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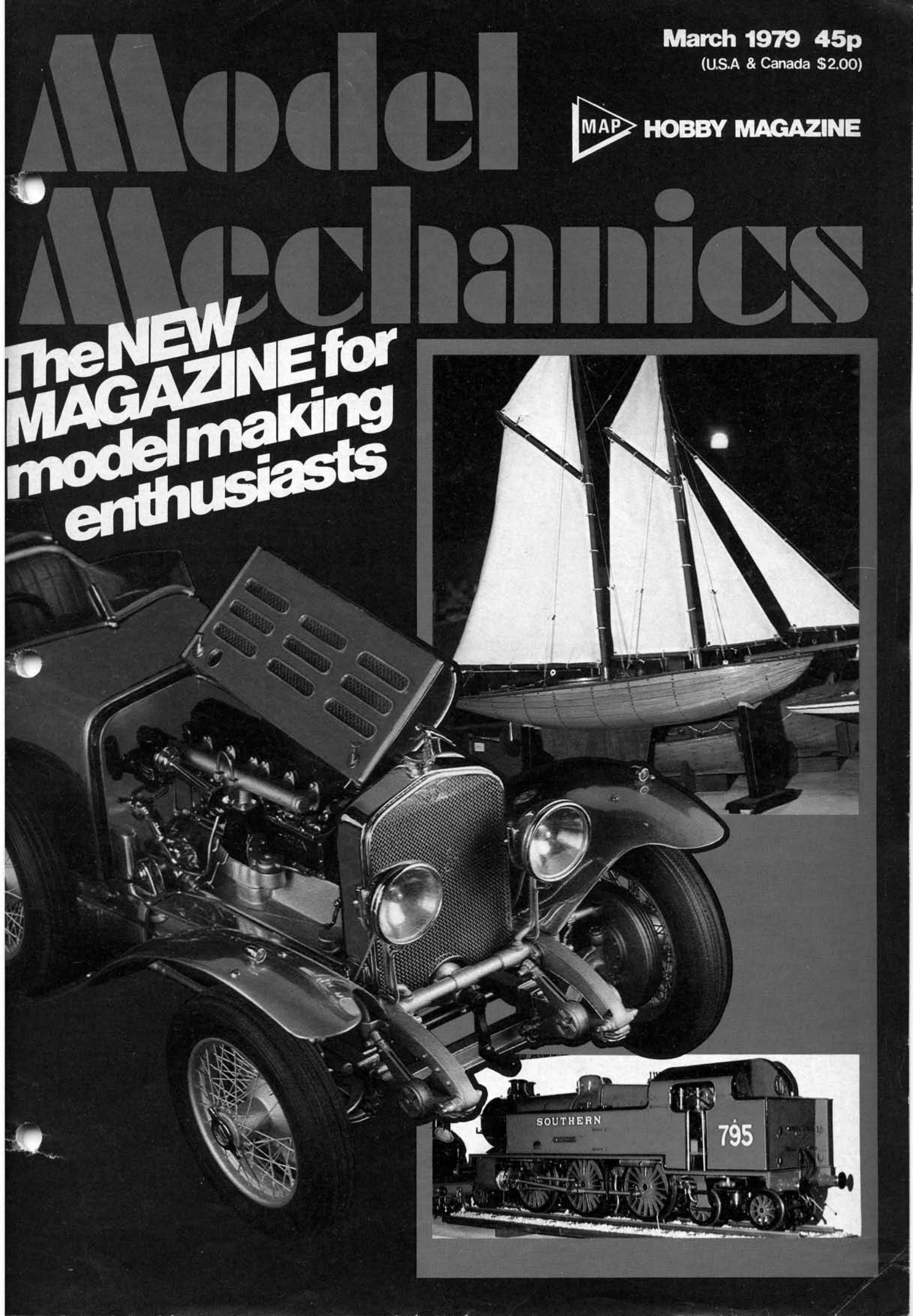
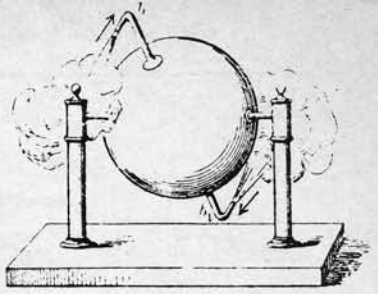
Model Mechanics

MAP HOBBY MAGAZINE

The NEW MAGAZINE for model making enthusiasts



Building a replica of Hero's Engine



The Eolipile.

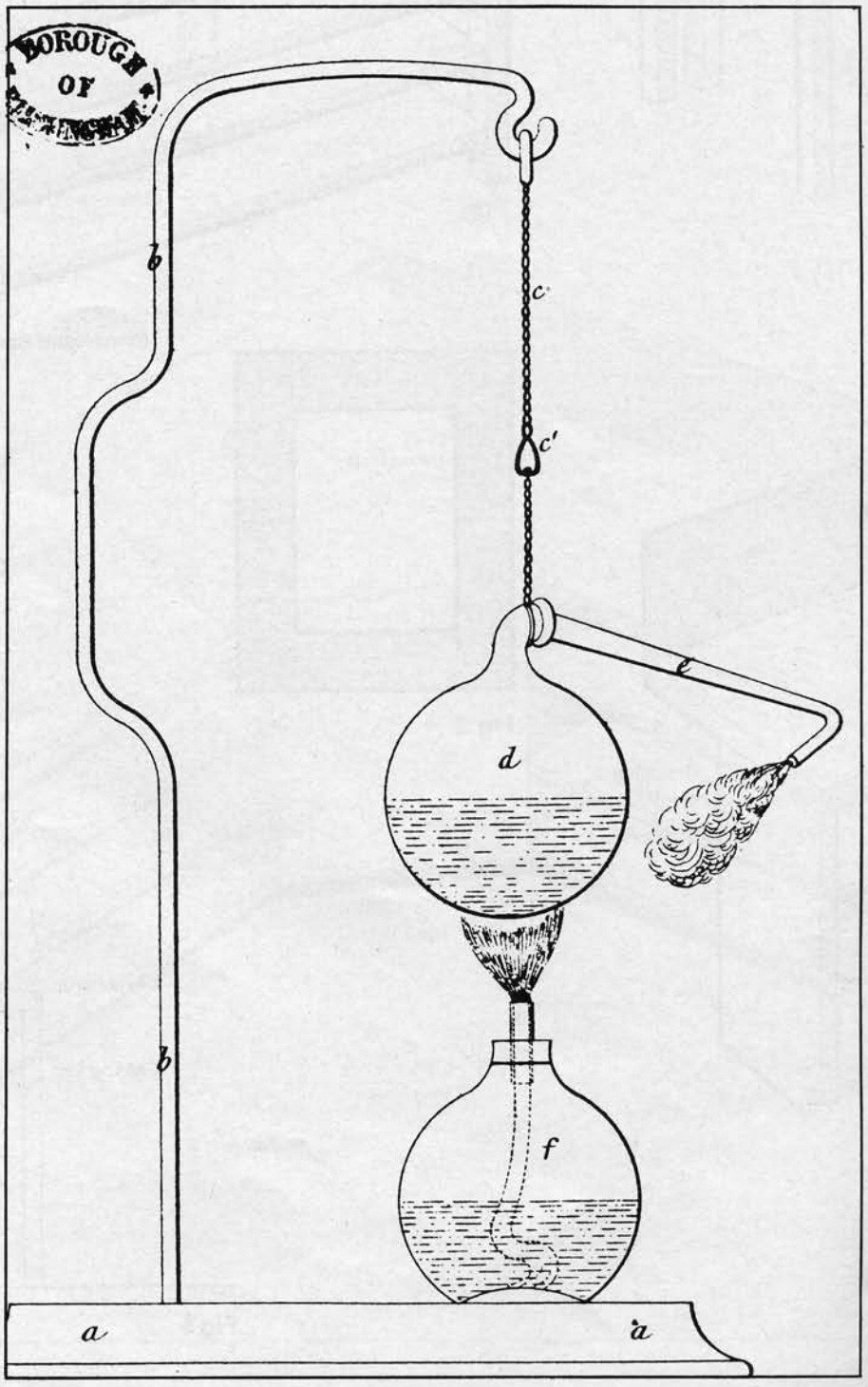
by Basil Harley

ONE OF MY INTERESTS is collecting early steam driven toys and, whilst many are now rare and of great charm, unfortunately the oldest of them all is not collectable since it no longer exists. This was Hero's Engine, the archetype reaction steam turbine known by reputation or illustration to every student of mechanical engineering — at least, it was in my student days. So this month I am going to describe the construction of the working replica shown in the heading picture which anyone with a small lathe and some metalworking experience can make. I shall not be giving very detailed step by step instructions to be slavishly followed, rather I shall tell how I made my version and leave plenty of scope for individual ideas and experiments.

Hero, or Heron, was a Greek philosopher who flourished in Alexandria about the end of the first century AD so its not surprising that none of his artifacts has survived. His ingenuity produced a number of fire operated 'toys' which intrigued and impressed not only his contemporaries but generations of people ever since. As well as his famous steam engine, his inventions included a machine' for automatically opening temple doors when the altar fire was lit. According to traditional descriptions the former consisted of a boiler with two vertical supports on the top between which could rotate a small copper sphere. One of the supports was hollow and conveyed steam from the boiler, via the bearing, to the sphere from which it issued from two diametrically-opposed jets tangential to the axis. Thus the ball spun round by the reaction to the emerging steam. A good model of this is on display at the Science Museum, London.

How Hero made a steam-tight joint nearly 2000 years ago without excessive friction I don't know and many of the later versions (and they have been legion) avoided the problem, as I have done, by making the sphere itself the boiler. The engine was often called an Aeolipile — literally *'A Sphere of the Winds'* and I have taken for my model the 19th century version illustrated in a book of elementary mechanics shown in Fig 1. There were many others, some made of glass (two of which I have in my collection) and some were even patented. Fig 2 shows the drawing from Charles Sutton's Patent No 2901 dated 1866. In the early days patent examination and search was pretty superficial, so the fact that Hero had priority wasn't really bothered about. Even so, it's quite astonishing that it was considered worth the trouble and expense to cover the idea; a note on the drawing indicated that the original was partly coloured too. Blue water and pink spirits, perhaps! A fairly recent example was made about twelve years ago, partly of plastic and with an aluminium sphere, by Triang-Lionel who sold it as a kit of parts to be made up at home.

Our starting point will be the copper sphere and for this there exists the very thing, ready made, in the form of a copper ball from a domestic ballcock. The standard size is about 4½in in diameter and it should be possible to find a perfectly satisfactory used one in your



local plumbers/builders' yard. The bigger ironmongers and plumbers' suppliers will be able to provide a new one if necessary for something just over £1.50 but be sure to get a copper one — some modern ones for loos are now made of plastic.

A threaded socket will be found to be soldered on the ball and this needs removing with the help of a gas torch or the like taking care not to get the ball hot so that the solder holding the two hemisphers together melts. Then, particularly if it is a secondhand one, it will need cleaning. For this, one of the new proprietory cleaners or a few hours in a mixture of vinegar and salt should make a good impression and a wire scratchbrush will help too.

Now the first thing to be done is to mark out and drill four holes in the ball, two for the shaft on which it will spin and two for the jets tube. Whilst we are not making a precision instrument it is necessary to have a reasonably well balanced ball that will not be visibly eccentric when running. I marked the holes for the spindle by using the lathe as follows. The three chuck jaws (perhaps reversed, it depends on its size) are opened widely so that the ball, when offered up to them, is supported equally between them. The tailstock centre is brought up so that, when the lathe is pulled round by hand (do *not* switch the motor on) the joint at the 'equator' revolves without wobbling. A pointer fixed in the toolholder will help here as indicated in Fig 3 (a). A number of adjustments to the ball and the position of the tailstock centre will have to be made before it is right. Then, with care force the centre reasonably hard into the copper and you will have a 'centre mark'. This can then be drilled 1/8in dia. later to be opened out to 1/4inch. The other hole is marked and drilled in exactly the same way except that the chuck is removed, a headstock centre put in to locate the already drilled hole and the tailstock centre again used to mark the second hole.

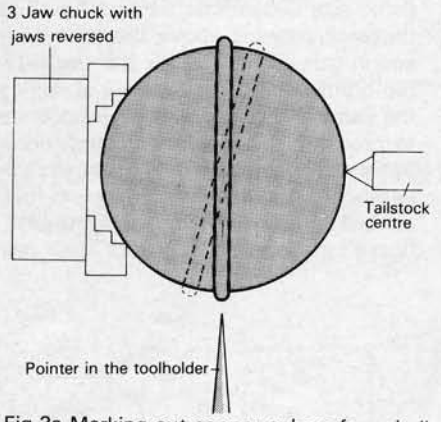


Fig 3a Marking out copper sphere for spindle

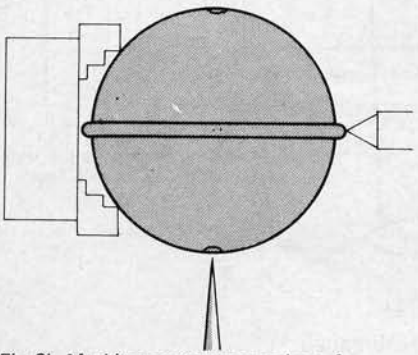


Fig 3b Marking out copper sphere for steam jets tube

The two 3/16in holes for the jets tube are marked out on the equator joint in the same way, the fixed pointer in this case ensuring that the two spindle holes already drilled are at 90° to the jet axis as shown in Fig 3 (b).

It is perfectly possible to make use of a Lyles Golden Syrup tin instead of the copper ball but it does not look very elegant. In this case the jets tube goes through the tin half way up and the pivot spindle through the centre of the lid and the bottom. But do use a ball if you can. Whichever you use, a 5in length of 1/4in dia. brass rod forms the spindle, each end being faced and centred in the lathe with a standard Slocumbe centring drill — 1/16in is a suitable size.

The jets tube is a 7½in length of 3/16in dia. copper tube (or 5/32in would do if you have suitable taps and dies). The steam must be collected near the centre of the ball since the circumference will be covered by a layer of boiling water held by centrifugal force when the engine is running at full speed. It is best then, to make the jets from a single tube with the centre filed away to allow the steam to emerge. First chuck the tube in the lathe and, preferably with a tailstock dieholder, thread 3/16in × 40 tpi for about 1/4in on each end for the nozzles. Copper is a 'sticky' metal to machine and the use of paraffin as a cutting lubricant will make the threads come clean. Now mark the centre of the tube and file a flat about 1 inch wide as shown in Fig 4, cleaning out the holes on either side to leave no swarf to block the jets. Since the projecting parts of the tube will later have to be bent tangentially, about 1½in at each end must be fully annealed. This is done by heating to red in a gas flame and then cooling — either quickly or slowly, it doesn't matter which — in just the same way that the copper pop-pop tube was softened for the launch *Daisy* which I described last month.

Now is a good time to make the nozzles themselves since they will protect the now rather soft threads on the tube during the bending operation. Fig 5 shows that these are turned, drilled and tapped 3/16in × 40 tpi from a length of 1/4in brass rod — either round or, if you have it in stock, hexagonal. There is room for some experiment about the actual jet size but a useful start is to make them about the size of a domestic pin. The

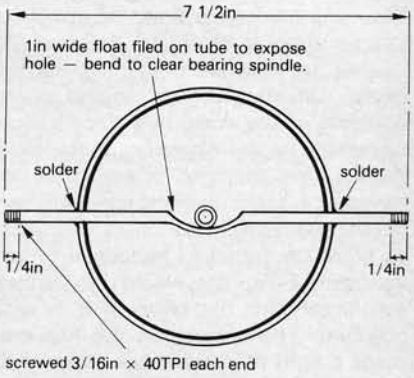


Fig 4 Jets tube 3/16in dia copper 1 off

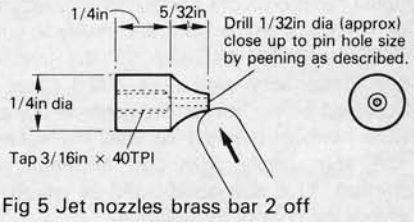


Fig 5 Jet nozzles brass bar 2 off

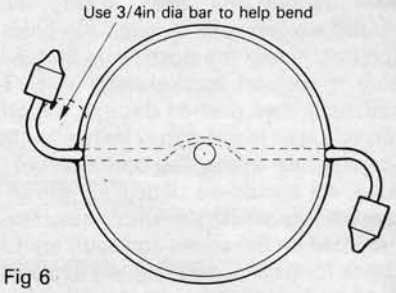


Fig 6

difficulty here is that drills of this size are not easily obtained and are naturally very fragile. A rough and ready method that I have used successfully is to shape the nozzle as shown, drill with the smallest drill available, 1/32in preferably and certainly not larger than 1/16in. Then, with the rounded and polished end of a piece of steel held in the toolholder at centre height and with the lathe running at top speed this hole can be 'pushed' or 'spun' till it is virtually closed up. To size it, an ordinary domestic pin from the sewing box is put in for the final push. Since the nozzles can be unscrewed when the engine is finished the same technique can be used to alter the size of the jets should this be desirable. One or two attempts may have to be made to get a good pair of matching nozzles.

