December 1979 45p
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MAP HOBBY MAGAZINE

Model Mechanics

R/C Stock Cars

Christmas Modelling

'Vauxhall 24'

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Soldering, Brazing & Welding

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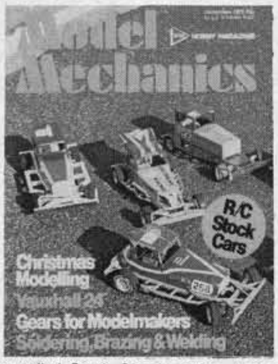
Model Mechanics

Volume 1 Number 11
December 1979



Radio-controlled Stock Cars in action. Left to right, Andy Clay's replica of full-size owned by Tony Leicester; Steve Talbot's No. 8, which is current World Champ; Tony Whitehorn's No. 384, replica of John Jebson's full-size and Roger Bye's No. 258, British Champ in 1978.

Last month we featured the ready-to-use model railway systems available so it is appropriate this month to have an electrical switching device that could be used to modify such a system. Roger Barrett, in this issue, gives the construction of a light operated switching circuit which is ideal for model railways. This device could be set up to switch points for instance, by letting the train pass through the light beam and using the switch to operate a solenoid. Solenoids suitable for this application can often be obtained from places such as Proops Bros. of Tottenham Court Road, London. A further application which would be a terrific novelty for younger members of the family at Christmas would be a battery operated vehicle that would go or stop by shining a torch at it. There is a point here, the current consumption of the motor should not exceed 1 amp.

Model Engineer kindly brought the photograph below left of Mark Norris to my attention. This was taken at the Pontins Model Makers Festival held at Brean Sands. Mark Norris is only seven years of age and built both of the oscillating steam engines himself from the plans published in the February and March issues of Model Mechanics.

Don't forget the Model Engineer Exhibition on January 2nd to 12th at Wembley Conference Centre. Below are two pictures from last year's show illustrating the super models you are able to see.

To end with, I would like to wish all our readers a very Happy Christmas and a good model making New Year.

Editor

(Apologies to Stewart Busby for naming you Steve)

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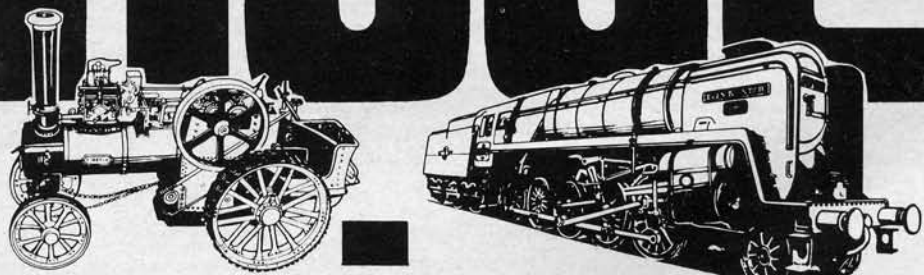
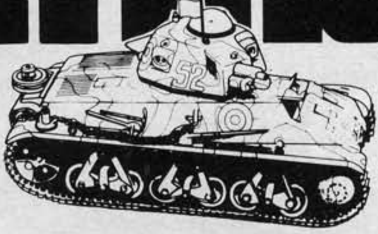
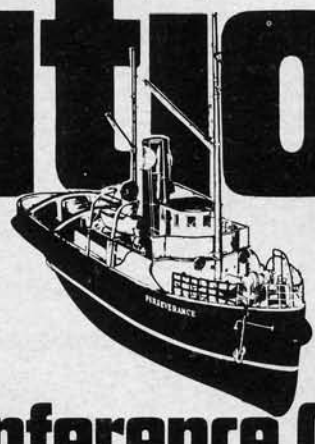
Model



Engineer

Exhibition





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Wembley Conference Centre
2nd - 12th January, 1980
(Except Sunday 6th)

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Teachers/Leaders must remain with their parties while they are at the Exhibition

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Please also note the special cheaper British Rail fare rates already advertised in this magazine for those booking to come by rail in advance and that trains to and from Marylebone on the Princes Risborough line stop regularly at Wembley Complex Station, three minutes walk from the Conference Centre. Car Parking at 55p for the day is available for thousands of cars between the Wembley Stadium and the Conference Centre.

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As models become more sophisticated they demand matching standards of detail painting, yet there are always modellers unaware of even the most rudimentary techniques. That model enthusiasts needed to know more was forcibly demonstrated in 1977 when MODEL COLOUR was published — it sold out in months. Now SCALE MODELS is reprinting this much coveted publication, updating it, adding more colour, providing new articles and amending and adding to the exhaustive much-acclaimed mixing colour tables.
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Christmas Modelling

Humbrol PMSI CO_2 Engine.

A review of interesting products for you to peruse over Christmas
By James and Rita Vanderbeek

One of the big advantages of a multi-hobby magazine such as *Model mechanics* manifests itself in the pre-Christmas period—when a feature such as this is made the more intriguing by the very scope and multitude of suitable subjects. Obviously we will not be able to deal in the following pages with all those modelling products which could rightfully claim their share of the available space, so we must do our very best to present as wide a selection as possible, there will come the point at which a local model or model engineering shop will be their final aid to wise buying.

Aircraft

We have tried to divide the many interests involved into logical groups, so let us start at the beginning of the alphabet with aircraft. Christmas has to be the time at which it is good to encourage the younger members of the family to take up aeromodelling and this can be very easily and efficiently achieved with some of the simply constructed gliders, rubber and CO_2 powered models which are available as kits.

Micro-Mold has recently introduced a range of semi-scale CO_2 models which have each a span of 19 in. and simple sheet Balsa construction with pre-cut parts, engine mounts and even decals. The same company offers the Telco CO_2 motor which is reasonably priced and which has many useful features, not the least being a finned aluminium cylinder barrel. The engine pack comes complete with tank, recharging nozzle, charger, airscrew and other accessories.

Some very interesting scale models are also available in the Micro-Mold range. The Spitfire and Mustang, the FW190 and Japanese Kawasaki Tony cover the World War II period, whilst the beautiful Sopwith Pup and a near scale Fokker D7 type are representative of the conflict.

The **Veron** range is equally well calculated to cover all Christmas modelling requirements—starting with four Combi-kit 20 in. span rubber powered models which are attractive in outline, light in weight by virtue of tissue covering and which can easily be adapted to CO_2 power. Veron are also distributors for Telco motors. The larger model kits include highly efficient designs for both sailplanes and powered types, including several superb flying scale models designed for various degrees of radio control.

Vintage scale biplanes are represented by the Avro 504N trainer and the Sopwith 1½ Strutter whilst the Super Robot is a modern high-wing type, suitable for full-house, sport and multi-training. Sailplanes include the Big Impala, a 188 cm span model for R/C rudder/elevator or rudder/aileron control, and which can accommodate an auxiliary motor. Brand-new is the Vortex 252 cm span thermal soarer. This model is full of modern design features, including 2-piece fibreglass fuselage, low drag thin-profile wing section for light loading combined with good penetration, and there is ample room across the fuselage for up to three servos.

The same wide choice of models is available in the **KeilKraft** range, but of special winter interest are the groups of kits which are either easily adaptable to, or purpose designed for, RTP flying with electric power. Not only does KeilKraft offer a very wide choice of prototypes in scale models, but they are all very competitively priced.

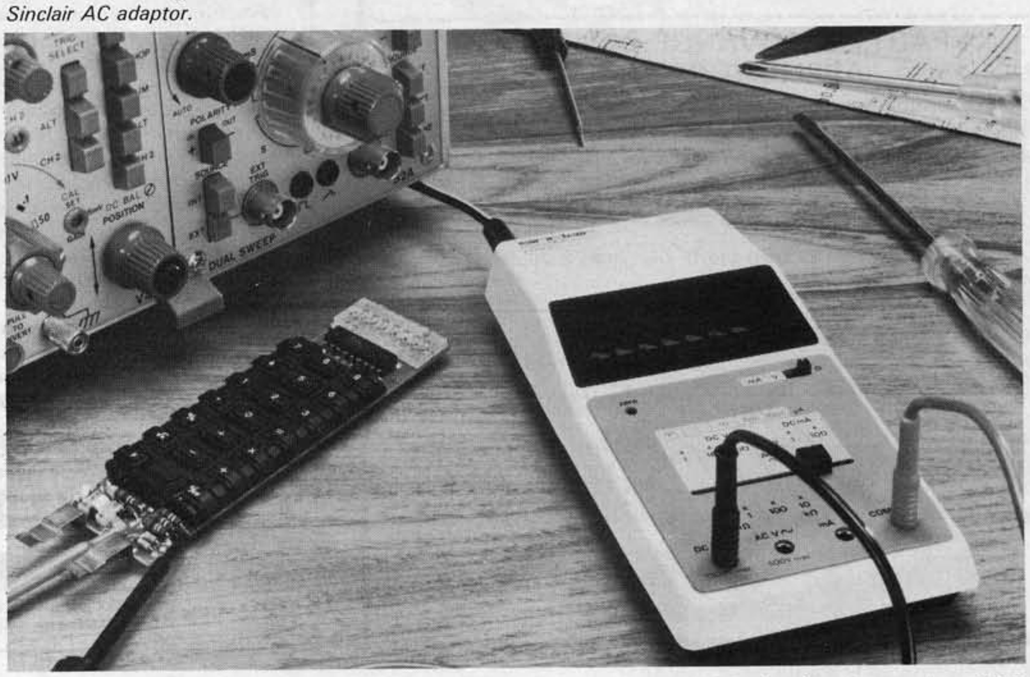
There is also the very appealing Mercury Master Kit range with gliders, control line and free flight flying scale types available in profusion.

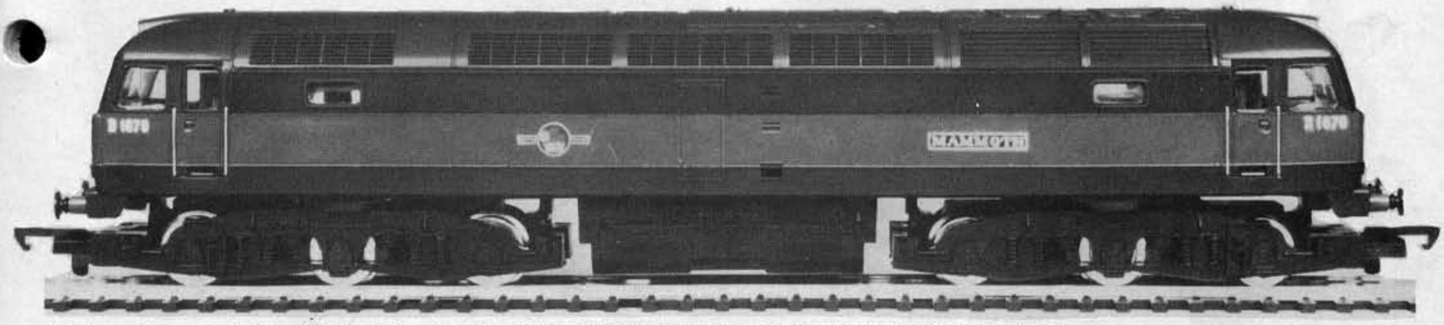
The name Super 60 has long been held in respect in power model circles, so the Super 60 R/C trainer and sports model recently announced by KeilKraft gets off to a good start. This is a very versatile model concept, in as much as the airframe is designed to cope with any degree of radio control, from single channel (rudder only) to four function, proportional. It is constructed from a very highly prefabricated kit pack, which includes adequate supplies of strip, sheet and block Balsa, plus all the necessary hardware and accessories needed to build the model. Also supplied are adhesives, modelling pins, knife and sandpaper, so that the only additional items required are the radio, covering and finishing materials, engine and airscrew which, wisely, are left to the choice of the builder.

Irvine Engines have recently released a particularly well-developed kit for a 62 in. span, Sportavia RF-5B, motor glider. The kit is so highly prefabricated that there is little more than one or two evening's work involved. It is designed for a Testors 0.049 engine and the kit is supplied either with or without this important item. This plastics based model with all-moving tailplane looks like an ideal R/C trainer—one is tempted to say for all the family to learn on!

Also distributed by Irvine Engines is the Kavan Series of scale R/C helicopters. Types such as the Jet-Ranger and the Alouette

Sinclair PDM35 digital multimeter in use. It is powered by a standard 9V battery or may be connected to a Sinclair AC adaptor.

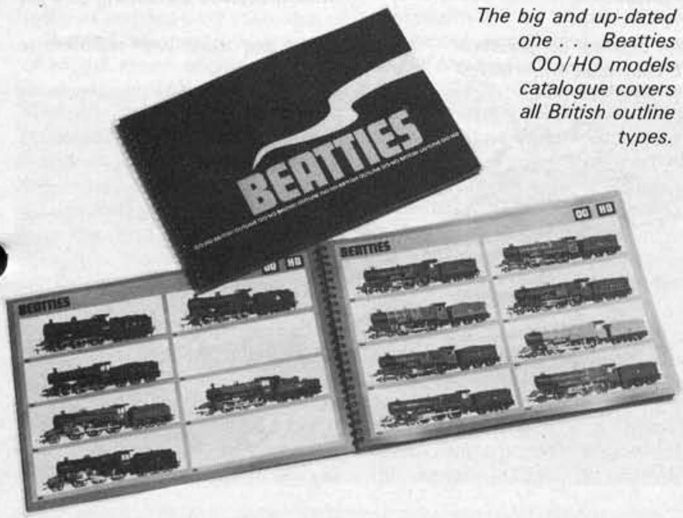




The latest, improved Class 47 diesel loco from Hornby features two-tone green livery and working headlamps.

2 are designed for 4-channel control and reproduce the full flying envelope of full-size choppers. The Kavan kits are remarkable examples of modern production techniques so that, for the serious rotary-wing enthusiast, they have a great deal to recommend them.

Perhaps better known for its huge range of adhesives and surface coatings for model use, **Humbrol Ltd.** also offers a growing range of model aircraft kits and two types of CO_2 engine. The gas engine powered models include monoplanes and a biplane of various types, whilst there is also the Electro clip-together kit for a high-wing model of 88 cm span which is powered by a small electric motor. larger types include the Svenson range of R/C kits, with more than a dozen gliders and powered machines to choose from. Their R/C requirements are similarly spread across the board.



The big and up-dated one . . . Beatties OO/HO models catalogue covers all British outline types.

Electronics for Christmas

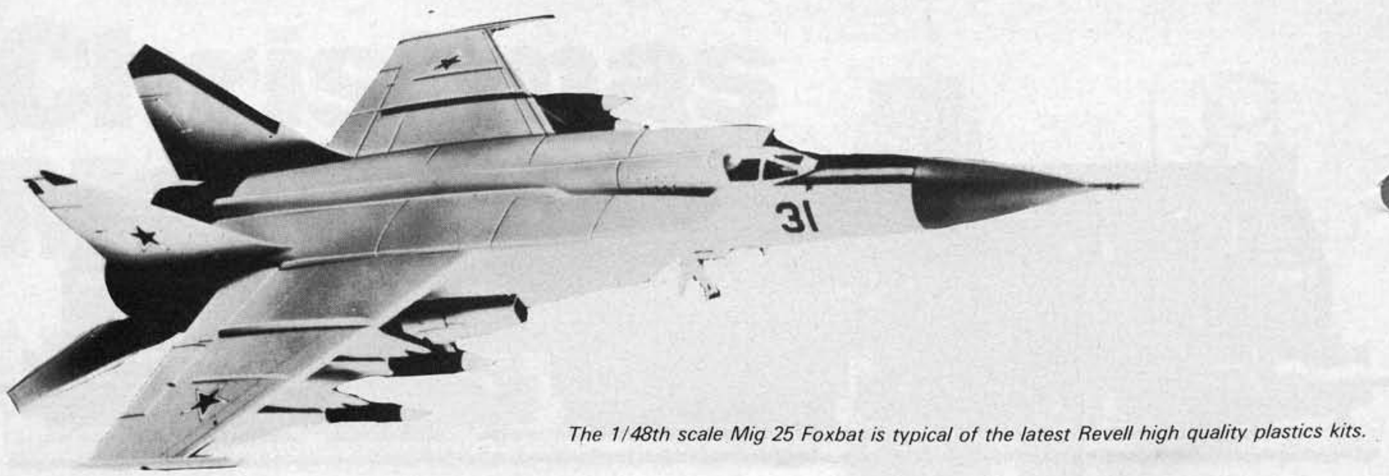
There is every indication that this Christmas will be the one notable for, as aptly stated by one maker, chips with everything. The chips in question are miniaturised electronic marvels, rather than variously shaped vegetables, and their availability in quantity and at very low prices has indeed meant that many type of advanced technology toys, games and models, and their operating equipment, can be made better, cheaper and to provide degrees of control which have not previously been achieved. Look around the shops for these electronic marvels, for there are plenty. One word of warning, however—in such a rapidly expanding market it is inevitable that some fring companies may try to load the electronics bandwagon with items which are, perhaps, less than fully developed and so often without spares or service arrangements—so be wise and buy carefully.

Already in the *Check & Report* monthly feature we have mentioned items from **Actiongable.** Worth looking at is the voice controlled, custom finished, delivery van named 'George' and which contains a pair of installation which are battery powered — one to drive the model and the second to activate the sonic response unit. George is great fun and is thoroughly up to date. The same might be said about the Gammonmaster II outfit which incorporates its own electronic computer, especially programmed to provide considerable opposition to the human opponent.

Various ranges of electronic, experimental and construction outfits are also in the shops. They cover the needs of young children up to adult levels and include very well prepared instruction manuals which deal in detail with the practical and theoretical requirements of the rig or experiment. **Radionic Products** Ltd. produces a number of such outfits and distributes others from, for instance, Japan. We have tried out a number of them with considerable success, in particular the **Mykit** range which incorporates preparation and sub-assembly work which is praiseworthy even by modern standards. There are sets for 50 up to 200 circuits and they include special purpose components such as motors, solar cell, microphones and Cds light measuring cells. In each size the outfits have factory installed components between coil spring type connectors, so that every Mykit outfit comes with everything in place and ready for wiring.

Also worth looking at are the **Denshi** Block Experimental Kits. There are six basic outfits, plus add-on sets and other accessories,

Hammant & Morgan's best yet — the HM3000 power control module is one of the most advanced conventional units made in Britain.



The 1/48th scale Mig 25 Foxbat is typical of the latest Revell high quality plastics kits.

and up to 120 experiments can be made with the largest. A Denshi Block pack which we tested recently was sent to us all set up and ready to go, and a touch of the switch brought us BBC Radio 2 at considerable volume and with excellent tonal quality. Other experimental circuits which we tried out worked just as well so that the encapsulated component concept seems well worthwhile.

Electronic action kits of the plastics model variety have also made their appearance for this Christmas—in snap-together outfits by **Revell** for the Mustang and Curtiss P40-E fighters of World War II plus a Hughes police helicopter. All three are tagged by Revell as 'flick action' kits, for a flick of rotor or propeller switches them on. They have flashing lights and come with neat, battery powered power packs to create the action. For younger electronics experts this is a very lively idea.

Looking more like a R/C outfit than a television game is the Superstar console produced by **Binatone.** Various sports can be reproduced on the screen with this outfit and the makers offer four games cartridges to go with it. Special features of Superstar include authentic colour with realistic sound effects (tennis, Brands Hatch or motorcycling), whilst the players work from 360° joystick controls, with more intriguing buttons on the console panel.

About Railways

The November issue of *Model Mechanics* included a special guide to the various types and scales of model railways, which have achieved major hobby status in this country. Not only as Christmas presents, but all the year round the commercially produced model railway systems have much to recommend them in terms of value for money, excellent design and production standards besides, now that the long awaited electronics control systems are becoming available, ease of layout installation and eventual train and layout control.

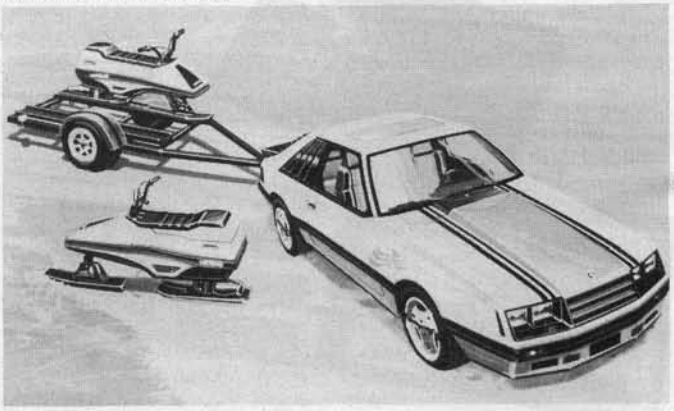
Reference to the November '79 issue will provide full details of the systems, so let us confine ourselves here to suggesting that your models should be bought with care and with long-term operating value very much in mind. Competition is so intense in several of the market sectors that the prices at which the models are offered—especially when they are discounted in addition—represent amazing value. Model railways can be the Christmas present of a lifetime—so make the most of them.

As a change from model railways there is a special offer presently available which has much to recommend it to enthusiasts for both model and full-size railways. Peter Jones China offer as individual pieces, or as sets, mugs and plates in fine quality English bone china, which are decorated profusely with illustrations which typify steam on the GWR, LMS, LNER and SR. Each plate is 10½ in. diameter, the mugs are all 3¾ in. high. They are priced at £35 per plate, £15 per mug or, of course, £50 for each set of two pieces. These specially prepared, limited edition pieces are being put out as representative of the 'Glorious Age of Steam' and, whilst we have not had the opportunity to examine an actual sample, they appear to fulfil this promise.

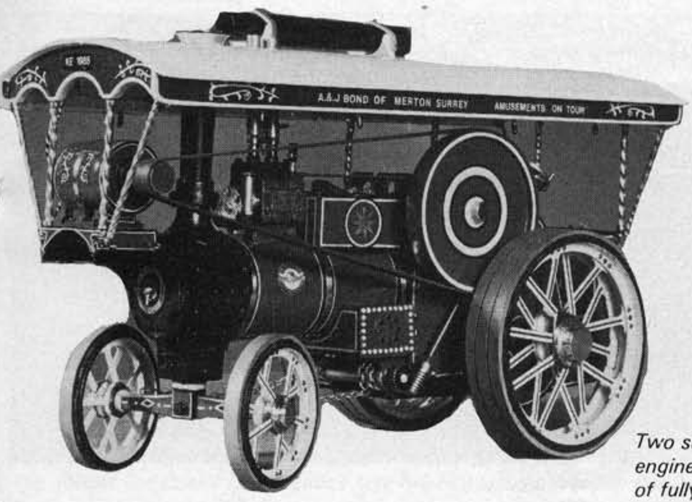
Model Steam Power

Live steam has a fascination all of its own, whether the object of such interest be a quantity produced 'toy' type engine or a craftsman built, true-scale, replica which could easily have involved several hundred hours highly-skilled work. Our own liking for steam received something of a jolt

An unusual combination — Ford Mustang and trailer with wetbikes to 1/25th scale from Revell.



All presents and correct! Three examples from the Matchbox kit range, the Mercedes-Benze 5SKL, USAF F16A and H.M.S. Tiger.



Two superb ¾ in. scale live steam engines built from the Taylor Hemmens kits of fully machined components.

only yesterday when a craft spotted from Sonning Bridge over the river Thames turned out to be a beautifully restored, vintage, steam launch with midships mounted vertical boiler and which showed, by smooth, silent running and acceleration which would be a credit to many a modern I/C launch, to be as worthy a craft today as perhaps sixty years ago.

Perhaps the best-known range of model steam engines quantity produced in U.K. is that from **Mamod** and this year's crop is notable for the re-designing which has been carried out throughout the group of stationary engines. The models have new chimneys, with the word Mamod picked out in white, and many other less noticeable, but nonetheless important modifications. Space here does not permit individual descriptions of these units—or the parallel series of wheeled types such as steam roller, traction engine and steam wagon—but if you thought that the previous Mamod range was worth a second look, the new models will more than reinforce that view.

More live steam is available in the imported Wilesco series. Here also there are stationary mill engines, besides steam roller with water tank trailer and traction engine with 4-wheeled timber trailer.

Live steam of a different type is represented by the Eagle locomotive, which has been one of *Model Mechanics'* feature projects during 1979. Two sources of castings for this model are available—Live Steam Services of S.W. London and Dave Goodwin in Lancashire. Sample castings have been checked by Martin Evans, so that a set of these might well prove to be an ideal Christmas gift for a total live steam enthusiast.

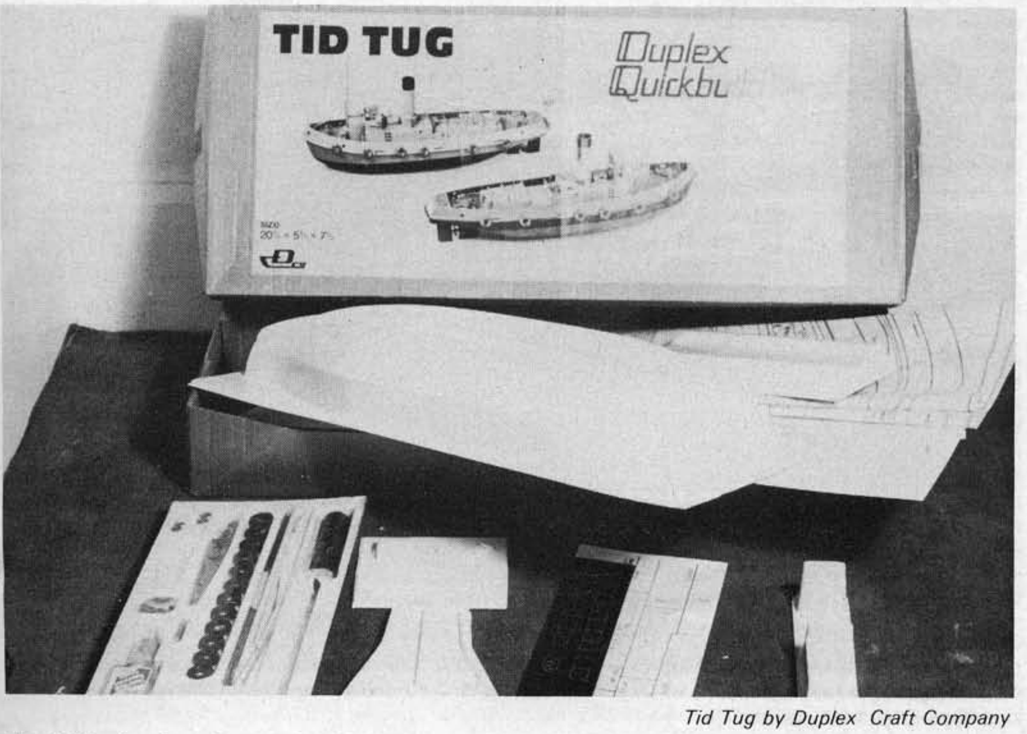
Very high quality live steam, ¾ in scale, traction engine kits are produced by **Taylor Hemmens Ltd.** They include agricultural engines, both coal and gas fired, a road locomotive, a portable engine and, the range leader, an Allchin Showman's Tractor which may be fired either way. The kits have been designed for enthusiasts without extensive workshop facilties, and enable fine scale working models, with all the operating features found normally only on individually produced machines, to be constructed. The kits contain a full sets of machined and finished components and accessories with, certainly, all the more difficult operations completed. The assembly of the engines will undoubtedly involve time, enthusiasm and skill, but the results can be superb. Typical of the care taken in the production and presentation of these live steam kits is their inclusion of watchmakers screwdrivers, spanners, needle files and a fully assembled boiler, which comes complete with its test certificate. Other accessories include water tanks, boiler feed pumps, steam blowers, water and pressure gauges. Obviously these engines are relatively costly, but in terms of real engineering, are to be recommended.

The 1/16th scale, 3½ in. gauge, **Hornby Railways** model of Stephenson's Rocket caused something of a sensation when it first appeared last year and its christmas appeal for the 1979 estivities must be rated as greater than ever. The model is supplied ready to run, with gas firing from a tank in the tender, and is provided with 25 ft. of special, plastics moulded tank. One filling of Butane gas provides around eight minutes of steaming and a reverse gear is fitted. A special feature of this Hornby model which is not present in the prototype, is hidden reduction gearing which causes the pair of large driving wheels to revolve at half-speed, with consequent gain in hauling power.

For Marine Modellers

The marine models field is another which is very well served as far as complete kits, accessories, power units and radio control gear are concerned. One of the best-known kit ranges is that of **Billing Boats** — Danish produced and including models from cutters and fishing boats up to historic vessels, such as the Toulonnaise schooner of the 1820s and the now preserved Cutty Sark clipper ship. Special mention must also be made of the kit for Drake's Golden Hind. The Billing Boat kits provide for all wood construction and are prefabricated to a very high degree. Separate packs for the fittings—matched individually to each craft—are also available, with true scale accessory items produced in appropriate materials, from brass for turnings to moulded plastics for fittings which have particularly complex shapes.

Soon to be reviewed in *Model Mechanics* is a quick-build kit by the **Duplex Craft Company** for the Tid Tug. This World War II design was developed when there was a dire need for tugs in quantity, so the designers concentrated on producing a type which would be easily built in large numbers. The model has a length of 20½ in. and the kit includes vacuum formed hull and other mouldings, besides



Tid Tug by Duplex Craft Company

LMS Pacific, 6247, City of Liverpool from the Wrenn 00 scale range.

a particularly comprehensive set of smaller parts which include an electric motor, propeller shaft assembly, servo trays, fender tyres, liquid cement and many other equally useful accessories. Full-size plans are, of course, included and the model will cope very well with one or two channel R/C. The same manufacturers produce other kits—including the 575 Ocean Racing Yacht—besides various sets of hull mouldings for craft such as a Thames sailing barge, destroyer, frigate, trawler and ocean-going tug.

Whilst on the subject of marine models the O.S. range of motors includes many types which are suitable for radio control applications and no less than seven which are ready adapted for marine use. The whole range of capacities is covered and the **O.S. Motors** are to be recommended both for power output and reliability.

We have just been looking at the latest **SHG Marine** catalogue, a volume which provides a great deal of interesting information on the successful range of power boats produced by this specialist company. Many of the craft names will be very familiar to marine model enthusiasts. Cigarette—a 1/12th scale, off-shore racing model is matched in the range by the endurance racing, 38 in. long, Barracuda and the slightly smaller Laser with its 33 in. hull. Only recently introduced is the SHG Shadow, with a hull based on the Shark 25 hull, and the kit includes hull, deck, superstructure, windshield plastics and rubbing strip. There is to be a special accessory pack matched to the Shadow. Also available from SHG is a large selection of boat hulls, fittings packs, engine mounts and couplings, trim tabs, buoyancy bags and other accessory components.

Modern Radio Control Gear

The popularity of radio control is something about which no active modeller needs reminding. The number of equipment ranges grows with considerable rapidity and, as a direct result of this competition within the trade, there are some very good value items available. Obviously, R/C equipment is something which must never be chosen on the grounds of price alone, so good value in this context involves a favourable balance between technical advantages and final cost. All the major manufacturers have introduced new equipment for pre-Christmas and 1980 sales, so that much of the stock in your model shop will be satisfyingly modern. For beginners there is every opportunity to buy simple units at prices which look to be enticingly low, whilst many of the advanced units—even up to 8-channel—are better value overall.

Fleet Control Systems now combine AM-FM equipment ranges and quote for a choice of outfits, ranging from 2-channel 2-servos up to 6-channel 6-servos and with choice of either all-dry battery power or other combinations.

Micron Radio Control claims to have introduced the first FM kit to be designed and developed here in Britain. The transmitter unit is very neatly styled, with choice of up to 32 frequencies, and up to seven channels are available. The receiver, servos and other Micron units are of equally advanced design, and the company makes much of its after-sales service with full-time engineers.

Another famous name in R/C is **MacGregor.** This range covers 1-6 channel Combos and, here again, the makers claim that the whole line has been reduced in price, quoting the new Minimac II outfit with transmitter, receiver and two servos for £49.

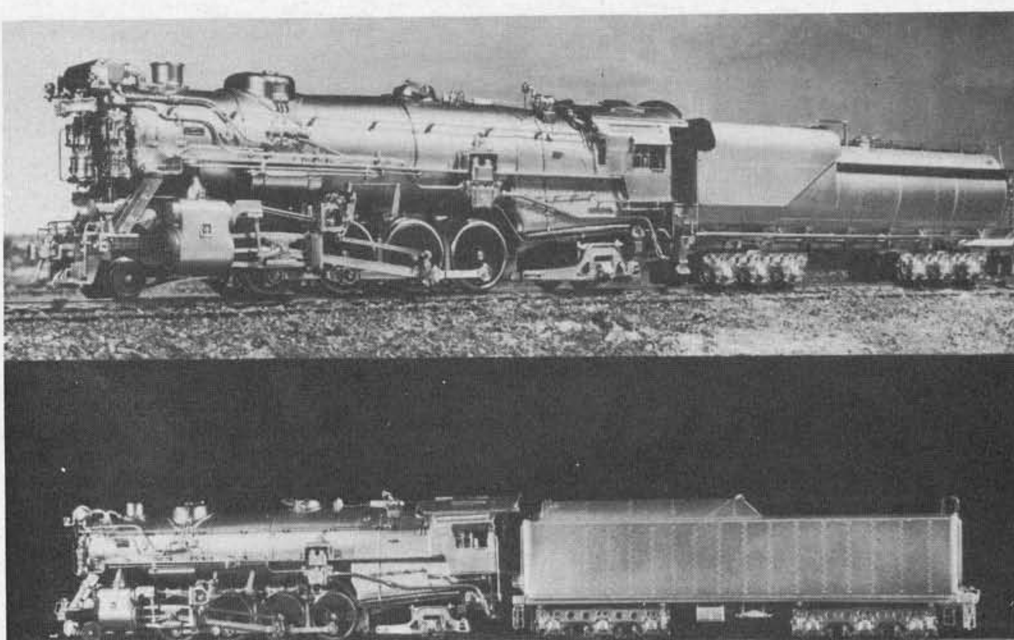
Recently announced by **Ripmax-Futaba** is a series of special deals which bring down a rudder-only RıC unit to about £37, and progress to just less than £100 for a rudder / elevator / ailerons / throttle outfit-including servos. Linked with the radio offers are series of kits for aircraft and boats so that, for each of the four R/C packs, there is a matched selection of Ripmax recommended kits.

Long Life Equipment

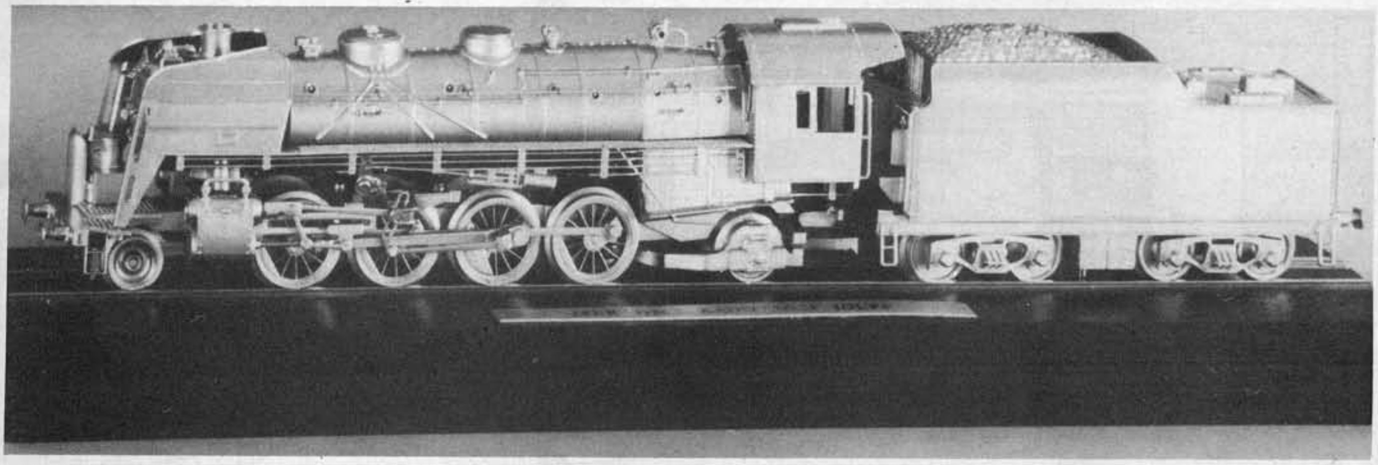
Good tools, whether hand or machine, are essential to high quality modelmaking. There is no substitute for quality, for precision and bargain basement offers simply do not go together. Perhaps the final confirmation of the advantages of quality comes from the fact that, as with so many older modelmakers and engineers, a fair proportion of our equipment goes back forty years or so. New items, therefore, are chosen with extreme care.

Any list of recent model engineering advances must include the new **E.M.E.** Unimat 3 Workshop System. This latest model is bigger, centre height 46mm, 205mm between centres and is capable of tackling a very wide range of precision tasks, in metal, plastics or wood.

