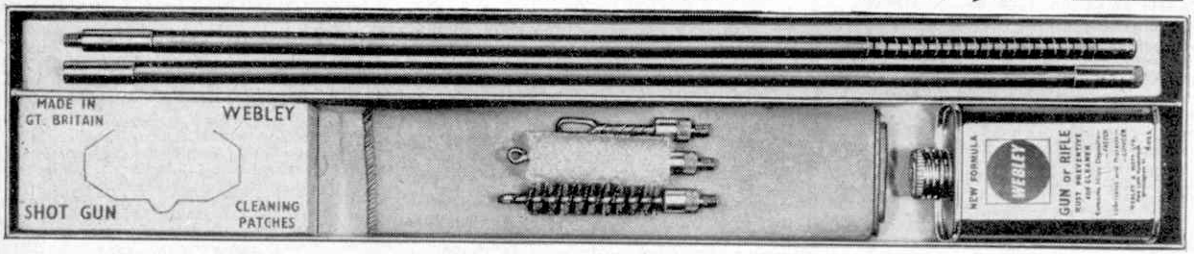

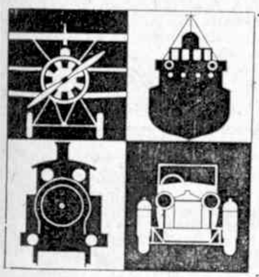

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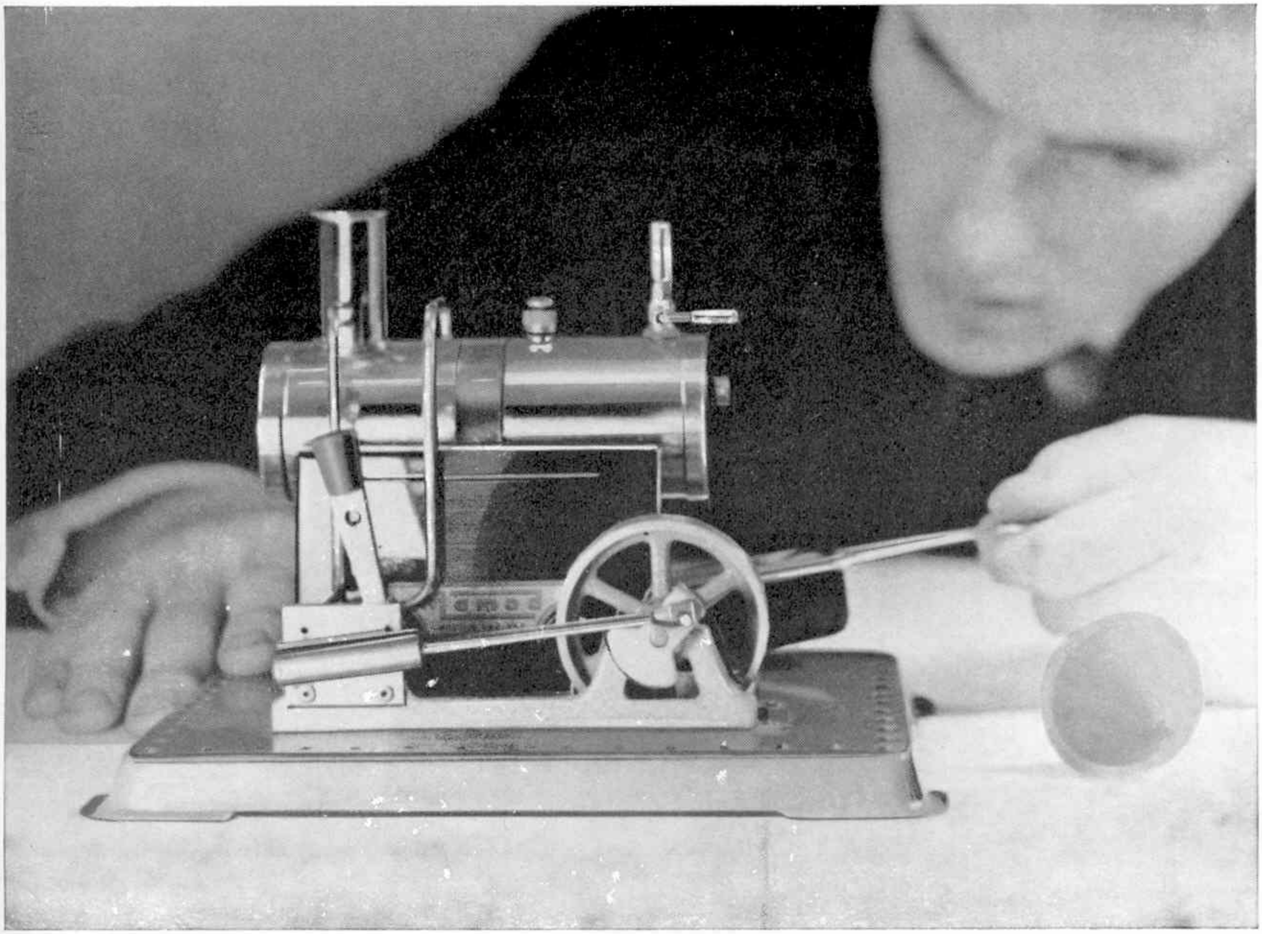

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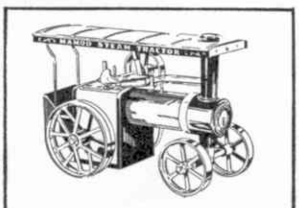

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CRACKER

designed by Vic Smeed

for MECCANO Magazine's RADIO 4-2.