Two ornamental pillars are needed to act as pivot supports for the sphere, mounted on a suitable baseboard; mine is a piece of oak 8in by 5½in by 1in thick but almost any piece will do. It will look better if neatly chamfered on the top edges and the corners. If the pillars are made now

they will be ready to hold the ball for balancing before it is soldered up. Hardly any dimensions are critical and much can be left to individual ingenuity in their design. Much also will depend on the contents of the scrap box since it is not necessary to use expensive materials. In Fig 7 I have sketched pillars made from lenghts of 3/4in diameter steel electrical conduit with mild steel bases and finials, all of which material I happened to have available. Solid bar would be perfectly satisfactory for the pillars if it is easily acquired. The spigots on the bases are made a tight fit in the tubes as are those on the finials. All can be Loctited or soft soldered together before being finally polished on the lathe. Holes for fixing screws in the bases are drilled and tapped — say 1/4in × 40 TPI and similarly the holes for the pivots are drilled and tapped in the pillars any small fine threads to suit; 3/16in × 40 TPI as used for the nozzles would do very well. The fixed pivot is screwed home firmly, the other is adjustable (with a locknut) so that the sphere can spin freely with the minimum of friction. This is a good point at which to check the sphere for balance.

First, tin the jets tube and the spindle where they will go through the ball, and also tin round the holes in the ball itself. Copper and brass are among the easiest metals to join by soft soldering but only after careful and clean tinning. Now thread the jets tube through the holes in the ball, screw the nozzles on and make sure it projects equally each side. The spindle is then pushed through the other holes; a little juggling may be needed here to get it clear of the filed centre part of the tube. All should be tight enough not to move easily whilst the whole assembly is mounted on the pivots and spun round to check for balance. Having got it as nearly right as possible by pushing the tube to one side or the other solder it in position without moving it and then similarly solder the spindle in place. This is best done with a small gas torch, using only as much solder as is necessary to make sound, steamtight joints. If you have some form of compressed air, even a tyre pump will do, put a finger over one end of the tube and blow down the other whilst immersing the lot in water. Any bubbles will show where holes are still to be sealed with solder.

To complete your *Sphere of the Winds* bend the tube where it comes out tangentially, as shown in Fig 6 taking care not to produce kinks. A 3/4in diam bar will help to get a nice curve and if it is a little too stiff for the fingers or a piece of wood to manage, a short length of tube slipped over the nozzles can act as a lever. Do make sure they both point in the right direction!

It was the inefficiency of these engines that prevented them from ever having much practical use though attempts were made early in the 19th century to drive circular saws by huge versions needing great fires. Our version, too, needs a fair amount of heat and the twin burner methylated spirit lamp shown in Fig.8 is necessary to provide enough steam. The lamp shown on the contents page is an early vapourising burner from a German Marklin steam plant which I happened to have available. It gives enough heat to run the engine at about 100 rpm for something like ten minutes. The lamp described here will do much the same.

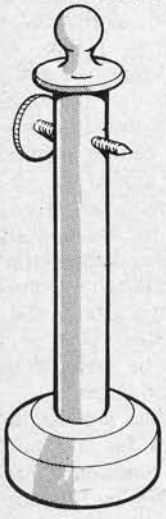
I have designed it to give adequate heat without flaring and in such a way that the ball will be heated as evenly as possible. The jet tubes spin round between the burners so the steam won't blow the flames out. There is no reason why a small tin box should not be adapted if something suitable can be found. On the other hand it won't take long to make up the one illustrated from a flattened sheet of tinplate which can be got from any fruit or soup can. Mark out with a scriber on the unpainted side and cut to shape with a pair of tinsmith's snips or a stout (old) pair of scissors. To make a good job of the bends use a wooden block, cut to the inside dimensions and bend up the sides sharply. The corners are soft soldered and it will be found a great help to have four pieces of wire 3/4in long (lengths from a galvanised wire coat hanger are ideal) to act as fillets and strengtheners in the corners.

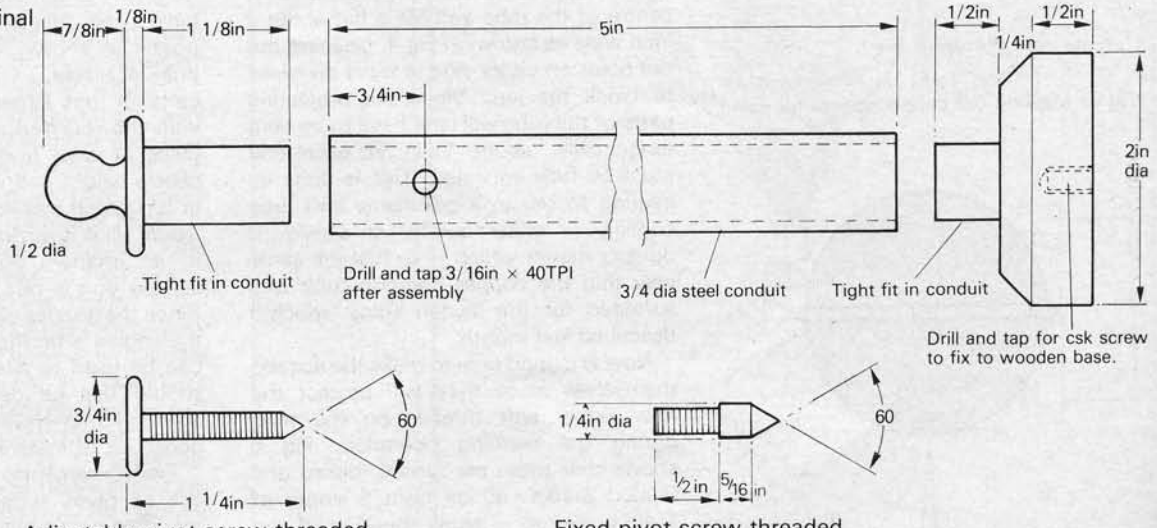
The lid is cut out and bent up in exactly the same way with the holes drilled for the filler bush and the burner tubes. This is made fractionally bigger all round so that it can be fitted and soldered over the box. The burner tubes can be short lengths of brass tube or, since this is getting increasingly expensive, there is no reason why pieces of the tinplate should not be rolled round a bit of wooden dowel of the right diameter and soldered in.

A proper filler bush and plug should be made from a short length of 3/8in brass bar as sketched in Fig 8, a simple enough turning, drilling and screwing operation. Don't forget to drill a small hole for ventilation in the plug otherwise the lamp will not burn properly as the spirit is consumed. It is a good idea to fill the lamp with water to check that it doesn't leak before putting the spirit in.

The burner tubes should now be packed with lengths of cotton wick, still obtainable at ironmongers' shops, particularly the rather older fashioned ones to be found in country towns. The flame size depends in part on how high the wick projects above the tube outlet and in part on how tightly it is packed — too tightly will inhibit the flow of spirit to the flame. I have not thought it necessary to provide a handle for the lamp nor to fasten it down in any way to the baseboard. Vibration should be very low if the ball is well balanced, and in any case it doesn't go very fast. A coat of black paint

Fig 7 Base column final — mild steel





Adjustable pivot screw threaded 3/16in × 40TPI brass or M.S. 1 off

Fixed pivot screw threaded 3/16in × 40TPI brass or M.S. 1 off

will help the appearance of the lamp, and the bases of the pillars too, perhaps. With everything else polished quite an attractive model will result.

Running the engine is obviously perfectly easy — put water in the 'boiler', meths in the lamp and wait for the kettle to boil. By those more familiar with conventional model engines however, two questions might be asked. How *do* you fill the ball and where is the safety valve? You fill it by putting one nozzle in a cup of water and sucking through the other. This ensures without doubt that *both* jets are clear — if either is blocked then no water can get in and no steam can be produced. For this reason a conventional safety valve is not necessary. Working pressure with the lamp shown and two pinhole jets is unlikely to exceed 8/10 psi. On hydraulic test the ball in the photograph withstood I didn't test it to destruction since it was the only one I had at the time. It is often forgotten that simple methylated spirit lamps don't generate enough heat to raise boiler pressures to very high values.

Don't put more than a coffee cup full of water in otherwise it will take a long time to boil and will in any case be very sluggish. Once steam starts fizzing out of the jets a slight push will start it spinning. If steam stops coming out, remove the lamp because this will mean that all the water has boiled away and some of the solder might melt. It is a very interesting 'toy' to possess, will attract a lot of attention and you will be surprised how many of your friends will prove to be unacquainted with Newton's third law of motion.

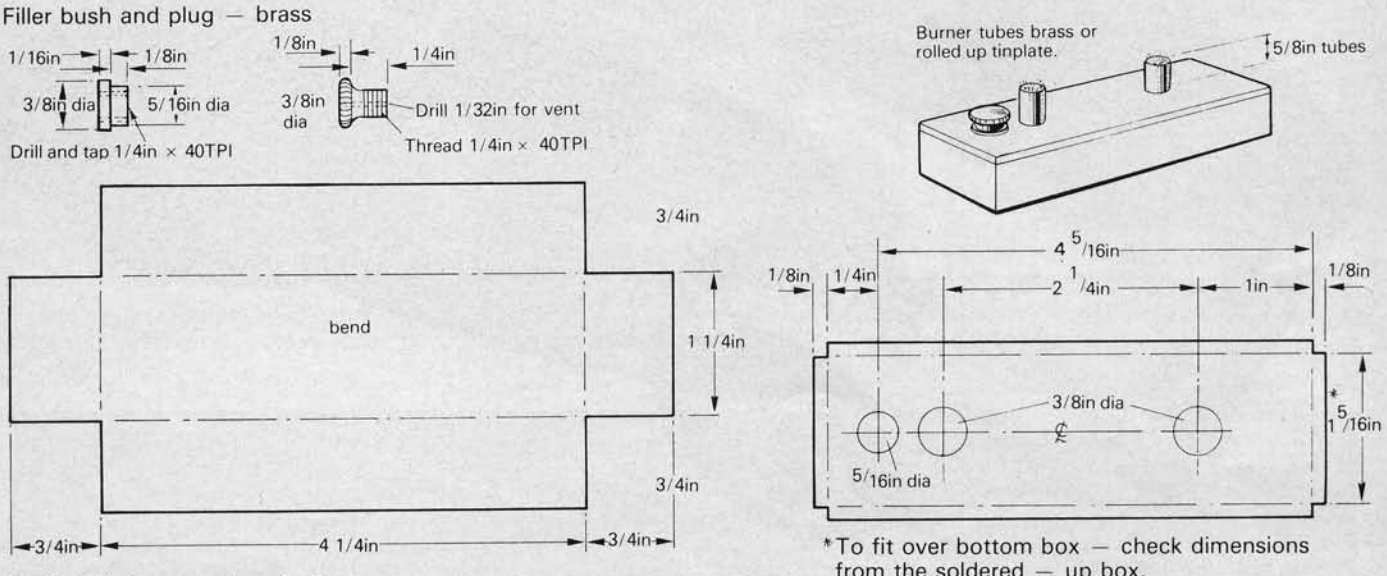
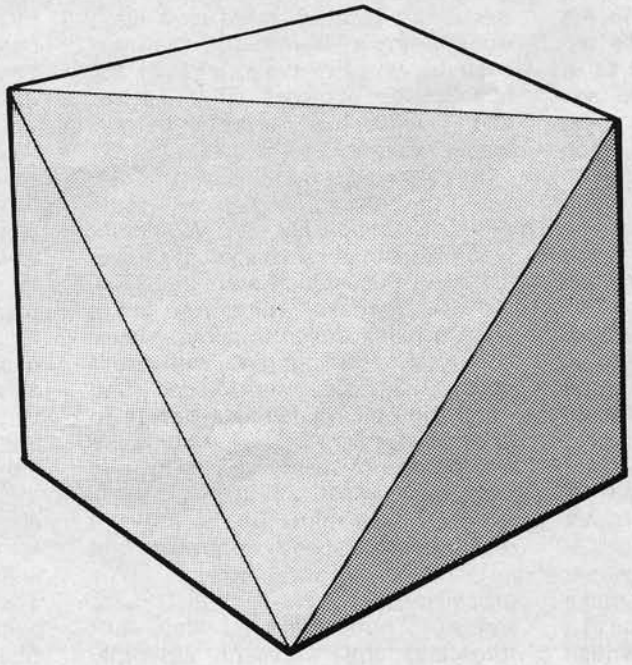
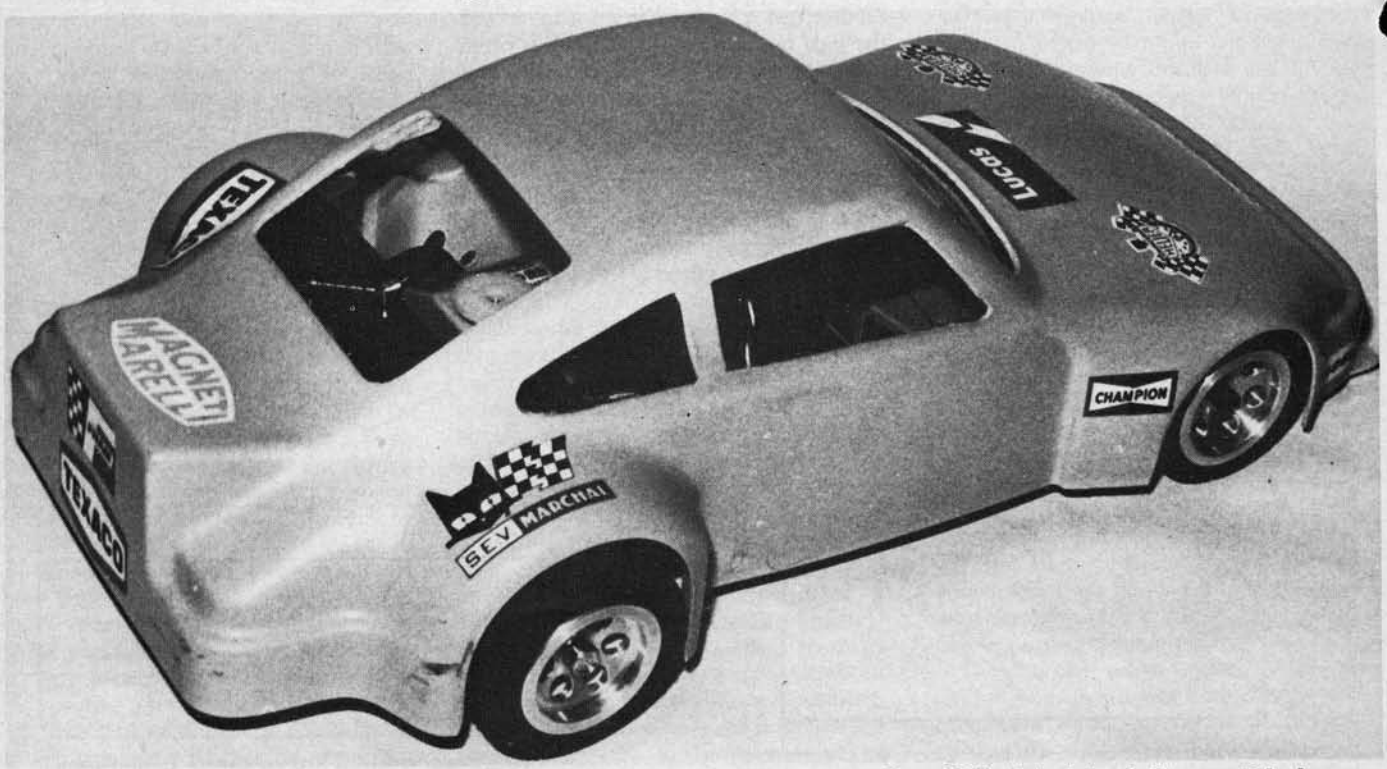


Fig 8 Spirit lamp tinplate 1 off

Solution to last month's Third Angle Projection task



Electric R/C Car Racing



Typical body on Mardave car

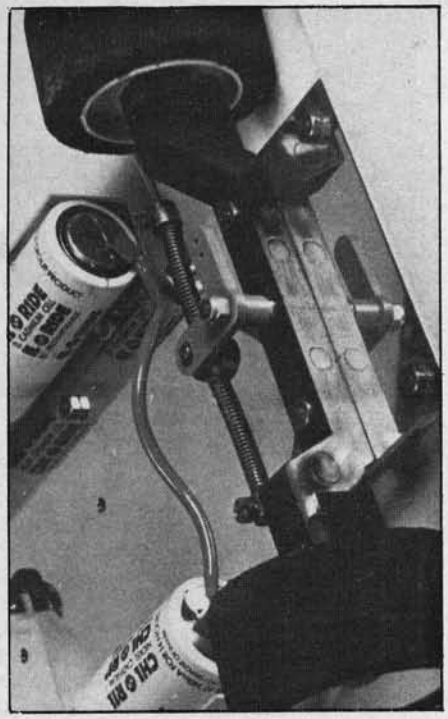
by 'Dickie' Laidlaw-Dickson

ONE OF THE DIFFERENT things about 1/12th scale electric r/c car racing is that you can race in practically any medium-sized hall with a smooth floor, a gymnasium, a school hall, a ballroom, a drill hall, indeed any place with enough room for a couple of badminton courts. Another thing is that racing takes place for the most part in the mid-week evenings when halls are not quite so much in demand as at weekends. Where to go and see some racing must be the next thought. Your local model shop should be able to help here with information. If there is no club racing in the immediate vicinity then this is the focal spot to get it started plus the help of the local newspaper. Failing this drop a line to Tony Devenport, 200 Windmill Road, Coventry CV6 7BE who is secretary of the newly formed Electric R/C Car Racing Association which will be handling affairs, hopefully in affiliation with the British Radio Car Association.