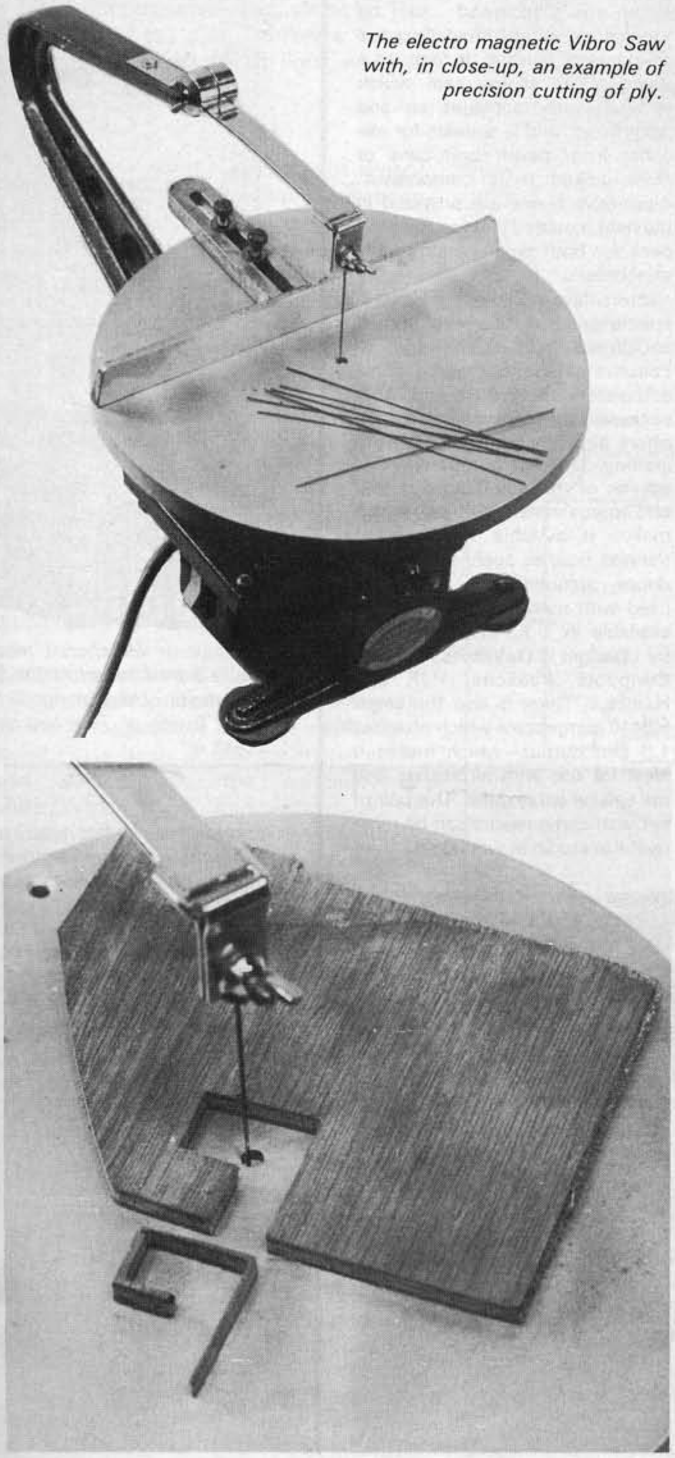
The Alpine range of workshop equipment from **Graham Engineering** (Midlands) brings in bench drills, mills, saws, grinders



Truly magnificent HO scale models of the United C&O, K-3a 2-8-2 and similar K3 with alternative tender. both are Pacific Fast Mail replicas.



The Jonuef Collector's Line features gold finished locomotives like this 2-8-2 model.



The electro magnetic Vibro Saw with, in close-up, an example of precision cutting of ply.

and vices. The company also offers competitive prices on small tools and is a main agent for Myford, Ajax and Astra.

Milling machines are available from **Sharp & Sons** and **Tom Senior** (Liversedge) Ltd. The former provides a machine which comes complete with motor and milling arbor and has a table size of 20 in. with 12 in. travel, 4½ in. cross feed and 10½ in. rise and fall. Eight spindle speeds are available. The small vertical milling machine from Tom Senior has a 25 in. × 4¾ in. table, 15 in. table travel, 14½ in. vertical travel and 6 in. cross travel. Both of these machines are of excellent quality and will prove to be long-term investment to any serious model engineer.

A lathe in kit form is the Simat 101 2 in. × 12 in. centre unit. The pack contains fully machined and finished parts and is complete with auto traverse, compound slide, back gear, face plate and centres. It is competitively priced.

A range of modelmaking hand tools which seems to grow both in size and interest value, is that marketed under the **X-Acto** banner. Knives, blades, saws and a first-class selection of other tools and knife and tool sets are available, besides twist drills and needle files. X-Acto quality is well known and the present levels of prices render them extremely good value.

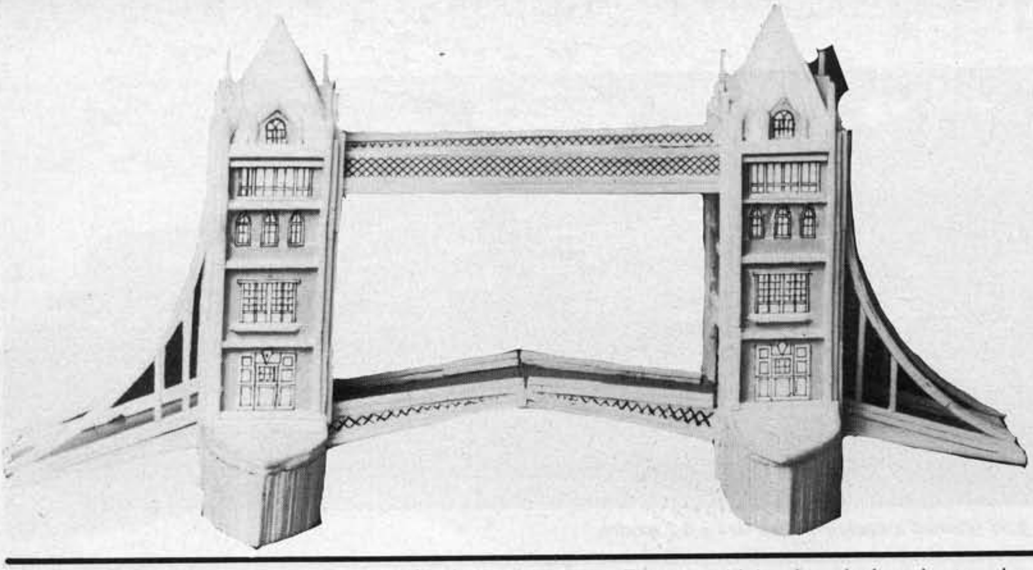
An item of craft and modelling equipment which is out of the normal run is the **Vibro Saw**. This unit is an electro magnetic fretsaw, which provides up to 3¾ in. depth of cut with an 11½ in. throat to give adequate clearance for modelling work in a variety of materials. The saw is quiet in operation and takes many types of blades, including fretsaw, piercing and cutting. Whilst we have not had an opportunity of testing the Vibro Saw. Messrs Euromodels claim that it is the only board fretsaw that will cut a 90° turn without breaking the blade and can cut to a right-angle without rounding the edges. They also state that no edge sanding is required as the saw will cut the work—aluminium, fibreglass, acrylic resins, other plastics, brass, copper, woods, vinyls etc.—without tearing or pulling at the edge. An impressive range of material thicknesses which may be cut with the Vibro Saw is quoted, from 9mm ply, 5-6mm hardwoods, copper and aluminium up to 4mm, and Balsa from 3½ in. thick block down to $\frac{1}{32}$ in. sheet. This sounds a very useful modelling aid, especially for cutting out those multitudes of bulkheads and ribs, and also appealing is the reported silence of the Vibro Saw's action.

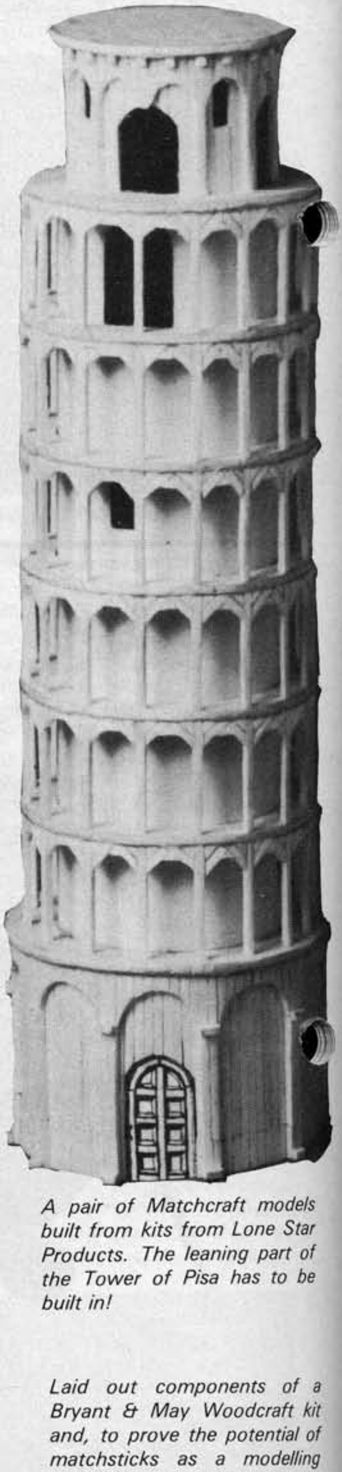
A miniature power tool which is bound to have considerable appeal is the Mini-Plus, hand-held, 12v unit which is available either in basic drill form or in sets with accessories and even a variable speed transformer. **Como Drills** offer a range which includes a wide variety of accessories such as battery adaptor, bench vice and a large selection of twist drills, burrs, carborundum discs, polishing wheels and wire brushes. The tools have many modelmaking and engineering applications and can extend the scope of modellers who are restricted to 'kitchen table' modelling many times over.

Three Ideas that are Different

A modelling system which has many applications is the 00 scale, **Linka** method of producing cast reproductions of brickwork, stone and timber structures for railway modelling, war gaming and the preparation of Dioramas—both modern and period.

There are two major Linka packs, the first for brick and the second for brick and stone structures. Both contain a number of flexible moulds, with appropriate supplies of compound, plus good supplies of the necessary accessories. The material is easy to use and the castings are not only readily assembled, but finishing is as straightforward as with other materials—if not more so. Besides the major packs there are adequate supplies of accessory units, ranging from plastic gutters and





drainpipes, through mixing bowls, packs of compound to vacuum formed moulds for roof and other surface effects. Relatively new is a thatch-making kit which comes complete with slow setting Linkalite compound.

The scenic advantages of the Linka System can be emphasised by the use, on model railway layouts especially, of Merit Hobby railway accessories. Available predominantly in 00/H0 scale, the range includes passengers, railway and public services personnel, platform units, including parcels, mail bags, trunks and trolleys, bicycles and even an electric parcels trolley with trailers, and also includes many freight yard items, plus scenic accessories such as the walls, fencing, tunnel mouths and, of course, animals of the countryside. These relatively low cost presents will be appreciated by every modeller.

Making models from matchsticks has long been a recognised spare time activity, but in recent years it has been brought up to date by several companies, notably **Bryant & May** with the **Woodcraft** Series of constructional kits. They are based upon all-wood construction, with a large proportion of their components formed of sticks of traditional match dimensions. They also include glue, sandpaper, a special safety cutter and involves prototypes as diverse and interesting as village buildings from church to pub or windmill, a railway station and signal box, a farm set-piece and a group of remarkably realistic 1/32nd scale working models of historical siege machines. There is also a separate woodcraft Make-Anything pack which contains 2,000 wood splints and, in contrast to rigid, kit type guidance, a full-colour broadsheet to stimulate the imagination of the modellers. The examples shown in the Woodcraft leaflet of models from the Make-Anything Pack include and old-time racing car, a Romany caravan and a chalet cottage.

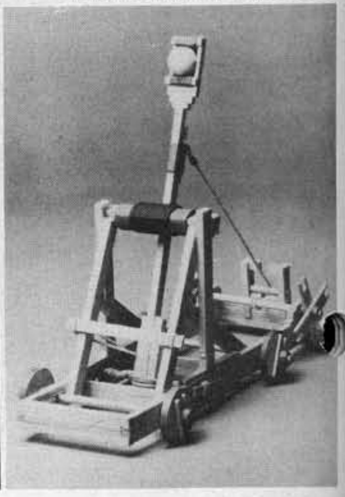
Glass engraving is a skill which may be a hobby, a craft or form part of an industrial process. There is a new **Burgess** engraver which although it was developed primarily for industrial use is likely also to be of special interest to hobby/craft workers for continuous engraving. This single-speed model, No. 376, runs at 6,000 strokes a minute and has a variable control to shorten or lengthen the stroke. It conforms to BS.2769, has reinforced nylon casing, and is double insulated. Each Burgess engraver comes complete with 2 hard points for general engraving, 2 hard points and one standard point for relatively softer materials including plastics.

And to Finish . . .

It is unlikely that modellers ever have a surfeit of the materials and equipment they use most frequently. Certainly this applies to adhesives and other surface coatings, such as those in the **Humbrol** range, and perhaps applies particularly when one reaches the stage of spray equipment. There is no doubt that an airbrush finish can work wonders on the average model, so Humbrol offers both a simple Modellers' Airbrush, and the recently introduced, more advanced, Studio 1 Airbrush Pack, which is designed to be appropriate to both modelling and graphic arts finishes. It features a single action sliding cam which simultaneously activates air and paint flows, and is suitable for use either from power unit cans or when linked to a compressor. Alternative hoses are provided in the neat moulded plastics Studio 1 pack for both types of air supply attachment.

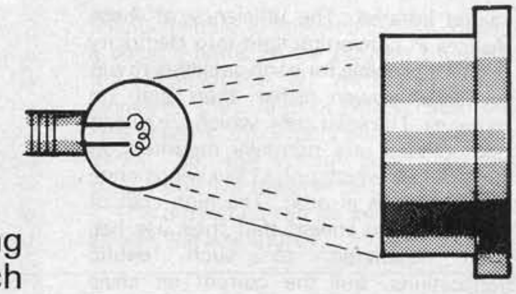
Microflame (U.K.) Limited specialises in surface finish equipment. It offers the range of Paasche airbrushes, which come complete with air hose and other necessary accessories, and also offers airbrush compressors by a leading U.S.A. company. The smaller of these is 0.5cfm output and approximately 30 lb psi, which makes it suitable for spraying thinned finishes such as cellulose dopes, lacquers, etc. it can be used with most of the airbrushes available in U.K. including those by Badger, DeVilbiss, Binks, Conopois, Paasche, VJR and Humbrol. There is also the larger HS410 compressor which provides 1.0 cfm output—which makes it ideal for use with airbrushes and the smaller spray guns. This pair of airbrush compressors can be most useful in studio or workshop.

A pair of Matchcraft models built from kits from Lone Star Products. The leaning part of the Tower of Pisa has to be built in!



Laid out components of a Bryant & May Woodcraft kit and, to prove the potential of matchsticks as a modelling material, a finished siege machine from the same series.

Opto Electronics



Roger Barrett continues this month with the sensing and detection of light, plus a light beam operated switch to build

In Part 1 (October issue) I discussed light sources with emphasis on LED's. I tried to point out the advantages of LED's over filament lamps in models and I hope that this will encourage readers to make wider use of LED's which can give far more realistic results if used sensibly. The other side of the optoelectronics coin is the sensing, or detection of light, which is the subject of this article.

Fig. 2 *CdS Exposure Meter with two typical cells.*

Light Sensors

There are several types of light sensor in use today, many of which have been developed for highly specialised applications. For example there are the photomultiplier tubes, which are constructed rather like radio valves, and are used to detect the tiny flashes of light given out during collisions of sub-atomic particles. There are also special Geiger tubes used to detect the minute amount of ultraviolet given off by a fire. These are used to detect fires in aircraft engines, and are fitted to Concorde.

These applications are very special but the more common, therefore cheaper, sensors are finding more and more applications in everyday life and it is these types that I will be discussing.

Photoconductive Cells

The photoconductive cell, also known as the photoresistor or light dependent resistor has been in use for many years and is probably the simplest to understand.

Electrically this device is simply a resistor whose resistance varies according to the amount of light that falls on it. The circuit symbol is shown in Fig. 1.

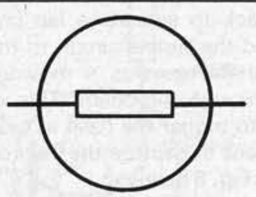


Fig. 1 *Photo resistor circuit symbol.*

The most common material for this type of cell is a compound called cadmium sulphide whose chemical formula is CdS. This particular type is often called a CdS cell.

The change is resistance with light level is large for a CdS cell, the resistance decreasing as the light level increases. A typical cell may be 100 ohms in sunlight and as much as 10 megohms (10,000,000 ohms) in moonlight. This high sensitivity makes them easy to use in things like the photographic exposure meter shown in Fig. 2. The circuit of this kind of meter is shown in Fig. 3 and could hardly be simpler. The current through the meter depends on the resistance of the CdS cell so that as the light level increases, the resistance falls and the current increases. The switch is included to save the battery when the meter is not in use.

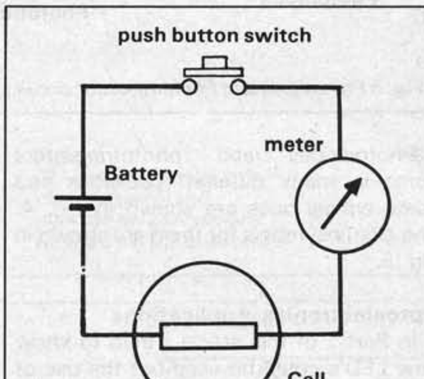


Fig. 3 *CdS Exposure meter circuit.*

CdS cells find many other applications such as in automatic switches for street lamps and as flame sensors in large oil-fired boilers in ships. Probably their biggest limitation is that they cannot respond very quickly to changes in light level. If the level changes instantaneously the cell resistance will change but will not reach its new value for about 10 to 100 milliseconds (0,01 to 0,1 seconds). These times are very short in everyday terms but in the world of electronics they seem very long indeed.

This small speed limitation is largely overcome by the semiconductor junction devices described below.

Photodiodes

We have already met the semiconductor junction diode as a device which allows current to flow in one direction only. A related device is the LED which I discussed in Part 1.

One of the properties that all of the junction diodes have in common is that they respond to light. If light falls on a junction the interaction between the light and the junction material generates an electric charge which is seen as a current in the external circuit. The amount of charge generated depends on the light level and is zero in dark conditions. This current will flow even when the diode is reverse biased so the diode would not be terribly useful as a rectifier as it would allow current to flow in either direction. For this reason ordinary rectifier diodes are packaged in such a way that all light is excluded from the junction.

Photodiodes on the other hand are packaged in such a way that the whole of the junction is exposed to the incoming light. The most common material for photodiodes is silicon, and devices made from this will respond to light from ultra-violet right through the visible region to the infrared. The efficiency of these devices in converting light into electricity makes it possible for earth satellites to run on solar power rather than just on batteries. The solar cells, which are silicon photodiodes, are normally mounted on large panels which unfold like wings once the satellite is in orbit. The high cost of solar cells has meant that their use has been restricted to such exotic applications, but the current oil crisis provides real incentives for the development of cheaper cells. It is already possible to buy watches and calculators that run on solar power, and in a few years time we may be powering our model aircraft radio receivers from cheap lightweight solar panels mounted on the aircraft wings.

Although the generation of electricity is becoming more important, the main uses of photodiodes are still in the detection and measurement of light. Like the CdS cells they are used in photographic equipment, and many of the sophisticated automatic cameras are now using silicon cells because they are more stable and predictable than CdS types.

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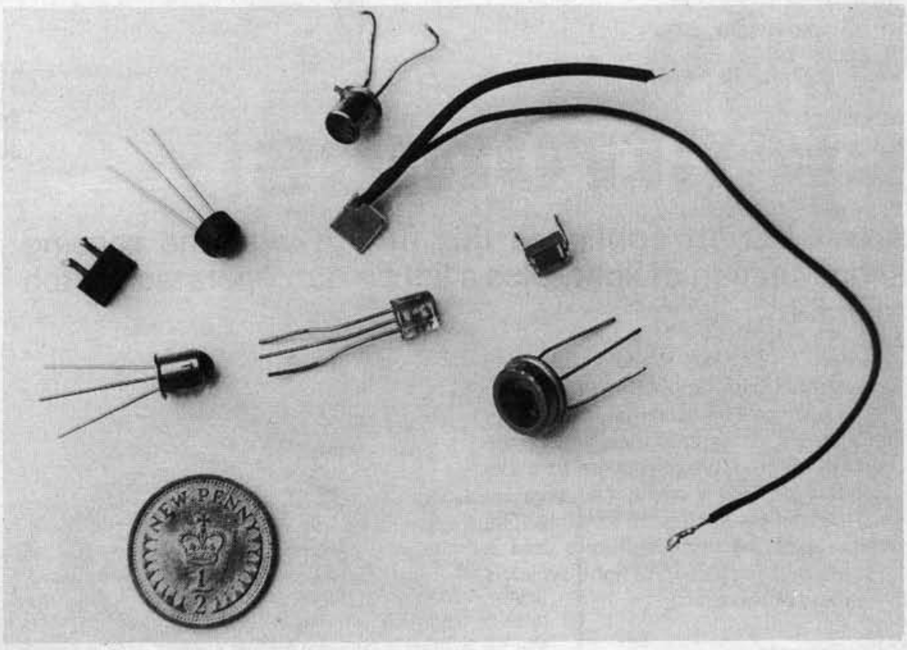

Fig. 4 *Some typical silicon photodiodes and phototransistors.*

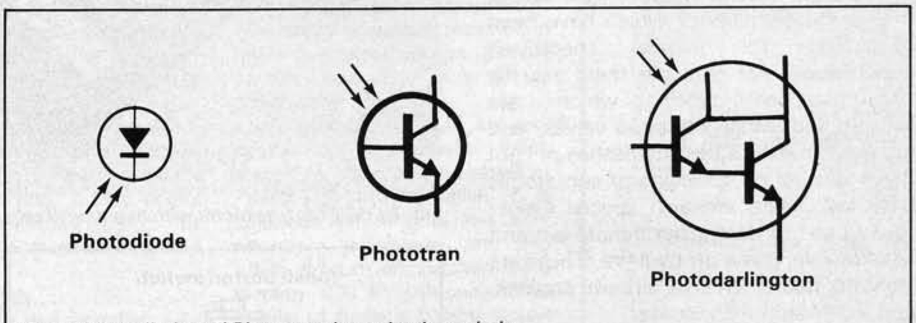

Fig. 5 *Photodiode and Phototransistor circuit symbols.*

Photodiodes and phototransistors come in many different packages and some typical ones are shown in Fig. 4. The circuit symbols for them are shown in Fig. 5.

Optoelectronics Applications

In Part 1 of this article I tried to show how LED's could be used but the use of emitters and sensors together is a bit more complicated. I mentioned optical communication systems and this is one area in which optoelectronics may make a big impact on the modelling world. Optical links are becoming more practical as new devices are developed and these links are being used for such mundane jobs as the remote control of TV sets. There is also on the market now a model car which is controlled remotely using an optical link. The principal is the same as that of ordinary radio control except that the radio transmitter is replaced by a pulsed LED (or IRED — see Part 1) and the radio receiving aerial by a photodiode or phototransistor. The range is limited at present but within a few years the light controlled model may be as common as the radio controlled one is today.

Such a control system is much too complex to be described here, but there is a fairly simple circuit which I will describe which can be both entertaining and useful. This simple system uses a light source and a receiver but the job of the receiver is to detect the presence, or absence, of the source rather than to receive complicated messages and instructions. This type of beam is very widely used in sensing objects that pass through the beam and I am sure that you will all have come across the infrared beam type of burglar detector if only in James Bond stories.

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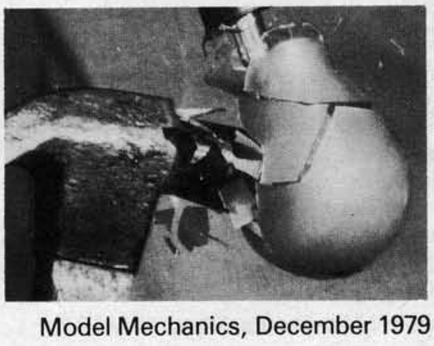

The light source in this kind of beam is not at all critical and can be a filament lamp, LED or IRED. My flash trigger used an ordinary two-cell torch which was effective from a distance of about fifteen to twenty feet. Once you have the receiver made you can experiment with different sources to operate at different distances.

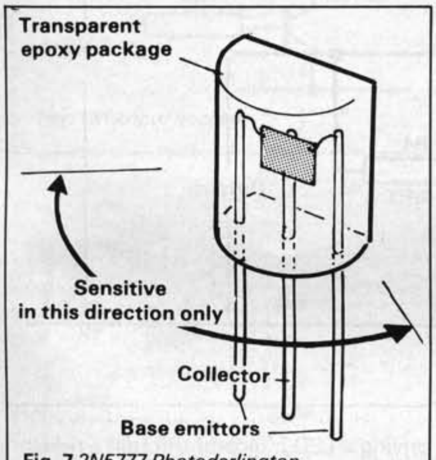

Fig. 7 *2N5777 Photodarlington.*

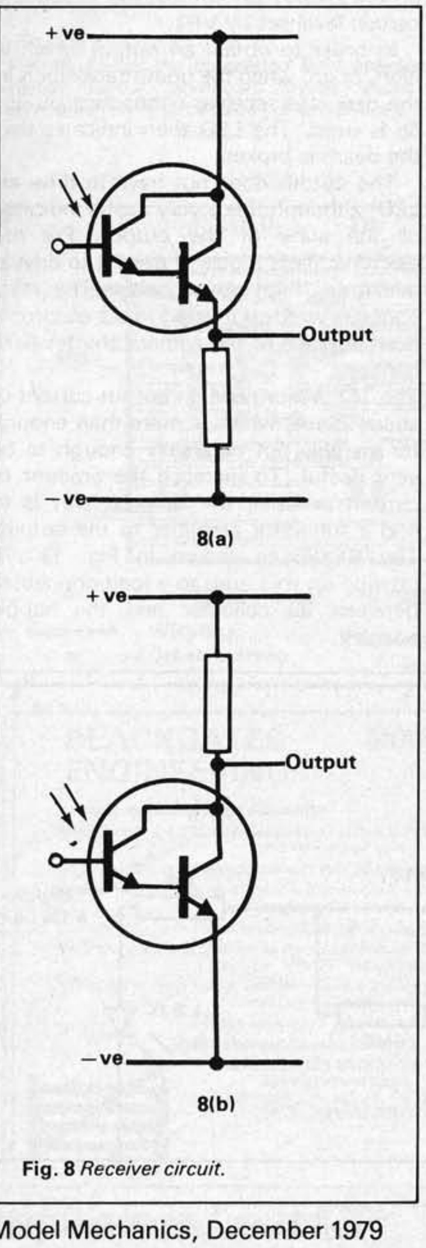

Fig. 8 *Receiver circuit.*

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The receiver that I have used is a phototransistor, type 2N5777, which is plastic encapsulated. The package is shown in Fig. 7. Notice that it will only respond to light from one direction. This device is in fact a photodarlington which is made up of two transistors cascaded to give extra gain. The light causes current to be generated in the base of the first transistor and this is amplified by the two transistors in series to give a combined gain of over one thousand times.

The final current flows between the collector and emitter of the second transistor, and increases as the light falling on the device increases. In order to make use of the output we really need it in the form of a voltage rather than a current, and we can get this voltage simply by making the current flow through a resistor. The resistor can be in either of the positions shown in Fig. 8. The output voltage in each case is taken between the negative side of the supply and the resistor, but there is a very important difference in the outputs. In each case the current is zero (or very nearly zero) when no light falls on the photodarlington; this gives an output voltage of zero in the circuit of Fig. 8a but a voltage equal to the positive supply in the circuit of Fig. 8b. As the light level increases, the output of Fig. 8a rises from zero towards the supply positive whereas in Fig. 8b, the voltage falls from the supply positive towards zero.

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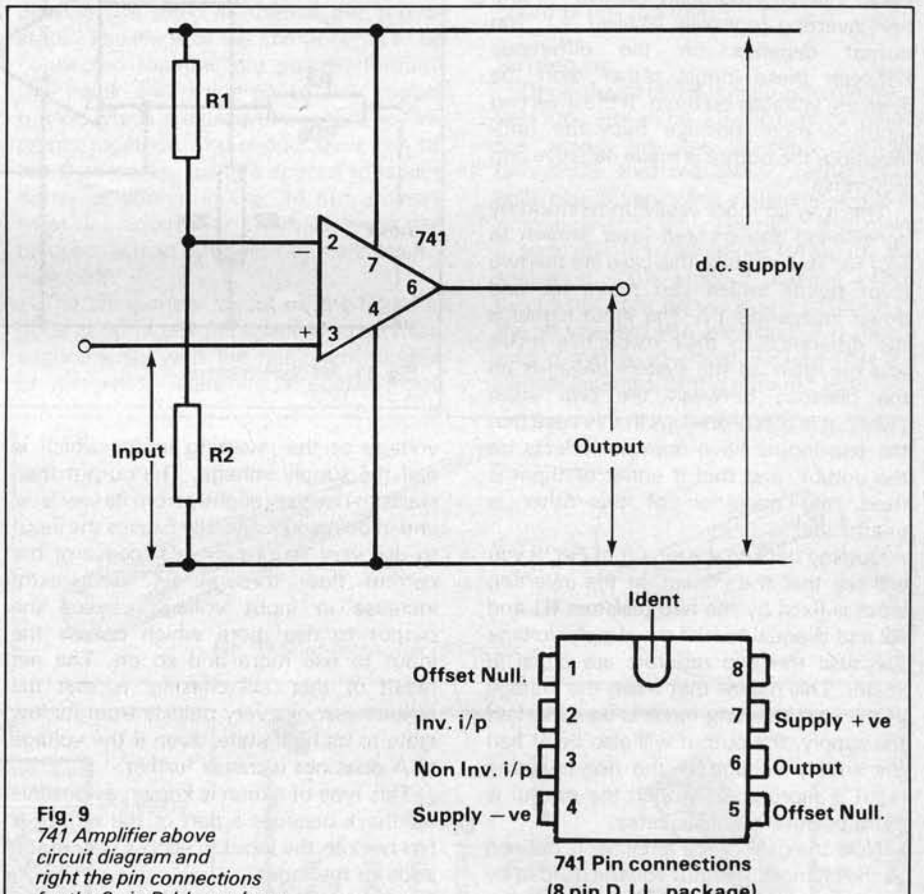

Fig. 9
741 Amplifier above circuit diagram and right the pin connections for the 8 pin D.I.L. package.

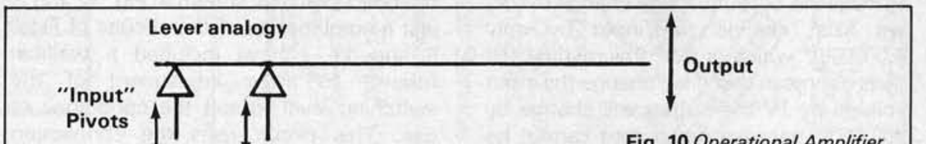

Fig. 10 *Operational Amplifier.*

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The simple sensing circuits shown above are useful but are rather limited in their applications. The output is varying continuously with the light level and is most suitable for light measuring systems, such as photographic exposure meters. For our application we need to know whether the light level is above or below a certain level so that we know if the beam is obstructed or not. We could decide this for ourselves by connecting a meter to the sensor output and watching the meter reading continuously but this is not a very efficient use of our time. Instead of this we can use a simple circuit to make the decision for us, and the circuit shown in Fig. 9 will do this job.

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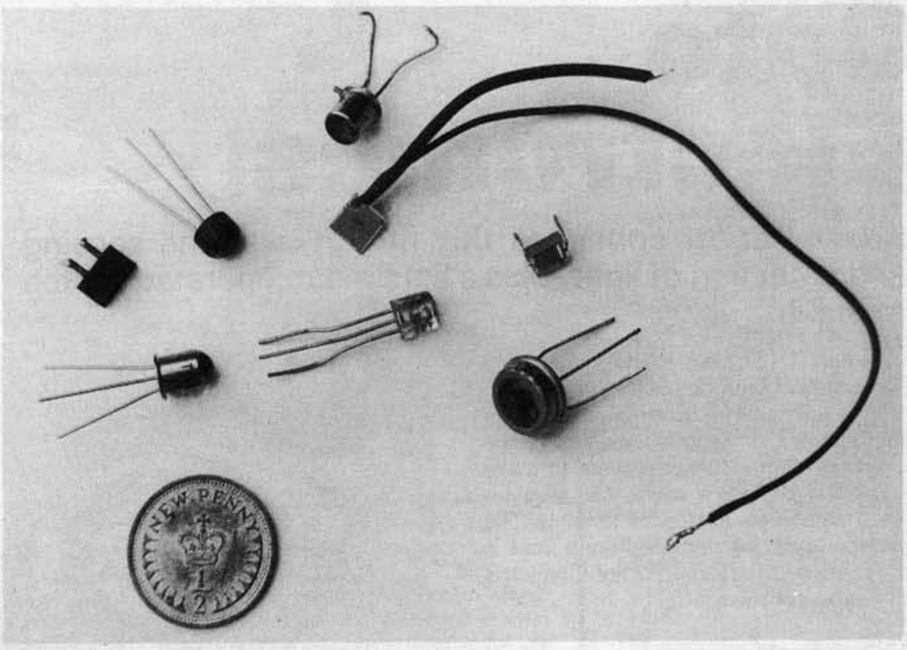

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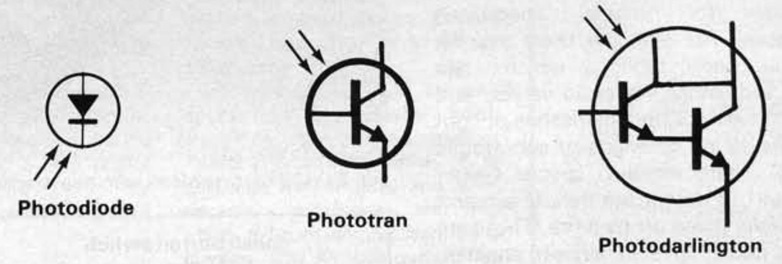

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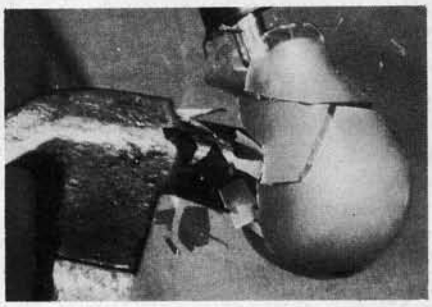

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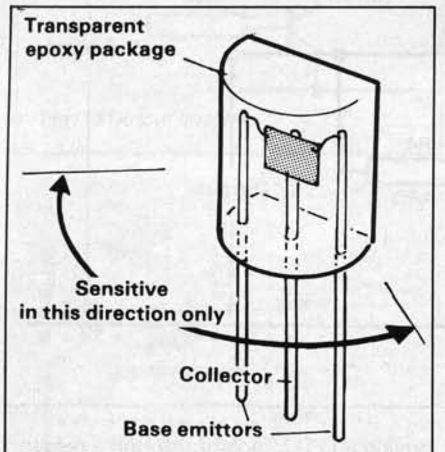

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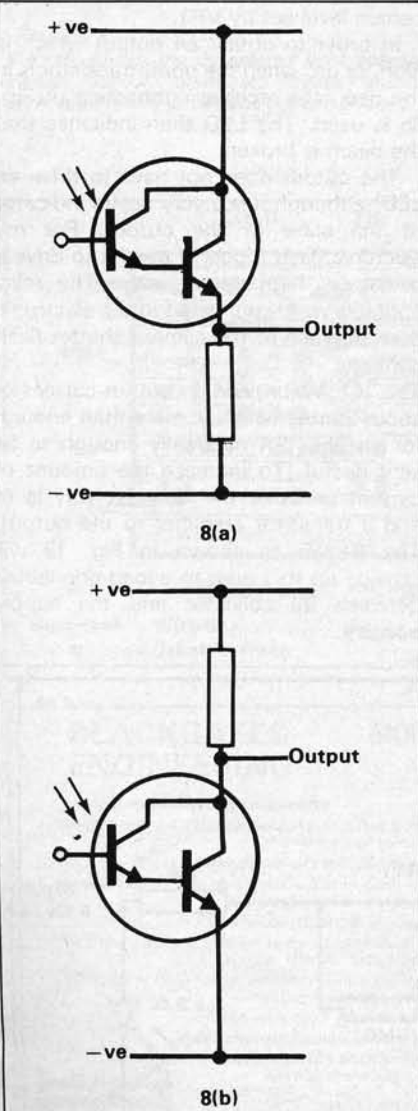

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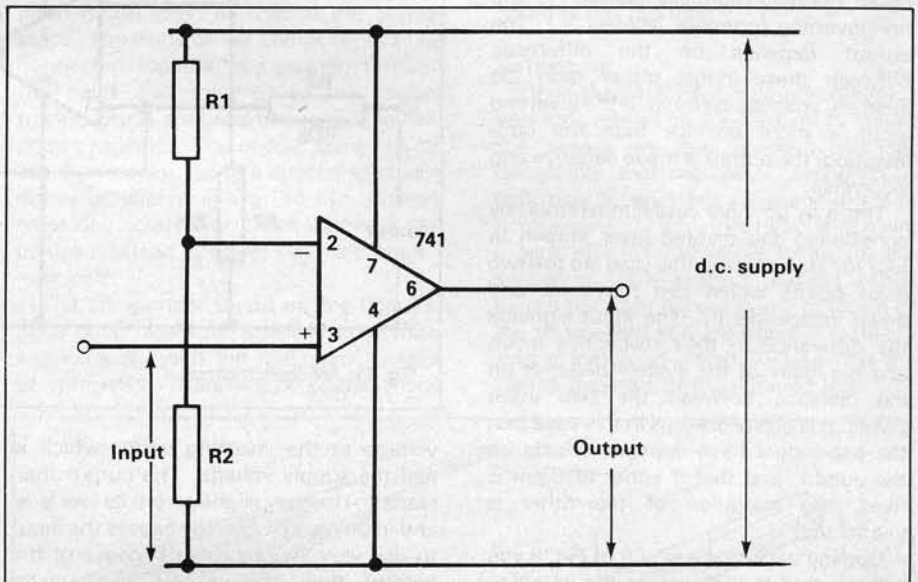

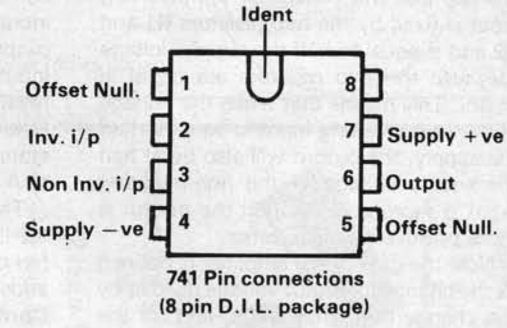

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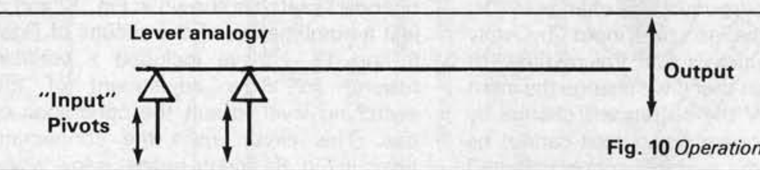

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For reasons of simplicity and economy I have used an integrated circuit amplifier in this design, and the type that I have chosen is the '741' which is made by many manufacturers under slightly different numbers. These are all made to the same design using the same pin connections and any 741 should work in this circuit.