BUILDING INSTRUCTIONS

Study the plan before building. Cut out all parts for fuselage, wing, and tail. Start the fuselage by glueing 1/16" sheet doublers in place back to F.4. Mark former positions on inside of both sides, also bearer positions. Epoxy bearers in place, on each side, followed by 3/16" sq. uprights for escapement former & put aside. Sew & epoxy undercarriage to F1 & F3. Next start the tail. Pin lower spar in place, pack leading edge (L.E.) up with scrap pieces of $\frac{1}{8}$" sheet, & pin in place. Glue all ribs in place followed by top spar & ready shaped Trailing edge (T.E.). Back to the fuselage. Glue F1 & F3 on one side & F2 & F4 to the other. Now lift the tail of the plan, trim off waste wood at tips & sand smooth, glue $\frac{1}{4}$" sheet tips in place. Next glue fuselage sides together, check for squareness, pin formers through sides. Join sides at rear with $\frac{1}{8}$" sheet upright between, check fuselage is square. Lay aside to dry & start on the wing. Cut spars L.E. & T.E. for centre section. Pin down spars & T.E. Glue 1/16" ply brace to front spar, followed by $\frac{1}{8}$" sheet ribs & L.E. Note slant on L.E. Glue top spar in place & leave to dry. Next job on the fuselage is to glue F5 to F7 in place. Now cover the centre of tail with 1/16" sheet, top & bottom, pin in place. The wing centre should now be dry, so lift from plan & start the left or Port wing panel. Notch L.E. & T.E. for ribs. Pin down spars & T.E., trim end to accept angle of centre section. Glue ribs R3 in place, then L.E. Next step on the fuselage is to glue in place $\frac{1}{8}$" sheet gussets at tail & wing, $\frac{3}{8}$" sq. between F1 & F2, $\frac{1}{8}$" sheet around tank, & radio bay floor. Leave to dry. Now trim L.E. at slant & glue centre section in place followed by R2. Glue top spar in place & pin down. Next, finish tail. Carve & sand tips to shape & sand whole of tail, shaping L.E. to section shown on plan. Sheet top of fuselage with 1/16" sheet, pin in place. Now epoxy & screw $\frac{1}{8}$" ply engine plate to bearers. Lift wing off plan & repeat building process for opposite panel. Mount the engine & tank, connect tank outlet to spraybar with plastic fuel pipe. Cut & fit $\frac{1}{4}$" sheet around engine & tank. Glue in place followed by $\frac{1}{4}$" sheet top & bottom. Also cover bottom of fuselage back to main wheels, with 1/16" sheet. Next cut $\frac{1}{4}$" sheet pieces & glue in front of F.2. Lift wing off plan, & glue $\frac{1}{8}$" sheet gusset as shown on plan, then $\frac{1}{8}$" x $\frac{1}{4}$" rear brace. carve fuselage nose, top sheet & cabin. Drill holes for 3/16" dia. dowels & glue in place. Fit escapement former, with escapement mounted, then fit torque rod. Next build fin, pin down L.E. & T.E., followed by crosspieces. Now sheet wing with 1/16" sheet. On the bottom of centre section wood is let in between spars & ribs. Lift fin off plan & glue soft wire hinges in place. Cover fin both sides with 1/16" sheet. Trim off surplus wood at wing tips & sand smooth. Glue $\frac{1}{4}$" sheet tips in place. Complete fitting escapement assembly, including rubber motor hook. Sheet bottom of fuselage. Shape fin outline & sand to rounded section. Fit trim tab & tape rudder to fin. Glue to top of fuselage, also $\frac{1}{4}$" sheet at front of fin. Trim & shape wing tip sand whole of wing & tips. Trim off 1/16" sheet on fuselage bottom & sand the whole of fuselage. Bolt 18 s.w.g. wire loop to rudder & fit over torque arm. The model is now ready for covering.

MATERIALS LIST

4 sheets	1/16" x 3" x 36" med.	2 strips	½" x 5/8" x 36" L.E. Stock
2 sheets	3/32" x 4" x 36" med.	1 piece	1/16" x 4" x 12" ply
1 sheet	⅛" x 3" x 12" med.	1 piece	⅛" x 3" x 9" ply
1 sheet	¼" x 3" x 36" soft	1 piece	¼" x 5/16" x 24" beech
6 strips	⅛" x ¼" x 36" med. hard.	1 piece	3/16" dia. x 18" dowel
1 strip	3/16" x 3/16" x 36" med.	1 piece	18 s.w.g. x 6" piano wire
3 strips	¼" x ¾" x 36" T.E. stock	1 piece	16 s.w.g. x 36" piano wire
1 strip	⅜" x ⅜" x 36" med.	1 piece	12 s.w.g. x 36" piano wire

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