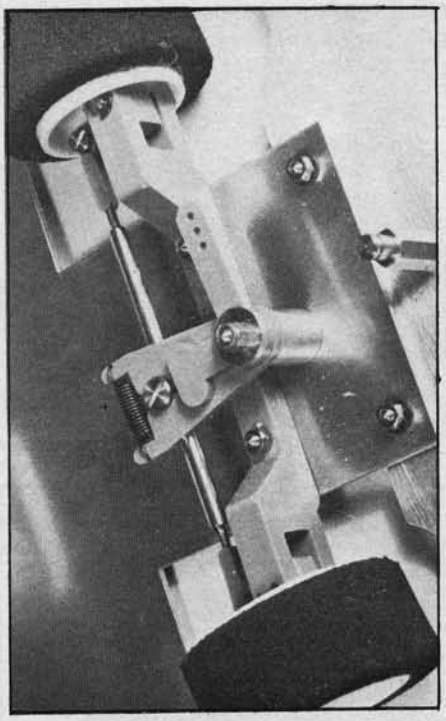
But very many would-be racers will have already seen the sport in operation at the Model Engineer Exhibition and will be eager to make a start themselves. At the momment there is a choice of three British made kits: Mardave, Lectricar and Spectron. Imported kits include Bo-Link, Associated, Jerobee, M.R.P. which all come from U.S.A., though they will have acquired a few Japanese parts *en route*. Indeed all the motors currently in use are of Japanese origin. More expert modellers may feel an urge to produce their own design car but this is not recommended as a start, since in any event most of the parts such as wheels, tyres, motors will have to be acquired commercially, and you will have a better bargain buying a complete kit.

All the cars mentioned perform well, though some demand more skilful handling. For the beginner I would recommend one of the lower priced outfits, which start at £37.50 for the Mardave. Here you get a chassis ready drilled in alloy, wheels and tyres, steering gear with cross beam, kingpins, stub axles and track rods plus a fail-safe device to protect your servo. Then there is the electric motor with spur gear and main gear wheel, about 5:1 ratio, a set of ni-cad batteries, which are rechargeable, speed controller and a choice of body, plus miscellaneious connecting rods, screws, nuts and bolts, not forgetting the excellent assembly instructions. In addition, recharging leads are supplied for you to plug into a 12 volt accumulator to re-charge your batteries on the spot. This enables you to race for a whole evening, since you need twenty minutes re-charge to get ten minutes racing, which may well be just about the time between your various turns to race. The Mardave by the way has both forward *and* reverse speeds — very useful to the beginner who may be running into obstructions more frequently than the expert.

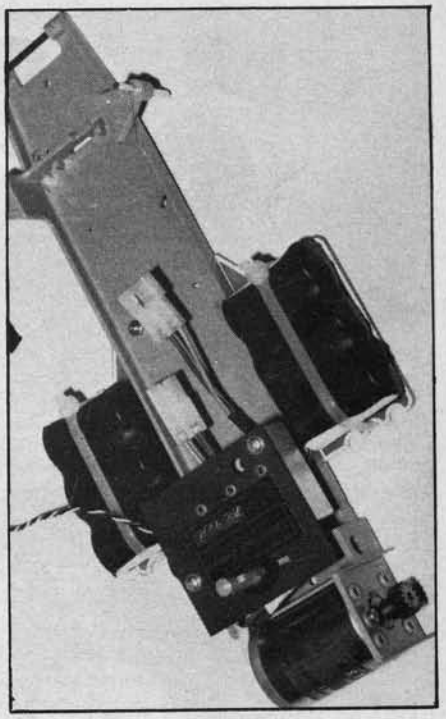
Your body — there is a choice of several makes — can be either formula or Sports/GT and is supplied with the kit. You will have to cut out the openings for windows (in case of sports cars) and glaze them, and paint up the car as you fancy. It will be in ABS which can be painted with an aerosol spray such as you buy for touching up a full-size car. Decals to add colour and interest can be bought in sheets, either waterslide or self adhesive. More expensive Lexan bodies can also be obtained in a wide variety of styles but require to be painted with enamels or Lexan approved paints. They are painted on the inside, being transparent and are stronger. Ready painted bodies can also be obtained.



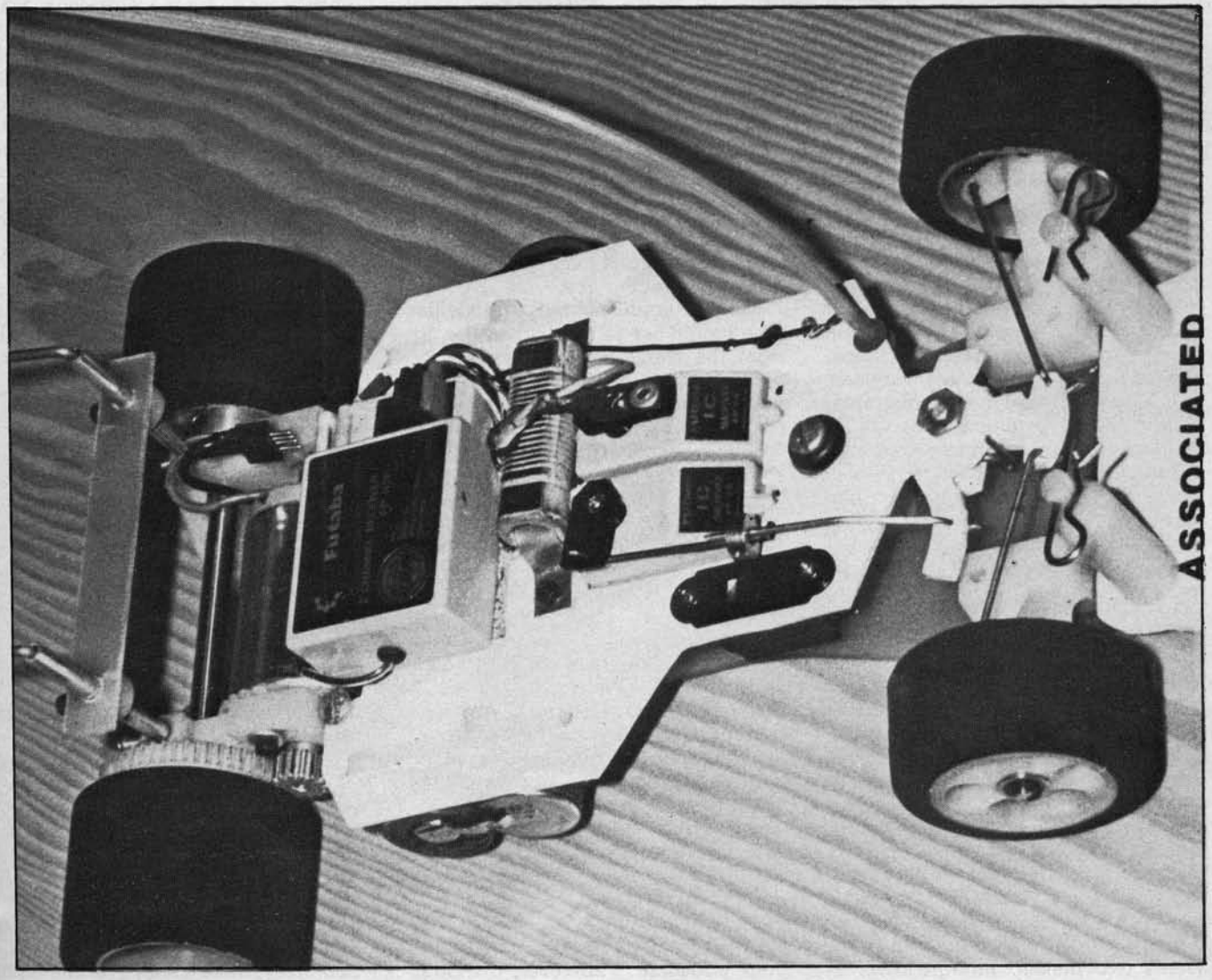
Steering on Mardave car with self centering springing which can be adjusted.



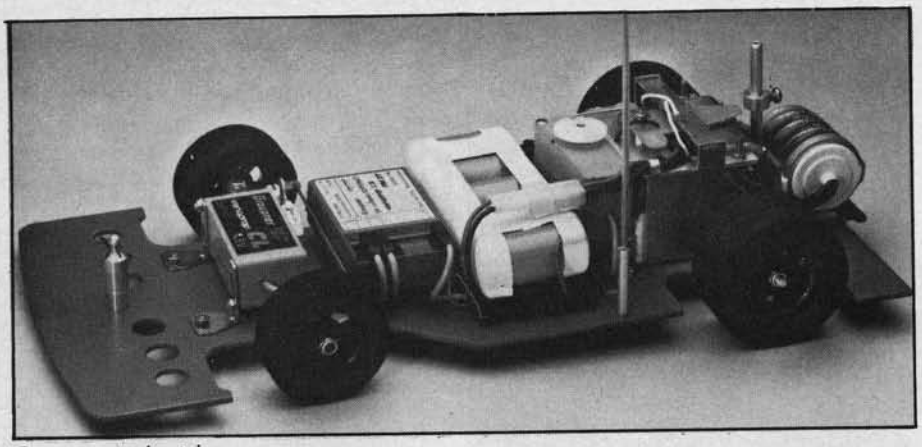
Steering of Lectricar with clever spring loaded fail safe



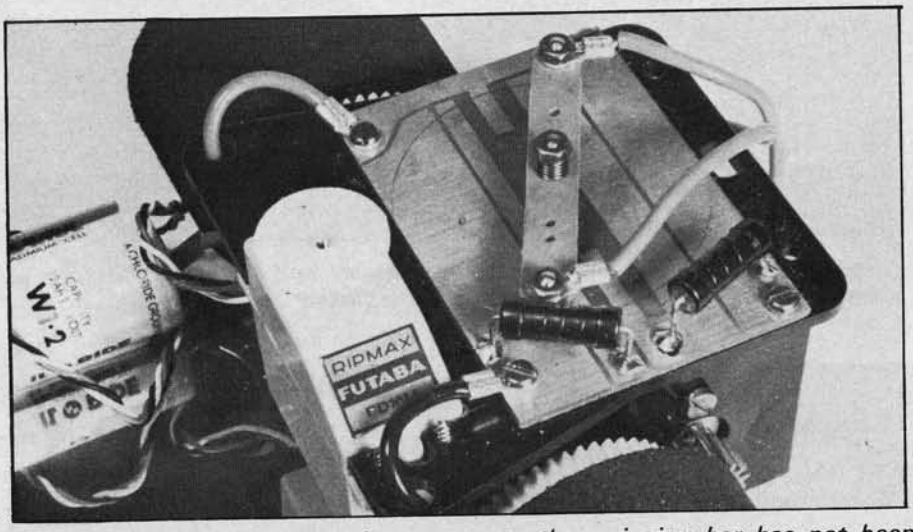
Chassis and layout of Jerobee and Bo-Linkcar



Latest Associated RCIRE car now being distributed by Irvine Engines



Groupner electric car



Mardave speed control arm from servo to the swinging bar has not been connected.

Radio equipment will be needed, plus a 12 volt car or motorcycle battery. The latter is preferred being much smaller and lighter and holding enough charge for your needs. It can be trickle charged with a mains charger between times. Choice of radio is almost limitless, and if you already have equipment used for boats or aircraft this will do spendidly. Two channels only are required plus two servos. Demands are less severe with 1/12th car than for larger 1/8th i.c. use When buying equipment any of the lower priced sets are adequate but I would mention Digiace, MRC, Talisman, Skyleader in their lower priced ranges still around £70. If you are also thinking of outdoor use with 1/8th scale then Futaba or MacGregor gear would be a wise choise.

If you feel like something a little more expensive, then the Lectricar can be yours for just under £45. This is very similar to the Mardave in specification but just that little bit more *de luxe* that you would expect from the price difference. Again it has both forward and reverse and all the items mentioned with Mardave. These two makes, though lower in price than the others, have during the past season managed to win most of the racing series arranged, so do not hesitate even if you do feel a potential racing ace.

More sophisticated modellers who would like to go right to the top from the start can consider Bo-Link for example. This company, with Jerobee, were the original devisers of this form of racing and have a very long history of success in USA. Here the chassis is plastic (designed for 1/12th scale glowplug powered cars and so very strong, though flexible) and the choice again is there for rheostat speed control. However, the more usual approach is to have a "black box" with a proportional speed control circuit built-in. This provides forward speed and dynamic braking, and via a voltage regular enables the Rx battery to be dispensed with as well as the servo actuating the speed control. The additional cost of the equipment is largely offset by the saving on dispensing with one servo and receiver battery, plus the advantage of weight saved. Equipment such as this will cost up to nearly twice as much as the Lectricar ready to go. You will lose your reverse however, though experts say there is more interference from cars backing out than advantage gained by it!

In the middle range of prices, there is the American Associated, which could be called the prettiest of the cars, like a miniature 1/8th car with radio plate and forward engine location.

This comes as a bare kit providing chassis, radio plate, steering, wheels and tyres, gears, plus nuts and bolts. Motor, rheostat or proportional equipment, and nicads will have to be provided separately. This means that though the price is low, when the additional parts have been acquired there is really nothing much in it. For the driver who already has some of the parts it is a good buy.

On the British front the new Spectron is supplied complete with Smoothtronic proportional control and all the necessary parts. This has a clear polycarbonate chassis plate, and embodies design features developed over the past eighteen months on the track by its designer. Price is just under £77.

Already there is a splendid range of accessories available to the enthusiast with special emphasis on wheels and tyres. Different track surfaces require tyres of varying degrees of hardness, and much of the success or otherwise of a driver depends on his wise choice of tyres. The model box will therefore normally carry a choice of tyres in several degrees of harness. To get adhesion on slippery ballroom floors it is usual to spread silicone rubber on the tyres — just how much is a matter of experience and knowledge of a particular venue. There are many other little dodges and tricks of the trade which make electric car racing more than just putting the car down and letting it tear round.

For the summer months outdoor racing is also possible — here the school playground or car park comes into its own. But beware! Asphalt surfaces give much more grip but are very hard on tyres so be sure you do not use your best soft tyres for such racing but select much harder ones. But, wherever you race — and racing is the name of the game — I am sure you will find a great deal of excitement on the track, and an immense amount of fun at home in the workshop fettling up the little car for its next outing.