The 741 is a particular type of amplifier known as an operational amplifier or op-amp. Op-amps have two inputs which are called inverting (normally labelled −) and non-inverting (normally labelled +). The output depends on the difference between these inputs rather than the absolute voltages on them. If the inverting input is more positive than the non-inverting, the output is made negative and vice-versa.

This may be more easily understood by considering the pivoted lever shown in Fig. 10. The inputs in this case are the two pivot points which can move up and down independantly. The input signal is the difference in their respective levels and the 'gain' of the system depends on the distance between the two input pivots. It is pretty obvious in this case that the two inputs have opposite effects on the output, and that if either of them is fixed, the operation of the other is unaffected.

Coming back to the circuit of Fig. 9 you will see that the voltage at the inverting input is fixed by the two resistors R1 and R2 and is equal to half the supply voltage (because the two resistors are equal in value). This means that when the voltage at the non-inverting input is equal to half the supply, the output will also be at half the supply voltage. If the non-inverting input is more positive then the output is more positive and vice versa.

Now the gain of the amplifier is defined as the change in output voltage divided by the change in input voltage, and for the 741 is typically 200,000. This means that to make the output voltage change by 1V, we must change the input by only 0.000005V which is 5μV (microvolts). (It does not mean that if we change the input voltage by 1V the output will change by 200,000V because the output cannot be greater than the available supply voltage.) If the input voltage (and remember that the input is the voltage difference between the two inputs) is more than about 1millivolt the output will remain close to the supply rail, either positive or negative depending on the polarity of the input.

Although the circuit in Fig. 9 can be used to compare the input with some fixed level, it is still rather vague when the two voltages are almost equal. We would obviously prefer a definite 'high' or 'low' output rather than one which can be halfway, even if this halfway region occurs for a very small range of input voltages. The circuit of Fig. 11 eliminates the uncertainty and works in the following way. Imagine that the input at point A is zero initially and is slowly made more positive. The output will start off near to the negative of the supply and will stay there until the voltage at A is near to the

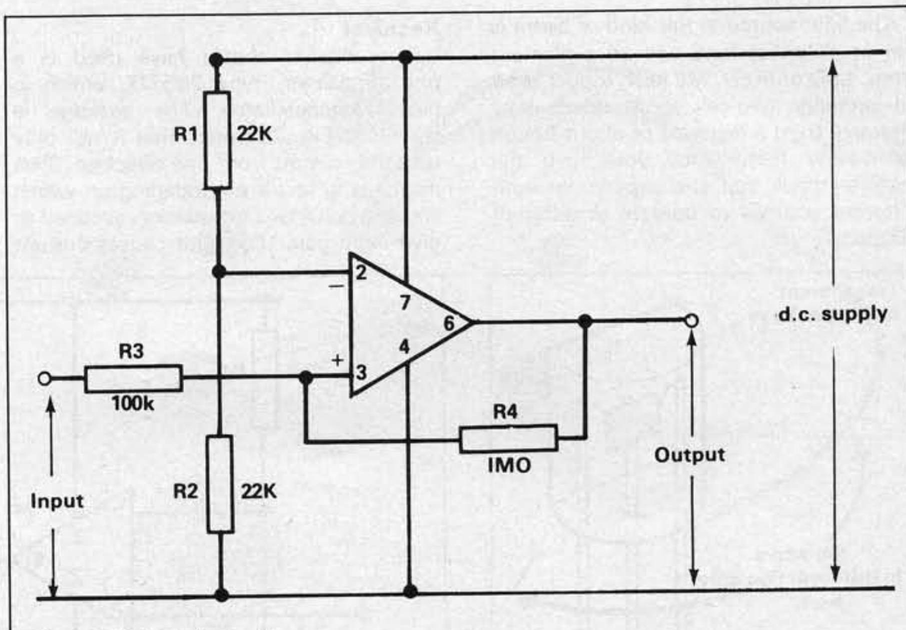


Fig. 11. *741 Switch circuit.*

voltage at the inverting input, which is half the supply voltage. The output then starts to rise very slightly from its low level and in doing so it actually causes the input to rise very slightly more because of the current flow through R4. This extra increase in input voltage causes the output to rise more which causes the input to rise more and so on. The net result of this 'tail chasing' is that the output changes very quickly from its low state to its high state, even if the voltage at A does not increase further.

This type of action is known as positive feedback because a part of the output is fed back to the input in such a way that it adds to the input.

Complete Circuit

The complete circuit of the light operated switch is shown in Fig. 12 and is just a combination of the circuits of Figs. 8 and 11. I have included a variable resistor to allow adjustment of the switching level to suit the conditions of use. This circuit uses the connection given in Fig. 8a and its output is low when the light level is low. The output is shown driving a LED indicator through a resistor. This LED will light when the light falling on the 2N5777 phototransistor is above a certain level set by VR1.

In order to obtain an output which is high, or on, when the phototransistor is in the dark, the receiver connection of Fig. 8b is used. The LED then indicates that the beam is broken.

The output does not have to drive an LED, although it is a very useful indicator of the state of the output. For my electonic flash trigger, I used it to drive a miniature, high speed relay. The relay contacts were connected to the electronic flash in place of the camera shutter flash contacts.

The 741 will provide an output current of about 25mA, which is more than enough for an LED but not really enough to be very useful. To increase the amount of current available the simplest way is to add a transistor amplifier to the output. The BFX85 as shown in Fig. 13 will provide up to 1 amp to a load connected between its collector and the supply positive.

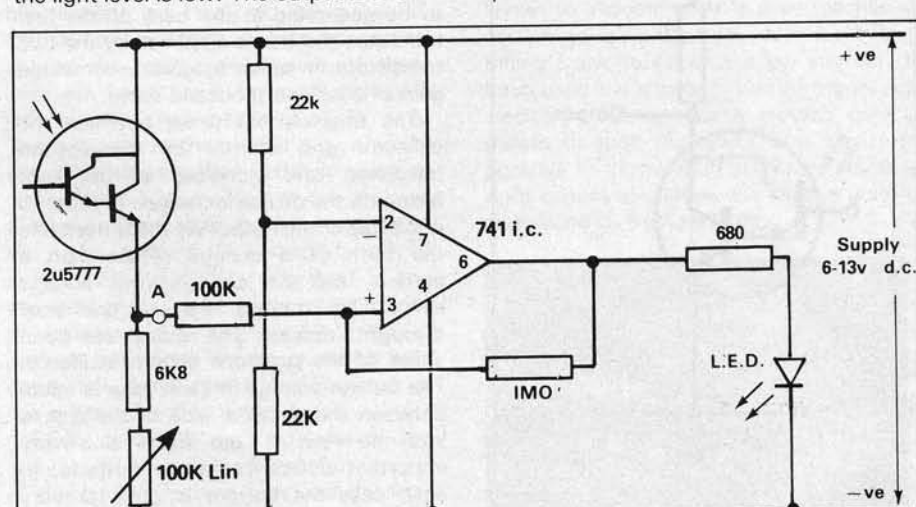


Fig. 12 *Complete circuit of Light-operated switch.*

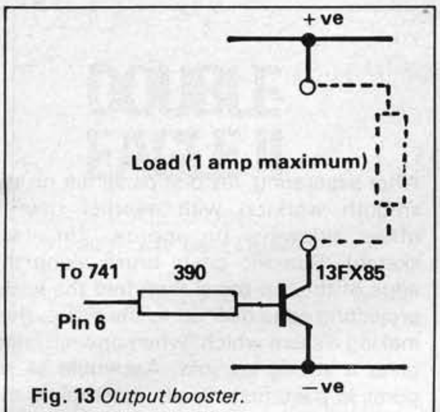


Fig. 13 *Output booster.*

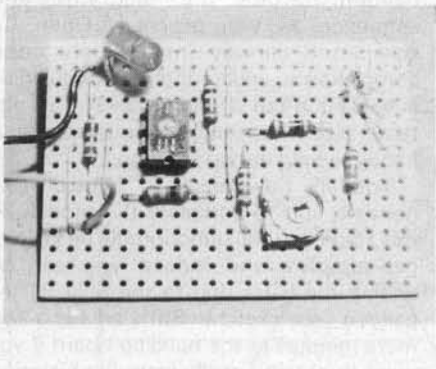


Fig. 15 *Above the completed light operated switch. Below, Veroboard layout showing components and track to be cut and bridged.*

Construction

This circuit is quite a simple one and can easily be constructed on Veroboard. For those readers not familiar with this method of construction I will explain briefly what is involved. Veroboard is an insulating board, 1,6 mm thick with narrow strips of copper bonded to one surface. The board (and the copper strips) is drilled with a matrix of holes whose pitch is the same as that of the copper strips. The leads of the components to be connected together are pushed through the holes and soldered to the copper tracks, which are used to connect several points together. The copper track can be cut if necessary using a special spot-face cutter as shown in Fig. 14 (an ordinary twist drill about 3 or 4 mm diameter can be used instead but does not make such a neat cut).

The component layout on the board is quite important if the space is to be used economically with the minimum number of wire links. There are of course many different ways to lay out any circuit and the one which I have used is shown in Fig. 15. Both the phototransistor and the LED are shown mounted on the board although this is not necessary. It will often be more convenient to mount them remotely from the rest of the circuit and this is quite permissible if the distance between the phototransistor and the board is not too long.

Setting-up

Once the circuit is constructed there is very little else to be done except to mount the sensor in the required position. Remember that the 2N5777 responds to light over a very wide angle and if it is in normal daylight it may be difficult to make it turn off. It is advisable to mount the sensor in some kind of housing which blocks out light except in the direction of the source that you are using. It is then a simple matter to adjust VR1 so that the switch operates at the required level.

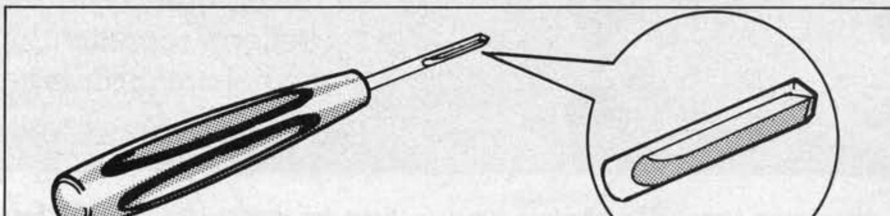
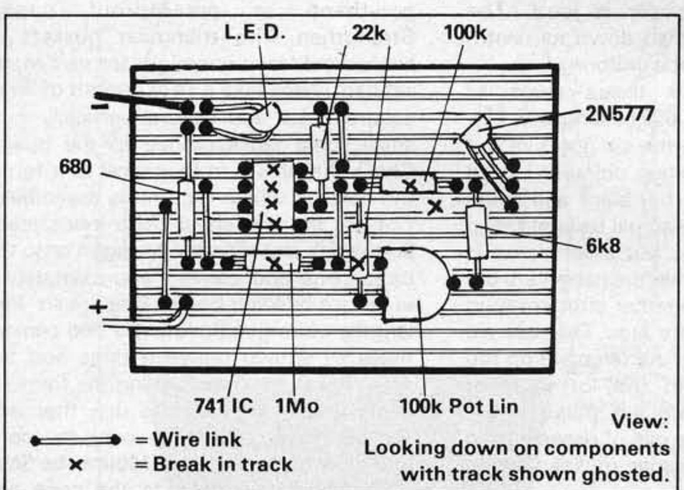
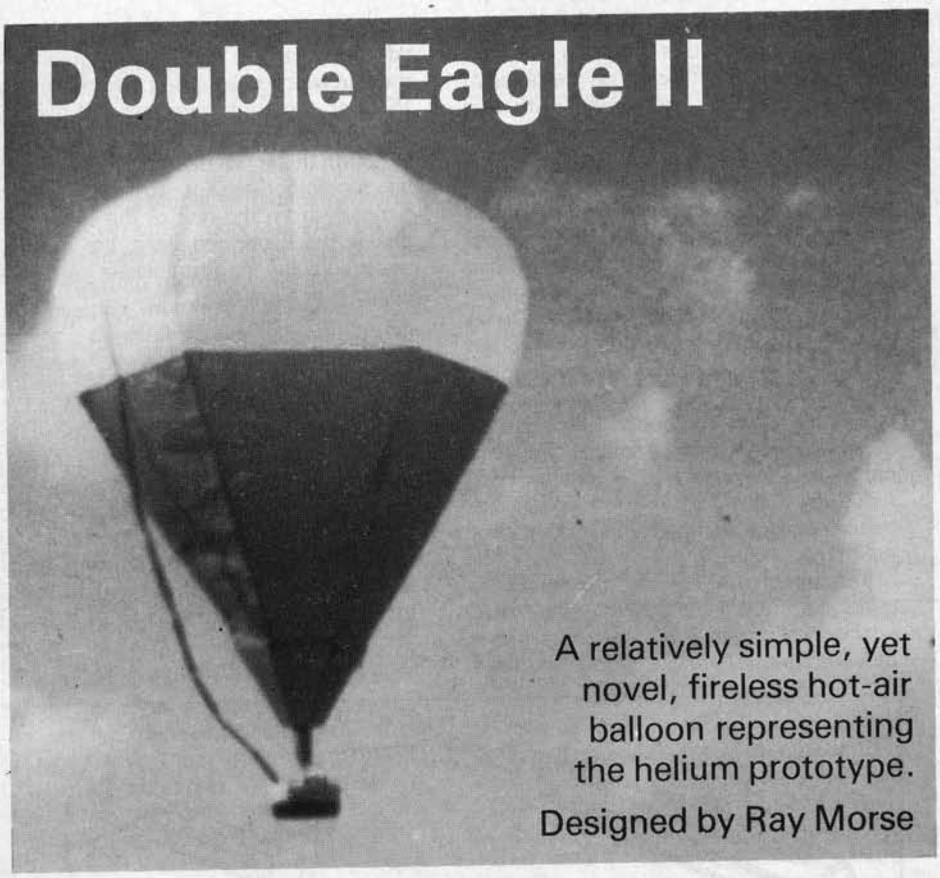


Fig. 14 *Spot-face cutter for Veroboard.*



Double Eagle II



A relatively simple, yet novel, fireless hot-air balloon representing the helium prototype.

Designed by Ray Morse

Yet another aeronautical milestone was reached in August 1978, when three intrepid Americans, Ben Abrusso, Max Anderson and Larry Newman became the very first men to complete the North Atlantic crossing by balloon. Previously many abortive attempts had been made, including the magnificent effort of Don Cameron and Major Christopher in Zanussi who very nearly made it, ditching only 103 miles from the French coast. Modern technology, coupled with radio and accurate weather forecasts, did much to aid the victors but, as well as this, the spirit of adventure, grit and determination, combined with a happy relationship between the crew members, contributed to the success of this enterprise.

Although we have to leave the hazards of Atlantic ballooning to the fortunes of the few, there is no reason why we cannot capture at least part of the excitement by the construction of a realistic flying model of the now celebrated Balloon Double-Eagle II. Before commencing my own description, I would like to mention the excellent one of a hot-air balloon which the editor has provided in the September 1979 issue of the new hobby magazine "Model Mechanics". Beginners in particular would do well to study this issue and conduct some experiments before embarking on more ambitious projects.

Now, up with the shirt sleeves and on with the model! The basic materials are very modest and will make only a shallow hole in your pocket. The items can be obtained at your local shops and scrap box without a major hunt.

Start by making the canopy. First, having consulted the plan, cut out a stiff brown paper template to dimensions as shown. Wrapping paper is ideal. The template may be folded down its centre lengthwise to get shape uniform.

Next, prepare six tissue strips as indicated in sketch p.600 pasting with $\frac{3}{8}$ in. overlap. These form the six gores of the canopy. Use contrasting colours. I used dark blue and white, but black and white would look well. The actual balloon fabric was silver and black, but silver tissue is hard to come by. When the panels are dry stack them neatly together after creasing each down the centre line. This will aid assembly later. Place the template on top of the pile and pin the lot together temporarily. Following the shape of the template, cut out the pile of tissues using a sharp pair of scissors or keen knife.

Materials

- Commercial tissue paper 12 sheets 30" × 20" for canopy (six of each colour).
- Strip balsa 3mm sq. Sheet balsa 3mm thick × 3" × 6" for frame. String for loop.
- Ali wire 16g. App. 18" length for gondola supports.
- Cartridge paper app. 10" × 7" for central support and flags.
- Plastic fruit punnet 5" × 3" × 2" deep.
- Steel wire 22g for neck closing hooks.
- Rubber bands for closing neck.
- Cotton bandage, 5" length for neck hinge.
- Poster paints for flags.
- Humbrol enamel for gondola. Yellow and red.
- Balsa cement.
- Tissue paste.

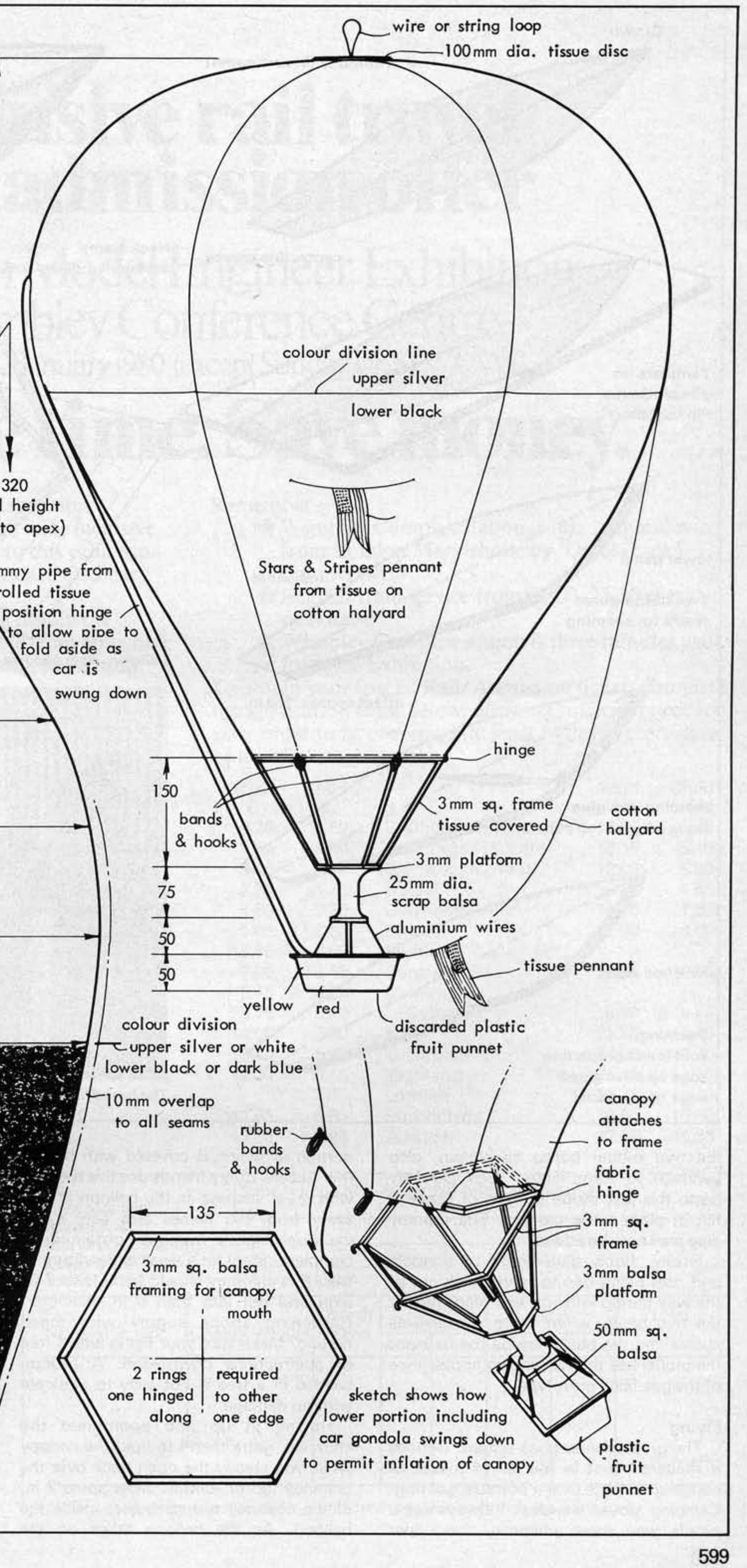
After separating, lay one panel flat on the smooth worktop with another over it offset sideways by approx. $\frac{3}{8}$ in. (see sketch). Run the paste brush along the edge of the top panel then fold the lower projecting edge over on to the paste, thus making a seam which, when opened later, gives a strong lap join. Assemble all six gores in pairs first, finally assembling the resulting three pairs to form the complete balloon. Study the diagrams and sequence as you proceed. Open up completed canopy immediately upon completion to ensure that no surplus glue is holding in the wrong place. A 4 in. dia. tissue disc with string loop at the crown is handy to hold during inflation.

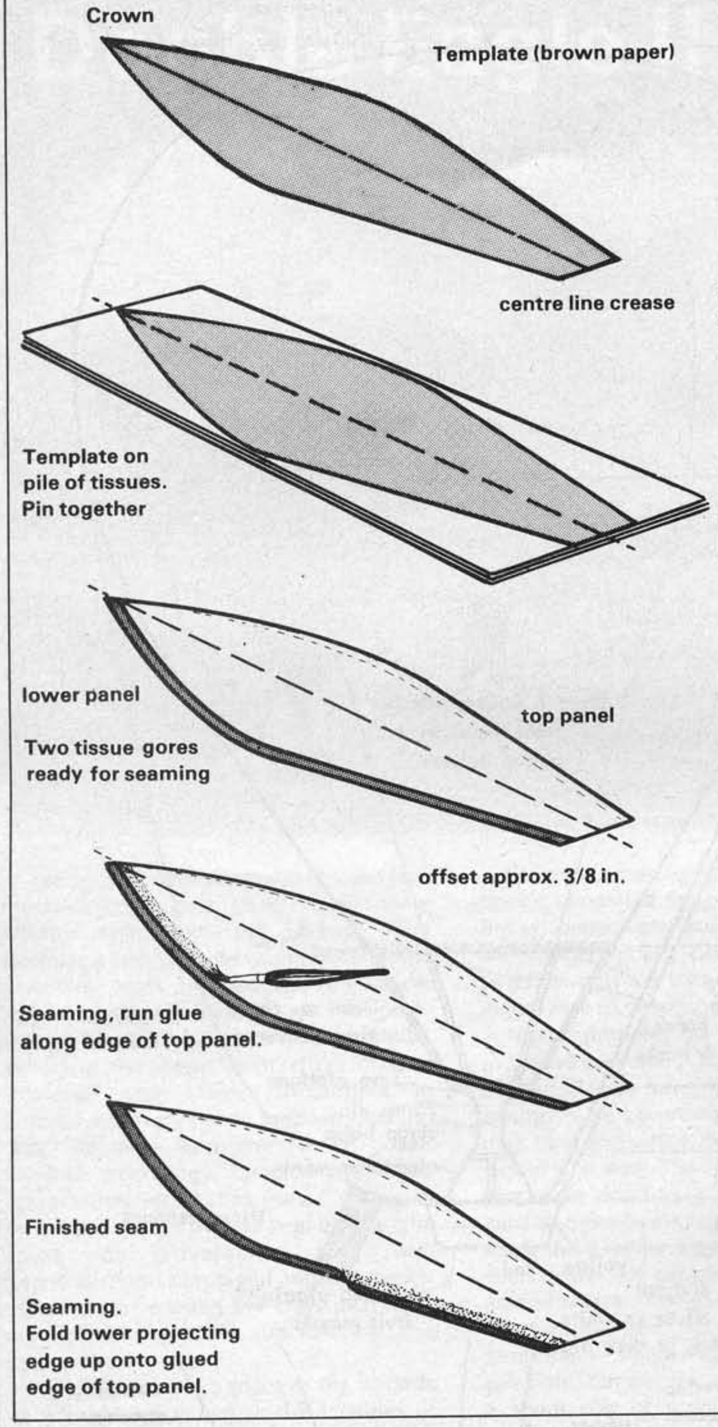
You are now ready to fabricate the gondola unit to complete the model. At this stage you will undoubtedly be keen to get airborne and indeed you can by adding the balsa ring to the neck of the balloon (see sketch). But I advise a few more minutes at the building board if you want to obtain a really satisying historical model.

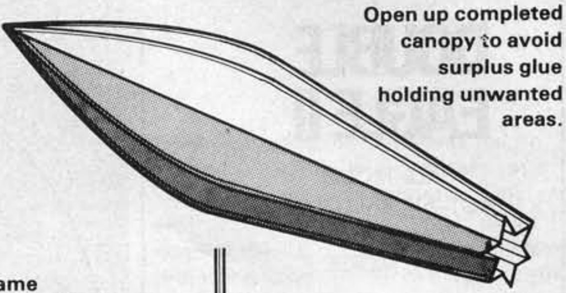
Back to the building board. Mark out hexagonal ring to dimensions given on the Plan and assemble two identical 3mm square balsa rings over it, separating with polythene or greaseproof paper. Strengthen with triangular gussets at angles and leave overnight for cement to set hard. Next take a 14 in. length of 3mm square balsa and mount vertically in a small scrap block pinned to the board. Check that this is truly vertical as it forms the core on which the unit is assembled. Cut out the two sheet balsa items, each 3mm thick and slide the hexagon onto the balsa cone and cement approximately 6 in. above building board. Prepare six 7 in. lengths of 3mm square balsa and cement these as shown between rings and the sheet hexagon, thus forming the frame at neck of balloon. Allow to dry, then add the cartridge paper tube over the cone and cement to hexagon. Mount the 3mm sheet balsa square on to the cone and cement tube also to cone. When dry, pierce the square as shown and add the four gondola support wires cementing to balsa square. The free ends are taken through holes in each side of the gondola and bent over after first piercing the bottom of the gondola centrally and sliding on to cone. Cement this as well. After cement has set hard, remove the unit from the building board, discarding the central block and cutting out the surplus length of balsa cone inside the neck frame. Now cover the neck frame including the cartridge paper tube, and cement the two wire hooks to retain the rubber bands for closure. At this stage paint the gondola. Add flags and cut out figures from magazines for further realism. Taking the other balsa ring, fix

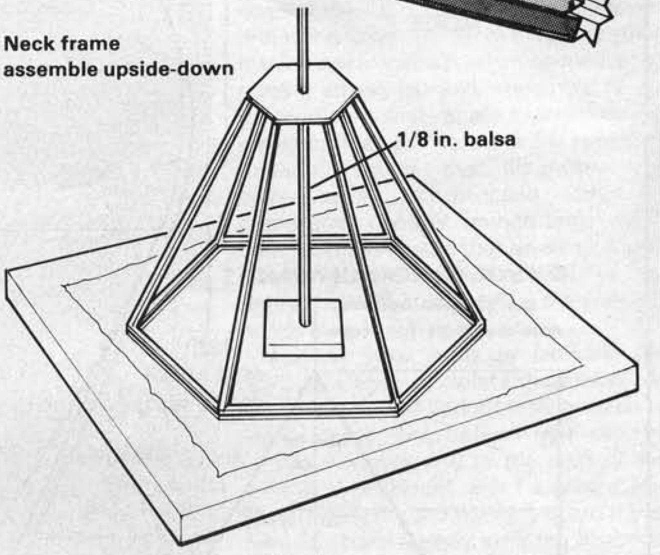
DOUBLE EAGLE II

SCALE MODEL
HOT AIR BALLOON
BY
RAY MORSE

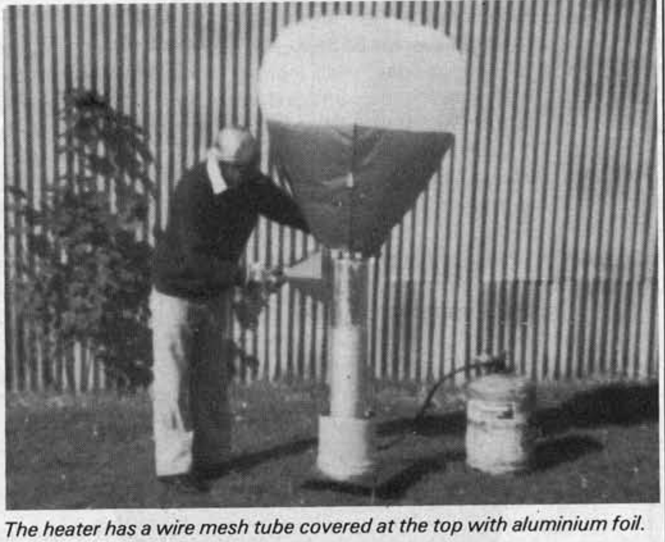








Inflation. Note gondola unit hinged open.



The heater has a wire mesh tube covered at the top with aluminium foil.

the two rubber bands as shown, also bandage to form hinge, then carefully paste this just inside bottom of canopy. Pin in place while glueing. The dummy pipe may now be added.

Finally, firmly glue hinge to gondola unit, this being free to swing back out of the way during inflation and held shut by the two bands when flying. As well as conserving the hot air inside the balloon, the model has the convincing appearance of the gas-filled prototype.

Flying

The great moment has arrived. Choose a sheltered spot in the lee of a wall or hedge and inflate over a portable gas ring. Camping stoves are ideal. I always use a simple wire mesh chimney, the upper portion of which is covered with baking foil. Several of my friends use this method with great success as the balloon is well away from the flames and very many exciting flights may be obtained in complete safety for a small expenditure of fuel. The chimney should be at least 2 ft. high and not less than 6 in. diameter. Gardening shops supply wire mesh netting. Make sure your flying site is free of obstructions down-wind. A balloon snarled in a tree is not easy to extricate without damage.

Having lit up and positioned the chimney, get a friend to hold the canopy while you steady the open neck over the chimney top or, better, allow some 2 in. of the chimney top to project inside the balloon. As the balloon takes on the familiar pear-shape your friend may release. You then get the feel of the upward pull or lift. Allow the air to expand still further for a few more seconds. You will note the lift increasing. Then, when pulling strongly, let the model lift off the chimney. Holding the gondola unit in one hand and one of the rubber bands in the other, close the neck smartly with band over hook. If you've time, secure the second band, but this is not essential. Each second's delay will cut your duration. Flights of twenty seconds plus are readily obtainable unless, of course, you have been too heavy with the paste, paint and cement or perhaps again, you may try to increase your heat source which will make a considerable difference to the lift. Many happy lift-offs!

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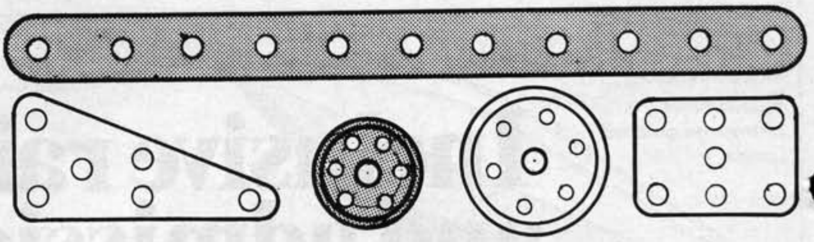


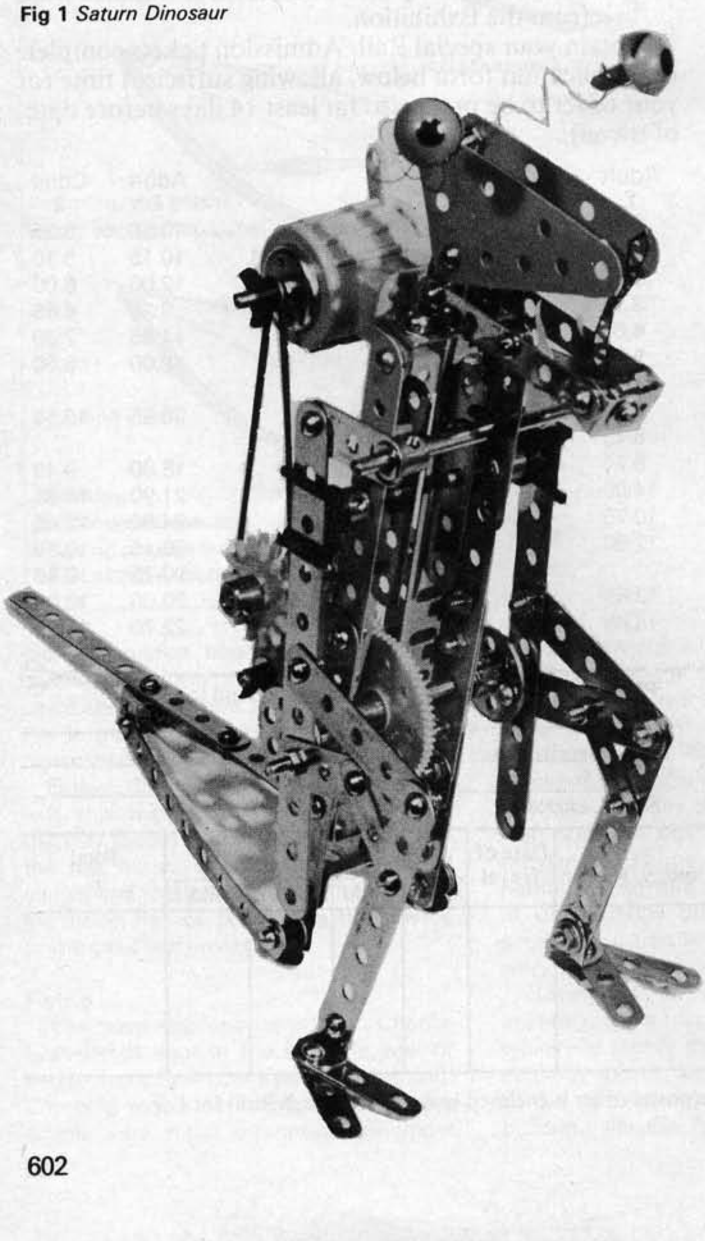
By BERT LOVE

A Construction Article on the new Meccanoids outfit

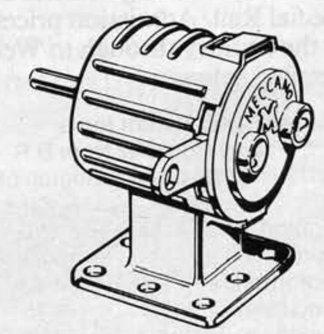
MECCANO In Deepest Space is the theme that gives us the name MECCANOIDS which is the latest motorised constructional set to come from Meccano Ltd., and it presents a new concept in the realms of imaginary but highly animated "Creatures from Outer Space".