CHANGE OF OFFICERS

Following their Annual General Meeting RADIO STOCK CAR ASSOCIATION officers are now:
Chairman: Mark Bye, 63 Heathfield South, Twickenham Middx (01-892-6634).
Secretary: Mike Varley, 10 Briarwood Road, Riddlesden, Keighley, Yorks.

JIM'S TRAVELS

WHILE PLANNING the contents of *Model Mechanics* our Editor conceived the idea of a regular feature introducing people, places and items relating to the interests of our readers that I encounter when on my many visits. Often, of course, they will be concerned with overseas destinations, principally in the USA and Europe, but they will also take in some of the excursions made in our own country. Normally such an introductory paragraph as this would have appeared in the first issue preceding any of my writings but time overtook our efforts and as you know the "Cass Railroad" was featured. There is nothing wrong in making the introductions after the story has started for it is now common practice in films and television circles.

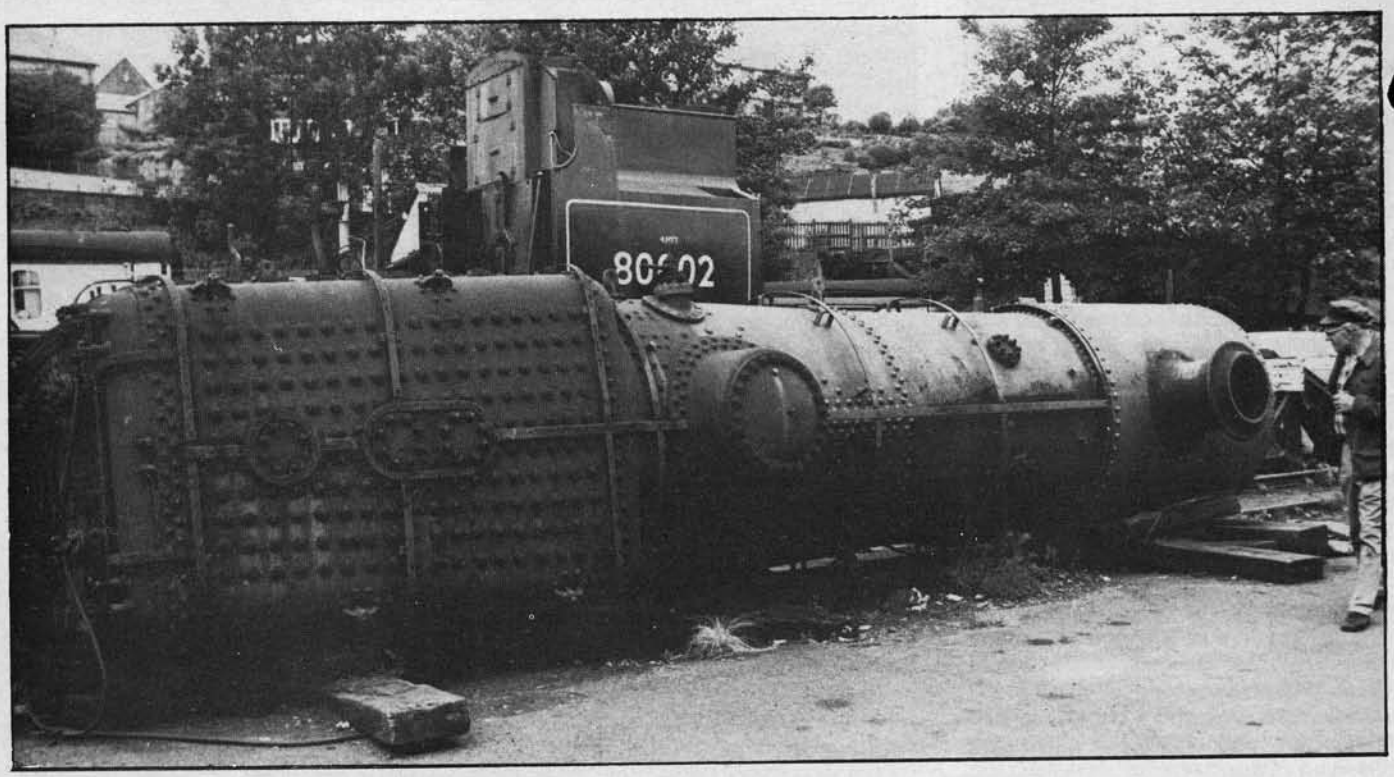
A little personal background for those to whom I am not known will not come amiss for in this sort of series some identification with the writer helps the reader, perhaps it will also provide an explanation of why the Editor picked on me to provide the material. Travel and contact with fellow enthusiasts have always been a part of my life and were aided in the days before retirement when I was an engineer on International Telex because of the many contacts that I made with my opposite numbers elsewhere. Retirement from Telecommunications in 1975 brought me to the job of Model Engineer Exhibition Manager and again my contacts increased. Added to both these factors is the other one of my being International Secretary of the Model Power Boat Association, and finally, family ties in the United States give me all the incentive to travel at least once a year to that country. Having retired from my last job in January 1978 theoretically I should now have more time for both model engineering and travel but the man who said that he did not have time to go to work never spoke a truer word and, while I have not achieved as much as I would like in both spheres, I hope to share my future activities with you, my readers.

Photography will play a large part in this series and I hope that they will help many in their search for accuracy for I will try and use photographs that will help the model engineer in his work with an emphasis on detail if at all possible. Not all the stories will be of overseas subjects and in order to provide a balance between the two USA subjects of last and next month I am going back a little in time to when I last made a visit to one of my favourite preservation venues, that of the Keighley and Worth Valley at Howarth, in Yorkshire. With easy access to the sidings alongside the depot this is a place where the rolling stock that is under or awaiting repair is right in front of the visitor and although at times I have heard some adverse criticism of the site I feel that the freedom to have a "look see" is worthwhile. When I was there, in early '78, there were several interesting projects under way. At the entrance to the shed they had an ex L M S 4F 0-6-0 loco and tender being stripped before the task of "sectionalising" them was undertaken for the National Railway Museum. At least I think it was for that museum, perhaps if I am wrong someone will correct me. With the lagging removed from the boiler the construction becomes more appparent and the great amount of riveting that exists in such a comparatively small engine will be an eye-opener to many. What a contrast to our own small boilers where current practice is to eliminate

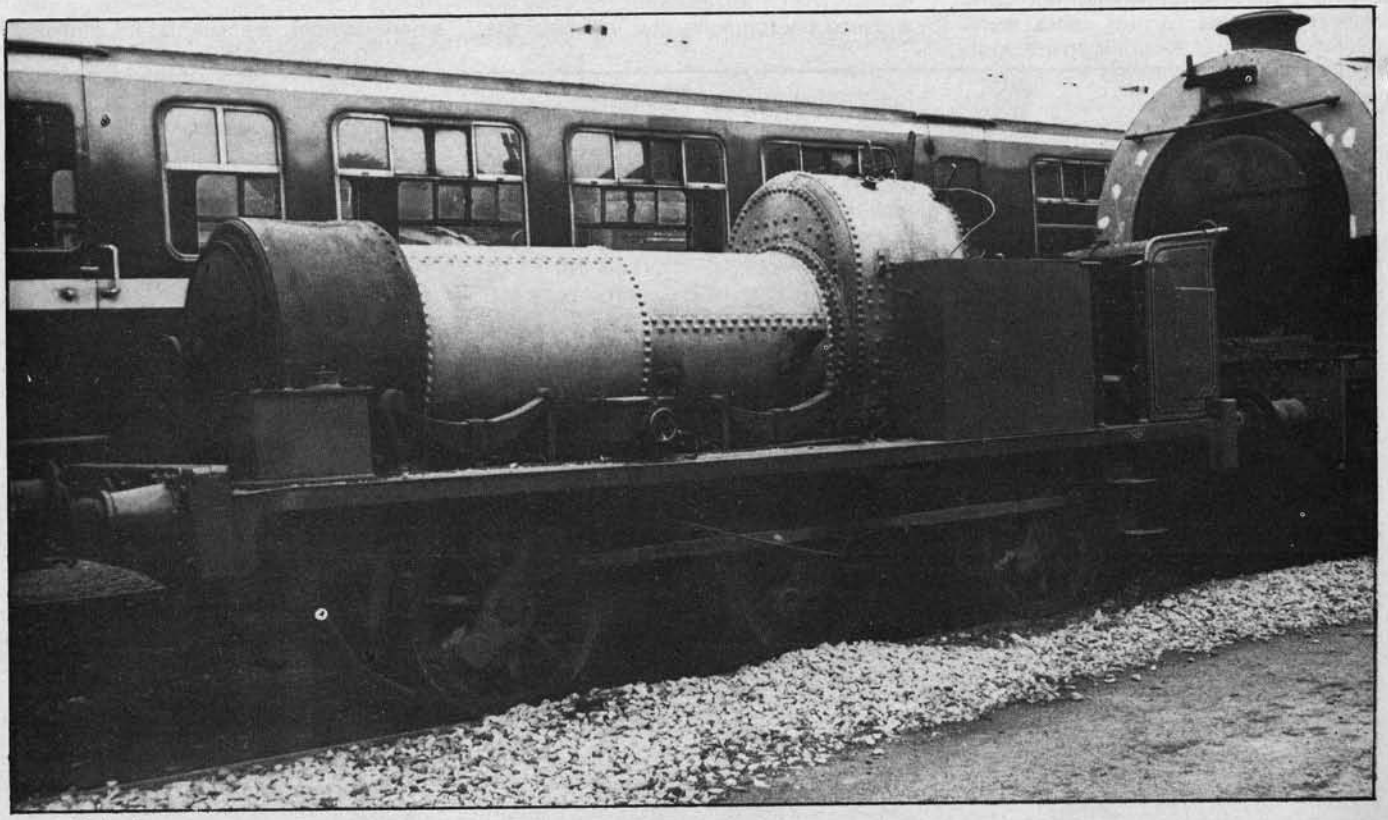
4F 0-6-0 being prepared for sectionalising

rivets in favour of an all hard soldered or welded construction.

More boiler work was visible further down the yard where the boiler for a Stanier 2-6-4 Tank was lying on its said by the chassis from which it had been removed. It is a much larger boiler and it is when one sees the pieces of a large steam locomotive at close quarters that the difficulties of the task of restoration become a little more obvious and the reasons for abandonment of some of the more fanciful schemes apparent. The problems of keeping such a pressure vessel steam tight by caulking in the traditional fashion must have been difficult for the early builders and one must admire the work of our immediate forefathers in contemplation of the massed rows of rivets on the tanker's firebox. A much earlier example of the boiler maker was to be seen on a partly dismantled 0-6-0 Tank almost next to the Stanier and although a much more simple arrangement of riveting, the skill of the makers still showed through. A much later example of locomotive design in the shape of a Bulleid West Country Class Pacific was being restored and was standing on a track adjacent to the sheds.



Stainier Boiler 2-6-4 Tank

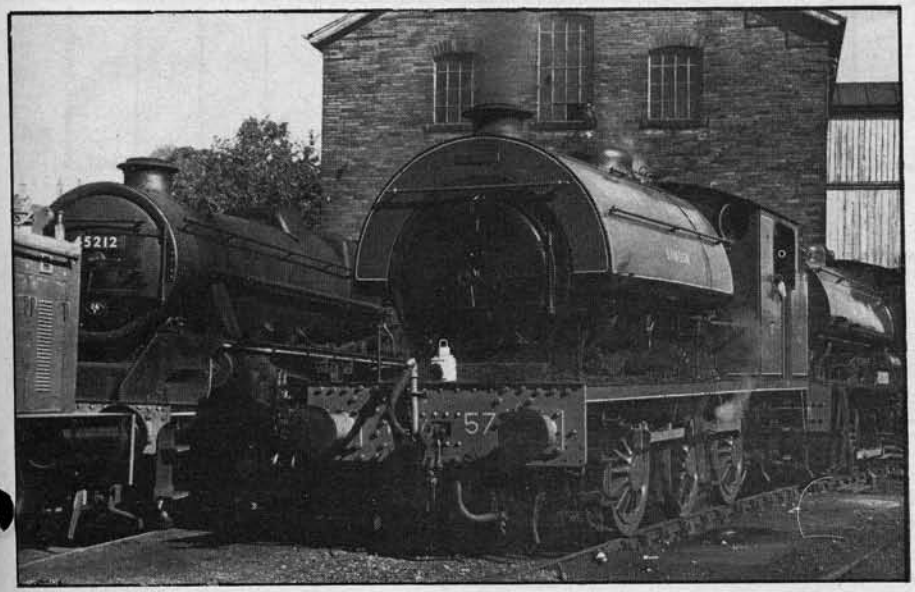


0-6-0 Tank

With its cladding removed and shorn of its trailing wheels it was very much of a contrast to the days I remember when Merchant Navy Class engines operated out of Waterloo, and could be seen from the office window at Vauxhall. Also when the other Bulleid Pacific were in general use on the smallest of the pre-nationalised groups, the Southern Railway, and I hope that restoration will be to the "air smoothed casing" state as designed and in the original "malachite" green. Southern greens were always attractive to many, so much so that after a visit to the UK in 1925, Fairfax Harrison, President of that other Southern Railway, in the USA, was so impressed that he decreed that the U.S. Southern's passenger loco's should be dressed up in the same way as their UK counterpart and if you are ever in Washington, D.C., go to the Smithsonian Museum of History and Science to see how magnificent a big US Pacific looks in this livery. The engine, a Pacific of Southern Railway Class Ps4 was built in 1926 one year after the Harrison visit and is finished in the complete paint job with gold lining, aluminium lining to the running boards, aluminium painted smokebox and highly polished motion work. This locomotive was one of the ten Ps4s, used in pairs, that hauled President Roosevelt's funeral train in April 1945.

West Country locomotive being restored

Ex-Southampton Docks U.S.A. wartime shunter



Sampson 0-6-0 St.

Seemingly I have strayed a little away from the wilds of Yorkshire but not really for the same keeness to present the steam locomotive in the fashion that we all respect pervades the activities on the K & W.V.rly. as a look at another American built loco that operates on the line will soon show. I refer of course to the ex-Southampton Dock 0-6-0T shunter that operates on the line. Built in the U.S.A. for WW2 use in docks and army depots, these machines were in the days of conflict hard working, dirty objects, but the results of much effort by the restorers show how even the humblest shunter, albeit of North American origin, can look after receiving cosmetic treatment. Interesting to see here is the differing approach to a common problem, that of providing useful shunting power, by the British and the Americans, for it happens that often No 72 can be seen coupled to No 118, *"Brussels"*, which came from the Longmoor Military Railway and is typically British of 0-6-0 wheel formation, inside cylinders and a saddle tank contrasting with the side tanks and outside cylinders of No 72. The engineman's protection is also contrasting for the yank was obviously designed with the thoughts of North American winters in mind, the cab having side windows that can be closed unlike the cab side sheets of the British engine.

Saddle tanks are popular engines on preserved lines as general maids of all work and lined up with the other tanks was *"Sampson"* being made ready for service and this 0-6-0St made an interesting comparison with Black Five 45212 lined up on an adjoining track also waiting to go into service. Altogether a place to which one returns and I am one who will do just that to see how much change is taking place and to support them in their efforts.

Jim King

Measurement

By Alan Carter

A SLIDE CALIPER GAUGE may be used for the taking of outside measurements. It has two jaws, one moving along a bar on which there is a horizontal scale. The moving jaw has a fine edge or mark on it, the line object which is held between the jaws. A double scale slide gauge has two scales, one for inside and one for outside measurements. Its jaws have projections on them of a known dimension to go inside the inside edges of objects for example, a tube. The mark on the movable jaw to indicate the size of the internal measurement cannot be in the same position as that which indicates the size of objects placed between the jaws. it corresponds to the width of the projections when the jaws are completely closed. If the smallest gap into which the jaws will enter is half an inch it will be opposite the half inch line on the scale.

A depth gauge may be fitted to a slide caliper gauge, and is connected to the movable jaw. When the mark is at one inch on the scale the depth gauge protrudes one inch from the end of the bar.