Fig. 1 shows an example of what the builder can expect to produce from this comprehensive kit in the shape of the SATURN DINOSAUR, complete with snapping jaws and kangaroo-like walk, driven by the Meccano 4½ volt D.C. motor with remote control from a newly designed Battery Box. A novel feature of the overall design of the models is that a basic drive chassis is made up to suit all of the models published in the constructional manual supplied with each MECCANOIDS set. Once built, the drive chassis unit can be applied to each of the models in turn, thus speeding up the construction of the entire range. All components are compatible with the standard range of Meccano parts but the finish on plated parts is obtained by a chromate/zinc technique combining the non-rusting properties of zinc with a hard wearing 'skin' from the chrome content. Colour finish thus produced on the plated parts is an iridescent 'gold'. Regular Meccano-builders will recognise the 4½ volt motor shown in Fig. 3 as the "Crane Kit Motor" although it is known in the Meccano lists as the standard 11053 D.C. reversible motor. Packed into the outfits in four separate parts, the motor must first be assembled as shown but care must be taken at stages (c) and (d). Two small connector lugs from the back of the motor must pass through the small slots in the reversing ring shown at (c). Two "pips" on the reversing ring (c) also fit snugly into the rear end of the motor (a) and these two components should be firmly in place, inside the motor housing (b), before any attempt is made to clip on the terminal cap (d). It is also necessary to see that the "M", embossed on this cap, is upright when placing it in the slots of the motor casing. If the cap does not snap into place cleanly, with free movement of the reversing lever, then the reversing ring (c) is back-to-front or not in its proper location. Forcing the cap can damage the motor terminals.

Fig 1 *Saturn Dinosaur*



3-4.5 V Motor Assembly Instructions



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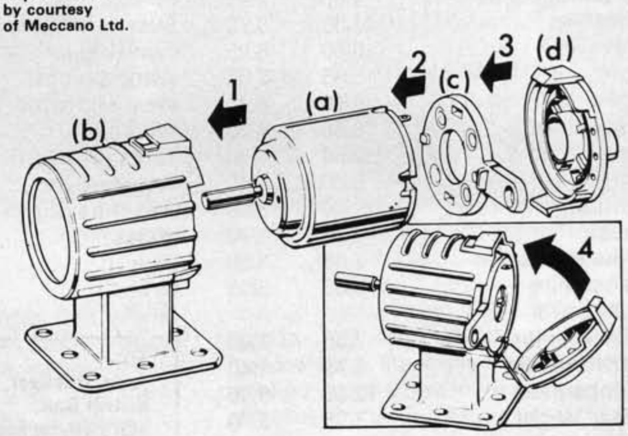


Hold the motor and cap (c) with 'Meccano' upwards. Insert the lower locating lugs then position top locating lug and push until it 'clicks' home.

Position motor (a) in motor housing (b) with end contacts at top and bottom (see inset). Locate the switch level (c) (smooth side outwards) over the motor end contacts.

Fig 3 *General assembly method for the electrical motor packed in the Meccano MECCANOIDS motorised construction set.*

Readers who purchase the MECCANOIDS set may find it in one of two versions. As shown in the manuals, the basic chassis drive unit is fitted with two pairs of 4:1 reduction gears, each pair being a 15 teeth Pinion and a 60 teeth Gear Wheel. The overall ratio thus obtained is 16:1. Some sets are provided with the higher ratio gears comprising a pair of 57 teeth Gear Wheels meshing with 19 teeth Pinions. This now gives a faster, 9:1 ratio which gives a more lively animation to some of the models. However, two modifications are recommended for the "high ratio" set as follows. Modern Meccano gears are made from a very high quality plastic moulding on an all-brass boss and carry the number of teeth moulded on the Gear Wheels. However, the overall boss lengths are slightly larger to where a 19t Pinion is used (in the sets supplied with 57t Gear Wheels) the 5½ in. Angle Girders forming the chassis of the drive unit should be spaced slightly farther apart at each corner by inserting a Washer between the girder holes and the lugs of the 1½ in. Double Angle Strips securing the 5½ in. Girders. Fig. 2 shows the two basic alternative constructions. An illustration, similar to that published in the MECCANOIDS manual is seen at Fig. 2 (a) where the clearance for the 15t Pinion is adequate below the flange of the 5½ in. Girder, spaced from its neighbour by the 1½ in. D.A. Strips at each end. In Fig. 2 (b), the gap between the Girders is wider by the spacing of two Washers at each end which allows the 19t Pinion to run clear in the gap as shown. It should be noted that both of these constructions mean that the 1½ in. square Plate attached to the side of the Girders is fixed by one Bolt and Nut only and this means that the Plate must be carefully aligned with the holes in the Girders to make sure that the 2½ in. Axle Rods carrying the gears are able to run smoothly and without any suggestion of binding when passed through the Plates and Girders. Fig. 2 (c) shows how temporary use of spare Rods ensure that the alignment is correct before tightening up the single Nut & Bolt. Any constructor who is unhappy about this single hole fixing may wish to adopt an alternative assembly which is shown in Fig. 2 (d). This moves the intermediate Axle Rod away from the bottom of the chassis unit and re-locates it in the diagonally opposite hole of the square Plate above the chassis as shown. This allows either the "high ratio" gears or the gears shown in the construction manual to be used without the extra spacing below by Washers and some readers may prefer this assembly for ease of access and simplification of alignment. It should be noted however that not all of the ten published models in the MECCANOIDS manual leave clear holes for this alternative assembly but the majority of them do. Which ever assembly is adopted, all Axle Rods must run freely, Spring Clips and Washers being adjusted to hold the shafts in place without pinching or tight spots. Manufacturing tolerances of the new plastic gears are very close giving a gear meshing contact with very little "back-lash" and if a tight spot is suspected, the gear teeth should be examined in good light for any trace of dirt or minute plastic residue in the teeth. In exceptional cases where this occurs clearance of the tooth valley should be made only with a fine modelling knife taking care not to damage the tooth formation. Where the alternative assembly is adopted, a second pair of Nuts & Bolts may be used to fix the side Plates to the Girders thus increasing the rigidity of the alignment.

Fig. 4 shows the full range or variety of parts included in the MECCANOIDS set and enthusiasts will be familiar with most of them at a glance. However, one or two new items should be mentioned, chief of which is the newly designed Battery Box, Part No. 13630 which enables three 1½ volt cells to be accommodated for a 4½ volt output to the motor. This gives that little extra 'punch' to get the models started and to keep them going even when the batteries are failing. An "on-off" reversing switch is fitted and connections are by small plugs, the wiring of which is shown in Fig. 5. Bare wire should be twisted tightly on the eye of the plug pin and a good jamming fit made when pressing the pin into the plug body. It is further recommended that when inserting these plugs in the Battery Box or Motor, pressure should be applied to the eye of the pin and not to the plug body. Most novel of the MECCANOID parts are the plastic eyes and special highly flexible spring, Part Nos. 369 and 368 which add animation to the models in giving them searching eyes which can be set to any angle prompted by the imagination and because the action of all of the models is deliberately jerky, the eyes wobble with great realism on the end of their 'stalks'. Attachment of the eye is by friction contact into the narrow taper end of the spring while the spring itself is fixed by a standard Bolt & Nut to the model. Part 221, small Flexible Triangular Plate is in yellow plastic, not metal and three other parts illustrated in metal are now being made from the plastics previously referred to. These are the two gears 27d and 26c and the Slide Piece, Part No. 50, is re-

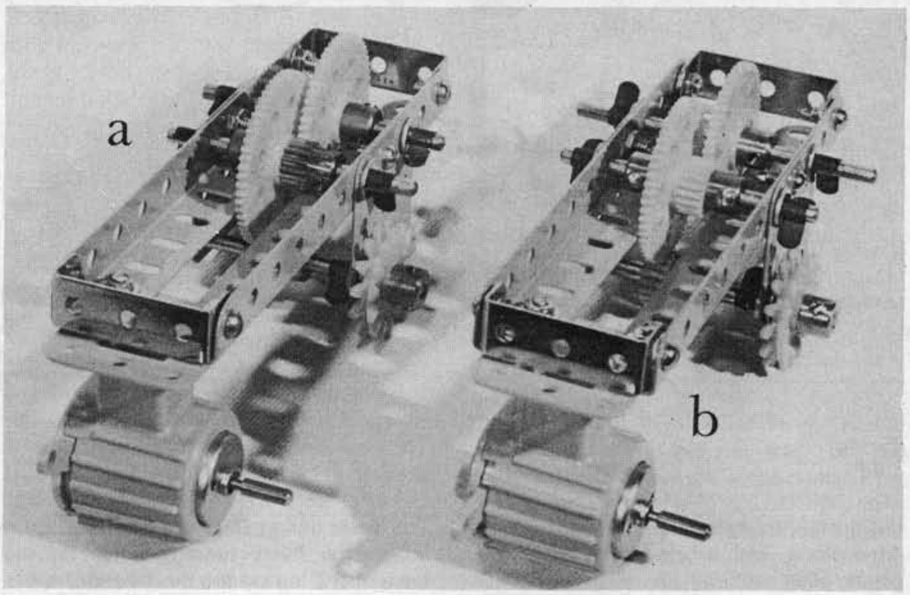
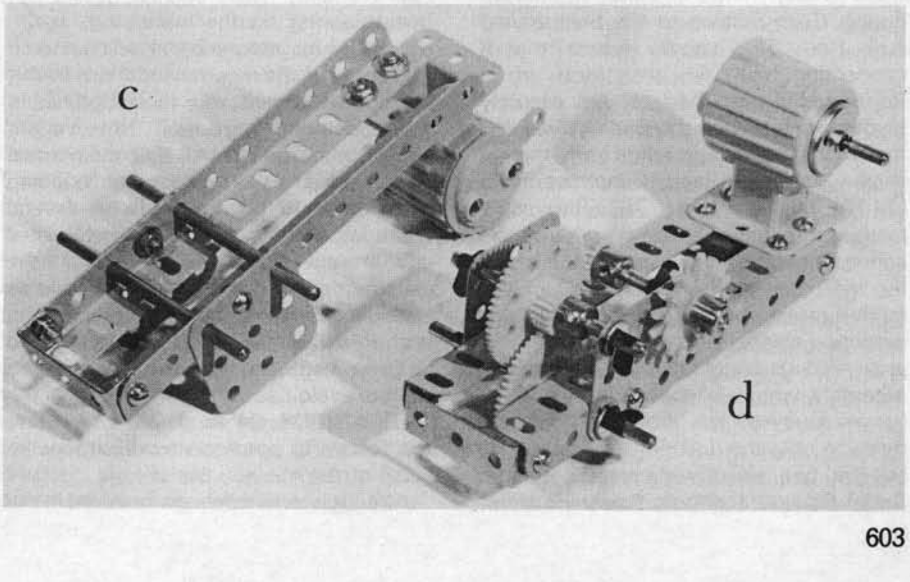


Fig 2



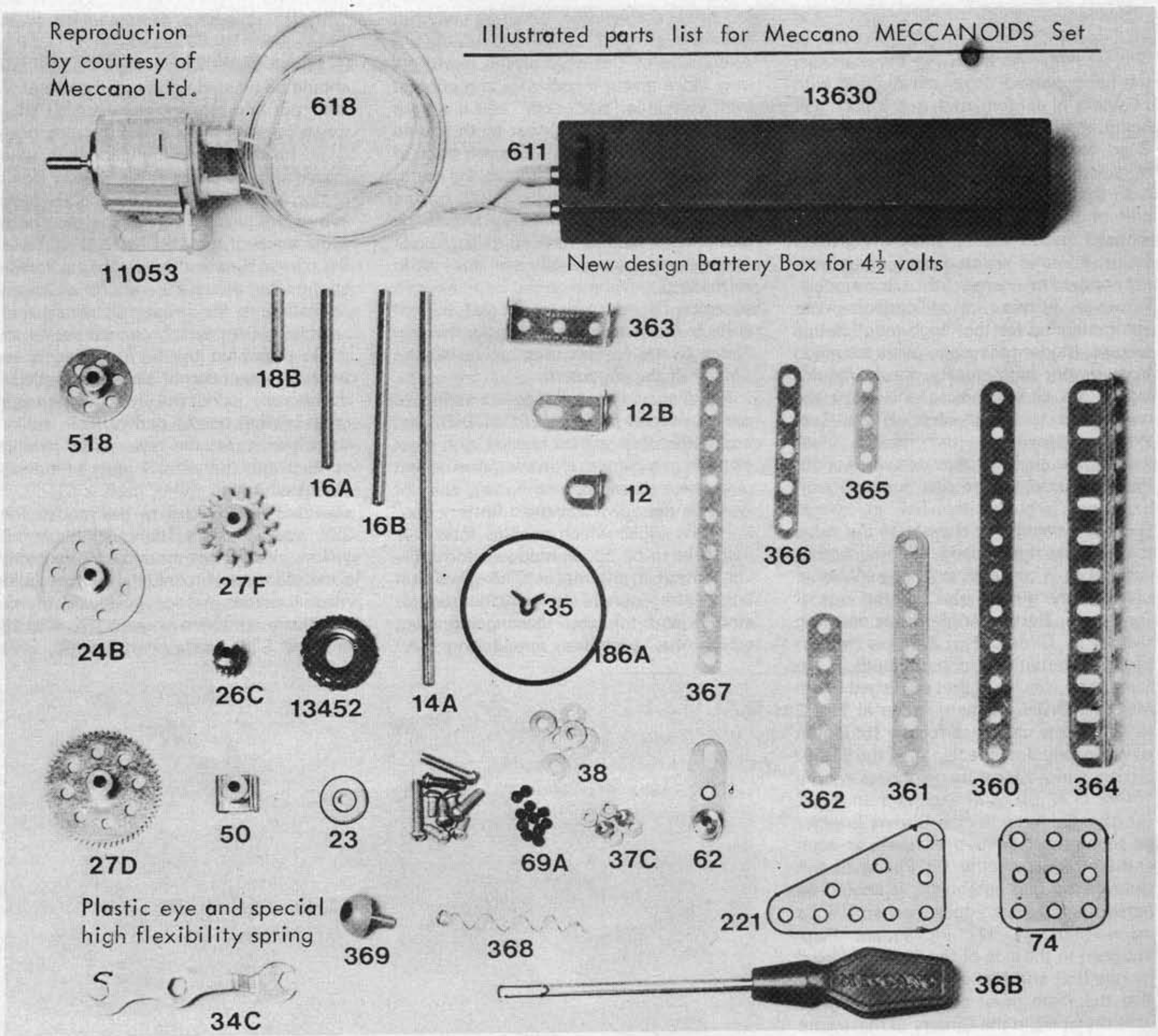


Fig 4

designed to slightly larger overall dimensions, with a brass boss fitted in a plastic slide section.

A majority of the published models are activated by crank motion from rotating Bush Wheels, large or small, fitted with double Grub Screws to the final driving Axle Rod. This usually means that a connecting rod, in the form of a Perforated Strip, has to be securely pivotted to a hole in the Bush Wheel and the recommended method for this is shown as BC2 (Basic Construction 2) in Fig. 6 and Fig. 7). The same method should be used where the connecting Strip is pivotted to the leg of the individual model. Since most of the models move, in steps, by this oscillatory motion, their backward motion is prevented or restricted by a drag-wheel assembly which is shown in Fig. 8. A careful study of this drawing should be made to note the direction of 'feathering' on the tyre tread with respect to the Angle Bracket acting as the brake shoe. The basic fixing BF3 should be used to attach the freely running wheel to the base of the leg on the model and the 1½ in. Narrow Strip to which the Angle Bracket is locked at the angle shown in Fig. 8 would, itself, be lock-nutted but free to swing on the model leg, again, using BC2 for attachment. It will be noted that some of the recommendations in this article are different from those outlined in the construction manual. However, it should be borne in mind that the manual is designed to give general building instructions to young people in several countries so the manual is largely visual and hence set out to make the construction of the models as simple as possible. However, those readers who wish to make their models to stand up to long running at exhibitions etc., or who wish to exploit as many of the parts in the MECCANOIDS set as possible, will find the following notes on modifications to some of the models, useful.

Although ten models are featured in the published manuals, only four of them will be considered in this article but the general recommendations or modifications outlined may be applied to other models in the series. We have already seen the SATURN DINOSAUR in Fig. 1 and the design by the author shown in that illustration features a stronger leg construction in which the thigh is made from two 2½ in. Strips instead of one and the knee is braced by a 1½ in. Narrow Strip. No extra parts outside the contents of the set are required for this, or any other modification but the rigidity obtained in the legs of the DINOSAUR mean that it will hop along continuously without collapsing. Another feature, common to all modifications in this article, reject any bending of Meccano Strips. Some of the manual models show a bending of Strips aimed at creating more realistic animal features but as it is often difficult to restore bent Strips to their original form, some constructors may prefer the "No bending" form of

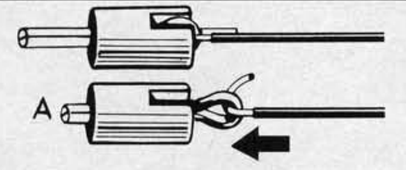


Fig 5 *Wiring method for plugs used in motor and battery box.*

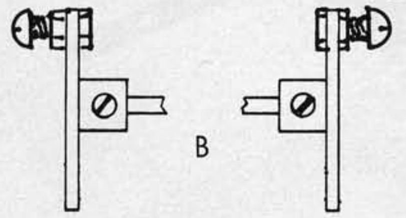


Fig 7 *Pivot mounted to bushed wheel*

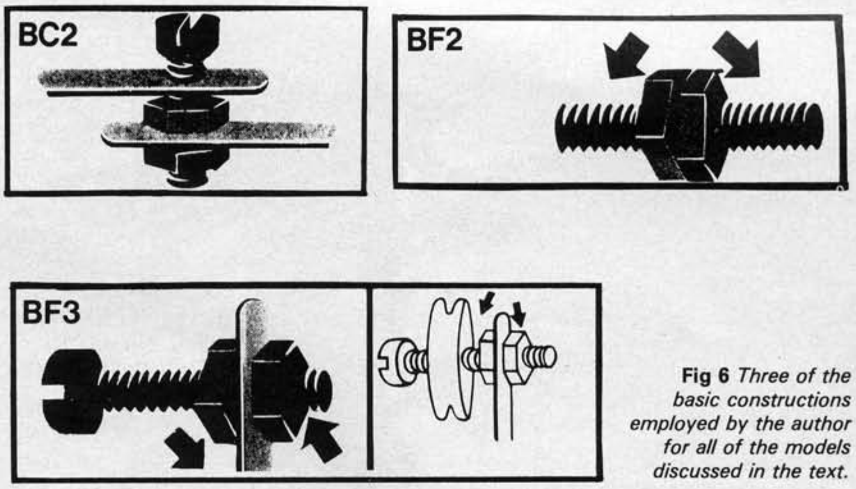


Fig 6 *Three of the basic constructions employed by the author for all of the models discussed in the text.*

construction outlined here. It will be noted that the chassis unit of the DINOSAUR is extended downwards three holes by a pair of 2½ in. Strips but these are not bent at all. Four Narrow Strips, 4½ in. long, make the tail section but only the natural 'spring' of the metal is employed, the front ends of two of these strips being attached to the body by ½ in. Bolts spaced outwards by two Washers and a Spring Clip. The other two Narrow Strips are lapped four holes and bolted to a spare 1½ in. Double Angle Strip from the set, this being fitted one hole up the body and spaced by an internal Washer each side. Outboard, a pair of ½ in. Brackets secure the rear joint of the tail section. A pair of cranks (bolted to the chassis as non-moving arms in the manual model) are used in the modified model at the top of the oscillating 5½ in. Strips, to actuate the 'jaw' of the model. Vertical legs of the DINOSAUR are made from 3½ in. Strips instead of 2½ in. so that no bending of the 'toes' is required, the actual grip of the feet being obtained very effectively by the Bolt shank in the bottom ½ in. Brackets shown. This model works very well in the lower speed range and will even walk backwards!

Very amusing but quite different in action is the DESERT BUG shown in Fig. 9. A number of modifications are made to the original including a more bug-like tail as shown but a stronger "dipping and walking" action is obtained as follows. First of all, crank drives are doubled-up in this version which relieves the strain on grub screws and drive in any of the models using this form of propulsion and both legs 'walk' together. It will be noted that the 2½ in. Strips forming the legs are bolted to Cranks, but the upper Bolt is ¾ in. long and passes straight into the Six-hole Bush Wheel where it is lock-nutted as BF2, shown in Fig. 6. As there are now direct connecting rods, 3½ in. Strips, being driven at each side of the model, there is no twisting strain on the front axle and Grub Screws in the Cranks are actually not required. A much stronger 'foot' construction is obtained by using the 1 in. × ½ in. Angle Bracket to secure the Double Angle Strip and a back-up ½ in. Angle Bracket as well makes sure that the foot does not twist sideways. Finally, the single leg trail wheel is also doubled up in this version, 3½ in. Strips being used for the legs each side, bolted to the chassis and braced with 2½ in. Narrow Strips as shown. Each wheel has a brake strip bolted to the lugs of a 1½ in. Double Angle Strip pointing to the rear but braced to the legs by ½ in. Brackets three holes up from the wheel bolts. As this model depends on piston motion in the same 'phase', it is non-reversible in its walk, regardless of the direction of the motor.

Yet another mode of propulsion is found in the SPACE SKATE shown in Fig. 10 and is best described as a 'waddling' action obtained from outrigger legs driven by connecting rods at each side but this time, the Bush Wheels are 180° out of phase. Construction is similar to that of the manual model but extra 3½ in. Strips (still within the set contents) are bolted at the sides of the chassis, extended to the rear and fixed by ½ in. Brackets to the upper Strips to form a girder-like rear extension. This gives stronger supports for the swinging arms. A close-up from below the model, seen in Fig. 10a, shows the various re-inforcements built into the author's modified version. Each swinging arm is made from three layers of Strips, the top two being 3½ in. Strips and the bottom one is 2½ in. To prevent the wheel legs from twisting, a 1 in. × ½ in. Bracket is fixed in the position shown in Fig. 10a at (X) and one of its Bolts holds an overhead ½ in. Bracket for the brake arm, at each side of the model. Lock-nut method BC2 is used at point (Y) to give a clean but not too sloppy pivot for the arms. Note that the 4½ in. Narrow Strips acting as connecting rods from the Bush Wheels are not bent, sufficient 'play' being available at the Bush Wheel lock-nutted Bolt and in the slotted lug of the ½ in. Bracket shown at (Z). Again, BC2 construction is used when lock-nutting.

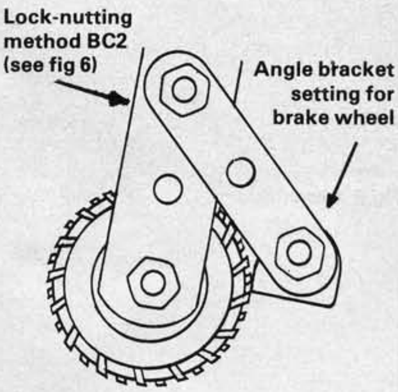


Fig 8 *Construction of drag-wheel assembly showing braking action common to several of the models in the construction manual.*

The DINOSAUR, DESERT BUG and SPACE SKATE, all run well on the reduced speed drive and if the constructor has a version of the MECCANOIDS with the 57 teeth Gear Wheels he should adopt the method of belt drive shown on the DINOSAUR. It can be seen from Fig. 1 that the Rubber Driving Band is forced on to the narrow stem of the motor shaft by the simple arrangement of one Washer (smooth side to rubber) and one Spring Clip, effectively cutting down the speed of the model by about a half.

In the last model dealt with here, the URANIAN RHINO, modifications are made to the body shape and to the leg construction both to avoid strip bending and to improve the stability of the leg pivots. A horizontal 3½ in. Strip is bolted, inside, to the leading middle hole of the 1½ in. square Plates and then to the vertical 2½ in. Strip which is also secured to the front of the chassis girders. The RHINO's head is then supported by a 4½ in. Narrow Strip running back to the top of the vertical 2½ in. Strip and this strong triangulation supports the head and the backbone assembly. General construction details are clear from Fig. 11 but pivots for

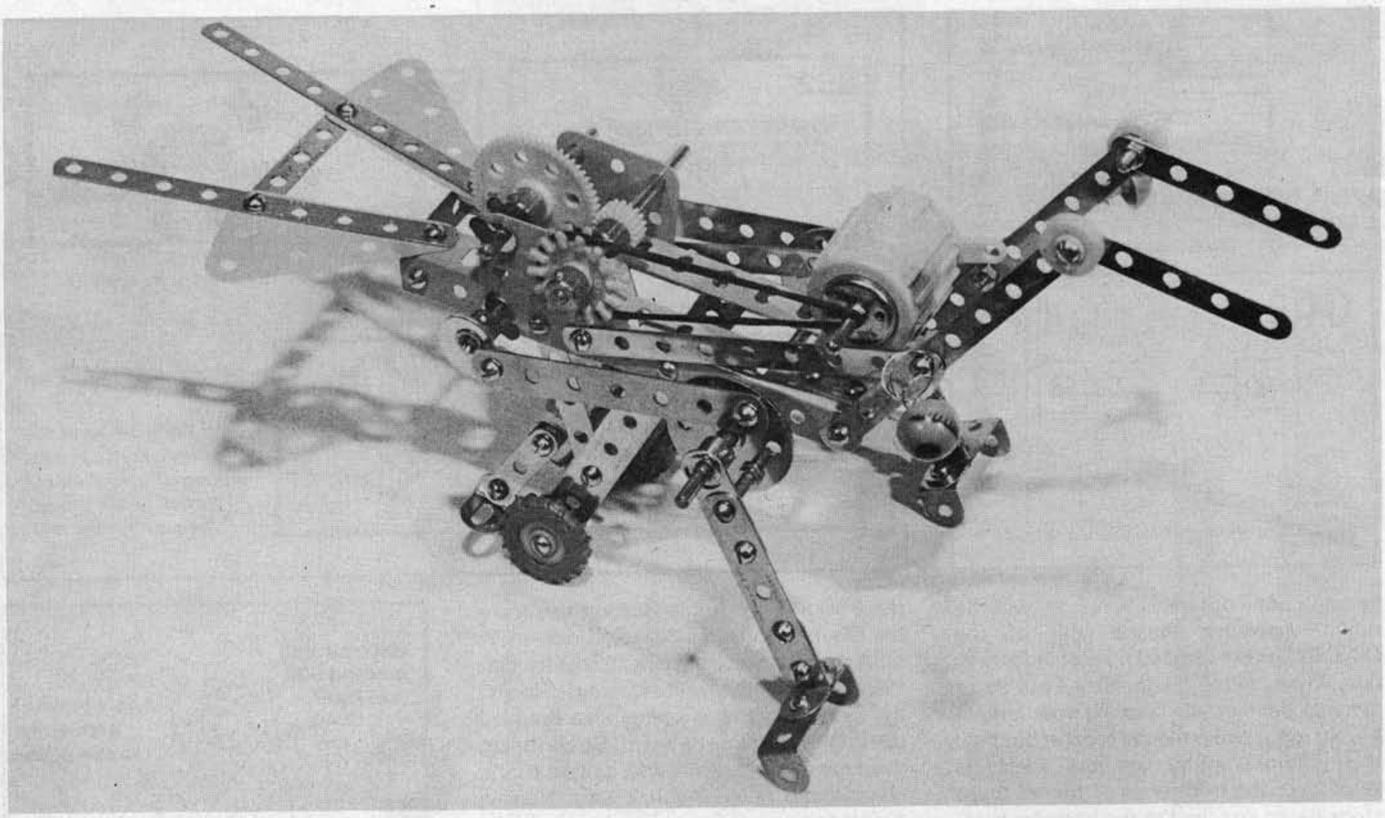


Fig 9 *Desert Bug*

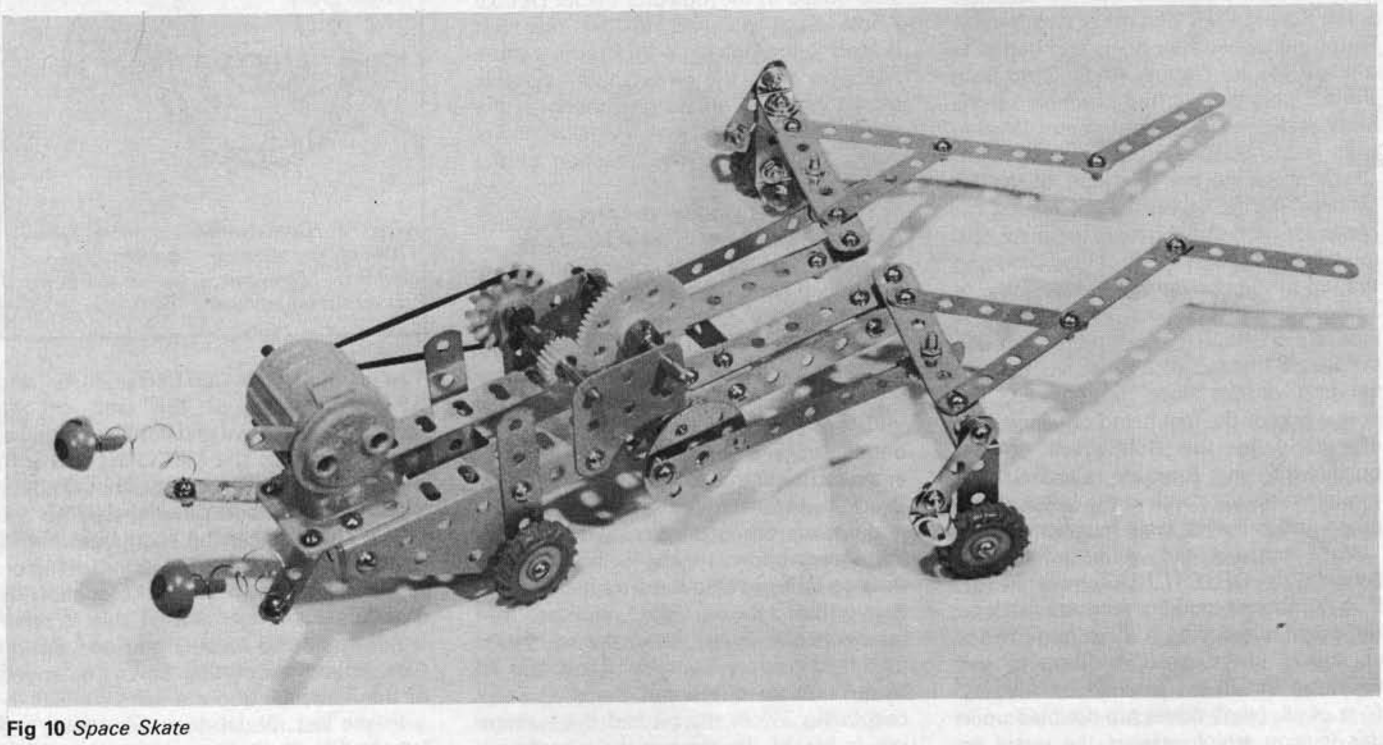


Fig 10 *Space Skate*

the legs need some detailed comments. Rear attachment of the 3½ in. legs to the Cranks is by a single Bolt & Nut in each Crank, sandwiching one Washer to give the Strip stand-off from the slightly raised peening of the Crank boss, the Axle Rod itself providing the second stage of rigidity. It is important that one Crank be locked to the back axle with a single Grub Screw but that the other be free to swing on the axle, held in place laterally by two Washers and Spring Clips. Quite recently, Meccano Ltd., have modified Part No. 50, Slide Piece and now make this partly in plastic. The new form is seen quite clearly in the close-up of Fig. 11a. This unorthodox use of the new part gives a firm support to the front legs of the RHINO as shown and it is only necessary to lock the 3½ in. Strip in place with a 1½ in. Narrow Strip before passing the front axle rod through the assembly. The small Narrow Strip is trapped in place by the natural elasticity of the plastic portion of the Slide Piece. Again, on one side the Slide Piece is secured by a Grub Screw but Washers and Spring Clips are used to locate the other Slide Piece in position. Cranks and Slide Pieces should be lined up on the axles to give a smooth location of the connection Strips from the large Bush Wheels providing the drive. These wheels are set with their lock-nutted Bolts (BC2 again) at 180° phase so that the legs 'walk' alternately. To give a fairly wide spacing of the legs across the RHINO's body, the 3½ in. connecting Strips from the Bush wheels have ¾ in. Bolts passed through their outer ends, then through the small Bush Wheels in the set (acting as stand-off spacers) and are then lock-nutted (BC2) to the overlap join of the

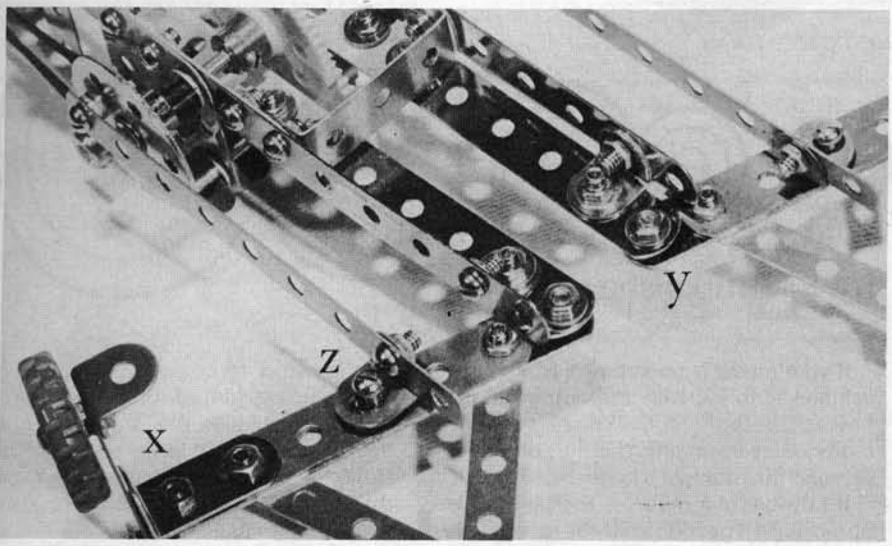


Fig 10a *Space Skate re-inforcements*

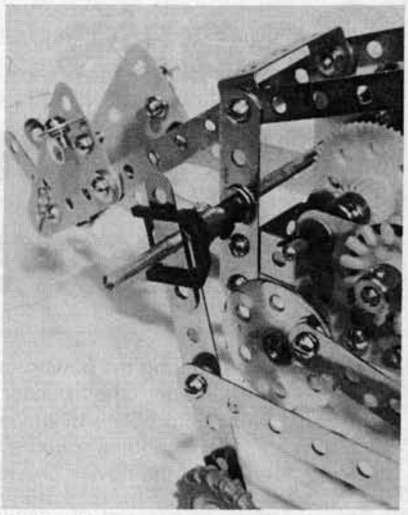


Fig 11a *Note modified slide piece*

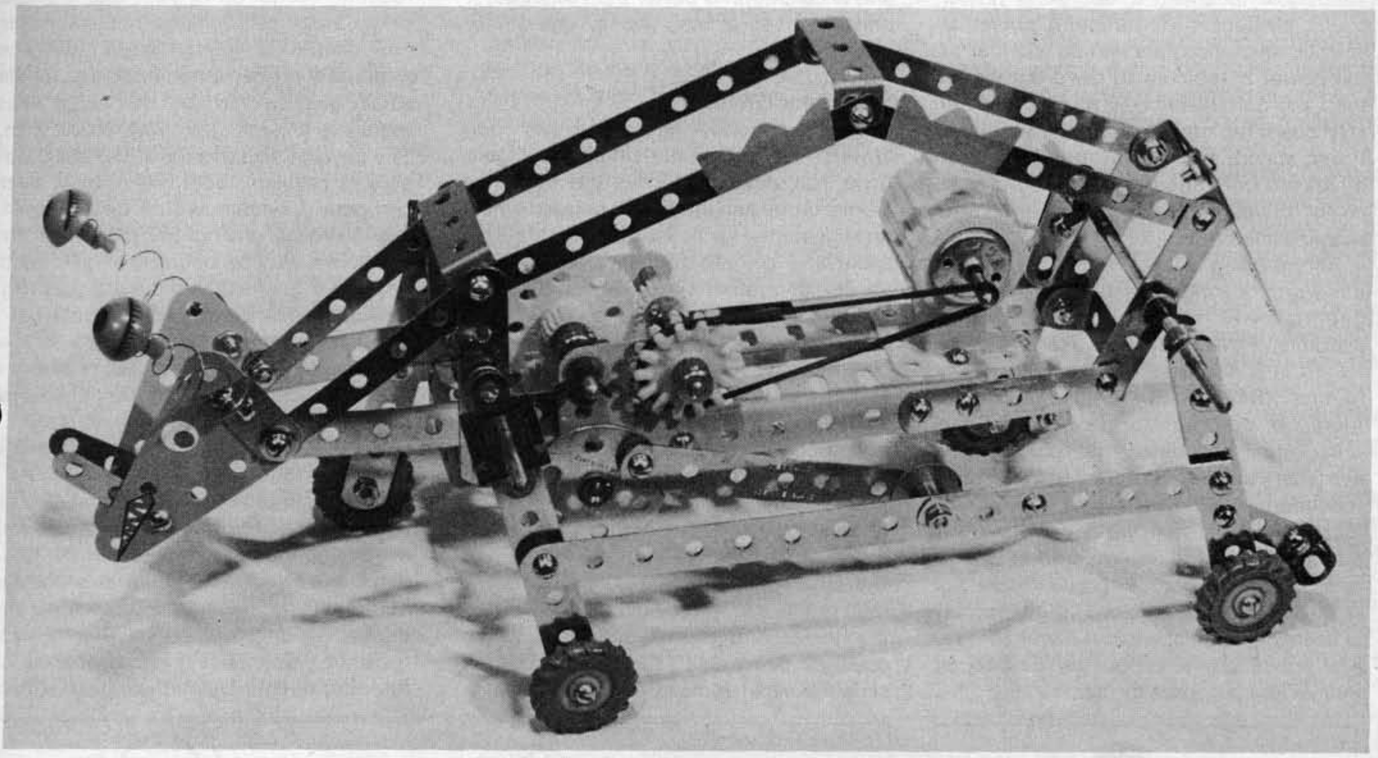


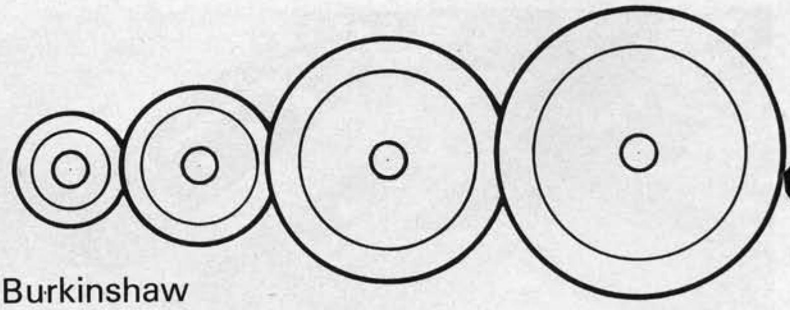
Fig 11 *Uranian Rhino*

PART No.	DESCRIPTION	QTY.	PART No.	DESCRIPTION	QTY.	PART No.	DESCRIPTION	QTY.
360	5½" Strip	2	26C	Pinion 7/16" x ¼"	2	186A	Drive Band 6" Light	2
361	3½" Strip	8	27D	Gear Wheel 60T	2	221	Triangular Flex Plate 2½" x 1½"	2
362	2½" Strip	6	27F	Gear Wheel M/Purpose	1	365	Narrow Strip 1½"	6
364	Angle Girder 5½"	2	35	Spring clip	17	366	Narrow Strip 2½"	4
12	Angle Bracket ½" x ½"	6	37B	Bolt ¼"	50	367	Narrow Strip 4½"	6
12B	Angle Bracket 1½" x ½"	2	37C	Nut	60	11053	Electric Motor 4½ v	1
14A	Axle Rods 5½"	2	38	Washer ⅜"	20	359	Sheet of Self Adhesive Labels	1
16A	Axle Rod 2½"	3	363	Double Angle Strip 1½"	4	368	Spring	3
16B	Axle Rod 3"	2	50	Slide Piece	2	369	Eye	3
18B	Axle Rod 1"	2	62	Single Arm Crank	2	13630	Battery Box	1
23	Plastic Pulley ½"	4	74	Flat Plate 1½" x 1½"	2	36B	Screwdriver	1
13452	Tyre for ½" Pulley	4	59A	Grub Screw 5/32"	20	34C	Spanner	2
24B	Bush Wheel 6 Hole Large	2	111	Bolt ¾"	2	618	Connecting Wire	1
518	Bush Wheel Small	2	111A	Bolt ½"	4	611	Plugs	4

compound strips (5½ in. plus 3½ in. Strip) which forms the tracking bar between the front and rear legs at each side of the model. A 2½ in. Narrow Strip forms the animal's tail and is bolted to the 1½ in. D.A. Strip across the RHINO's hindquarters.