The slide caliper gauge may be fitted with a Vernier scale which is a means of registering increments too fine to be engraved on the scale. Figure 2 shows a section of a scale measuring to one thousandth of an inch. The top scale is marked in fiftieths of an inch. A thousandth is one twnentieth of each division. On the bottom scale twenty divisions correspond to nineteen of the larger divisions on the top scale, each one being one thousandth of an inch smaller. To read the scale, the jaws of the caliper area closed upon the object to be measured, the top scale read, and in this case it shows a reading of two inches. The number of Vernier divisions on the bottom scale beyond that are counted to give the number of thousandths of an inch, starting at the point at which two bar divisions coincide, A, and counting towards the start of the scale. There are fourteen. The measurement is two inches and fourteen thousandths — 2.014".

A micrometer is used for taking very small measurements accurately, the principle being based upon a screw thread. The main parts of the outside micrometer, Figure 3 are the spindle, A, to which is attached the thimble, B; the sleeve, C, and the anvil, D. On the sleeve is a

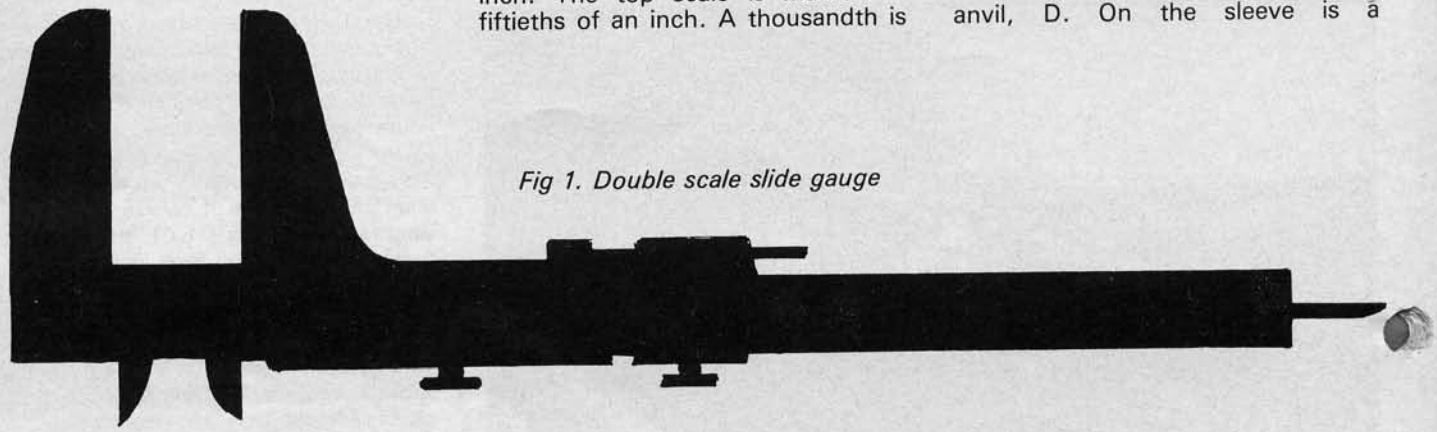


Fig 1. Double scale slide gauge

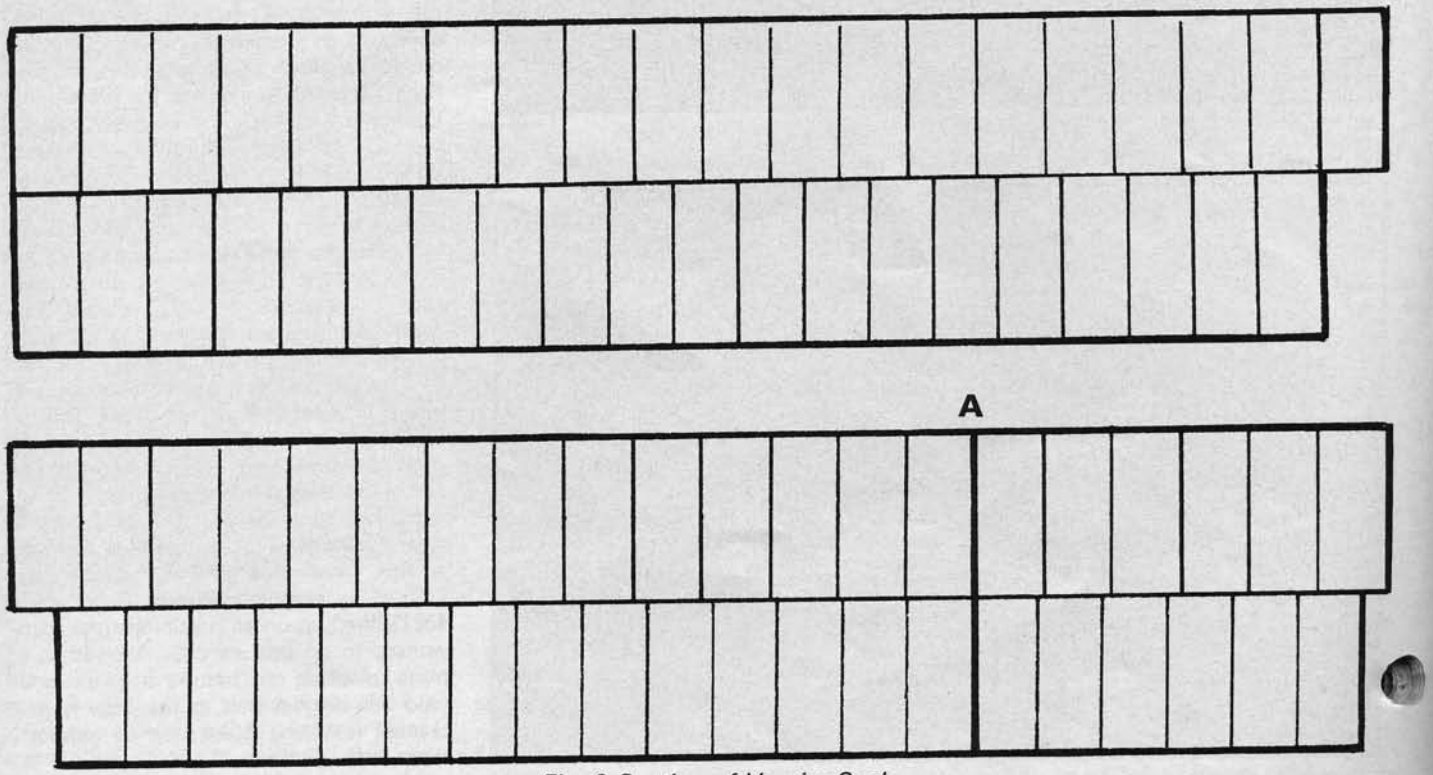


Fig. 2 Section of Vernier Scale

horizontal scale, the small divisions each equal to one fortieth of an inch, or twenty-five one hundreths of an inch. One revolution of the thimble, B, reveals one division, every fourth division is numbered and equivalent to one tenth of an inch. On the edge of the thimble are twenty-five small divisions each equivalent to one one thousandth of an inch. When the micrometer is measuring nothing the thimble is at zero on the sleeve. The micrometer is held with the top joint of the third finger of the right hand placed inside the frame, the thimble held upright operated by the thumb and forefinger of the same hand. The object to be measured is held lightly between the spindle and the anvil. Each large division on the sleeve that is revealed is equivalent to one tenth of an inch, each division past zero on on the thimble is a further onethousandth of an inch. In figure 4 the reading is 0.146in

The micrometer can give a measurement accurate to 1/10,000th of an inch by the addition of a vernier scale to the

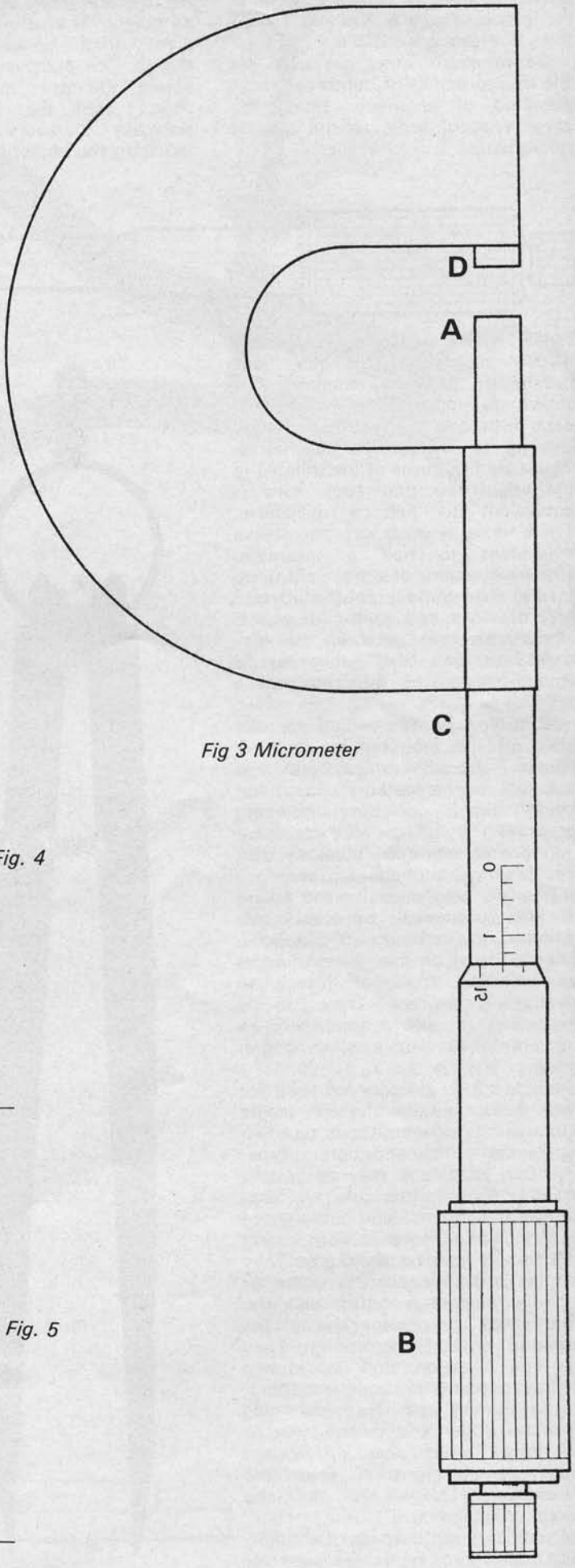


Fig 3 Micrometer

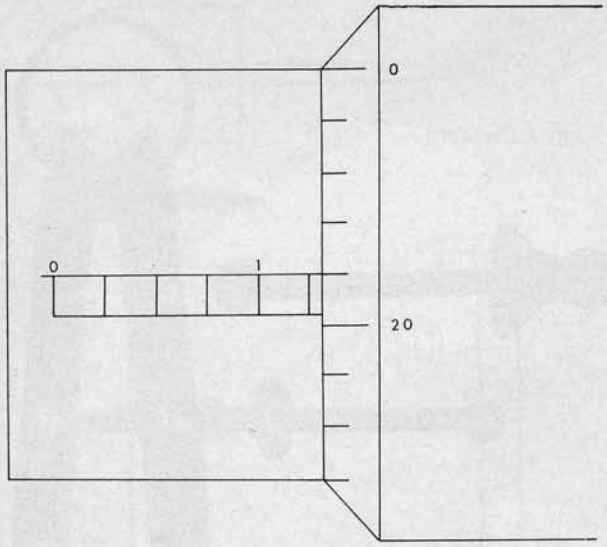


Fig. 4

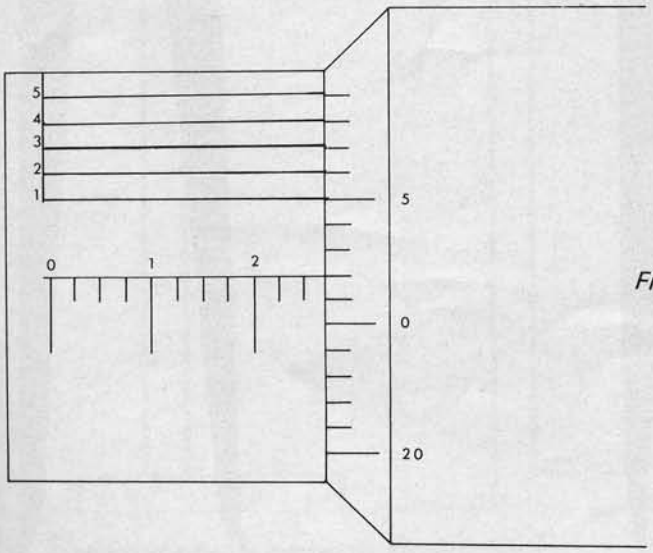


Fig. 5

sleeve, the divisions parallel to those of the thimble. Figure 5 illustrates such a scale. The reading is 0.2522 in.

Depth micrometers are used for the measurement of depth to a high standard of accuracy. Using the same type of scale as the outside micrometer.

the measurement of the outside of an object. They are held near to the pivot point between finger and thumb. One point is held against the object, the other moved along the object until the finest limit of accuracy is reached, both points touching the object lightly.

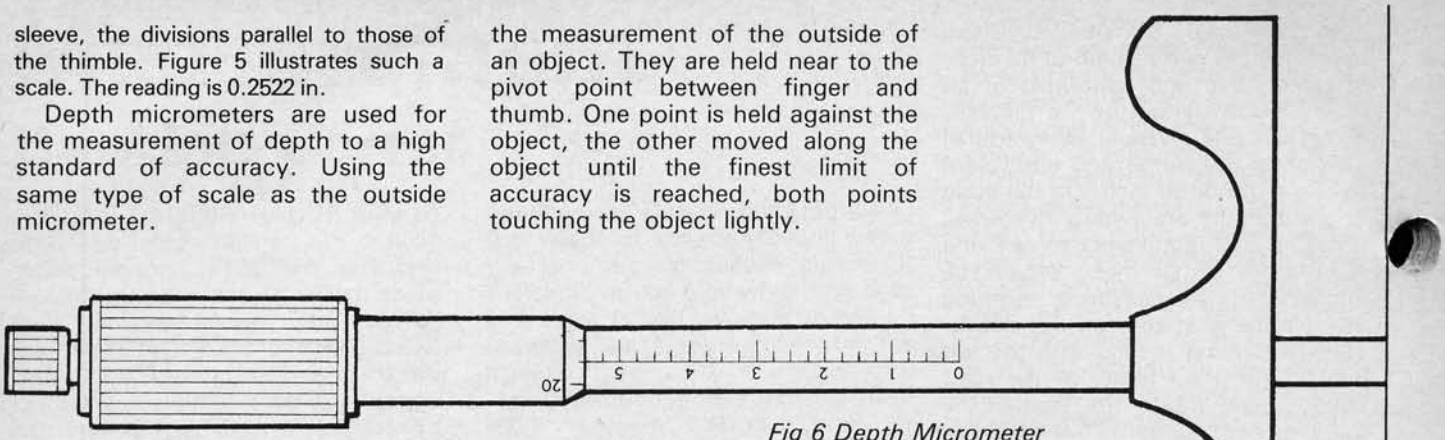


Fig 6 Depth Micrometer

The metric micrometer normally gives accuracy to one one hundredth of a millimetere. The sleeve is marked in millimetres, each fifth one marked by a longer line up to twenty-five millimetres. There are fifty turns of the thimble to that mark so that each turn is equivalent to half a millimetre. There is a division on the sleeve equivalent to half a millimetre between each of the millimetre marks. The thimble is divided into fifty divisions and each fifth one is marked so that each of the fifty divisions on the thimble is equivalent to one hundredth of a millimetre.

Accuracy is determined by the price of the instruments used. A cheap diecast micrometer is accurate to the stated standard but could distort in time affecting accuracy. The expensive micrometer made of steel or cast iron is almost impervious to wear.

Dividers are used for the taking of measurements between two points. They can step off distances. The points of dividers are ground at an included angle of fifteen to twenty-five degrees. They can be measured or set accurately in a micrometer or on a slide caliper gauge.

Inside spring calipers are used for the measurement of the inside surfaces of objects, there are two types, firm joint and spring type. The firm joint type may be sprung several thousandths of an inch between surfaces and they have rigidity. Spring calipers with spring adjustment may be set finely. They can be used to measure a recess, or a hole behind a small diameter "bottleneck" by pressing the calipers together against the spring. They can be inserted and withdrawn without altering the caliper setting. Inside spring calipers are held between finger and thumb near to the pivot point and are rocked crosswise to ensure that the measurement is taken at the maximum diameter.

Outside spring calipers of the firm joint and spring types are used for

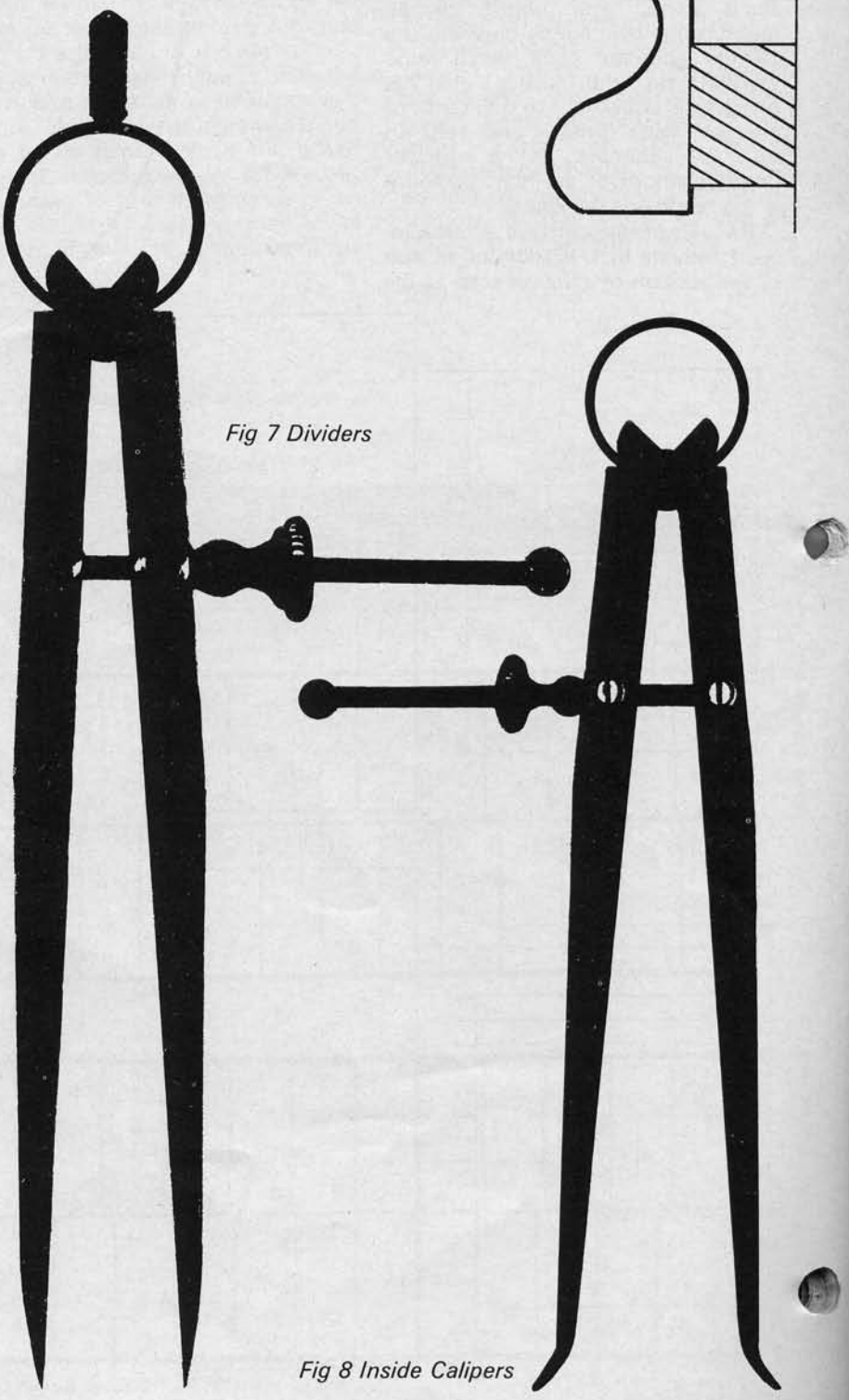


Fig 7 Dividers

Fig 8 Inside Calipers

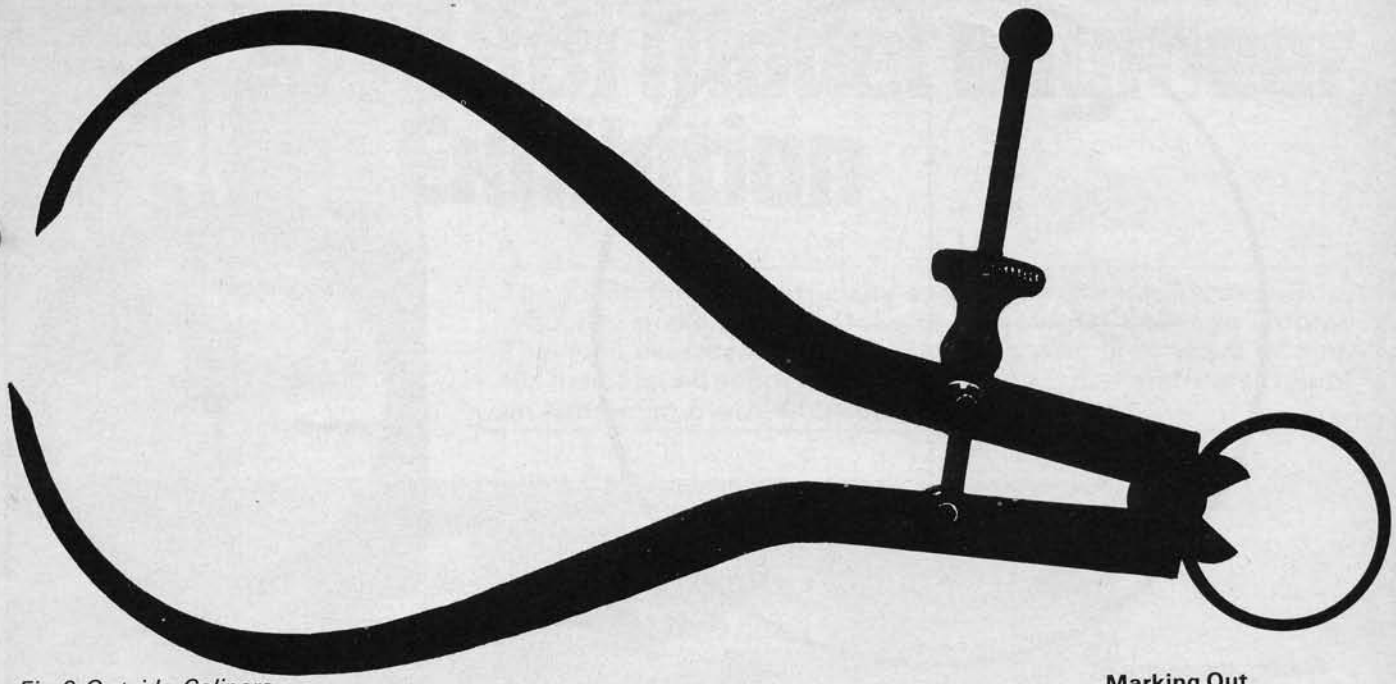


Fig 9 Outside Calipers

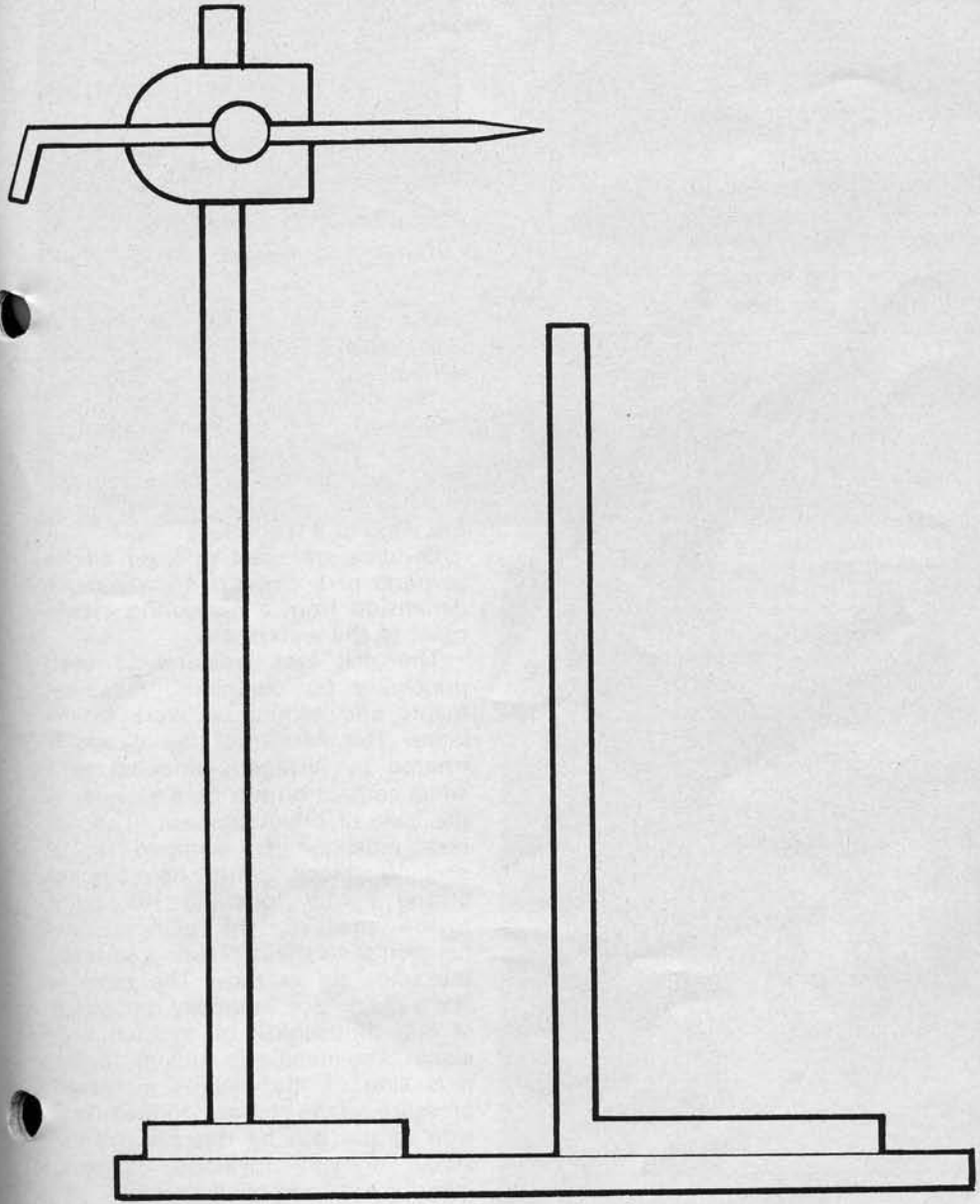


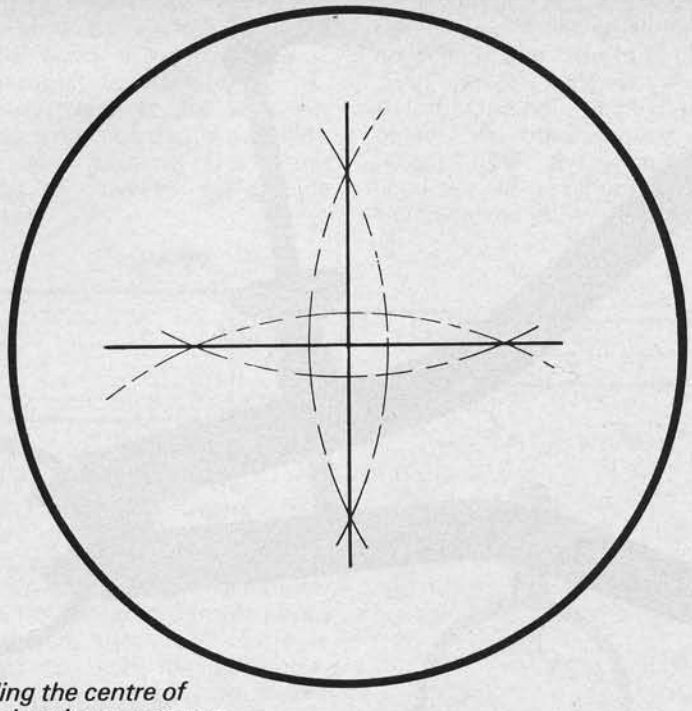
Fig 10 Surface plate, surface gauge and angle plate

Marking Out

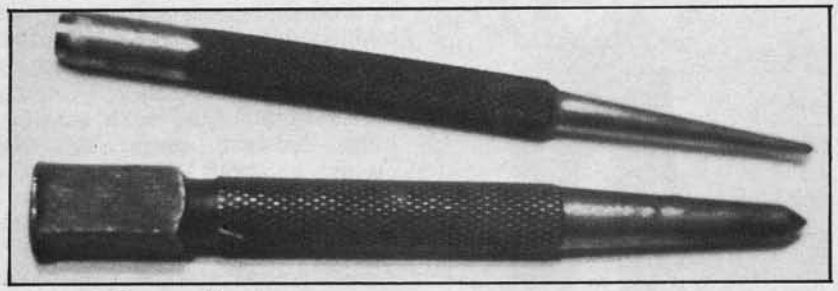
Iron and steel and similar metals which would not show lines made by a scriber clearly are coloured with a copper sulphate solution or another marking out fluid such as Prussian blue, red lead, white wash, applied with a cloth. Copper sulphate solution is made from one ounce of copper sulphate salt to four ounces of water and several drops of nitric acid. A white wash can be made from whiting desolved in alchohol to the consistency of a thin paint. Copper sulphate is not now as easy to obtain as when it appeared in all boys' chemistry sets. Any good engineers' merchants will stock blue dye sold specifically for marking out and this is to be recommended. Although Prussian Blue can be used it is intended more for use on a surface plate to show high spots on a piece of worked material.

Accurate marking out depends upon a flat surface, and is achieved more readily using a surface plate. This is used in conjunction with an angle plate, which supports the workpiece in a vertical plain. A surface gauge is used to scribe lines parallel to the surface plate by setting the point of the scriber at the desired height, bringing it into contact with the workpiece, the face of the surface gauge being held against the surface plate and moved slowly, so that the scriber makes a line on the workpiece.

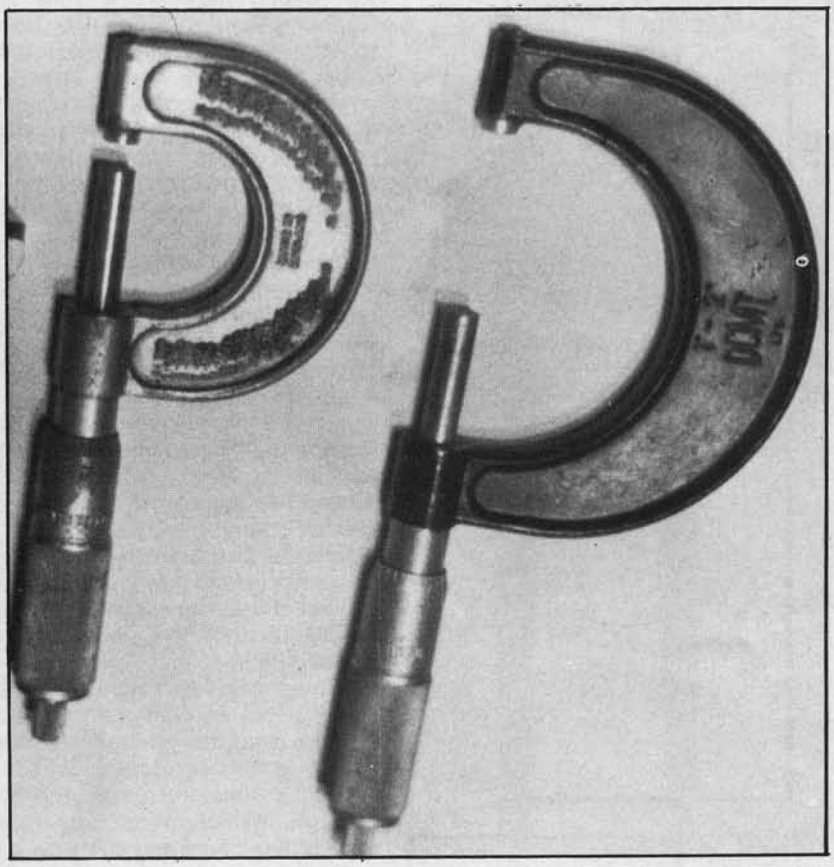
A vee block is used to support round bars. To find the centre of a round bar set the scriber of a surface gauge to the estimated centre and scribe a line. Rotate the work through 180 degrees and mark a second line. Turn the bar through 90 degrees and repeat the process, rotate another 180 degrees and



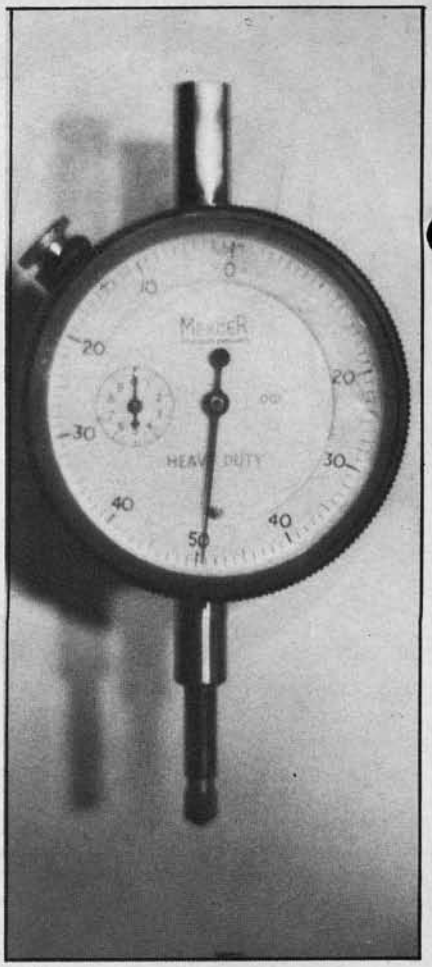
Finding the centre of a circle using a compass.