Each MECCANOIDS set is supplied with a small sheet of vinyl re-usable, self-adhesive stickers with which eyes, teeth and prehistoric features may be applied to the finished models for added realism. Each model should be tested for operation under the most suitable speed on completion and a very light oiling of the running axle bearings (just one tiny drop of sewing machine oil) is recommended. Where considerable effort is required from the drive motion in the case of the DESERT BUG and the SIRUS STROLLER (see MECCANOIDS manual), double Grub Screws are recommended in the gears and Bush Wheels on the final drives. A comprehensive parts list is shown here and the use of Washers at the appropriate points will assist with smooth running or rigidity.

Gears for Model Makers



By Bill Burkinshaw

Very frequently during the construction of a working model the builder is confronted with the problem of driving a part, or parts, at a rotational speed either higher or lower than the device providing the motive power. It is often an unsatisfactory solution simply to slow down the power plant, and frequently impossible to speed it up. Most power plants produce their optimum power at specific revolutions per minute and if all of the power is required to drive the model then the only solution is to use a speed step down (up) drive of some description. I say speed step-down (up), for gear drives are only one method—belt drives, chain drives, friction drives are also possible alternatives.

Before using a speed reduction system it is worth bearing in mind that no form of gearing will increase the POWER available. Power or Brake Horse Power (BHP) is a function of Revolutions Per Minute (RPM) and torque (rotational force). In truth any form of gearing can only serve to reduce the actual BHP available at the output end of the reduction drive, even if only marginally, for no gearing system yet devised is 100% efficient. What the gearing system can do is either provide greater torque (if speed is reduced), or greater speed (if gearing up is used), at the expense of lower torque. The actual power output remains to all intents and purposes the same.

If your model is underpowered the only solution is to increase the output of the powerplant be it I.C. engine, electric motor or steam engine, this may of course demand the fitting of a larger motor.

If however the model is too fast for its purpose then gear down by all means. Or, if actual speed is less than satisfactory, and acceleration is better than required, it may be that a step up in gearing is required.

Spur Gear Drives

Very frequently referred to as 'cog wheels' the apparently simple spur gear drive has developed over the centuries from a crude and inefficient pegged wheel arrangement Fig. 1, to a highly efficient silent and smooth running peak, with a variety of system types available to the designer and model maker. Far from being simple, triangular spurs on the circumference of a wheel, the teeth of the majority of spur gears are of an Involute shape which allow the teeth to make a rolling contact with one another (Fig. 2). Single stage reduction gearing is easy to understand; to calculate the reduction ratio simply divide the number of teeth in the small gear into the number of teeth in the large gear i.e. $60 \div 20 = 3$, thus the ratio is 3:1 or 1:3. It should be appreciated that the second gear always rotates in the opposite direction to the first (Fig. 3). A simple way of looking at the step up or step down is to consider the system for one complete turn of the smaller gear. In this one revolution the 20 tooth gear will drive 20 teeth of the larger gear past itself; to move 60 teeth will therefore require three complete revolutions of the smaller gear.

Frequently, however, the speed reduction required is such that a simple single stage reduction is not practicable i.e. should a reduction of 100:1 be required a probable minimum size for the small gear would be 10 teeth, thus requiring a large gear with 1,000 teeth. The physical size of such a gear could well present problems so a two or more stage compound system would be employed. e.g. 10 tooth driving 100 (10:1) with the 100 tooth directly coupled to a 10 tooth gear driving a further 100 tooth gear (Fig. 4). Note the direction of rotation.

It is sometimes necessary to fit idler gears in trains—an idler gear is simply a spacer which has no effect on the overall ratio, it does, however, have an effect on the direction of rotation of the last gear in the train (Fig. 5).

It is worth briefly mentioning gear sizes for it is not enough to choose gears with the correct number of teeth for the job in hand. It is obvious that for a given number of teeth a gear can be of varying size dependent upon the power that it has to transmit. Gear sizes are described by referring to their Diametrical pitch (DP) or

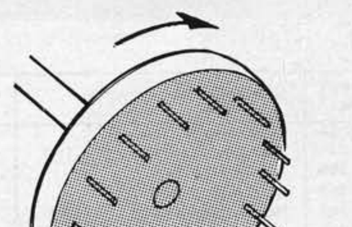


Fig 1 *Pegged wheel arrangement*

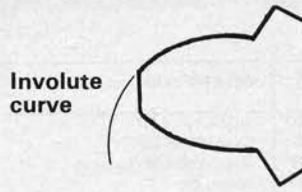


Fig 2

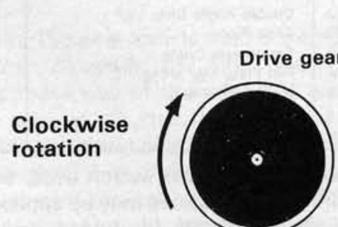


Fig 3 *Step up ratio*

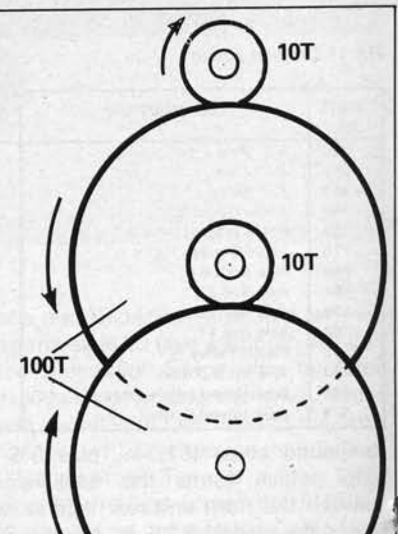


Fig 4 *100-1 Compound gear train*

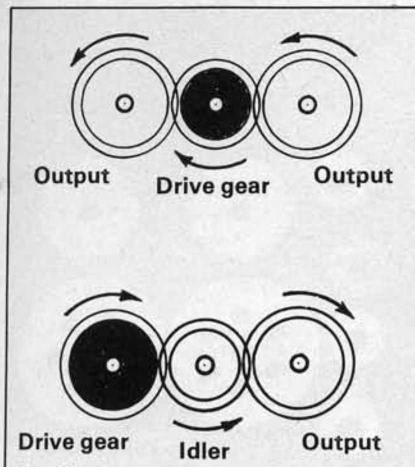


Fig 5

Fig 6

GEAR DIAMETERS (OVERALL)

No. of Teeth	24DP	32DP	40DP	MOD1	0.7	0.5
10		0.375				
20	0.916	0.687	0.550	0.866	0.609	0.433
30	1.333	1.000	0.800	1.259	0.880	0.629
40	1.750	1.312	1.050	1.653	1.157	0.826
50	2.166	1.625		2.047	1.433	1.023
60	2.583	1.937	1.550	2.440	1.708	1.220

more recently Module Number. It is not advisable to attempt to mesh gears of one DP with gears of another, a high rate of wear and a serious wastage of power will result. Suppliers of gears will always quote the D.P. of Module size of gears in their catalogues. Fig. 6 gives an idea of the relationship between D.P. and physical sizes of gears for a selection of teeth numbers.

Once having decided upon the ratio required and the physical size of the gears needed, then mounting and arranging a suitable running clearance can be tackled. If the gearing is for a model such as an R/C car where a variety of ratios may be deemed desirable, then either a very detailed knowledge of gear design, or a very comprehensive table of gear sizes will be necessary. For example using Module 1 gears a ratio of 5:1 (100:20 tooth gears) will require a distance between centres for the gears of approximately 60mm. To change ratio to exactly 4.5:1 without moving the engine is not possible if correct clearances are to be maintained—the nearest available ratio is 4.45:1 (22:98).

However, assuming that only one ratio is required the simplest method is to approximately measure the centre distance of the two gears in mesh, then mount one of the gears (the one whose position is most critical). Now mesh the second gear, using a piece of very thin tissue to space the gears apart to allow for a running clearance. Use the hole through the second gear as a guide to mark the position of the shaft hole. The simplest way is to find a drill which is a good running fit in the hole and twirl this against the material to be drilled, through the hole in the gear.

Belt Drives

There are two types of belt drive in common use—toothed belt (timing belt) and vee belt (see Fig. 7). Timing belt drives are rapidly gaining in popularity particularly where it is essential to maintain accurate relationships between shaft speeds. The design of the belts used removes the necessity for tensioning facilities to be employed, nor do such drivers require lubrication. A wide range of Timing belt pulleys is available with 4 belt sizes covering a pitch range (distance between teeth) from 0.080 in. to 0.5 in. As with spur gear drives there are practical minimum and maximum sizes for the pulleys and maximum pulley speeds if reasonable belt life is to be expected. In the two smaller size ranges, a minimum pulley size of 10 teeth is recommended. Depending on pitch, pulleys of up to 130 teeth are available. For most model applications the extra light and Mini Pitch ranges of the Davall company will be suitable. Extra light pitch pulleys are available from 10-72 teeth and Mini Pitch from 10-130 teeth. Belts are available in a wide variety of lengths and widths. It is worth noting that a flange is needed on one of the pulleys—usually the smaller of the two as its cheaper, to keep the belt on the pulley.

Using this system it is relatively easy to design simple drive systems without too much worry over centre distances of shafts, for it is almost certain that a belt of suitable length will be available. There are limits to the power handling and speed capacity of these drives and if reasonable belt life is to be obtained the manufacturers recommendations should be observed. For example at 10,000 RPM the minimum advised Extra Light pulley size is 21 teeth. Smaller sizes are of course used e.g. the Micro-Mold Lark helicopter uses a small pinion of 8 teeth at up to 14,000 RPM, but a probable belt life in this instance of say 10 hours would frequently be unacceptable in an industrial application.

Calculations for Vee belt drives are simplicity itself—just compare the

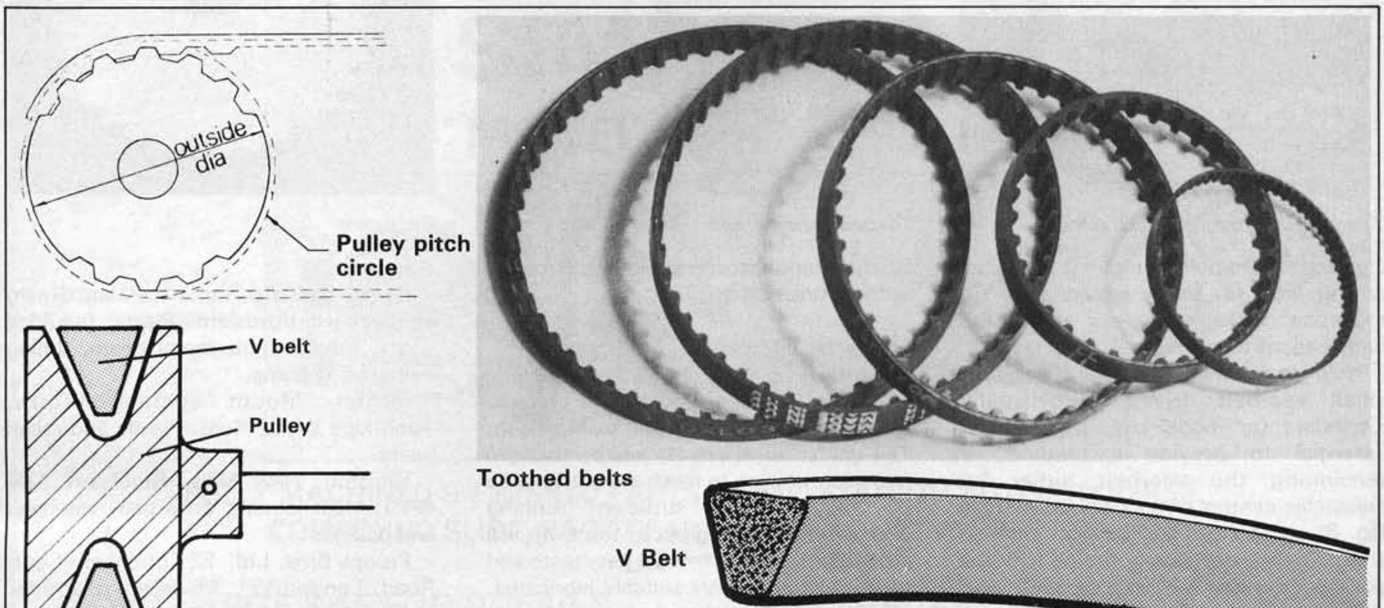


Fig 7 *Typical toothed pulley and V pulley, note the wide range of toothed belts available.*

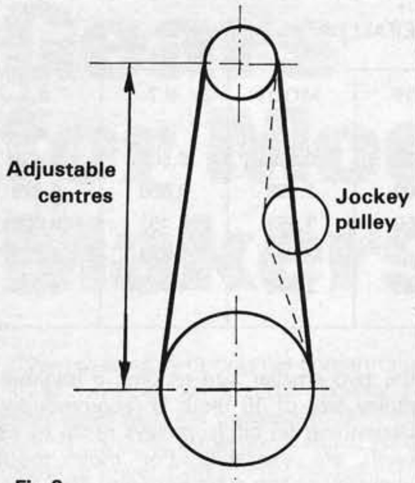
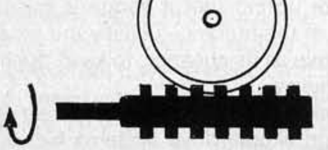
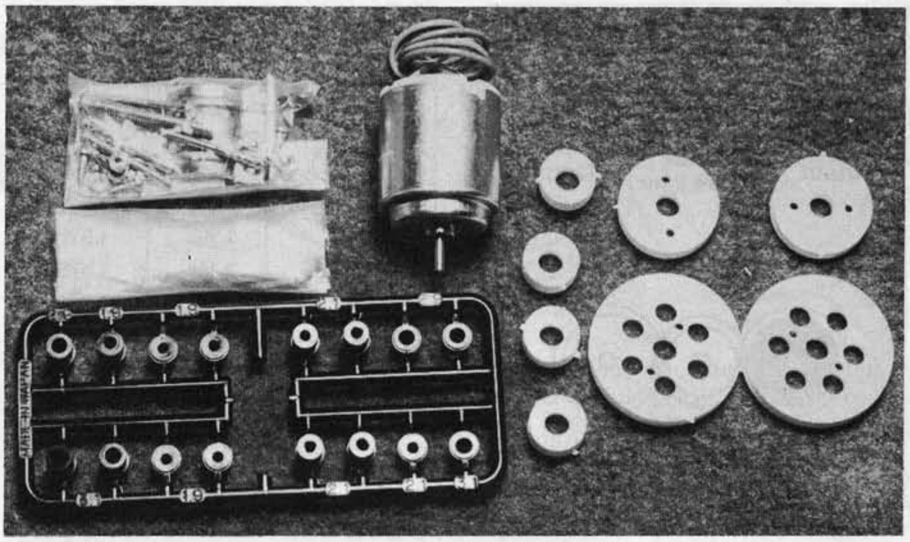
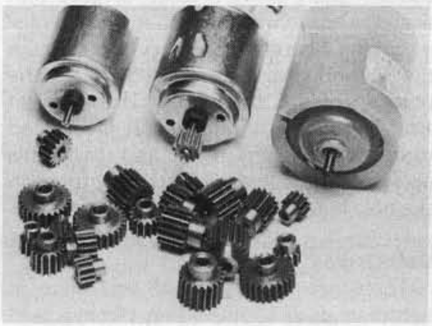


Fig 8

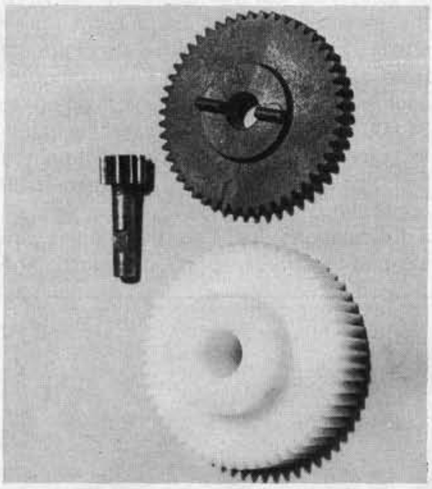


Worm gear this produces much higher ratios than those possible with simple gear pairs.

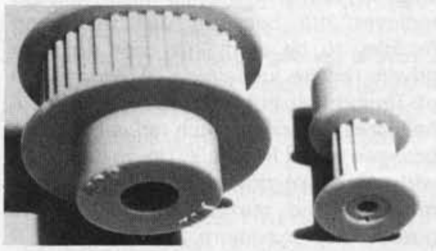


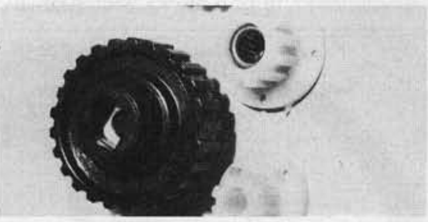


Above and right, a selection of useful motors, gears, and pulleys available from Proops Bros. Ltd.

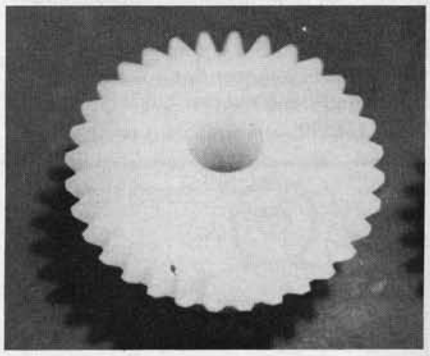


Straight cut gears (nylon and metal)





Toothed pulley wheels



Bevel gear

diameter of the pulleys e.g. a 2 in. pulley driving an 8 in. pulley results in a 1:4 reduction. You can forget π and all the ramifications thereof.

Now that timing belts are available small vee-belt drives are virtually redundant for model use. It is almost essential to provide a method of tensioning the vee-belt either by adjustable centres or a jockey pulley (see Fig. 8) and pulleys and belts of suitably small size are not easy to come by. It is possible to use vee type pulleys with round section belt for light drives and a 'join by heating' type drive belt is available for this purpose. Many small mechanisms such as tape-recorders use light, round-section, drive belts.

Summing-up

Devising speed reduction systems employing gears, or belts is not difficult. The golden rules are **(1)** ensure that the two gears chosen to mesh are of the same DP. **(2)** Allow a sufficient running clearance—not too great or the teeth will probably strip. **(3)** Keep the gear teeth and belts clean and gears suitably lubricated. **(4)** Make sure that the whole width of the teeth are engaged. Some suppliers of gears etc. are listed.

Gears

Davall Gear Co. Ltd., Welham Green, Hatfield, Hertfordshire. Plastic moulded gears, machine cut metal gears, timing belt drive systems.

Muffet, Mount Ephraim Works, Tunbridge Wells, Kent. Plastic and metal gears.

Whiston, New Mills, Stockport SK1 4PPT. Heat jointing drive belt, vee-belts and pulleys.

Proops Bros. Ltd., 52 Tottenham Court Road, London W1. Modellers gear sets. Meccano, Binns Road, Liverpool. Gear sets and pulleys.

Soldering Brazing & Welding

Stan Bray describes the types of materials available, their properties and how to go about it.

Anybody who works with metal has the need from time to time to join them by means other than nuts, bolts and rivets. To do this we weld, solder or braze. In actual fact, the latter two methods really boil down to the same thing which is the joining of the metals by causing a different metal to melt and stick to the work. It follows that if the metal sticks to both the items to be joined then the effect will be to hold them together. There are of course adhesives on the market that will also do this, but except in rare circumstances and often . only with lengthy preparation, will these give the strength of solder.

Welding is another technique altogether and involves the melting of two metals into each other. A metal rod is used to act as a filler, but it should really be used only for this purpose and not as a form of solder. It follows then that as far as welding is concerned the only metal likely to be welded by the amateur is steel. This does not mean that other materials such as cast iron, stainless steel etc., cannot be welded, but different techniques are required and except at technical colleges, the equipment is not usually available to those not employed in engineering.

How then do we go about home welding?

There are two methods available, gas welding, which is more commonly called Oxyacetelene, or Electric. Both have disadvantages and advantages. Most people who are not used to the equipment can make a better job with Oxyacetelene at least as far as neatness is concerned. The trouble is that the very nature of the heat source can cause the metal being welded to overheat and warp. In spite of this, it has a big advantage on thin metal such as car bodywork where electric welding can cause the metal to be burnt right through.

Electric welding consists of a high current electrode being brought close to the work. An arc is created and this causes the metals to melt and join. The heat is very localised and confined to a small area, it is also a much quicker process than gas welding, but needs a great deal of practice to obtain a good weld, once the art has been mastered it is very successful. Bad welding can cause the electrodes to splutter leaving nasty marks on the job. I have already said it is not a good method for working on motor cars and there is another reason for this. A loose bolt near the petrol tank has been known to cause an arc with pretty disastrous results. It is also absolutely essential that safety precautions are observed. The correct face mask must be used, particularly in the case of electric welding. Never under any circumstances should arc welding be looked at without the use of a mask, the ultra-violet light can burn the eyes causing what is known as 'arc-eyes', this is very painful and in extreme cases can cause loss of sight.

Whichever method one wishes to use, it is as well to get some sort of instruction either at evening classes or from an experienced welder. Most evening institutes hold short welding courses. I did two some years ago, they lasted ten weeks each and cost me £2.00 per ten-week session. It is doubtful if money could ever be better spent.

Equipment for welding is easily obtained. The large gas bottles are not available except to recognised organisations, but it is possible to purchase a "portapack". This comes as a small set of equipment and some includes a trolley. The bottles are hired from British Oxygen Company. Electric welders can be purchased almost anywhere. It is not a good idea to buy one that gives off less than 90 amps and even this is not really big enough. The ideal is at least 120 amps. It is possible to purchase a welder that operates off a car battery, I have no direct knowledge of these, but it seems unlikely that they would weld anything other than thin metal.

Soldering and brazing

Having talked about welding, let us come to soldering and brazing. The dividing line is a bit hazy as silver soldering, which is somewhere in the middle, is often referred to as brazing. We shall see the reason for this as we go through the materials used.

What then do we require for these methods? The requirements are the same whether you call it soldering or brazing. We need heat, joining material and flux. The heat can be supplied by either a blow lamp or an iron, depending on how much is required.

If we want to be successful at soldering or brazing, we must understand the reason why we use certain materials, and firstly we must look at the flux and why we use it. No matter how well we clean our metal, heating it will cause oxides to form and prevent the solder sticking to it. The flux then must remove any existing oxides and dissolve any others that might form. As all the various solders melt at different temperatures it follows that our flux must be matched to control the oxides at the temperatures at which the solder will be used. In other words then, the right flux for the job. For most soft soldering, spirits of salts will do. As the temperature required increases, life gets more complicated and so perhaps it would be best if we deal with the flux when we talk about the solder.

Soft soldering

At the bottom we have the so-called soft solders which are alloys usually of tin or lead. The melting range is between 183 and 225 degrees centigrade, depending on the alloy. These are the solders sold in hardware and do-it-yourself shops and probably the most common. They will give a reasonable joint on brass, copper or steel, although because of oxidisation problems, steel is a little more difficult to work with. It is possible to purchase solders that melt at some 50 degrees lower than these, but these have very limited use and little strength. As far as ordering soft solders are concerned, they can be purchased in sticks or as wire, some manufacturers put in a core of flux. It is also possible to purchase the solder as a paint. You simply flux the joint, paint on the solder and heat the job until the solder melts. What then if we do not use a ready-fluxed solder, what do we use for flux?

They can be purchased quite readily by brand names, and come either as a paste which is basically resin or as a liquid which is an acid. The most common of these is Spirits of Salts and is quite effective, but phosphoric acid can be used with possibly better results. Any of these are suitable for temperatures up to about 300 degrees centigrade, after this they begin to be less effective, although the acids will work at about 380 degrees.

The ready-cored solder is most effective on electrical joints as the work should in most cases be fluxed before heating to prevent the formation of oxides. Small joints can be dealt with by means of soldering irons but on larger areas, it is probably better to use a small blowlamp or gas torch. When a soldering iron is used it must be large enough to heat the work sufficiently to allow the solder to melt on the metal. It is no good melting the solder with the iron, this will only result in a dry joint which is one which has the appearance of being good whilst the solder has not fully adhered to the metal, making the joint brittle.

A few years ago the next step up from soft soldering was silver or hard soldering. Nowadays, however, there is an intermediate range. They melt from about 220 degrees to 390 degrees and some have considerable strength. They are known by a variety of trade names and melting at 221-235 degrees we have plumbsol which is an alloy of tin and silver. A similar product is known as ST300 and the name just depends on which manufacturer's product you buy. There are a range of about eight of this type of solder, probably the best for our purpose being SX2500 which might be bought as HT5, the temperature range for this is 270-285 degrees. Another is L.M15 which has a range of 280-290 degrees. Slightly lower is Comsol which is 290 degrees. All these are very strong and make excellent joints. As a result of their introduction, many people can now manage a form of higher temperature soldering who could not do so before because of the amount of heat required to use the true silver solders. It goes without saying that these solders are not really suitable for use with soldering irons, because only the very largest irons on the very smallest jobs would give enough heat. A torch or blowlamp is a must if using them.

As far as flux is concerned then, in theory our acids will do the job. I say in theory because in practice, prolonged heating causes them to break down and they are no longer effective. Special fluxes can be bought if heating is to be over any length of time, it is advisable to use them. One other point with these solders is that they work very nicely on stainless steel, which is not normally the best of materials to solder.

Silver soldering

The next step up is to silver soldering in the traditional manner, and once more have a vast range of products to pick from. The job to be soldered must be the thing that decides for us the solder to be used. If there are several bits to be joined together at different times, then progressive soldering is required. This means that various grades are used that melt at different temperatures, starting with the highest and working down to scale. Possibly even using soft solders on the last stages. The range of hard solders is quite amazing and in circumstances described above, it is as well to start with a solder with a melting point in the upper 700 degrees range.

Johnson Mathey Silver Flo 16 has a range of 790—830 degrees whilst Silver Flo 24 has a range of 740-780 degrees. Incidentally, the fact that two figures are quoted does not mean that the manufacturers do not know the correct temperature. The lowest one is known as the solidus and the higher one is the liquidus. Being an alloy, the different components melt at different temperatures. With the lowest one melted, the solder forms a semi-liquid state and this is the solidus and when all components have melted, this is the liquidus. There are of course firms other than Johnson Mathey who make silver solders, but apart probably from the Sheffield Smelting Company Ltd., they are not usually available through retail outlets. Nevertheless, if you are buying from a retailer it may be as well to ask for the stuff by temperature range in case it is not Johnson Mathey's. As far as I know, the Sheffield Smelting Co. do not do one that is the equivalent of Silver Flo 16, but their LX8 has a range of 700-780 degrees. They have a progressive range similar to J.M.

In order to use these types of Silver Solders, special fluxes are needed and Johnson Mathey Tenacity No. 5 is probably the best all-round commercial flux. (Ordinary Borox will work quite well with Silver Flo 16). Sheffield Smelting Co. Flux "F" is a similar product, for the 600-780 degrees range.

The various Silver Solders progress downwards in variations of 40 degrees or so, but we now come for our purposes to the widest used range. These have melting temperatures of 620-630 and trade names are easy Flo and MX20, and below this at 608-620 we have Easy Flo No.2 and MX12. It is surprising how much easier it is to work at 608-620 than at 620-630. Those extra 10 to 20 degrees are quite difficult to obtain. For these solders, Easy Flo or "Y" flux are the best bet.

These types come in a variety of forms and this is something that is not generally realised. The usual way to purchase is in sticks of about 1.5 or 3mm diameter and for general purpose work, these are excellent. Silver Solder is expensive stuff however, and using those sticks can be very wasteful. It is possible to purchase the solder as a paint, a powder, in various diameter rings as foil and as very thin wire, all of which have advantages. Personally for small jobs I like 0.5mm wire. It seems to go a long way and is very easy to use. When working in awkward places I feed it through a thin steel tube which prevents it melting when not required.

A few more words about types of solders and then to get on with the how to do it bit. That part is fairly easy once you understand the materials you are working with. Most silver solders cannot be used to form a fillet, they have a capillary action and joints must be close fitting. Therefore if we have had to leave small gaps we need something else to do the job. Special solders are produced for this purpose and they are in the Argo-Flo, Argo-Swift and Argo-Bond range.

Again the temperatures are progressive. Argo-Flo being 595-630, Argo-Swift 607-685 and Argo-Bond 616-735. They are available in forms similar to Easy-Flo. A little practice is required in their use in order to obtain a satisfactory fillet, to the uninitiated they seem to puddle a little.

There are some solders available that when used on copper are self fluxing with obvious advantages, they are known as Sil Fos, and Sibralloy or in the case of Sheffield Smelting Co., it is the "Phos" range. Temperatures are similar to ordinary Silver Solders. They do tend to have a rough texture when allowed to run uncontrolled on a job, and not requiring a flux they of course cannot easily be confined to a particular area. My own experience with them is that joints made with them are a bit on the brittle side, this is confirmed by many and so their use should be confined to joints which will not be subject to too much stress.

Brazing

If we go up the temperature range a little, we come to true brazing although silver soldering is more often than not referred to as brazing. This consists of using spelter instead of silver solder. Spelter being an alloy in the form of a low melting point brass. It has great strength, is relatively cheap and for these reasons is a most useful way of joining copper or steel. It should not be used on brass as the melting point of the job is close to that of the spelter and a great deal of control is required. Neither should it be used on boiler construction as brass deteriorates rapidly in those circumstances, and it can be both inconvenient and dangerous. For work on steel it has the advantage of being a good filler and has a considerable advantage over silver solder.

About the only solder not discussed so far is for joining aluminium. Both hard and soft solders are available for this purpose, but hard soldering is difficult because of oxidisation problems. In industry this is overcome by use of a controlled atmosphere (usually soldering through a film of Argon gas). For the home worker, the advice must be to stick to soft soldering if you have really got to solder aluminium. There are numerous makes of aluminium solder on the market, together with the special fluxes. A torch is essential for their use and they do not flow like ordinary solder. The technique is to pull the solder along the joint as it only puddles. Any attempt to make it really flow will only end up in the work melting. It is, however, a highly successful operation once the technique has been mastered and when you are no longer afraid of it you will be surprised how often it can be used for jobs that previously you would have thought impossible.

Next month Stan will continue with the practical side of the job.

Vauxhall 24

This competition organised by the Student Training Dept of Vauxhall Motors Ltd., is designed to see how many miles can be achieved by a man-powered vehicle in 24 hours

The Shell/Motor Mileage Marathon has aroused considerable interest—not only all over the country, but all over the world. 2,000 m.p.g. makes a good target which fires the imagination in the same way as the 4-minute mile once did. However, there is another group of young enthusiasts who have gone off on another tack and do without petrol altogether. For the past 6 years, a number of groups have competed in the "VAUXHALL 24". In this event, which raises thousands of pounds in sponsorships, a team of six must pedal a four-wheeled car as far as possible in 24 hours. There are a few rules about the car, but still plenty of room to manoeuvre. What is their "4 minute mile"? Judging by the results of the past few years, I would say 400 miles in 24 hours. Given just the tiniest bit of luck to go with the enormous effort put in by the teams, this particular goal must be reached in 1980. Then what do you suggest? 450 miles or 500 miles in 24 hours? What about 1,000 Kms, or is that too much?

Most of the teams are from establishments where young engineers are under training. Projects like this always bring enthusiasm and motivation into the learning process. It must be said that it can be to an extent, that the training staff find rather trying. Young men begging for the workshop to be kept open and of course supervised, late at night and at weekends is only too common as the race day draws near. One member of staff was woken up at 3.30 a.m. on the race day to let the team into the workshop to make a replacement back axle! I understand words did not fail him to begin with. To the ignorant, like what I was, it seems that all one needs to do is knock up a car and go into pedal training. Not so much an engineering competition as an athletic event. How wrong I was. The winning team needs talents in many areas that actual ability to pedal hard seems almost unimportant. Of course, it must be important, but experience proves that the race is nearly always won or lost by breakdown time spent off the road. If you are like me, you will already have begun to make mental note of some of the design specifications. One that surprised me was the need to be able to make frequent driver changes — usually every lap of 0.6 of a mile. Those that come to mind are:

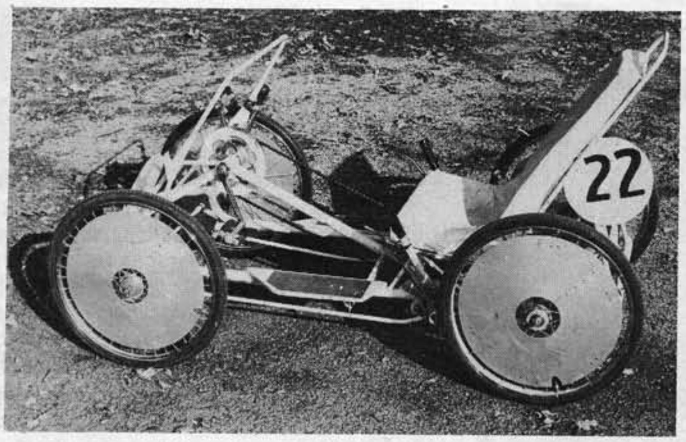
Design specifications
1. **Correct position for effective pedalling**
2. **Light weight**
3. **Brakes**
4. **Steering**
5. **Cost**
6. **Reliability**
7. **Maintainability or repairability**
8. **Lights (It always gets dark every day)**
9. **Ease of driver change**
10. **Protection from shunts**

to name but ten! Already one can begin to see the challenge of the design. Having decided on a design, one needs then to make or obtain the parts. Only when manufacture is finished, can training begin and you can bet your boots it will reveal a need for redesign and modification. Now we can start anticipating spares requirements. (One team needed seven wheels to complete the race and then they did not win). The more one thinks about the problems, the more one realises that it is just like running a Grand Prix or Le Mans team in miniature. Co-ordination, planning, leadership and teamwork are all needed to bring into being a competitive team.

I was able to look over Vauxhall's own car and talk to Mr. Ian Deamer, the race organiser. Ian works in the Student Training Department of Vauxhalls Ltd., and has the enormous task of organising the event again in 1980. 40 entrants have already applied and for 1981, a reorganisation is being considered because the grid is over-full and heats are now necessary. Bolton—who twin with the town of Le Mans, are running a similar event in June of 1980. It is hoped this might be used as an eliminator in the future, although it is not possible this year because the "Vauxhall 24" is held in May.

As you can see in the results list, the 400 mile mark is enticingly close. The lap record is about 22 m.p.h. on the circuit at Wardown Park, Luton. Straight line speeds of 45 m.p.h. have been claimed.

If you find this event intriguing and would like to have a go, then grab a pencil and start now on the back of an old envelope. All you need then is to form a team from such sources as enthusiasts as schools and apprenticeship schemes, or even as a private entry.



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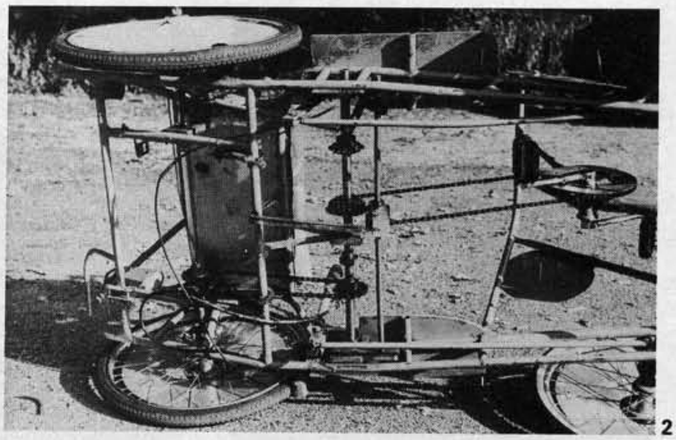

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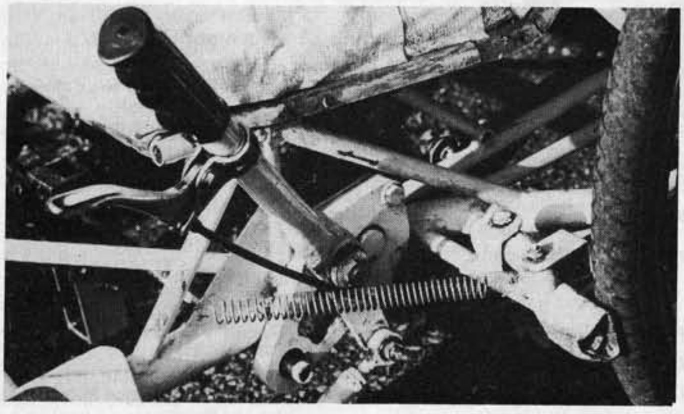

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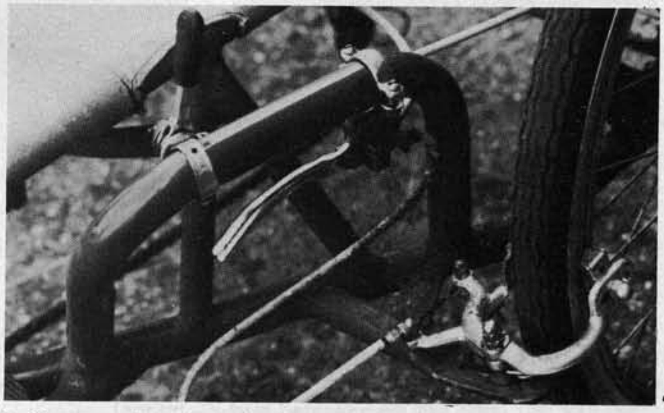


4

1 *The British Aerospace car.*
2 *Close up of the same car, note steering lever and brake that works directly on the tyre.*
3 *Close up of steering rod and handle incorporating brake lever.*
4 *Vauxhall's machine showing braking system and gear change lever.*

car specification

(1) Number of road wheels: 4.

(2) Configuration of road wheels: Arranged in two pairs.

(3) Divisions: (a) maximum length, 1,850mm; (b) Maximum height, 925mm; (c) Maximum width, 950mm; (d) maximum diameter of wheels (including tyres), 560mm; (e) maximum width of tyres, 55m; (f) minimum distance between front wheels (pitch), 550mm; (g) minimum distance between rear wheels (pitch), 550mm. Note: Cars which, in the opinion of the scrutineers, do not comply with the above specification will be penalised according to the following rule: "for each centimetre or part of a centimetre a penalty of 10 laps will be incurred".

(4) Driving Position: Driver to be seated with feet forward (Driver's feet must not pass *beneath* his/her body or head when propelling the vehicle).

(5) Drive: Rotating pedals, through any system (or systems) to one or more of the road wheels. Any system to alter the velocity ratio between input to output is permitted (e.g. gears). (Note: the only motive force allowed is that of the driver himself).

(6) Braking: Braking to be provided to *both* rear wheels. (Note: additional braking is encouraged but is not obligatory).

(7) Lighting: Adequate lighting must be provided during the hours of darkness. Lights at the front of the car must be white. Lights at the rear of the car must be red. At least one light must be visible at the front and one at the rear at all times during darkness. (Note: lap counters will be instructed to 'not count' for any car failing to comply with this rule). Glass lenses are prohibited.

(8) Safety: No protruding parts liable (in the scrutineers' opinion) which could cause damage or injury will be permitted.

With the exception of the road wheels all moving parts must be adequately guarded and every reasonable effort made to obviate trapping points.

Notes:

(i) the organisers will be pleased to give advice on all matters concerning safety before the event.

(ii) any entry which, in the opinion of the scrutineers is unsafe, will be refused permission to start.

(iii) if any entry which, in the opinion of the scrutineers, becomes unsafe by reason of damage or failure of any components it will be suspended from racing until suitable repairs have been effected. Where an entry has been officially suspended in this way approval from the scrutineers must be obtained before the suspension is withdrawn.

(9) *Identification:* Racing numbers will be allocated according to order of entry. These numbers must be displayed at the front, rear, and both sides of the car. Minimum size of numbers: 250 mm × 150mm. Numbers may be either white on black or black on white. (Note: it is recommended that the front number is illuminated so as to aid the lap counters and the teams own change-over crew).

(10) *Approach Warning:* All cars to be fitted with a means of giving audible warning of approach *other* than the driver's voice. (See also Racing Rule 5).

Team Specification

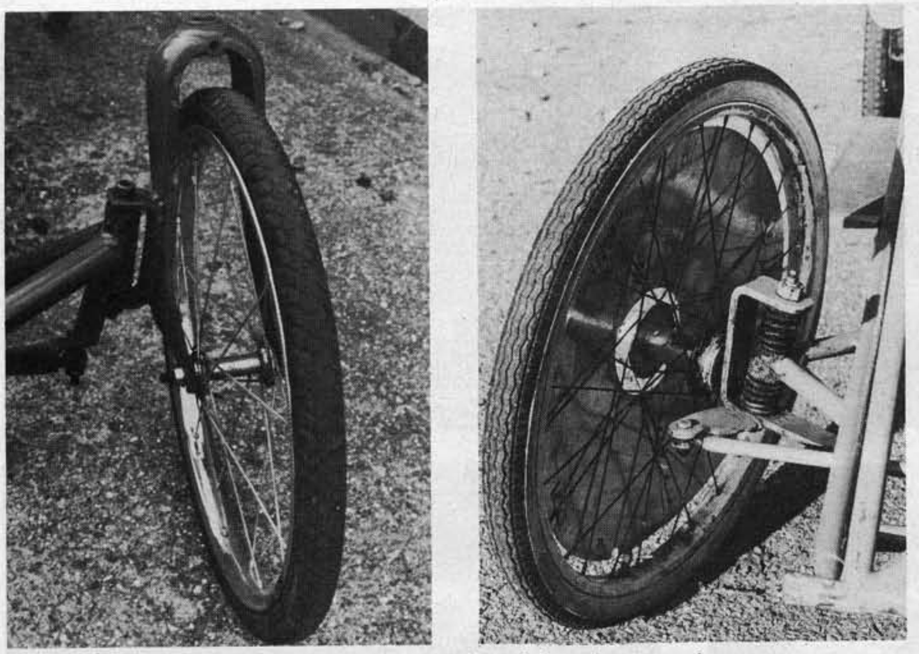
(11) Drivers: Teams may include up to six drivers. One additional driver may be used as a substitute at any time during the race, providing that the teams follow the correct procedure for substitution which will be laid down in the final instructions. The maximum age of any driver shall be 25 years on the day of the race.

(2) Mechanics: Teams may include up to two mechanics.

(3) Managers: Teams must include a non-racing manager who is over 25 years of age.

(4) Identification: All team members must be identified with their entry numbers clearly displayed on the backs of their tunics/overalls/jackets/etc. Anybody not thus identified and who is not an official will be ejected from public no-go areas. Where more than one team is entered from the same organisation the teams should wear different colour tunics.

(5) Safety: Drivers must wear crash helmets at all times whilst driving. The helmets must comply to BSI specification. Failure to comply with this rule may result in disqualification.



Two contrasting wheel designs. Left rigid construction, right spring suspension.

Racing Rules

(1) Practice: The track will be opened for practice for at least 4 hours before the race commences. Details of practice periods will be issued separately nearer to the date.

(2) Pits: Pit areas will be allocated and marked out as shown on the map of the venue. Teams may only use the area which has been marked with their number. This is important, please co-operate by discouraging supporters from entering the pit area.

(3) Driver Changing:

(i) Changeover stations will be allocated and number in the changeover area. Space will be very limited and managers are requested to keep to a minimum the number of team members in this area.

(ii) No pushing of cars will be permitted except by the driver entering the car. (Note: penalty will be one lap/infringement).

(iii) In the case of breakdowns, cars may be pushed directly back to the pits. (note: no car may be pushed across the bridge).

(iv) Driver changing may only take place in the changeover area or in the pits.

(4) Repairs: All repair work must be carried out in the pit area— NOT ON THE TRACK SIDES—except when replacing an intact chain.

(5) Overtaking: Drivers are asked to keep to the left-hand side of the track and to overtake on the right. To signify the intention to overtake drivers are asked to use their 'audible warning of approach' by sounding it twice in rapid succession.

(6) Safety: All complaints of dangerous driving will be recorded and investigated by the organisers. Drivers found guilty of such an offence will be disciplined. This may take the form of a warning for a minor offence, or suspension or disqualification for the driver or his team for serious or repeated offences.

(7) Marshalling: each team is requested to provide marshalling (one person at any given time during the race) for a short section of the track. The organisers will then arrange that at least two marshalls patrol each section at all times. Failure to provide marshalling cover may result in less than adequate cover being available for all areas. Minimum age of marshalls to be 18 years.

1979 Winners A. P. E. Allen Limited.

Vauxhall 24—Six-year Summary

1974	**Entrants**	**10**
	First	**Hawker Siddeley**
	Second	**Vauxhall**
	Third	**W. H. Allen (Now A.P.E.)**
	Best Av. Speed	**13.72 m.p.h.**
	Laps	**549**
	Miles	**329.4**
1975	**Entrants**	**18**
	First	**W. H. Allen**
	Second	**Hawker Siddeley**
	Third	**Chrysler**
	Best Av. Speed	**13.85 m.p.h.**
	Laps	**319**
	Miles	**190.5**

Raced for only 13.75 hours — race abandoned due to flooding.

1976	**Entrants**	**19**
	First	**W. H. Allen**
	Second	**Hawker Siddeley**
	Third	**S.K.F.**
	Best Av. Speed	**15.6 m.p.h.**
	Laps	**623**
	Miles	**373.8**
1977	**Entrants**	**23**
	First	**Hawker Siddeley**
	Second	**Hawker Siddeley**
	Third	**W. H. Allen**
	Best Av. Speed	**15.1 m.p.h.**
	Laps	**603**
	Miles	**361.8**
1978	**Entrants**	**29**
	First	**Vauxhall**
	Second	**Hawker Siddeley**
	Third	**A.P.E. Allen**
	Best Av. Speed	**16.6 m.p.h.**
	Laps	**663**
	Miles	**397.8 (best yet)**
1979	**Entrants**	**29 (37 entrants applied)**
	First	**A.P.E. Allen**
	Second	**Compair Industrial**
	Third	**British Aerospace (Hawker Siddeley)**
	Best Av. Speed	**15.83 m.p.h.**
	Laps	**633**
	Miles	**379.8**

Note: Best Average Speed—Does not allow for time cars were undergoing repair of wheel change etc. Therefore, the average speeds based on time racing would be higher.

For further information on the Vauxhall 24, contact:

Mr. I. Deamer, Student Training Department, Route 8713, Vauxhall Motors Ltd., Kempton Road, Luton, Bedfordshire.

and for the Bolton event:

Mr. Roy Heath, Dr. Barnados Matchsticks Appeal Campaign, 72 Broad Street, Pendelton, Salford, Manchester M6S B2.

Check and Report

by James and Rita Vanderbeek

Our Review Models this Month . . .

High Fidelity motorcycle models from Polistil

Whilst it would be true to say that the British manufacturers of diecast/plastics scale model vehicles have never gone in for 2-wheelers in a big way, the opposite applies in the Italian manufactured Polistil range. The models are of special interest, not only because they include the world's best bikes by makers in Europe, U.S.A. and Japan, but also because the chosen prototypes have a great deal to offer in terms of adding still more detailing and additional paint embellishment. At first glance one would be tempted to think that there was relatively little scope for additional finishing work but, in fact, these quantity produced replicas may be given finishes which take them well towards exhibition standard.

The distributors provided us with examples for Check & Report of two machines—the BMW R75 Elephant bike and sidecar and the Suzuki Daytona Texaco in full racing trim with aerodynamic windshield and fairings. Both are to 1/15th scale so that they are large enough to make the most of the high standard of tooling which typifies this series. The BMW combination has a number of appealing features such as a removable spare wheel, sprung saddles, two hook, movable gear change, steerable front wheel and sprung rear suspension. Several of these are repeated on the Suzuki which, in contrast, is painted and labelled in red, yellow, black and white and carries authentic lining and decals.

We could not help but be impressed by these Polistil replicas for, quite apart from their potential as models with special finishes, they provide such an accurate record of modern motorcycle development—both in styling and in the mechanical and technical features which are so beautifully portrayed.

RAF Phantom from Revell

From the number of McDonnell-Douglas Phantom kits produced by Revell and almost every other manufacturer in the business, it seems that this aeroplane is set fair to become one of the plastic model classics. The latest version which we have received is a 1/48th scale RAF Phantom II and, whilst it follows in design and construction the other Revell kits for this type, it is particularly well detailed, with nicely fitted-out cockpits and canopies, optional position tricycle undercarriage and a full complement of underwing missiles. The sheet of waterslide transfers is similarly good and includes serials, squadron markings, the various warnings and, of course, roundels and current type fin flashes.

Another rapid piece of machinery, but this time a car, is the subject of a new 1/25th scale Revell colour moulded kit. The aluminium toned mouldings make up into a Porsche 928 Rally—one of the most potent saloons in international events—and a set of slightly smoked transparencies, wide section soft tyres and colour printed decals complete a kit which must appeal to all automotive modellers.

Jouef HO scale ore hopper

New from Le Jouef Francais in HO scale is a triple hopper ore wagon of a type extensively used on French Railways by Arbel-Fer—in whose colours the model is finished. With an overall length of about 6¾ in., this vehicle reproduces steel underframing, end platforms with access ladders to the hopper compartments, bogies with plated finish metal wheels and standard Jouef Continental type auto-couplings. The lettering of the various operational instruction panels is very neatly executed and this is a model fully representative of modern image bulk transport on the other side of the Channel.

On test it proved to be as stable and reliable at all speeds as previous freight wagons of the Jouef marque. There were no snags and the model looks absolutely right behind its diesel or electric loco, although in full-size practice the wagons are formed into very long trains. often permanently coupled.

Parcels vans from Lima

Some excellent examples of competitively priced OO scale rolling stock have already been issued by Lima this year and the new 4-wheeled BR parcels van, Type CCT (GUV), is certainly no exception. Immediately apparent is the very good standard of moulding for both the long wheelbase underframe and the van body, whilst the window glazing has a realistic protective bar effect. Also very good is the brake and suspension detail around the wheels, whilst the battery boxes, dynamo and generator and brake cylinders add the final touches to what is undoubtedly one of Lima's best OO scale vans yet. The model comes in early BR maroon or current blue, besides the special 2-colour livery of the Tartan Arrow Parcels Service.

Now they are called Great Model Railways

A most interesting group of new Airfix OO gauge railway models typifies the recent change of name for this system to GMR—Great Model Railways.

Top of the list was a BR Class 4F 0-6-0 tender loco of the type which formed the mainstay of the old Midland and, later, the LMS, for many years. Brief examination of pre-production models of the 4F at trade exhibitions had indicated that this Airfix replica was likely to be good, and in appearance and on the test track our initial impressions were more than confirmed, for the Fowler turned

Jouef HO scale model of the Arbel-Fer triple-hopper ore wagon now running on SNCF. Finish overall is in red oxide.

Current type parcels van in Tartan Arrow colours. Lima also offer this new OO model in maroon and rail blue liveries.

out to be as versatile in performance as its prototype and capable of coping with almost any task on a layout. The tender drive is smooth and quiet, current collection via the driving wheels is efficient, and the detailing of the plastics moulded loco and tender bodies leaves nothing to be desired. The finishing touches are provided by plated wire handrails, articulated coupling rods on the all-flanged drivers and at both ends are metal buffers, dummy brake pipes and, of course, automatic couplings. This has to be one of the best value Airfix locomotives yet.

New passenger coaches now available in the GMR system include BR maroon liveried versions of the Stanier 57 ft., non-corridor, brake/3rd and 1st/3rd composite vehicles. These are directly developed from the LMS versions which have been available for some time, but carry authentic lining-out and numbering of the late '50s period of BR.

No less than five new freight vehicles were provided in this batch, including 5-plank fitted and unfitted BR open wagons, a similar BR 7-plank wagon and, from earlier years, a GWR 20-ton, steel-bodied loco coal wagon and LMS 20-ton brake van—double-ended, with lettering, numbering and handrails picked out in white.

All these new rolling stock models were very satisfactory test subjects, so much so that throughout our session we did not have one instance of derailment or failure of the auto-couplings. They demonstrated as a group how consistent the Airfix models are in respect of free-running, smooth traversing of complicated trackwork patterns and total lack of fussiness.

Heller car model kits

So international is the model kit scene that there is nothing at all out of the way in the fact that Italian, British and German cars should feature in this group of French manufactured kits. These 1/43rd scale replicas include the BMW 630CS, the Alfa Romeo Alfa-Sud, the Leyland Princess 2000 and that very desirable carriage, the Jaguar XJS. As ever, the Heller tooling and mould finishing leaves nothing to be desired. Each of these kits contains beautifully finished sets of mouldings for the body, engine, interior fittings and wheels, with transparent glazing, bright plated parts for items such as the bumpers, lamps etc., besides correct pattern number plates.

Construction is straightforward, with multi-language instruction sheets which include parts lists, so that builders without previous car model experience can be assured of success.

To match these new Heller kits are cars such as the Mini, Mercedes Benz 450SL, Rover 3500, Renault R30TS and the very stylish Peugeot 604 saloon. It is a range which cries out to have miniature electric motors installed!

Gilmour pre-printed stations

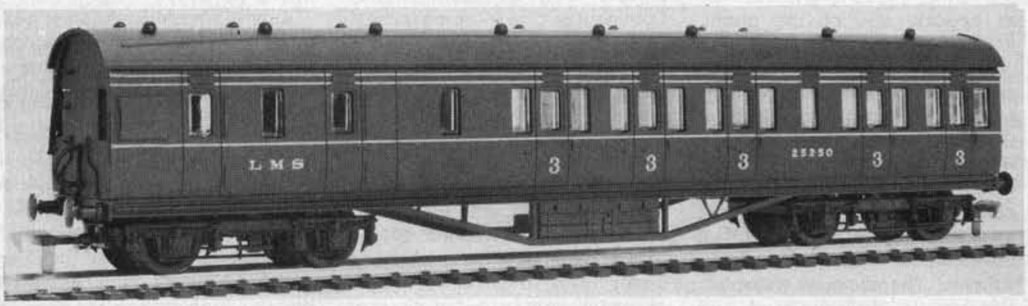
Competition in OO/HO model railway products is, to say the least, intense. It now seems to have extended to the kits of printed and cut-to-shape board parts for lineside buildings and other appropriate structures—from churches to coalmines.

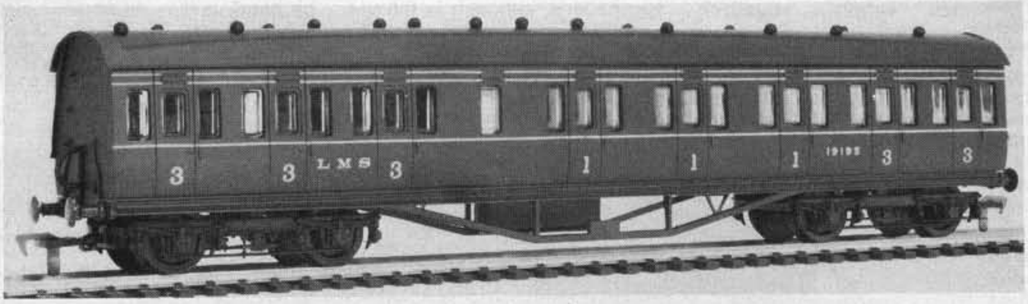
One of the most recent series to be released is that by Gilmour and they have just sent us a group of three packs for station buildings and platform. The printing throughout is very good, whilst the cutting to shape of the sets of components and the apertures for doors and windows is accurate in positioning and neat in execution. The two kits for the buildings are of different styles—one of country station character, with centrally located main entrance to the platform but without a canopy, whilst the second has a centre hall entrance and full width platform canopy. This kit also provides a set of parts for the traditional 'convenience' which was so often located at one side of the main building. The third kit is one which is simple in character but, nevertheless, very useful—a 31 in. long straight platform, of printed brick and stone construction, with ramps and printed board fencing.

These latest Gilmour kits look well, are simple to assemble and, thanks to the heavier gauges of board now employed, are long life models which will fit well on any British outline layout.

Private Owner wagons from Graham Farish

Now available from Graham Farish stockists are eight new OO-gauge Private Owner goods wagons—5-plank in the liveries of





The Airfix GMR OO scale models of the Fowler designed Class 4F 0-6-0 loco and Stanier 57ft. non-corridor 1st/3rd and brake/3rd coaches—all shown here in LMS livery as BR model photographs were not available.

D. Pitt & Sons, Spiers and Snow & Sons, and 7-plank for G. F. Sleight, Powell Gwinnell & Co., Ocean and Staveley Coal & Iron Co. There is also a steel bodied mineral wagon in the overall grey of Stephenson Clarke. All these wagons have their interiors picked out in contrast colour and feature printing which is not only authentic, but of appropriate accuracy in colour and lettering style. We particularly liked the inclusion of the Sleight vehicle, for it makes a change to read that an owner is a fish merchant and curer, based at the fish dock at Grimsby!

The other features of these models include well detailed underframes, spoked wheels on pinpoint axles, standard type automatic couplings and precise detailing of the surfaces of all the mouldings.

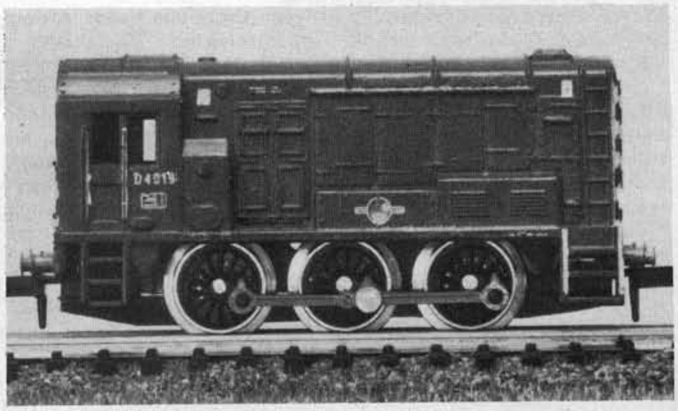
A test train formed of these eight wagons was not only a colourful sight on the layout, but gave our 0-6-0 locomotive very little work to do. In fact, we noticed that on an almost imperceptible gradient the vehicles wandered off without waiting for their motive power.

Graham Farish N-gauge models now feature new couplings.

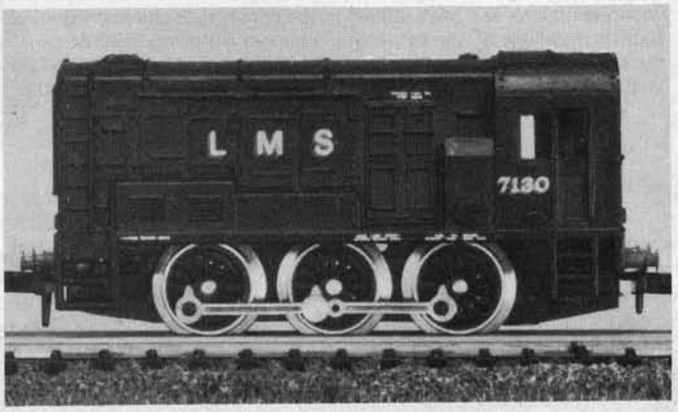
We had hoped to review these Graham Farish N-gauge models some time ago, but the samples went adrift in the post so that only now are we able to catch up. Most important new Graham Farish loco this year is the Class 08 0-6-0 diesel shunter and the makers have taken advantage of the type's early service to provide replicas in LMS and Southern black, besides green and blue inverted liveried British Rail versions. The latter pair is very striking, with yellow/black striped ends, but all have numbering and lettering which is quite remarkable for the small size of some of the operating instructions. It is worth taking a magnifying glass to these inscriptions.

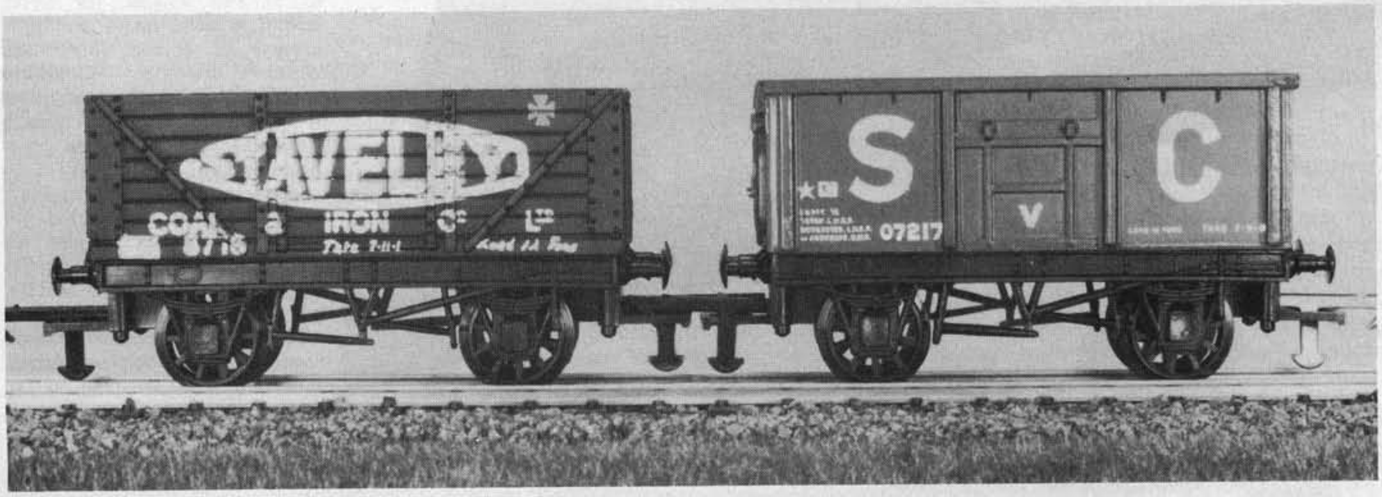
The 0-6-0 loco frame is entirely new and is, therefore, correctly matched to this model. It runs very smoothly and ensures that the full potential of the motor is realised in both controllability and load hauling. The all-up weight is quite heavy for a model of this size—thanks to the very well detailed diecast metal body—and traction tyres are simply not required.

Six new goods vans and wagons are also now in full production, with GWR loco coal and NE Brick bogie vehicles making good use of the 40-ton open wagon body first used for Sulphate vehicles. There are three twin-vent vans, for Anglo Sportsman, Gibbs SR and John

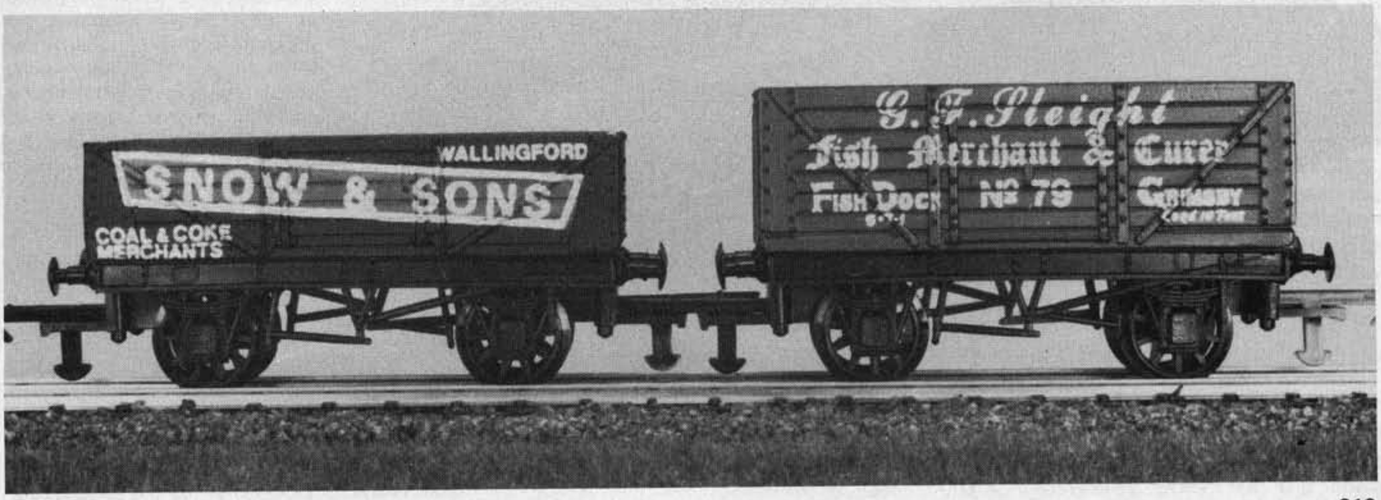


The Class 08 diesel shunter in LMS black and BR green, newly modelled by Graham Farish in N-gauge. The close-coupled 0-6-0 chassis is entirely new, as are the auto-couplings.





Graham Farish OO scale wagons in some of the latest Private Owner liveries. Note the fish wagon and SC mineral wagon.



West Salmon, besides a Stephenson Clarke steel mineral wagon.

The production standards achieved by Graham Farish in these competitively priced items of rolling stock will be known to many of our railways orientated readers, but special mention should be made of the new pattern auto-couplings now being fitted by Graham Farish to their locomotives and rolling stock. These are neat in appearance, do not require additional springs and behaved throughout our long test sessions with a very pleasing degree of reliability. So many improvements have been made by Graham Farish to the N-gauge range that these new couplings bring this department into line with others such as the all-metal wheels which do so much to improve running characteristics.

Swiss Crocodile heads Arnold locomotive list

Following a period of relatively slow development of this system in U.K.—as opposed to Europe where it has flourished as the originator of N-gauge—the Arnold models are now being strenuously promoted. Many model shops now stock them and prices seem more competitive for models of this undoubted quality.

No less than five new locomotive types have been provided for our review, including the remarkable 2-6-6-2 Swiss Railways Crocodile of Type SBBCe 6/8. This very large loco was specially designed for heavy freight train work and its 'double jointing' enabled it to cope with the tight curves and many gradient changes in the mountain areas.

The Arnold N-gauge model has a length over the buffers of just 4¾ in., yet features a centrally mounted DC motor with double worm drive to the two sets of driving wheels. These are all equipped with plated tyres, whilst one wheel on each bogie has a plastics traction tyre. Correct type side motion is fitted, with lay-shafts. The three parts of the locomotive body are beautifully reproduced, with handrails, inspection panels, vents, lights (which work) and access steps with yellow finished handrails all incorporated. The silver finished roof of the centre section includes the electrical installations of the prototype—from two spring-loaded pantographs down to the various dummy cable runs and sets of insulators. Choice of normal 2-rail or overhead current collection from a catenary system is available.

Also newly-introduced are pre-war German Railways electric locomotives from Classes DB 117 and the later, and slightly more shapely, DB 118. They were used for heavy train operations, with the DB 118 specified particularly for express workings over steep gradients. Both have 2-4-4-2 wheel arrangement and have diecast frames, carrying the 12v DC motors with their double worm drives. A total of four axles is powered on each model. Electrically they are good representatives of modern Arnold-N practice with printed circuit boards, selection of either rail or overhead wire current collection, and long life components. A more modern electric unit is represented by the very widely used DB Class 111 Bo-Bo in the latest local train livery of light grey, with broad red band, and roof detail picked out in silver. In standard colours this model is one of the most popular in the Arnold-N series and, again, it features two bogie drive via gear trains, traction tyres, excellently modelled bogie frames, full roof detail including two pantographs and glazing all round.

The smallest of our Arnold loco models is the DB BR 245 0-4-0 diesel shunter. This interesting little model has a die-cast metal body, handrails all round and a 12v motor with multi-stage gear train to all four wheels. Its overall weight is quite heavy and it is capable of coping with loads which are in complete contradiction to its own small size.

Express length rakes hold no terrors for the BR 245!

Our test sessions with these new Arnold models were extended over some days, partly because we were not so familiar with this marque as perhaps we should be, but also because we were both pleased and interested by their overall performance envelopes. Reverting for a moment to the Swiss Crocodile—suddenly a very popular prototype in more than one scale—we must confess that this locomotive was unusually impressive in action and provided us with more operating enjoyment than most. This must not be taken in any way as decrying the performances of the other Arnold locos, for all were uniformly good, consistent in performance, eminently controllable (using our standard AGW controllers) and one hundred per cent reliable. In this last respect they served also to show how well the N-gauge system has been developed by Arnold.

Two of the latest Arnold N-gauge electric locos—the pre-war DB118 and the latest version of the extensively used DB111 in grey/red colours.

Radio Controlled Stock Cars

An Introduction by Steve Busby

FULL SIZE stock car racing and its offshoots such as Banger racing is probably the largest regularly attended spectator sport in the motorsport field. Run all the year round on oval circuits, frequently under floodlights, a fantastic atmosphere is generated with colour, lights, noise, clouds of dust, and an element of danger that adds spice to the whole proceedings. Model stock car racing with $\frac{1}{8}$ scale i.c. engine powered replicas has been growing in appeal since 1973 when as a result of much development work by Bob Webb and Wes Raynor, the *Mardave* stock car kit was introduced. Since that first introduction many thousands of modellers have purchased *Mardave*'s and other manufacturers' products both for pure fun use and competition.

This scale produces a model approximately 18″ × 9″. Their basic design features have remained the same to the present day with their appearance and construction being similar to their full size counterparts.

Typical Construction

The basis of most model stock cars is the welded steel chassis which is generally ½ in. square tube. Attached to this are side 'nerf' bars and front and rear over-ride bars, these provide protection to the vulnerable wheels and steering during races. The front beam axle uses moulded or machined steering blocks which contain steel king-pins and steel wheel spindle with coil springs for suspension. Several drivers have dispensed with the coil springs on the front axle but their efforts were not rewarded with success for it seems that the handling characteristics of stock cars rely on some form of front suspension.

The rear axle is also sprung, which is usually achieved by using radius or trailing arms, with hairpin pattern springs.

A toothed belt drive is usually employed driving via a centrifugal clutch to a toothed rear axle pulley. Wheels are generally of the moulded nylon type to which sponge rubber tyres are glued, with the same diameter and width front and rear.

To operate the stock car two channel radio control equipment is required operating throttle and steering, for protection this can be housed in a moulded plastic radio box. One servo is used for the steering operation which ideally should incorporate a servo saver to protect the servo from the inevitable knocks. The second servo is for the throttle; brakes are not normally fitted as throttle control and engine braking have been found sufficient during racing conditions, although some drivers do fit a brake to the clutch drum for 'emergency stops'.

Linkages are generally piano wire and plastic swing keepers, although more sophisticated ball joints can be used.