Punch for marking centres



1in. and 2in. Micrometers



Dial gauge

scribe once more. The diagonals of the square formed cross at the centre.

The odd legs, hermaphrodite, or Jenny caliper is used to scribe lines parallel to the edge of a plate, or to find the centre of a round bar, marking an arc from a position at the edge of a workpiece.

Dividers are used to draw circles or parts of a circle or to transfer a dimension from a measuring instrument to the workpiece.

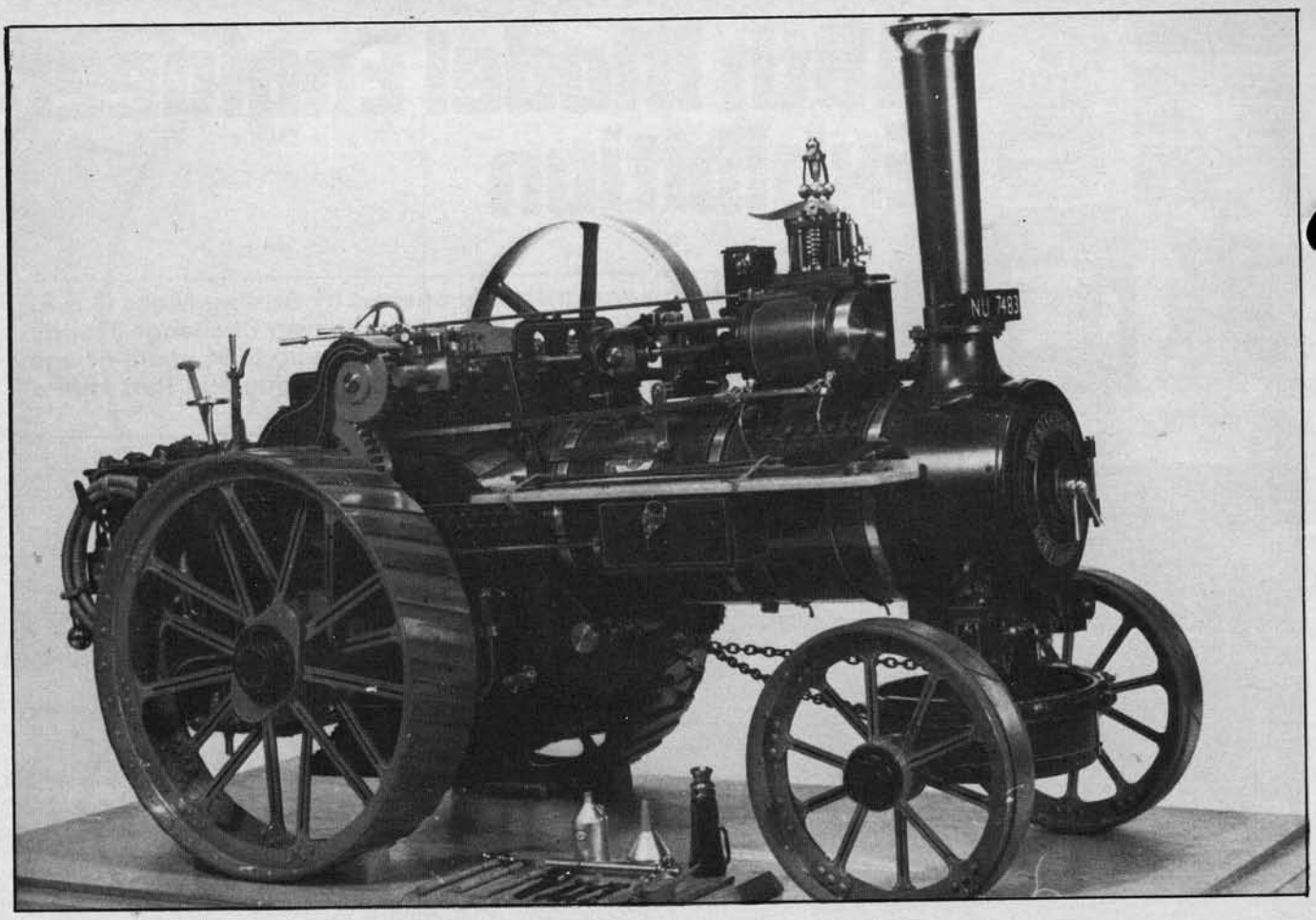
The dial test indicator is used principally for comparing measurements and setting up work in the lathe. The needle of the gauge is rotated by linkage connected to a small contact button on a plunger in the case of the instrument. The dial test indicator is clamped to a scribing block with its contact button lightly touching the point to be checked, the plunger perpendicular to the measuring surface, the scale set at zero. The scale is like a clock face, normally graduated in one thousandth of an inch divisions. The needle is moved to the plus side of the dial by increased pressure on the contact, to the minus side of the dial by decreased pressure. It will measure flatness, straightness, and concentricity.

48th Model Engineer Exhibition

The Exhibition was officially opened by Stirling Moss O.B.E., who also presented the Duke of Edinburgh Challenge Trophy. This was awarded to Mr. G. Hartung who is 84 years of age, for his spendid model of a Starboard Engine and Part Hull of an American Stern-wheeler.

Mr. Stirling Moss getting up steam

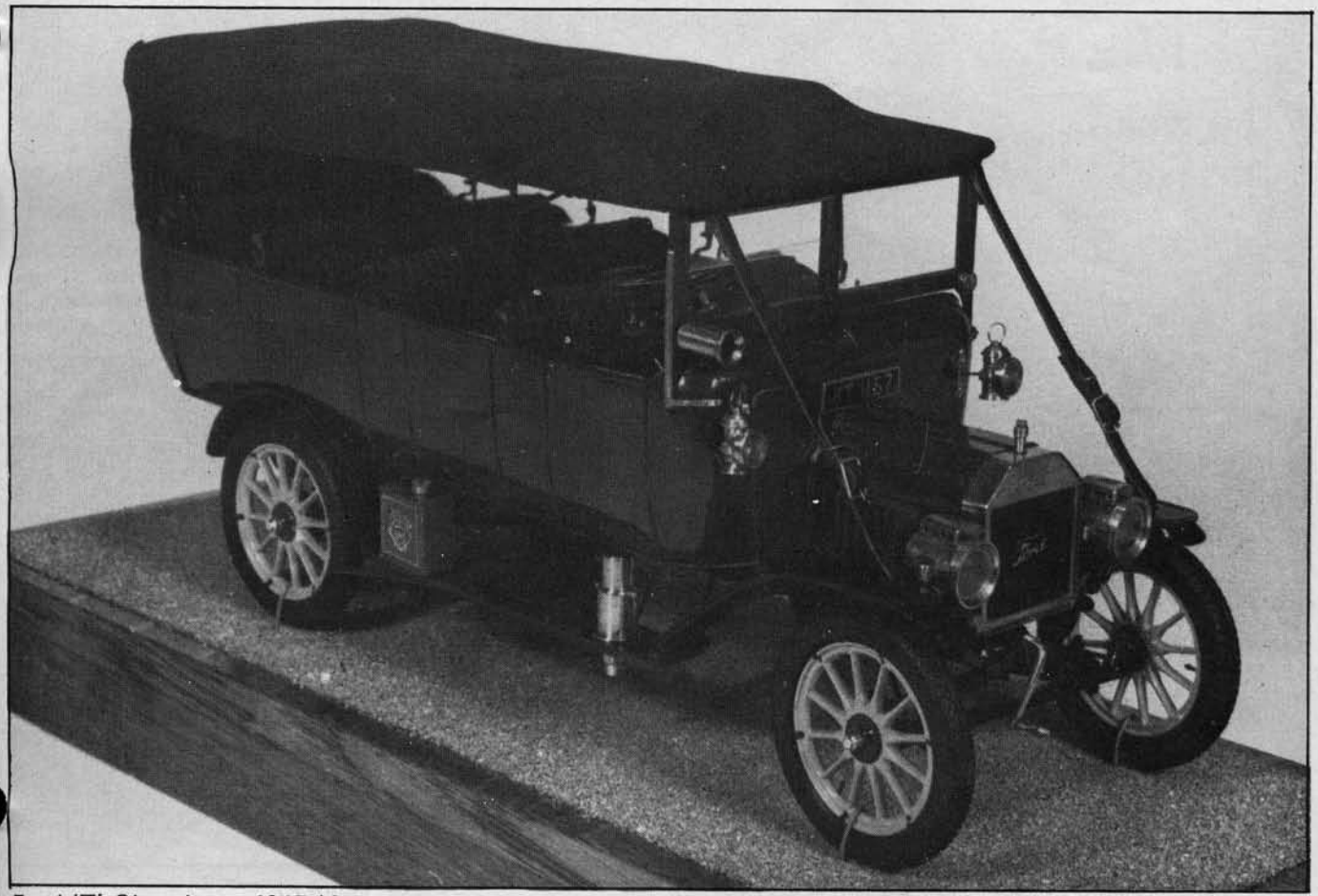
Mr. G. Hartung holding the Duke of Edinburgh Challange Trophy



Royal Chester Allchin Traction Engine *K. F. Clover — Bushey Heath*

Scammell Recovery Vehicle *W. B. H. Stevens — Tring*

"Savage" 3-a-Breast Gallopers R. G. Russell — Newport

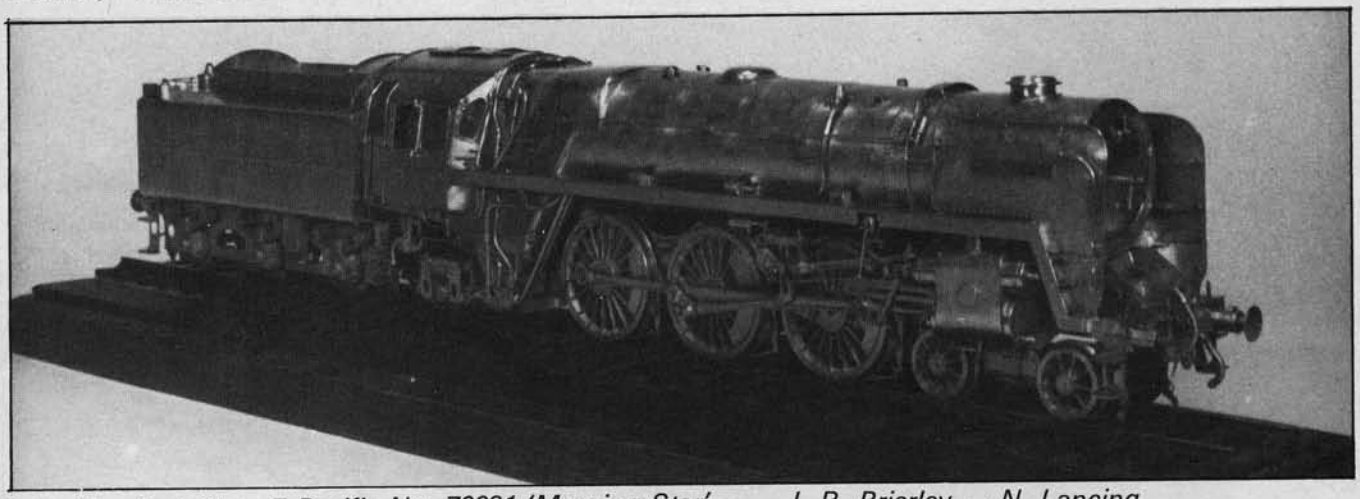


Ford 'T' Charabanc 1915 (Circa) 14 Seater C. Hall — Twickenham

The Clown
K. Horsey—Addlestone

Lantern Clock
J. E. Chantler—Weybridge

Pit Scene (4 Figures & Lola Car)
D. Saunders—Tunbridge Wells



B.R. Standard Class 7 Pacific No. 70021 'Morning Star' *J. R. Brierley — N. Lancing*

B.M.W. R75/5 Motor Cycle E. J. Wharton—West Drayton

Essex Waggon E. H. Horne — Ilford

Soldering

By Les Bryant

Oryx model 9 low voltage soldering iron

IT HAS BEEN FOUND by experience that if the following five rules are adhered to closely good sound joints will be made:—

1) Selection of solder.
2) Selection of flux.
3) Good joint.
4) Clean joint.
5) Correct heat.

I will take each rule in turn to cover most needs of the home worker but must stress that notes do not cover the soldering of aluminium and its alloys.

Solders

Most, if not all, solders are alloys of two or more metals, the alloying being carried out to obtain a set melting point. The melting point of the solder must be lower than that of the metals we wish to join or in applying it we shall melt the job.

Consideration must be given to the strength of the joint and the use it is to be put, and whether the solder will have any effect on such things as food stuffs if they are to be kept in the finished job i.e. soft (lead) solders are at the moment being investigated for lead poisoning from food cans which are invariably soldered with them. Also lead solders are mechanically very weak and should not be used for pressure vessels i.e. boilers for steam engines. On the other hand, they are easily applied and make excellent electrical contacts and minor repairs.

Appearance must also be considered, particularly in art metal work. They can be selected so that they blend entirely with the job so that the joint becomes almost invisible.

Adcola 101 unit

The Little Torch portable welding unit

(1) Types of Solders

(a) **Lead or Soft Solders**
An alloy of lead and tin.
Pewterer's 95°C—105°C
This solder has a small quantity of antimony added to obtain the very low melting point. It is used only with work on pewter.
Plumber's 185°C—248°C
For joints in lead. In cooling it goes through a longish eutectic stage (plastic stage) allowing the solder to be formed (wiped) into shape.
Tinman's 185°C—227°C
The most common and useful alloy. It is the strongest of the lead solders. Ideal for electrical and mechanical joints which do not have to carry heavy loads.

(b) **Silver Solders**
An alloy of copper, zinc and silver. Many firms produce these solders each with its own range of melting points, names or code letters. It is best to buy them by quoting the melting points to ensure getting the correct grade for the job. All have considerable mechanical strength similar to brass. I will list only three to give some idea of the temperature range.

EASY	608°C—617°C Very fluid when molten.
MEDIUM	650°C—660°C Good working properties and strength.
HARD	705°C—723°C Not quite as fluid as those above and can be rather brittle when cold.

(c) **Brazing**
Melting point of spelter is 850°C—950°C. The solder is usually brass, although some spelters are a form of bronze. Alloy—copper, zinc and sometimes a little tin. Suitable for jointing copper and steels. Considerable mechanical strength.

(2) Fluxes

These chemicals are used to either dissolve oxides which form when the job is heated or to exclude the air so that oxidation cannot take place. They must remain in place until the joint is complete so fluids and inflammable fluxes cannot be used at red heat.