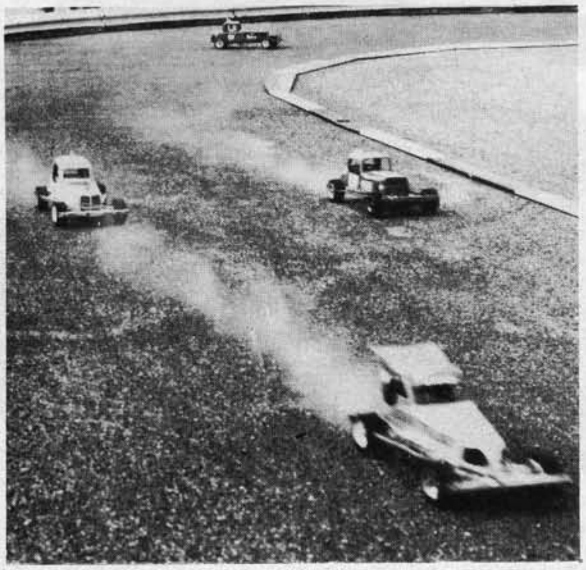
Practically any engine can be used, preferably one with a ball raced crankshaft due to the side loading on the shaft. Engines of up to 3.5 cc or 0.214 cu. in. capacity are used for competition, these limits being set by the national governing body for stock car racing—the Radio Stock Car Association. The most popular engines at the moment are *Veco, Fuji, Irvine* and *H.B.* The carburettor on any engines used should have an adequate air filter to protect the engine from dust and dirt. A fuel tank, either moulded plastic or fabricated in plate and a good fuel filter are also required.

Stock car bodies are available in various shapes and sizes made either from A.B.S. plastic or fibre-glass. Window areas have to be cut out and trimmed. It is a good idea to leave the roof pillars as thick as possible for strength, in the event of any 'flip overs'.

The Radio Stock Car Association

This Association was formed soon after the appearance of model stock cars and has a membership of around 280. It is the U.K. governing body for the sport

Standing start at Sandown Park R/C Symposium. Engines idling with clutches disengaged, the Stox wait for the 'off'. Most races are rolling starts.



They're off! Smokey exhausts are inevitable due to use of throttle for slowing at bends, then accelerating into straights. Line-up illustrates the colourful decor which drivers use to simulate real stockers.

deciding on racing and construction rules for National competition cars.

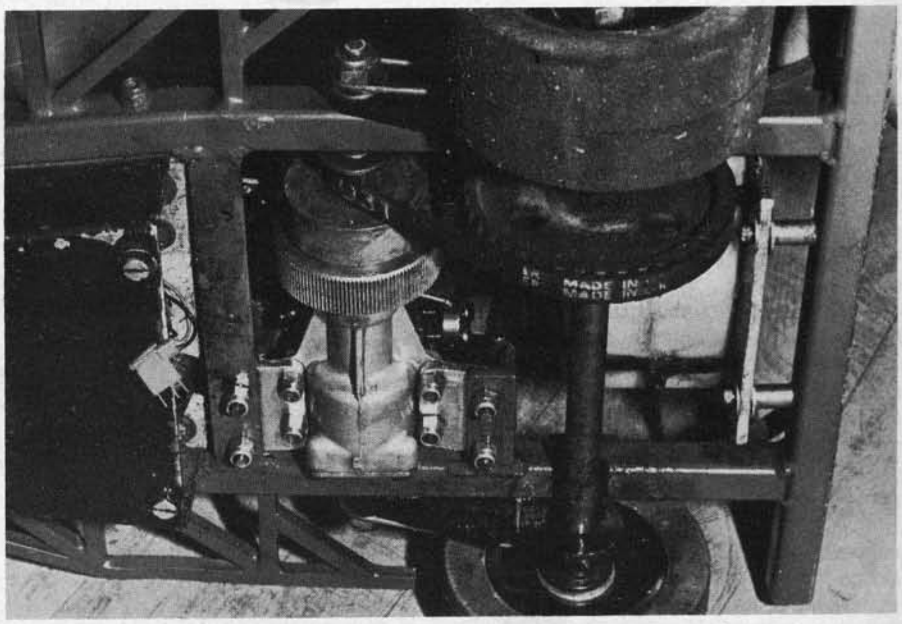
One of the reasons why stock car racing started off so well and has continued to flourish is the fact that these rules incorporate a maximum cost clause, which governs how much may be spent on the car and engine. This ruling acts as an encouragement to youngsters with limited finance and to everyone who wants to enjoy competitive racing without spending a great deal of money. Similar rules have been employed in Holland by the national Dutch association, Stock Car Racing Holland, which has resulted in another thriving area for stock car racing developing with an association membership of around 350; the Italians have also shown an interest in this idea.

The R.S.C.A. offers its members third party insurance, a national fixture list compiled in co-operation with its affiliated clubs throughout the country, plus a regular newsletter and recommendations of race meeting procedure. Points scored at race meetings are used to arrive at a grading system for association members following full size practice to the extent of using different roof colours to denote a driver's progress. In ascending order these are white, yellow, blue, red, red with white star and gold for the World Champion.

Many people have taken up R/C stock cars through their interest in the full size cars. Many have their own favourites whose cars they duplicate in miniature often making their own body shells and spending many hours on the paint detail.

Model stock cars have two main advantages over Formula and Sports GT R/C cars in as much as they have higher ground clearance and can therefore be run on grass and relatively rough surface; the individual can have great fun driving over 'obstacle courses'.

For organised racing a comparatively small track area is needed. An oval shape, with track length of approximately 35 to 50 yards and width of between 5 and 8 feet represents in scale the average full size stock car track. An outer fencing of



Toothed belt drive from centrifugal clutch to axle on swinging arm suspension takes care of variable loads which are inevitable in stock car racing.

Two bright Stox, with driver's names for Malcolm Ayling No. 234 and Bob Williams No. 263. Bodies are glass fibre, come in varied shapes from Mardave, Ke' Jon, Puma, etc.

wood about 6 in. high and preferably at least 1 in. thick is necessary. This has to be supported by brackets or framework and made into manageable lengths for storage and transport which can be bolted together for use. An inner boundary of some sort is also required to discourage corner cutting, this again can be wood, 2× ½ in. laid flat or rope nailed down.

During stock car races, a certain amount of contact with other competitors is allowed. The idea of being able to shadow the car in front until the next corner and then with a slight nudge on the rear bumper send him wide of the corner and then cut through on the inside to overtake—it sounds easy in theory but in practice is rather difficult and most overtaking is done on the straights or by carefully controlled use of the throttle, 'out-braking' the opposition entering corners.

Race meetings generally consist of 4 minute heats from which the top five drivers go straight through to the final. The next six compete in a consolation final, the winner of which goes through to the main 5 minute final.

Due to the cost formula of the R.S.C.A., the cars are evenly matched which results in close, exciting racing with everything depending on car preparation and the driver's skill.

If any of this has whetted your appetite for stock car racing why not contact either one of the clubs listed below or the Radio Stock Car Association. If there is no club near you why not start your own? Existing clubs would welcome fresh competition: new blood keeps the hobby thriving.

Clubs

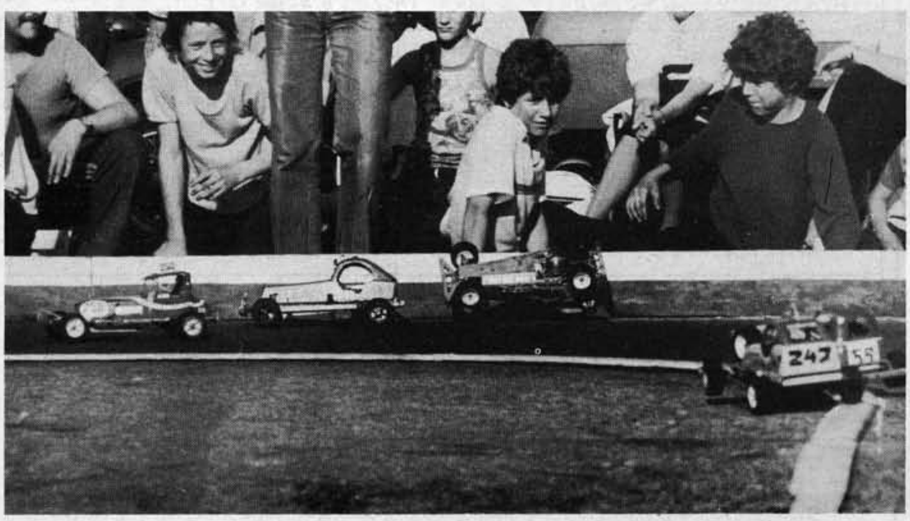
Coventry: Mr. S. Holmes, 101 Oldfield road, Coventry.
Chessington: Mr. R. Bye, 63 Heathfield South, Twickenham, Middlesex.
Craven: Mr. I. Fearnley, 3 Collange Road, Cowling, Keighley, Yorkshire.
Haywoods Heath: Mr. P. Crawley, 16 Turnermill Road, Haywoods Heath, Sussex.
Leicester: Mr. S. Busby, 72 Rosamund Avenue, Braunstone, Leicester.
Keighley: Mr. K. S. Parkin, 48 Park Road, Bingley, W. Yorkshire.

Radio Stock Car Association
Secretary: Mr. Mike Varley, 10 Briarwood Avenue, Riddlesden, Keighley, Yorks.

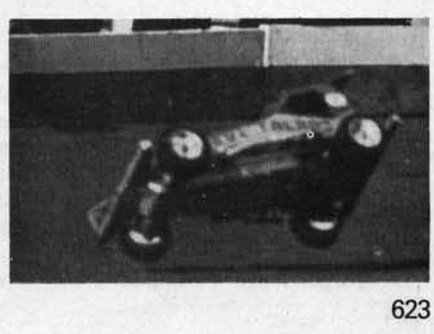
Hard drift, with the nearside front wheel clear, as the rear tyres cope with the tight turn on this leading car.

Rolls and other tumbles are part of the Stock Scene as over zealous drivers 'cook' the turns.

Action on the oval (below) at Sandown Park R/C Symposium with Steve Talbot's car doing its best to complete a roll and another short-cutting the corner.



Oops!—upside down with nothing on the clock, but the maker's name! The roof can take it, but will the engine keep going? Below, Steve Talbot 'at-it' again, showing his chassis to the sky.



More action, with Steve Talbot upright though only in contact on one wheel, and No. 34 about to circulate the wrong way around the track!

Increasing the swing of the Unimat 3

Rex Tingey describes his useful modification to this popular lathe.

Now that the Unimat SL is discontinued, it is time for a long hard look at the Unimat 3 with its complexity of limitations. The bed of the Unimat 3 is a one-piece casting of cast iron, onto one end of which the headstock is bolted, being held to its correct position by the machined front rail of the bed, which is a 90° angle, point uppermost, and also by the machined back rail of the bed, which is flat. The point of the angle is machined to a flat and fits the headstock base to give perfect location at the front; the rear of the headstock rests flat on the back rail. Fittings, such as the tailstock, have bases machined to the same configuration, with clamping plates, underneath the rails, to slide and clamp in small grooves either side. The headstock is secured hard by two screws from underneath.

It would appear that this system of quite complex fitting shapes provides limitations to any improvement work which the Unimat owner may be able to carry out and increase the versatility of this machine tool, particularly in the lathe mode. However, after a great deal of thought it occurred to me that the "puzzle" was not a solid one, but one consisting of two separate parts. That is, if the base machined to fit the lathe were to be made in two small parts, it became very simple. This is because the main parallel line-up of parts is carried out on the triangle of the front rail, the rear rail provides positive line-up of the centres in only a small way: just loosen the tailstock under-clamp and see what I mean.
Once the complexity is seen in the light of this simplification, ways can be found to make the accessories and improvements to match those of the Unimat SL. The first major improvement is to increase the swing of the lathe, which, when used in conjunction with the improved drive, can provide turning for diameters over 4 in. and up to 5 in. with confidence. The limitations then become the maximum size of material which the chucks can hold.

Cross-Section

If a diagram of the cross-section of the Unimat 3 is examined it can be readily observed that the limitation to the maximum swing is from the front top edge of the back rail as this is the point nearest to the centre line. All measurements are therefore to be made with this limiting point as a reference.

A perpendicular dropped from the point of a centre to meet a horizontal line across the bed is then 11mm from the limiting point, and the point of the centre itself is 47.5mm from the limiting point, being the hypotenuse of a right-angled triangle. If the centre point is raised 10mm vertically the 11mm remains a constant in the triangle. The hypotenuse of the new triangle formed is increased by a little under 10mm, being the increase in the radius of the swing.

Increasing the Centre Height

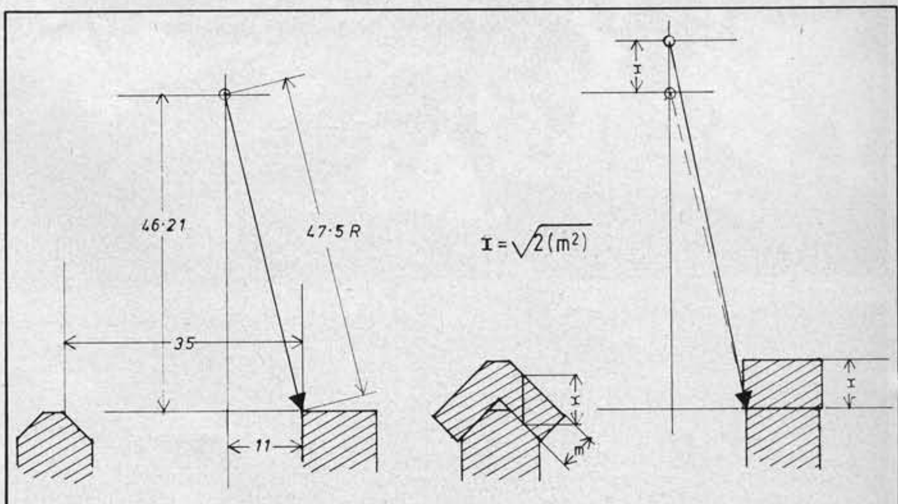
The increase of swing is obtained by increasing the centre height. First the headstock is increased with packing pieces under the front and back rails. The front packing is a piece of angle iron cut to the length of the headstock, which itself is fitted with longer securing bolts to allow for the extra thickness. The angle iron fits its angle over the angular rail, which means that the augmented height

INCREASED SWING INCHES

"m"	1/8	3/16	1/4	5/16	3/8	7/16	1/2
"x"	·177	·265	·354	·442	·530	·619	·707
new swing	4·08	4·25	4·43	4·6	4·77	4·95	5·12
"m" mm	3·18	4·76	6·35	7·94	9·53	11·11	12·7
swing mm	103	108	112	116	121	125	130

INCREASED SWING MILLIMETRES

"m"	3	4	5	6	7	8	9	10	11	12
"x"	4·24	5·66	7·07	8·49	9·9	11·31	12·73	14·14	15·56	16·97
new swing	103	106	108	111	114	117	119	122	125	128
"m" in	·118	·157	·197	·236	·276	·315	·354	·394	·433	·472
swing in	4·06	4·17	4·28	4·39	4·5	4·6	4·7	4·8	4·9	5·0



CROSS-SECTION UNIMAT 3 EXTENDED UNIMAT 3 is greater than the thickness of the angle iron, and can be calculated as a diagonal through the thickness at 45 degrees. For 12mm thick angle iron the increased height will be (by Pythagorus) 16.97mm, giving an increase in swing of 33.94mm (to 125.94mm or 4.95 in.).

The increase of height imparted to the front rail section must, of course, be balanced by packing the space between the back rail and the headstock block to the same extent as the increased height. The packing is made by milling dural flat-stock to a precise thickness, best achieved on the milling table with careful use of the vertical feed attachment. The packing block is made large enough to fill all the space and does not need to be secured except by the clamping action of the headstock screws. These screws hold the front angle in place by means of cutaways, before the screws are tightened.

The Tailstock

The tailstock is brought to the new centre height by similar means. The same angle iron material must be used so that variation in stock thickness is matched to produce an accurate result. The packing piece for the back rail to tailstock must be cut from the piece milled for the headstock. If a great deal of work is envisaged at the increased height then the back packing should be secured by a bridging piece to the tailstock or it will slide out with the constant adjustments. The front angle piece is sufficiently held by the clamping screw positioned in the cutaway.

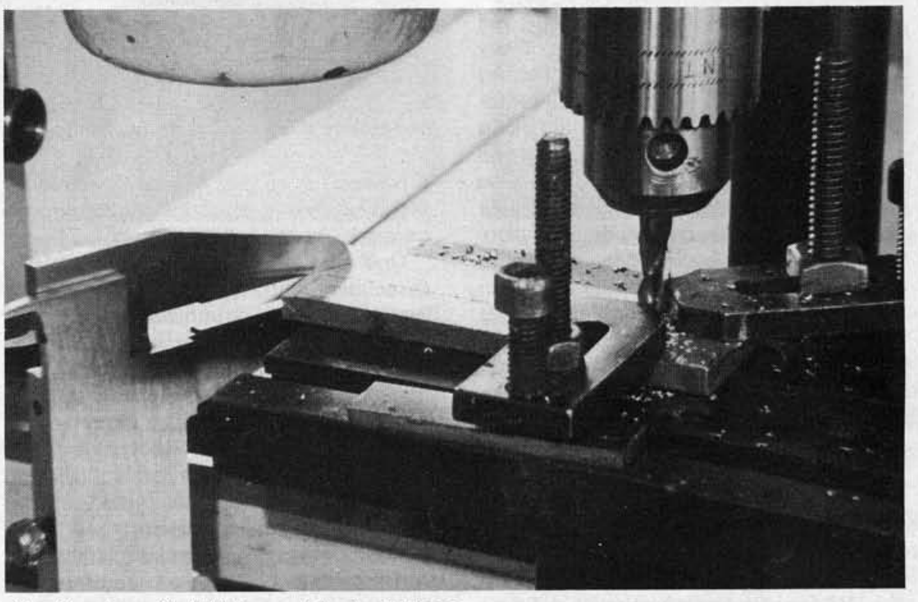
Raising Other Attachments

An extra piece of the back packing should be milled and used to bring the tool post to the new centre height whenever the increased swing is used. This block will require a hole drilled for the securing screw of the toolpost.

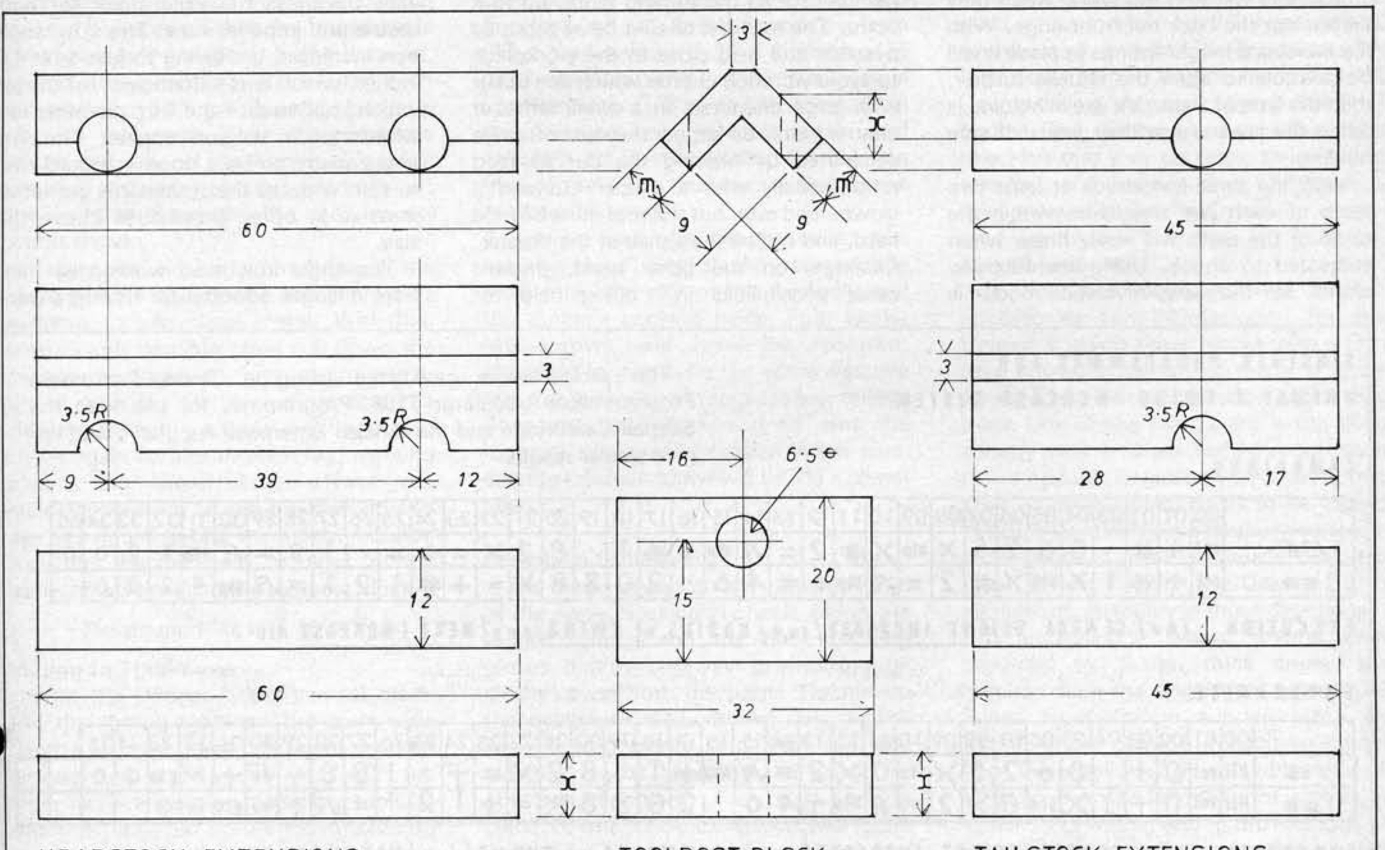
The threading attachment does not require raising to accommodate a new centre height, at least, not up to the rise given by the 6mm angle iron. This is because there is sufficient variation in the possible angles of the threading tool in the attachment not to require raising the whole. The supports of the threading attachment do tend to limit the swing unless they are taken to the extremes of the bed.

The indexing attachment, when required to be used affixed to the bed, can be brought to the new centre height with the packing pieces, and since the tailstock is not generally used in this mode, the pieces made for the tailstock can be used in this case, without having to make more.

The three point steady can be used, raised, with the raised head and tailstock, but the pass-through of the steady is only 40mm (diameter) and so workpieces of a particular type of shape, large down to small diameter, only, could utilise the



Checking the milled thickness of the back Pieces.



raised steady. Where a steady is used on larger diameters it is usually to assist on a bore from the end, and the tailstock is not brought up, so that the extension pieces for the tailstock can again be used, for the steady.

Motor Mount

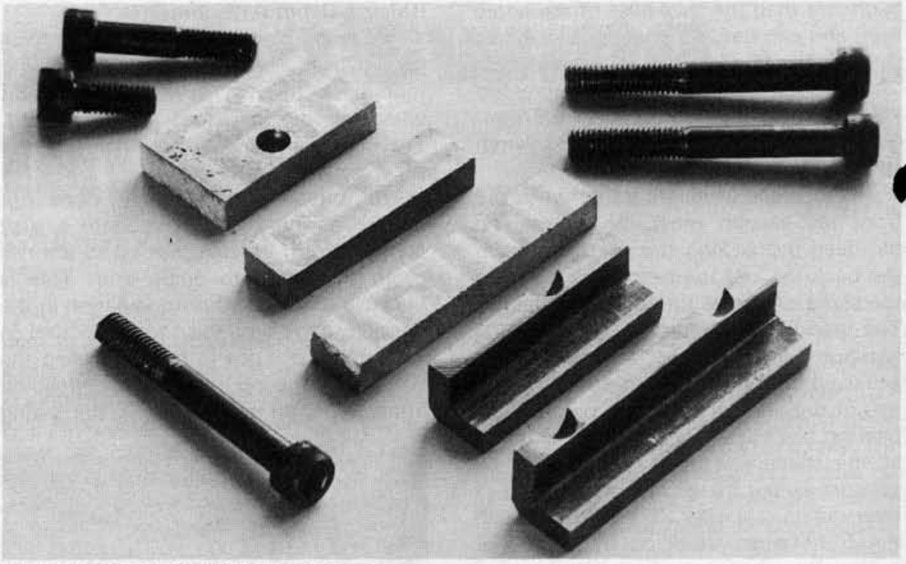
When fitting the improved drive you will have made your own motor plate, and so will have no reluctance to modify the plate. Lathe owners are often unwilling to alter standard manufacturers fittings, quite understandably, and this is a good reason why most of my modifications and accessories are self-sufficient and require no alteration to the machinery.

In the case of the increased swing it will be necessary to move the motor away from the bed, if full use of the extra swing is to be made, by filing the motor mounting holes to elipses. Before filing make sure that the flat on the side of the motor is presented correctly, to give maximum clearance. Also, move the plate around the loosened headstock plate mounting screws to get maximum clearance with the drop. Only then can the direction and amplitude of the elipses be marked in to just take the motor below the circle from the centre line, restricted by the back rail front edge. It will only be about 1.5mm, without taking it too far.

Limitations

It must be remembered that both the three-jaw and four-jaw chucks tend to limit the maximum swing of material in the Unimat lathes, because of their small size. With no increase in centre height the chuck jaws will limit the swing when they hit against the back rail front edge. With the increased height fittings in place it will be possible to open the chucks further, then the limit of a chuck's use in holding is when the jaws are at their limits of safe holding.

With the three-jaw chuck at least two teeth of each jaw should be within the scroll or the teeth will easily break when subjected to shock. Using the four-jaw chuck in the jaws-reversed mode is precarious since part of a jaw may readily break off, even when just tightening up on work.



An increased set of swing components.

One way of overcoming the problems associated with the small chuck is to design the work, or introduce an order of work, where the work is held by a small diameter, or by an internal diameter, less than the outside diameter of turning. Another way, which I have pioneered, is to secure the larger workpiece to a faceplate using cyanoacrylate adhesive on flat to flat surfaces; the workpiece can be readily removed with modest heat. This system will not suit most circumstances.

If the work is to have a bore through it is satisfactory to drill through and fit a mandrel for all the turning work, up to a point. The mandrel should be as stout as possible and held close to the workpiece to avoid vibration chatter which can occur with large diameters in a small lathe. If chatter marks do appear they can often be eliminated by altering the cut to feed ratio, usually with a deeper cut and a slower feed rate, but the tool must be held hard, and not be the cause of the chatter. Castings, on the other hand, present other possibilities in being held for turning on the small lathe, particularly with using the surplus material for the fitting of plates and pegs for the jaws of a chuck to hold, similar to using a smaller internal diameter. Care must be taken to ensure concentricity, but guide marking can be carried out, rather outside the limits of normal chuck use, by rotating the lathe spindle by hand whilst marking with a tool or scribe in the toolpost, before drilling for the fitting of the plates or pegs.

Making the Extension Blocks

I made two sets of packing blocks from $\frac{1}{8}$ in. and then $\frac{3}{16}$ in. angle iron, equivalent to 3mm and 5mm in metric material. The tables show the various increases gained with thickness of angle stock for both metric and imperial sizes. The $\frac{3}{16}$ in. angle iron increased the swing to just over 4¼ inches, which was suffiencient for the job which I had to do—the 4 in. diameter rear wheels of a traction engine. The $\frac{3}{16}$ in angle seems to be a good standard size, to start with, as the stock sizes get rather massive in other dimensions above this size.

The angle iron is all worked by hand from a length selected for having a good

SINCLAIR PROGRAMMES FOR UNIMAT 3 SWING INCREASE SYSTEM

The tables were calculated using a Texas Instrument Programmable calculator T158. Programmes for use with the Sinclair Cambridge and the Sinclair Enterprise are given, and will give similar results.

CAMBRIDGE

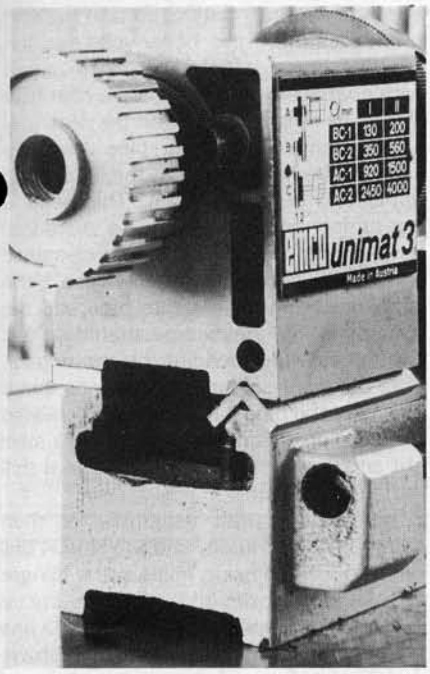
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1/16″	rcl	+	#	·	0	6	2	5	×	sto	×	#	2	=	√x	stp	+	#	1	·	8	2	×	=	+	#	·	1	9	=	√x	stp	▾	2	0	0
1mm	rcl	+	#	1	×	sto	×	#	2	=	√x	stp	+	#	4	6	·	2	0	8	8	×	=	+	#	1	2	1	=	√x	stp	▾	2	0	0	

EXECUTION run/ CENTRE HEIGHT INCREASE/run/ RADIUS of SWING/run/ NEXT INCREASE etc

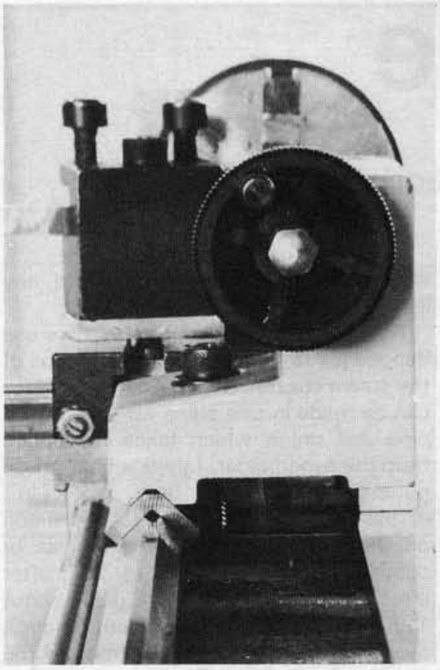
ENTERPRISE

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
1/16″	HIt	rcl	0	+	·	0	6	2	5	×	sto	0	×	2	=	√x	stp	+	1	·	8	2	×	=	+	·	1	8	8	=	√x	+	=	gto	0	0		
1mm	HIt	rcl	0	+	1	×	sto	0	×	2	=	√x	stp	+	4	6	·	2	0	8	8	×	=	+	1	2	1	=	√x	+	=	gto	0	0				

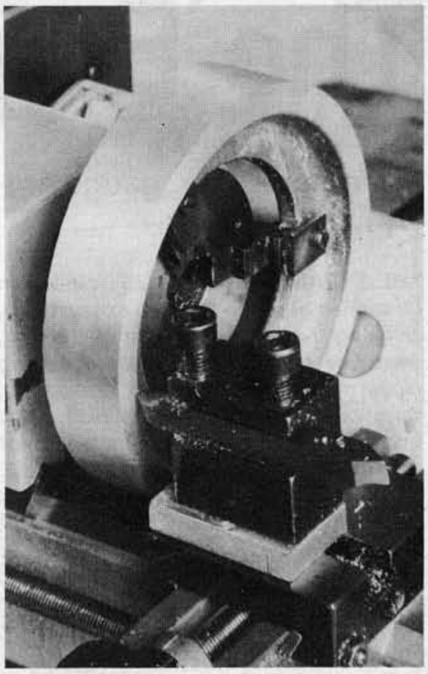
EXECUTION run/ CENTRE HEIGHT INCREASE/run/ DIAMETER of SWING/run/ NEXT INCREASE etc



The headstock fitted for the increased swing.



The tailstock fitted for the increased swing.



Turning a 4 in. diameter wheel, using the increased swing components.

90° angle, measured with an engineer's square. It may be found that one side of the angle is a little thicker than the other to the Vernier caliper or micrometer in which case the thicker leg must be kept to the front on all the packing pieces made from the material. Keeping the thicker side to the front will bring the centre line nearer to the front and away from the back rail. Discard angle iron which has a thickness discrepancy of more than 6 thou.

Whatever thickness you have chosen make the pieces so that the inside angle dimension is the same as in the drawing, letting the outside take its own dimension, which will depend upon the material thickness. Saw the pieces to length and saw off the surplus sides. File the ends and edges to a finish, and file off the point of the angle, the apex, to the width shown.

Secure an old large hand file in the clamped vice and gently rub the inside surfaces to just clean metal. With fine emery cloth on plate glass rub down the outside surfaces to just clean metal. Check with the Vernier caliper that the cleaning up has not been overdone, and check again for the thickest leg, marking it on the lower edge. Note the measurement (m) of the thickest leg and use this figure to find the height increase and thus the thickness required for the back rail increase and the toolpost block.

Height Increase = / $2(m^2)$.

Milling to Thickness

With the Unimat in the vertical mode and the milling table on the cross-slide clamp a piece of duralumin flat-stock hard by one end, and by one side, with the other end overhanging the milling table by about 4 mm, for on-the-job measuring purposes. The piece should be about 30mm by 75mm, and about 3mm overthick. The side which is down should be finished.

With a ¼ in. end mill, mill all the top surface that the clamps will allow, taking off about 1mm, and measure the thickness remaining with the Vernier caliper, after winding the slide to one end of the bed. Check that the work is not sprung, away from the milling table, with the clamping, repositioning the clamps if necessary. Bring the work back under the mill, with the cutting edge half over the back edge of the work. Switch on and fine feed the mill into the work by 1mm (10 graduations) to 1.5mm (15 graduations) and mill to leave approximately 0.2mm to be taken off in the finishing cut. Measure again and calculate the precise setting for the fine feed to make the final cut, milling to the finished thickness.

Remove and mark out the milled part for the three blocks; the rear of the headstock, the rear of the tailstock, and the toolpost packing piece. Four longer M6 screws will now be required, increased in length by the same distance and the thickness of the piece just milled. The two headstock screws and the toolpost screw will be M6 × 40mm plus, and the tailstock screw will be M6 × 35mm plus.

Fitting and Checking

File the cutaways on the unmarked legs of the angle pieces and check, fitting the longer screws and the back packing pieces, that the cutaways provide enough clearance on both the parts. Tighten up the headstock well. Oil the rails, fit the two dead centres and slide up the tailstock to the headstock to check for absolute alignment. The back packing piece of the tailstock self-retains quite well whilst the rail is newly-oiled and free from swarf, but the piece may slip out in working, and a retaining bridge could be made to be screwed to both parts. Alternatively a spring clip could be fitted to each end of the back packing piece so that no hole need be drilled in the tailstock.

Set of parts

The sets should be kept together in a polythene bag with a little oil to prevent the mild steel from rusting. Although I made two sets of these extension blocks, in all probability the smaller set will not be used as the medium set will cope with all eventualities, and provide good accuracy at the new height. If I find the need for a greater swing at some time I could, of course, use the two sets together after checking that they do retain the required stability, and keep in line. Otherwise a thicker set will have to be made.

Developments

It becomes obvious that further accessories can be designed for the Unimat 3, using these blocks with a firm base affixed to the top of them, or some similar idea. Two accessories which may make use of the blocks are a travelling steady, with a larger pass-through than the standard accessory, and a boring table, enabling boring work to be carried out unrestricted by the level of the cross-slide height. I have previously designed these accessories for the Unimat SL to increase its versatility in those directions.

If increases in swing, greater than provided by ¼ in. thick angle, are required then the angle may have to be milled from square section block as thicker angle may be difficult to obtain from the suppliers. This should provide no great problem if a little thought is given to the order of milling and to the methods of clamping the material to provide a good 90° angle.

The 'Eagle'

A simple 2 ½ in. gauge 4-4-0 Locomotive. by Martin Evans Part 9

THE STEAM AND EXHAUST pipes can be tackled now. To take the exhaust first, as being the more important of the two, there are four items to be made—two pipes made from $\frac{9}{32}$ in. o/d brass tube, thick-walled if possible, a blast pipe, made from $\frac{7}{16}$ in. square brass, and a blast pipe cap or nozzle, turned from $\frac{7}{16}$ in. dia. round brass or gunmetal. It will be seen from the drawing, that there is very little room for the two cross-pipes; they lie immediately above the steam chests and the lower, square, part of the blast pipe has to be arranged in between the two steam chests.

The blast pipe is made by chucking the square material in the 4-jaw, turning down the outside to $\frac{5}{16}$ in. dia. as shown, and threading the end $\frac{5}{16}$ in. × 40t, then drilling not deeper than $1\frac{1}{8}$ in. with $\frac{7}{32}$ in. drill (use a smaller drill first of course). Remove from the lathe and drill across the square part $\frac{7}{32}$ in. dia., tapping right through ¼ in. × 40t, then run the $\frac{7}{32}$ in. drill down from the top, to break into the tapped cross-hole. Try the blast pipe between the steam chests, and if necessary file it a bit narrower until it is an easy fit between.

Next, make the two cross-pipes, from $\frac{9}{32}$ in. thick-walled brass tube (18 SWG minimum). If this size is hard to obtain, use solid brass rod, and drill it out with No. 15 drill. Both ends are then reduced to ¼ in. dia. and threaded × 40t. Finally, make the cap or nozzle. Although the internal shape of this, shown on my drawing, would need a special short reamer, which could be home-made quite easily, this is not by any means essential. The shape could be left as drilled, using a series of drills from $\frac{9}{32}$ in. dia. in steps downwards to about $\frac{9}{64}$ in. dia., finally, reaming right through $\frac{1}{8}$ in. dia. The properly reamed "cone" is however slightly more efficient.