Passive Fluxes

These only coat the joint and do not clean it.
Tallow — used with plumber's solder on lead — non-toxic.
Sal Ammoniac — the ideal flux for food containers.
Resin — used on electrical wiring, will not corrode even the finest wire and is clean to use with lead solders.
Fluxite — A greasy flux — used for general work. It contains some 'active' chemicals.
Borax — A white powder which will remain as a liquid film over the joint at red heat. Standard flux for silver soldering and brazing.
'Chemico' brazing flux — a modified borax which does give better results at high temperatures.

Active Fluxes

These dissolve the oxides as they form, but are usually corrosive so must be flushed away as soon as the joint has been made. They make soft soldering easy but should *NOT* be used on food containers.
Zinc Chloride — must be diluted 1:1. Very corrosive.
Baker's Fluid — a modified zinc chloride. A good flux for general work on most metals.

(3) The Joint

Other than when lead is being wiped the solder should be quite fluid when the joint is being soldered. Large gaps in the joint will allow the solder to run through and to be lost. Any soldered joint must be a really good fit, allowing the solder to be drawn into it by capilliary attractions. The solder will thus fill the whole joint. This will make the strongest joint.

(4) Cleanliness

The joint must be both mechanically and chemically cleaned, all oil, grease and oxides being removed.

(5) The Correct Heat

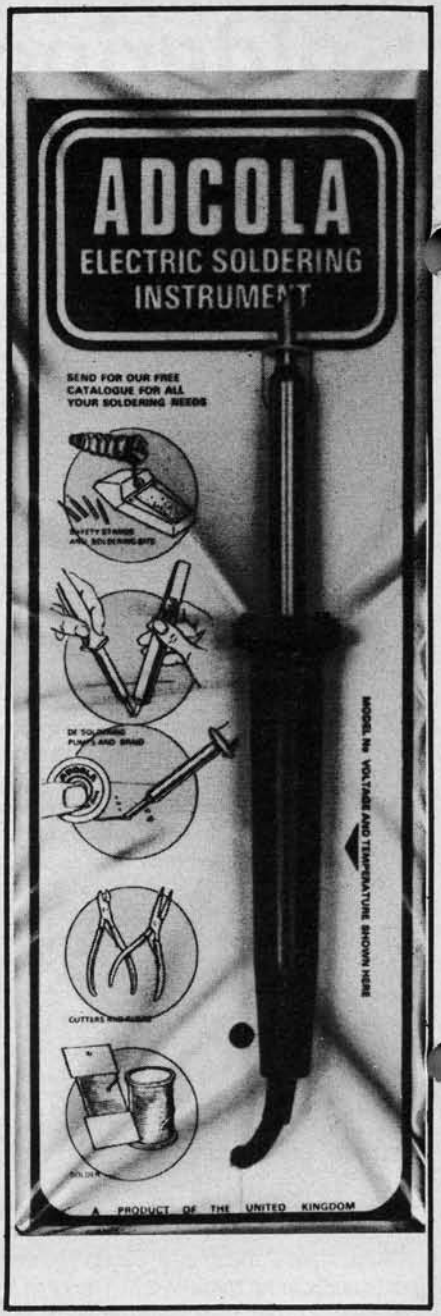
Both sides of the joint must be brought up to just above the melting point of the solder so that complete wetting of the metal is achieved. Too much heat will destroy some solders.

Soft Soldering

By far the cleanest and easiest method of applying soft solder is by using a soldering iron provided the metal is not too heavy. Thick, large jobs are best done with some form of blow torch or lamp.

When using a soldering iron examine the tip before starting. It should be smooth, clean and coated with a film of solder. Should the tip be pitted and dirty it must be filed smooth and re-tinned. This applies to a new iron and also to gas heated or electric irons. To tin the tip the iron is heated to the melting point of the solder (check with the stick of solder), dipped in and out quickly in a tray of flux and rubbed on a piece of the solder, either direct from the stick or some placed on a piece of tin plate.

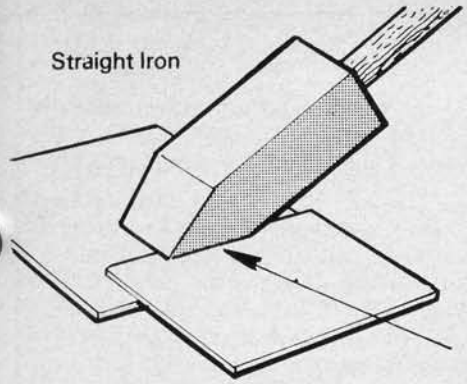
While the iron is reheating (do not allow a gas heated iron to get anywhere near red heat) flux may be spread on the joint. The iron is now re-dipped in the flux tray and will then pick up solder from the plate. It is applied to one end of the joint and held STILL until the solder can be seen to flow onto the job. Now draw the iron slowly along the joint and the solder will run into the joint following the heat. When the solder supply runs out on the iron, redip and pick up more solder (the gas heated iron may need reheating), and

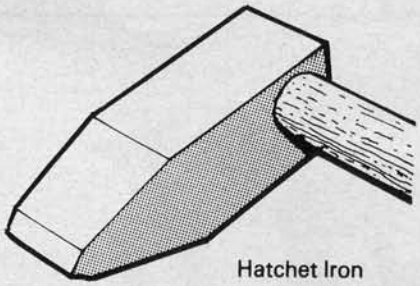


continue from where you left off until the joint is complete. Do not forget to wash off all traces of flux, preferably with soap and water.

For heavier work a gas torch or blow lamp should be used, but the solder is applied from the stick. It is advisable to flatten the solder to a thin section so better control of the amount of solder can be obtained. Only enough solder to thoroughly fill the joint is necessary. After applying the flux, start heating the joint at one end, as with the iron, taking the flame away occasionally to test if the job will melt off some solder when applied to it. The stick of solder must never enter the flame. When some solder has melted onto the joint the flame is drawn along the joint and the solder will follow. Only add solder when movement of it stops. This way a sound, smooth and strong joint will be obtained.

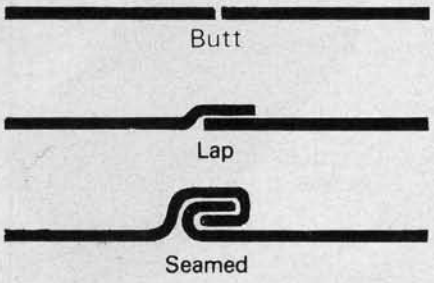
One last word on soft solders. They are not strong enough to hold Butt joints,





The tinned face must be layed flat on the joint.

lapping is absolutely necessary and in some cases where considerable strength is necessary seamed joints will have to be made and soldered.



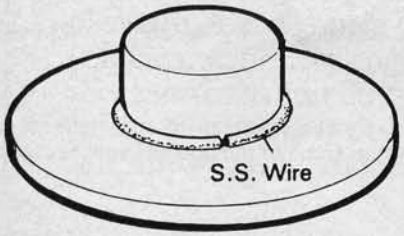
Sweating

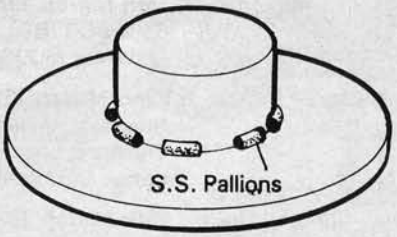
This is the process of coating meeting faces of the joint with a thin film of solder before the joint is assembled either applied by iron or flame. When cold the joint is assembled with a wipe of flux between and then the whole is heated until the films mate, completing the joint. This is often used when several pieces of exactly the same shape are needed, the pieces being sweated together, worked to shape and then separated by melting the solder when they can be knocked apart.

Silver Soldering

Silver solders are the ideal method of 'jointing' copper, brass, steel or silver provided that taking the job to red heat will do no damage. Electro-plated articles cannot be repaired by this method unless the article can be replated after soldering.

The process is simple provided all 5 of the rules are obeyed. The joints should be close and no burs left, small bevels on each meeting face will help the solder enter the joint. The borax flux, a white powder, should be mixed with water to a thin paste and applied to the joint (I use a small water colour brush) if possible to both sides. The selected solder (see below) may either be applied from the stick when the job is hot or in wire or pallion form before heating.



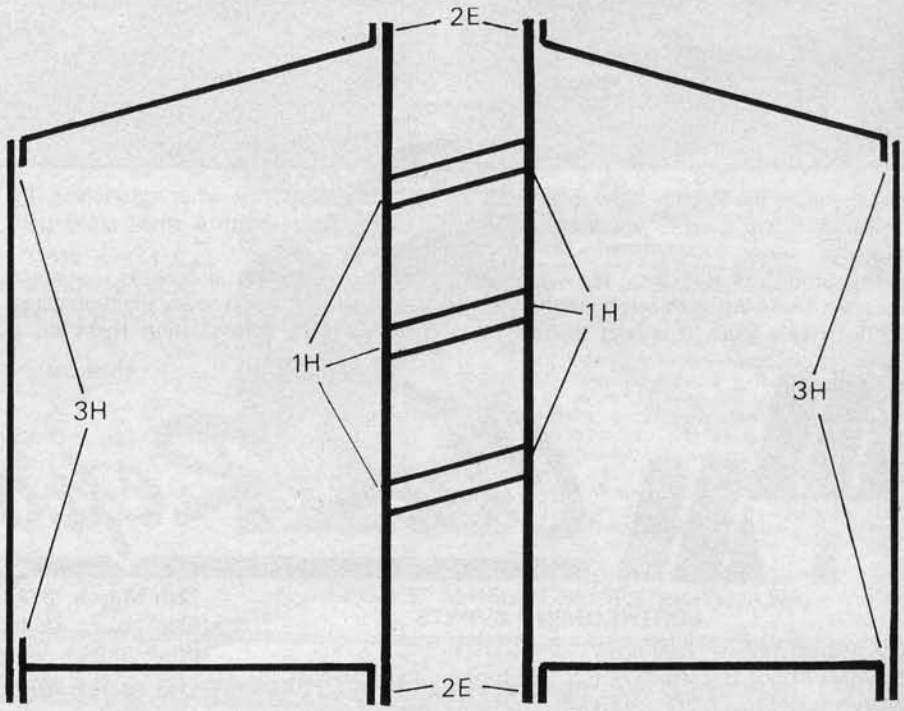


The joint and the surrounding metal should be heated very slowly to dry out the flux. Should it boil the flux will leave the joint and some oxidation may take place and the solder will not flow easily. Also if pallions are used they will be displaced from the joint. Once the flux has dried the job may be brought up to temperature to melt the solder into the joint. If the solder is applied from the stick the same procedure as with lead solder is used, the solder never entering the flame but being melted off by the heat in the job. Care must also be taken to see that both sides of the joint are at the same temperature as the solder follows the heat i.e. the solder flowing onto one side of the joint. Should the solder not run in a spot or two it may be helped by scratching the area with a pointed steel rod which has been heated and dipped into the flux.

After allowing the joint to harden (freeze) the job must be cleaned. The usual treatment is to quench in cold water to crack off as much of the glass-like borax and then pickle in a dilute sulphuric acid bath for about 10 minutes. A few words of warning here — do not immerse a hot job into the pickle unless you are wearing complete rubber apron, gloves and face shield. Even then it can be very dangerous.

It is best for beginners to buy their dilute (6 water — 1 acid) from a garage or chemist, but if you must mix your own remember always to add the acid to the water and very slowly without splashing. Should the acid splash onto anything of value or yourself wash it off with copious supply of water as quickly as possible. And do not forget the rubber gloves and at least a pair of goggles.

The range of solders shown in the table enable consecutive joints to be made by using the grades in descending melting points i.e. hard, medium, easy. A little thought in deciding the steps of assembly can often treble the number of soldered joints made on one complex job. The illustration shows the method of assembling a small pot boiler, the numbers represent the steps of soldering and the letters, the initials of the grades of soldering. — 1H, first joint, hard solder. 2E 3H 3H 1,H 1,H 2E 3H 3.H



Provided the heating is removed as soon as the solder has flowed properly then the previous joints should not be affected in any way.

Brazing

This is the soldering process requiring the highest temperature and by far the strongest. It is mainly used on steel structures. Of course it needs most heat

and therefore the torch or blow lamp must be very efficient even for moderate sized jobs.

The procedure is exactly the same as for silver soldering with one exception — do not pickle steel. It is best to remove any remaining flux after quenching by chipping lightly with a small cross pein hammer.

With all these processes, practice makes for perfection so try them on scrap materials first before using them on a costly, hard worked job.

One last word of warning. Keep your soldering area clean particularly if you intend using both lead and silver solders. Lead solders have a disasterous effect on copper or brass at red heat.

Club Report

FORTHCOMING EVENTS

1st March 1979 — 7.30 p.m.
Newton Abbot & District M.E.S., Film night and chit-chat. St. Mary's Institute, Highweek Street, Newton Abbot.

3rd March 1979 — 14.00-18.00
Gauge 'O' Guild, Joint meeting with South Hants 'O' Gauge Group. Baptist Church Hall, Swan Lane, Winchester. (Running tracks and facilities for display of models).

3rd-4th March 1979
Sat — 10 a.m.-7.30 p.m.
Sun — 10 a.m.-5.30 p.m.
Sutton Coldfield Railway Society. Annual Exhibition — Dunlop Hall, Fort Dunlop, Holly Lane, Erdington, Birmingham.

9th March 1979 — 7.00 p.m.
Thames Shiplovers & Ship Model Society. Anchors, Winches & Deck Fittings for modellers. St. Botolphs Church Hall, Bishopsgate, London EC2.

12th March 1979 — 7.30 p.m.
Meeting — United Reformed Church Hall, Colwyn Avenue, Rhos-on-Sea, Colwyn Bay. N. Wales M.E.S.

12th March 1979 — 7.30 p.m.
Modelmakers discussion night. Patrick Halls, Burgh Hall Street, Glasgow, Clyde Shiplovers and M.M. Society.

13th March
Meeting Night, Basingstoke & District M.E.S.

15th March 1979
Sailing & Boat building by John Martin, N. Wales M.E.S.

22nd March 1979
Specialist Vehicles, Mr. J. Poulter, member of the Institute of Transport Engineer will talk on some of the unusual vehicles seen today. Sutton M.E.S.

26th March 1979
Willesden & W. London S.M.E. Club Meeting.

28th March 1979
Harrow & Wembley S.M.E. Bits & Pieces and Bring & Run. St. Andrews Hall.

30th March 1979 — 7.30 p.m.
Rugby S.M.E. Model Night (to be held in the main hall). Clubhouse, Hillmorton Community Centre.

31st May 1979
Centenary of Electric Railways 1979.
The Centenary of Electric Railways Committee is proud to announce that many events are to take place to mark the Centenary of Electric Railway Traction, which occurs on 31st May 1979. An exhibition showing the development of the electric railway and tramway over the past 100 years will visit major cities throughout Britain. Negotiations for the exhibition to go on show in London. Birmingham, Manchester and Glasgow are well advanced, and we hope to arrange further venues.

June 30th — July 1st 1979
Sudbury Mammoth Olde Tyme Rallye.
Melford Hall, Long Melford, Sudbury.
For those of us who witnessed the enjoyment of the thousands who attended the last "Mammoth", the memory is so clear that it seems incredible that another is already being organised. The administration grows more complicated each time, but then so do the crowds, and the pleasure. However, large though the Rallye may be, there is no truth in the rumour that British Rail are going to re-lay the track from Sudbury to allow a visit from the "Mallard".

Steam Section
"As to date, the engine section seems to be going very well, except that estimates for best quality "Lady Windsor" coal have proved too high, and we shall have to make do with standard steam coal, which will make things a little smoky!
There will be two live steam railways (5" and 10¼" gauge) and six model live steam traction engines.
For the fairground, we have a set of galloping horses, another steam ride and hand driven 'old tyme' rides and side shows."
For further information, contact Mr. Underwood at: 9 Aukingford Gardens, Ongar, Essex. Tel: 3394.

Lastly, the MODELS SECTION.

Mr. J. Archer (9 Lancaster Road, Sudbury, Tel: 74936) would like to point out that *all* models are eligible, not just steam. Everything from Railway models to horses or farm tools are acceptable; in fact, anything in miniature.

Don't hesitate to contact Mr. Archer for more information.

Guest Appearances
The models used in making "Wings", the W.W.I.T.V. series will be in flight as well as those being used in making a new I.T.V. series "Flambards", featuring aircraft of 1910 vintage. Biggles will only make it if Ginger can find the starting handle!

7th-8th July 1979 — Bristol
IMLEC — M.A.P. Sponsored event. International efficiency trials — Model Railway 3½" & 5" gauge.

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