To assemble the exhaust, screw the two cross-pipes as far as they will go (meeting in the middle), with a taste of Plumber's jointing on the threads, slacken off the bolts holding one of the cylinders, so as to ease the whole cylinder group away from the frames just enough to allow the exhaust assembly to be slipped into place, start to screw one of the cross-pipes into the cylinder that has not been slackened, bolt up the other cylinder again, and screw the second cross-pipe into it. Note that the threads on the cross-pipes should be on the tight side—easily obtained by having the screwing die opened out a little. This is because we can only screw these pipes into the tapped holes in the cylinders by a bare $\frac{1}{8}$ in. and although they are only subjected to exhaust pressure, we can't afford any leakage here.

Now for the steam pipes. Here we use flanged joints, bolted down to the tops of the steam chests. The central "tee" piece can be made in one piece with the steam pipe and union which takes the steam from the superheater. I think it best to use gunmetal or bronze bar here, $\frac{5}{16}$ in. × $\frac{5}{8}$ in., as this will take the thread for the union on the upper end better than brass or copper, while not difficult to bend after annealing. But first chuck a piece about $1\frac{5}{8}$ in. long in the 4-jaw, with enough overhanging to permit the turning of the ¼ in. dia. and $\frac{5}{16}$ in. dia. parts. Support the outer end by centring and bringing up the tailstock with its centre. Having successfully turned the outside, drill $\frac{3}{32}$ in. dia., then follow up with $\frac{5}{32}$ in. drill, thread the outside of the $\frac{5}{16}$ in. dia. part × 32t. Be careful when drilling not to go right through, about 1¼ in. will be sufficient, as the hole can be completed after we have drilled the cross-hole, this is drilled $\frac{3}{16}$ in. dia. right through. For the cross-pipe, use a single piece of $\frac{3}{16}$ in. brass tube, around 22 SWG thick, pushed through so as to lie central and silver-soldered using the minimum of solder. Now run the $\frac{5}{32}$ in. drill down from the top, to break into the $\frac{3}{16}$ in. tube. Clear out any swarf.

Next, drill a $\frac{5}{32}$ in. hole from the front, and tap this $\frac{3}{32}$ in. hole from the front, and tap this $\frac{3}{16}$ in. × 40t. This is to take the connection from the lubricator. The two flanges can be filed up from brass bar about $\frac{3}{8}$ in. × $\frac{5}{16}$ in. or if this size is not available, use $\frac{3}{8}$ in. square. Use the 4-jaw chuck again to machine the surface that is to be bolted to the steam chest, as we cannot afford any leakage here.

To silver solder the two flanges to the cross-pipe, a simple jig is almost essential. All we need is a slab of steel about 1 in. × ¼ in. section, with two holes of $\frac{5}{32}$ in. dia. drilled the same distance apart as the holes in the steam chests on our locomotive (check this from the job, with care). Drill the $\frac{5}{32}$ in. dia. holes in the two flanges, then the $\frac{3}{16}$ in. hole at the sides, to take the cross-pipes, followed by the two bolting holes No. 34. Locate each flange on the jig by slipping tiny stubs of $\frac{5}{32}$ in. dia. rod into the holes in the jig, of such a length that they protrude about $\frac{1}{8}$ in. The steam pipe/cross pipe is now assembled between the two flanges, the pipe entering the flanges by about $\frac{1}{16}$ in. on each side. The joints can then be silver-soldered, using the minimum of Easyflo. It is of course essential that the metal, where it is desired the solder shall flow, be absolutely clean—put the parts in the acid pickle used for the boiler jobs for ten minutes or so, after giving them a rub with coarse emery cloth, then a neat fillet should be obtained all round the joint.

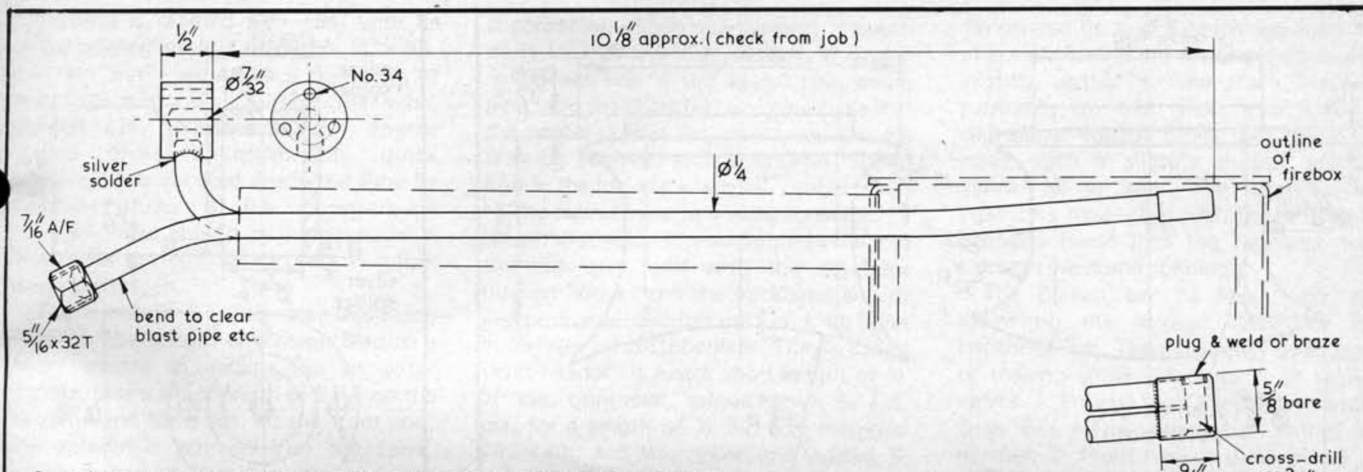
The completed steam pipe assembly can now be removed from the jig and the upper end bent as shown. This bend is not critical and should not be overdone. Its only purpose is to give more clearance for the connection between the superheater and the steam pipe and the blast pipe. The steam pipe should be soft enough to allow bending by the fingers, after the silver-soldering operations, but if not, heat the pipe just below the threaded top end, protecting this thread by a steel nut screwed on to it. Heat just to a dull red, then quench.

The steam pipe assembly is then assembled in position, and the No. 34 drill run through the fixing holes in the flanges to make countersinks on the steam chests, which are then drilled No. 43 and tapped 6 BA. Use slips of oiled brown paper as gaskets.

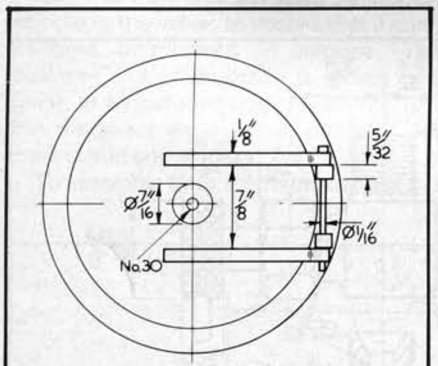
For the lubricator connection, a length of $\frac{3}{16}$ in. dia. brass rod is threaded × 40t, leaving the threads a bit oversize. It is drilled through $\frac{3}{32}$ in. dia. If screwed into the steam "tee" tightly, Plumber's jointing should keep it steam tight, but if there is any doubt about this, the joint can be soldered with "Comsol" (high-melting-point soft solder).

We can make the lubricator next. This is a very simple displacement type. Its action is as follows: It is filled with oil about ⅔ full. Steam enters at the top, above the oil and condenses. Water being heavier than the oil, it sinks to the bottom, pushing the oil up until it reaches the outlet, when it gains access to the steam "tee" and thence to the cylinders. I won't pretend that displacement lubricators are particularly efficient, and some builders may prefer to tackle a full-blooded mechanical type (they can be obtained from most Trade houses at quite moderate prices). However, for a simple model such as *Eagle*, the lubricator shown should suffice.

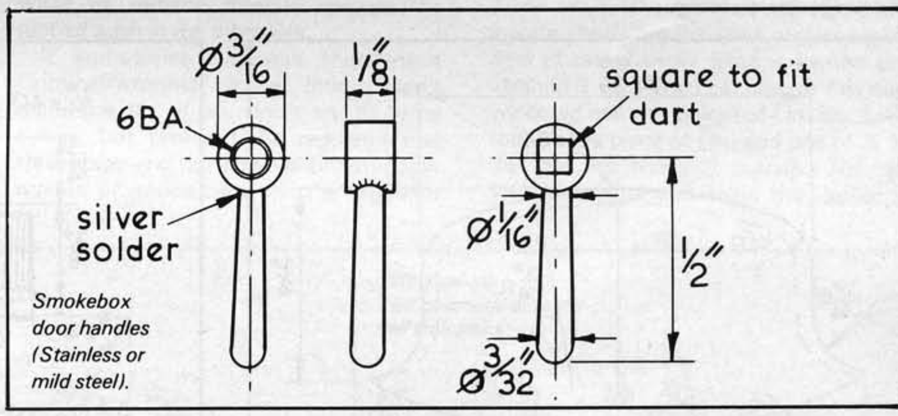
The basis of the lubricator is a short length of $\frac{5}{8}$ in. × 18 SWG brass tube, with ends silver-soldered in as shown (as the inside is subject to full steam pressure). At the bottom, a simple drain valve is made by filing a flat on the end of the screw, but here again, the threads of this screw (4 BA) should be on the tight side, near the top of the lubricator, a little turned fitting is silver-soldered in. This has a fine jet of No. 58 drill size at one end, the other end being drilled about $\frac{3}{32}$ in. dia. and the outside threaded $\frac{3}{16}$ in. × 40t. To join the lubricator to the pipe fitted to the steam "tee", a simple connector is used, made from ¼ in. brass hexagon. It is tapped right through $\frac{3}{16}$ in. × 40t. This is screwed right home on to the threaded pipe on the "tee", using jointing again, the lubricator is then applied hard up to the pipe, and the connector run back half way. To make doubly sure of steam-tightness, two little



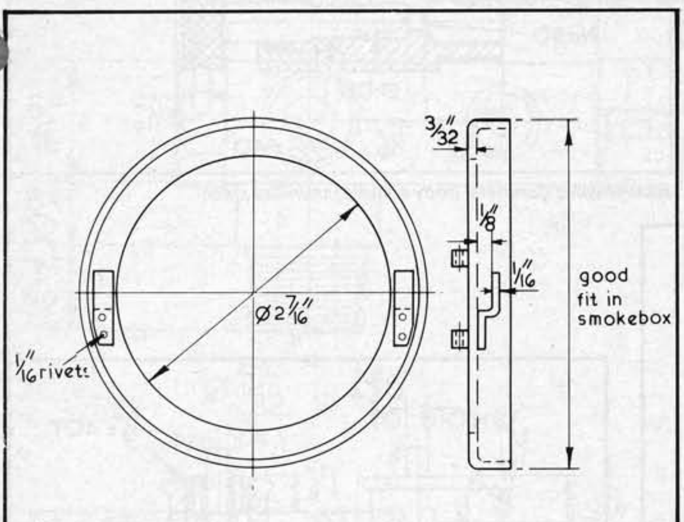
Superheater: Stainless steel preferred, but copper or mild steel may be used.



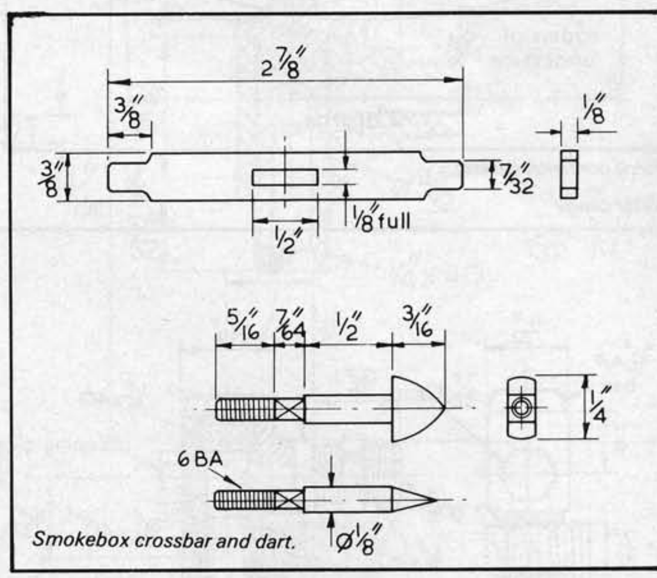
Door details



Smokebox door handles (Stainless or mild steel).



Smokebox front



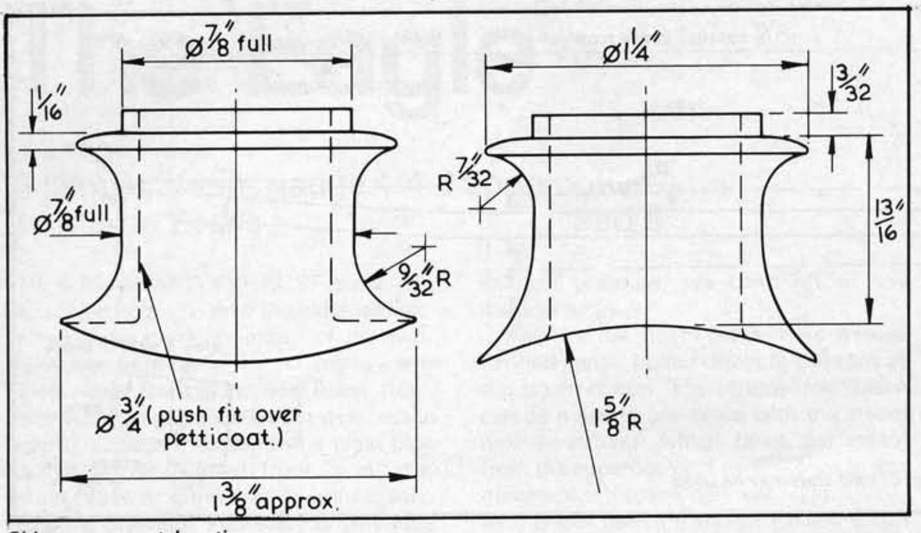
Smokebox crossbar and dart.

nuts, tapped $\frac{3}{16}$ in. × 40, can be made up and fitted, one on each side of the connector. There is just room for this with the dimensions give.

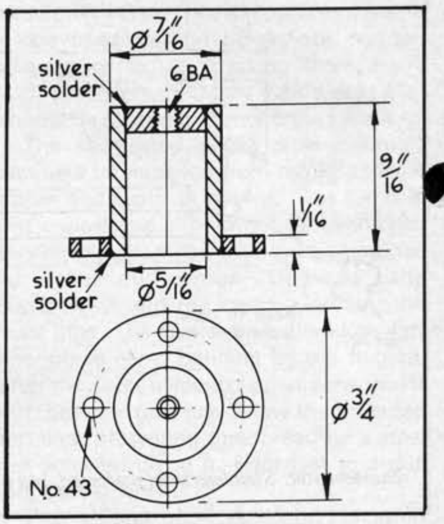
Now for the superheater. Stainless steel is much the best material to use here, but it is rather more difficult to bend and to braze than copper, so copper may be used if preferred. It will give a reasonable life, especially if not too thin, ¼ in. o/d × 22 SWG is about right if in stainless steel, but if copper, make it 18 or 20 SWG. At the firebox end, a solid flat piece of the same metal is used for the "return bend". This is best made from a short piece of $\frac{5}{8}$ in × $\frac{5}{16}$ in. or the nearest larger obtainable. Drill the two holes for the ¼ in. dia. superheater elements, as close together as possible without danger of the holes running into one another, then drill a cross-hole in one side, near the far end, tap this ¼ in. × 40, and screw in a thin plug, not so long that it blocks the steam-way. Braze the joints, using something of higher melting point than Easyflo. (Johnson Matthey's "B.6" would do nicely).

For attachment to the boiler, we need a short length of ¾ in. dia. gunmetal or bronze. This is drilled as shown, and one end of the superheater is silver-soldered into this (Easyflo No. 2 here). At the other end, a large nut, threaded internally to suit the steam pipe, forms the "male" part of the union, connecting the superheater to the steam pipe.

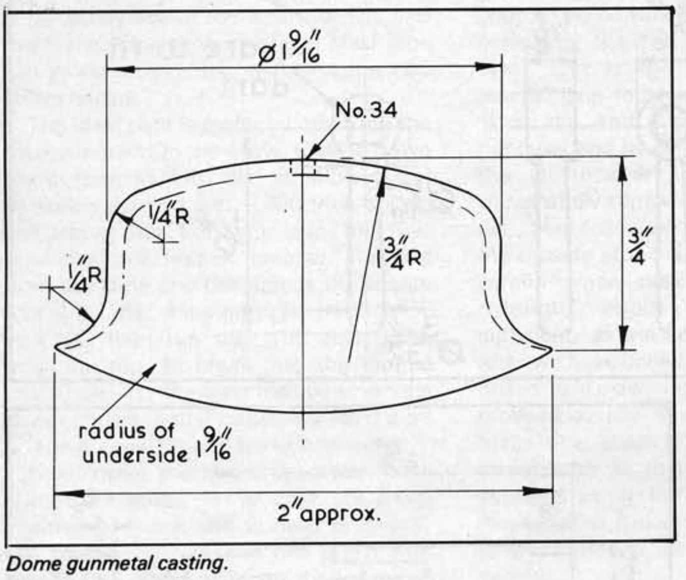
Before we can erect the superheater however, we must make the regulator. The regulator is about as simple as one can make it, subject to good performance. It is really just a glorified screw-down valve inside a long tube. This is cut from $\frac{5}{8}$ in. × 18 SWG brass tube. The flanged fitting at the backhead end is fitted with a packed gland. The fixing holes around its periphery can be jig-drilled from the steel washer made up earlier for the boiler test. At the front end,



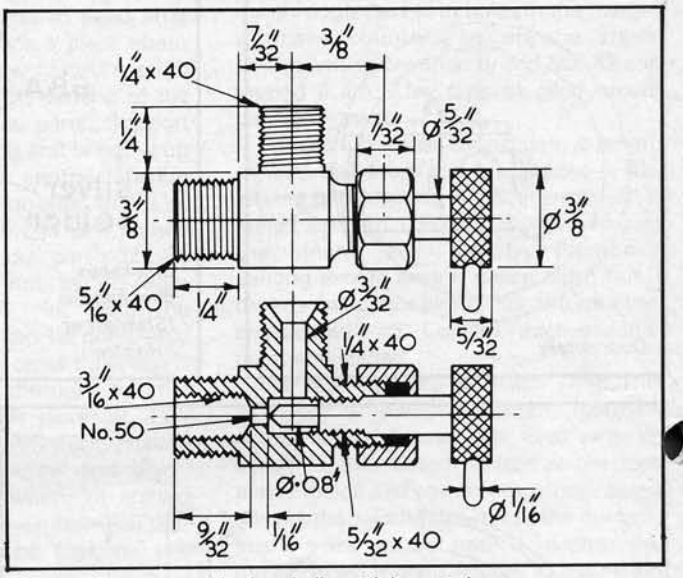
Chimney gunmetal casting.



Inner dome Brass.

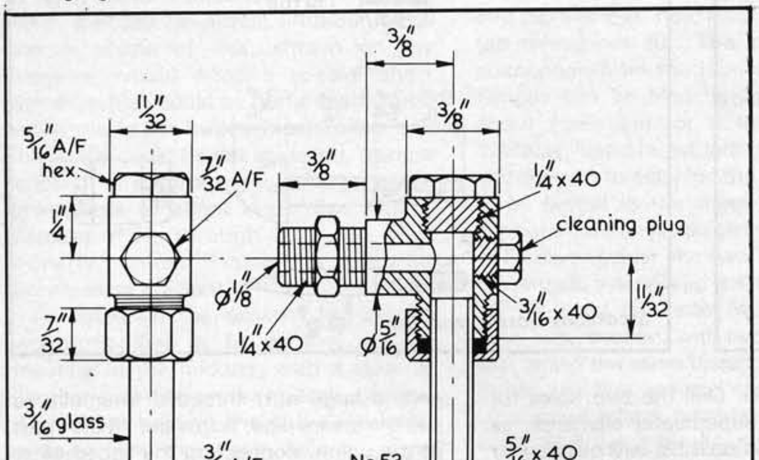


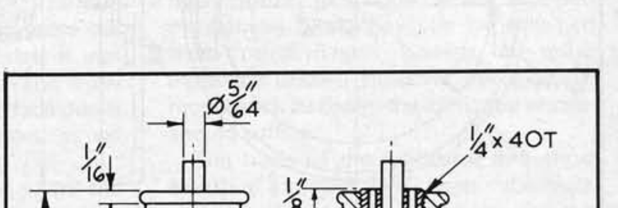
Dome gunmetal casting.



Blower valve gunmetal body spindle: stainless steel.

Water gauge





Safety valve gunmetal or brass. Ball stainless steel.

the fitting is reamed $\frac{5}{32}$ in. dia. with its outlet opened out and tapped ¼ in. × 40t. For the "nut", we use a $\frac{5}{16}$ in. length of gunmetal a good fit inside the tube, tapped $\frac{3}{8}$ in. Whitworth—the coarse thread gives a reasonably quick opening—it is secured inside the tube by two or three 8 BA countersunk screws—these should be home-made in bronze for preference, as brass is rather weak for this job.

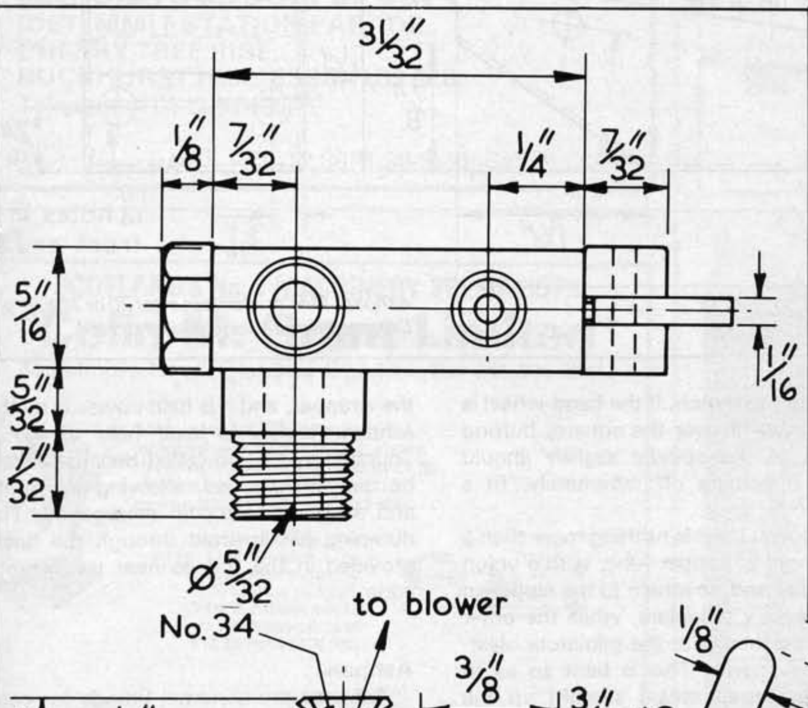
The spindle is $\frac{5}{32}$ in. dia. stainless steel, its outer (backhead) end being filed to a short square to accept the regulator handle, plus a short length of 6 BA on the extreme end for a nut. At the front end, the spindle is screwed into the valve, which is turned from $\frac{3}{8}$ in. dia. stainless steel or bronze and threaded $\frac{3}{8}$ in. Whit. to match the nut. It is advisable to pin the spindle in the valve, to ensure that it can't become unscrewed in service. The business end of the valve is turned to a point, at an included angle of about 110°, but the exact angle is not critical if the cone is true and smooth.

To assemble both the regulator and the superheater, all we need now is a length of ¼ in. × 20 SWG brass tube, threaded × 40t each end, to act as the main steam pipe, and the short piece of pipe to collect the steam inside the dome, which will later be screwed into a suitable tapped hole in the top of the regulator tube.

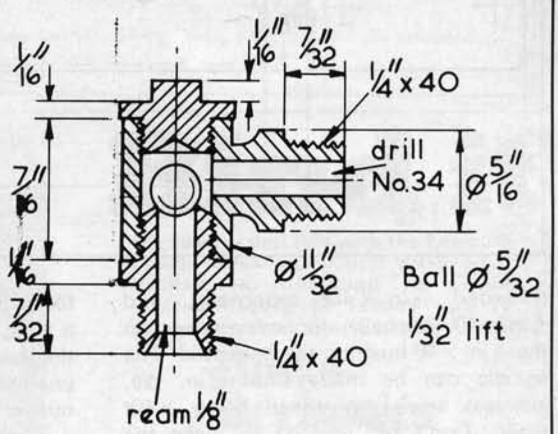
The main steam pipe must be of such a length that when screwed right home into the regulator, and with the regulator pushed home from the backhead end, it just protrudes through the $\frac{3}{8}$ in. × 40t bush in the smokebox tubeplate. The so-called "wet-header" is just a short length of ¾ in. dia. gunmetal, turned down to $\frac{3}{8}$ in. dia. for a length of ¼ in., and threaded $\frac{3}{8}$ in. × 40t, and also drilled and tapped ¼ in. × 40. This is then screwed home, engaging the end of the main steam pipe, while its outside threads engage the tapped bush in the tubeplate.

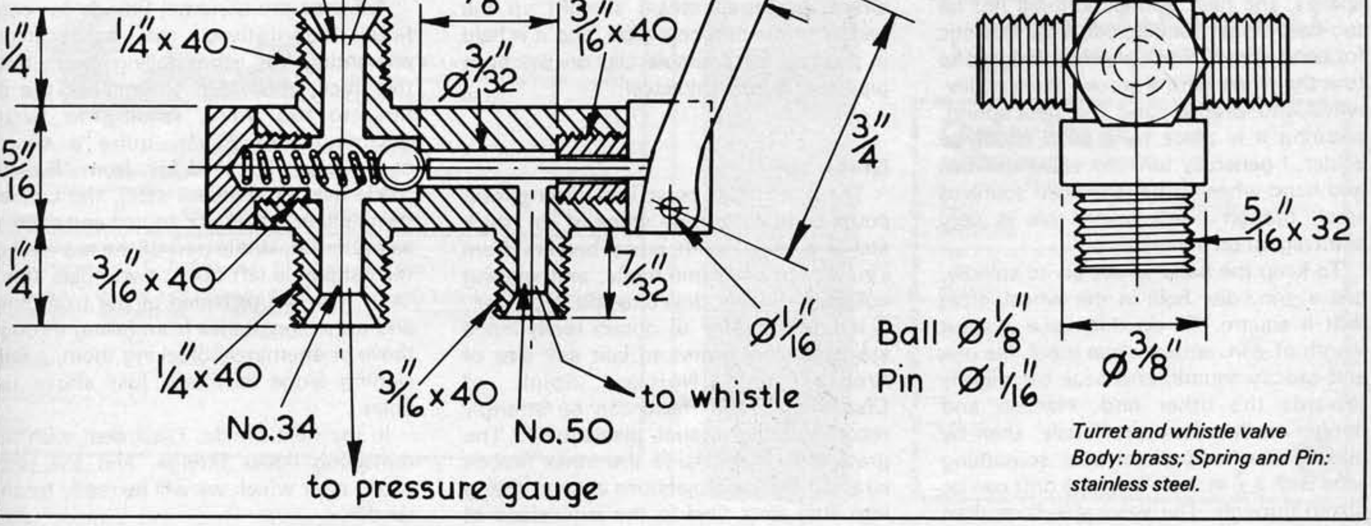
It sometimes happens that these "internal/external" thread fittings don't quite line up. If so, don't try to force things, but take out the regulator and steam pipe and put an oiled brown paper washer or gasket between the regulator flange and its bush, which will have the effect of moving the whole assembly very slightly further to the rear. This will probably do the trick, enabling the threads to engage easily, but if not, try again with a slightly thicker washer. When all is well, the short steam collecting pipe—$\frac{3}{16}$ in. dia. brass tube—is screwed home into the regulator tube through the dome opening.

The Blower can be fitted next, but make up the blower valve for the backhead first. There are really three ways of making small valves such as blower valves. 1. Entirely from the solid, in which case $\frac{5}{8}$ in. × $\frac{3}{8}$ in. brass bar would be needed. 2. From two or three pieces of bar silver-soldered together. 3. From a casting. Method 1. would call for mainly 4-jaw work, though the end result is a square "body" to the valve, unless a good deal of rather tricky filing is carried out. Method 2. is a practical one; in this case we could use two pieces of $\frac{3}{8}$ in. dia. brass rod, or one piece of $\frac{3}{8}$ in. and one of ¼ in. dia. for the (vertical) branch. The end which is screwed into the boiler is

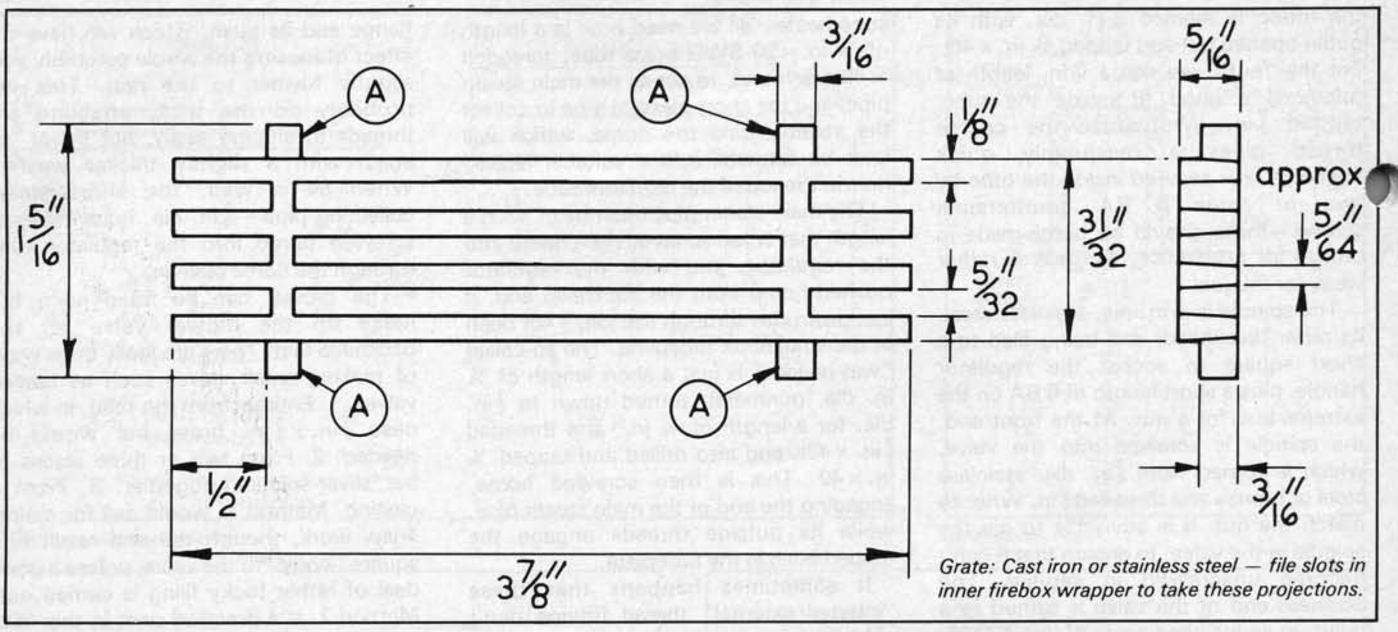


Safety valves
2 off gunmetal or brass
Ball stainless steel.

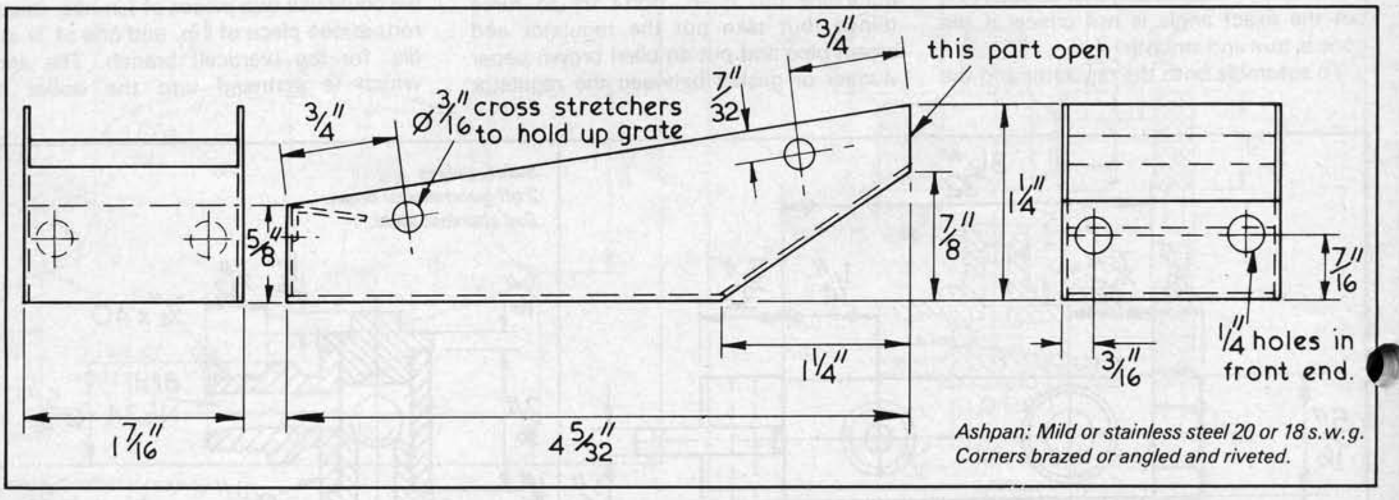




Turret and whistle valve
Body: brass; Spring and Pin: stainless steel.



Grate: Cast iron or stainless steel — file slots in inner firebox wrapper to take these projections.



Ashpan: Mild or stainless steel 20 or 18 s.w.g. Corners brazed or angled and riveted.

threaded $\frac{5}{16}$ in. × 40t externally, and $\frac{3}{16}$ in. × 40 internally, for screwing on to the $\frac{3}{16}$ in. × 40 bush on the backhead. The spindle can be made from $\frac{5}{32}$ in. dia. stainless steel, the thread being × 40t again. Don't be tempted to make the handwheel from brass or gunmetal, as these metals conduct the heat from the boiler too readily, leading to burnt fingers. Mild steel is better in this respect, and if the wheel is made with four quite thin spokes, the heat conduction will not be too bad. Some builders use a hard plastic for handwheels, while another dodge is to turn the wheel with a groove like a pulley-wheel and wrap around it a steel spring, securing it in place by a bead of silver-solder. I generally turn my valve spindles and hand-wheels from the solid stainless steel, though I will admit this is very extravagant on material!

To keep the hand-wheel on its spindle, drill a $\frac{3}{32}$ in. dia. hole in the wheel, then drift it square. To do this, take a short length of $\frac{3}{32}$ in. square silver-steel, file one end exactly square, and back off slightly towards the other end. Harden and temper as described previously, then by placing the hand-wheel over something solid with a $\frac{5}{32}$ in. hole in it, the drift can be driven through. The valve spindle is then filed square to match. If the hand-wheel is a light press fit over the square, burring the end of the spindle slightly should prevent it coming off; alternately, fit a nut.

The blower itself is nothing more than a short length of copper tube, with a union at the inner end, to attach to the nipple on the smokebox tubeplate, while the other end is furnished with the miniature blast-nozzle as shown. This is bent so as to direct the jet of steam straight up the middle of the petticoat pipe, and it is held in position by a simple clip on the blast pipe, made from thin steel.

Grate

The grate could be an iron casting, or it could be built up from strips of $\frac{1}{8}$ in. thick stainless steel, with cross bearers from $\frac{1}{8}$ in. dia. of the same metal, and spacing collars $\frac{5}{32}$ in. long, drilled to suit. However, it is now possible to obtain ready-made stainless steel grates to suit any size of firebox from Norman Spink of Chesterfield, and these can be strongly recommended (usual disclaimer). The grate is located inside the inner firebox wrapper by the projections shown, fitting into little slots filed in the extensions of the wrapper, and it is held upwards by the ashpan, which is itself held up by a "dumping pin", so-called because it can be quickly removed, allowing the grate and ashpan to drop in emergency. The dumping pin is fitted through the holes provided in the frames near the bottom edge.

Ashpan

Ashpans are essential fittings for coal-fired locomotives, as apart from preventing hot ashes falling direct onto the track, they help to equalise the air flow to the grate, leading to better steaming. For *Eagle*, quite a simple construction is called for, from 18 or 20 SWG mild or stainless steel, the corners being either brazed, or angled and riveted, as preferred. While part of the rear end of the ashpan is left open, two holes about ¼ in. dia. are provided at the front end, and to prevent ashes from falling through these or alternately blocking them, a little sloping ledge is fitted, just above the holes.

In my next article, I will deal with the remaining boiler fittings, and the plate work, after which we will be ready for the tender.

SHOP GUIDE

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GENERAL

Mr. C. Archer & Cleveland Meccano hope to meet all Meccano enthusiasts at The North Eastern Meccano Society's 4th Annual Exhibition held on Saturday, November 17th, 1979 at the Bondgate hall, Darlington, Co. Durham, 11.00 a.m.-9.00 p.m. I