Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED

GOING BY
TEAM WHEN
ICKENS WAS
YOUNG

IN THIS ISSUE

A NEW SERIES ON BUILDING A MODEL RACING CATAMARAN

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Contents

Cover picture

Something of the air of the traditional Christmas greeting card is conveyed by these two pictures of early steam-driven carriages. Top illustration shows the steam coach of 1827 *by Goldsworthy Gurney, the one below is Walter Hancock's steam omnibus* ENTERPRISE *which he built in* 1833

Next week

Edgar T. Westbury contributes the first article in a new series about the uses and properties of magnets in December 28 issue

Smoke Rings A weekly commentary by VULCAN

ETYMOLOGISTS take great pains to trace the origins of words, most of which have their roots in classical languages.

The issue of November 2 MODEL ENGINEER saved them a lot of work for the printers presented etymologists with a bright new word, an unusual word, a word that lingers nicely on the tongue. "Anodule."

This was what a compositor made of the term module which occurred in a letter in the angular handwriting of Mr K. N. Harris.

It was too good a word to go begging. The Editor invited readers to submit meanings. "Who will be the first to discover, invent or concoct something which can be called an 'anodule'?" he asked in ME for November 23. A prize of one guinea was offered for the best suggestion.

In the Editor's opinion the best reply was that submitted by Mr Haydn D. Smith, of Orpington, Kent, who wrote:

"Anodule—noun from the Greek 'ana' and Greek 'odous'—having no teeth. Generally applied to a gear-wheel that has had it!"

A guinea is coming your way, Mr Smith.

Princess Royals

WHEN Sir William Stanier's famous Princess Royal Pacifics went into store there was a rumour that they would not enter service again.

Then, during the hectic summer traffic, they reappeared and many people, including myself, hoped that the rumours were false.

Unfortunately it seems that they are true, for all Princess Royals have returned to store and four of them have been withdrawn.

The class introduced the first Pacific to the Midland in June 1953.

Princess Royal, No 6200, was a tremendous locomotive, yet despite its huge size it was a good looker. Some enthusiasts, and I am not sure that I disagree with them, find the Princess Royals more pleasing to the eye than the later Duchesses.

King-like

The engine bears a strong similarity to the GW King class. The tractive effort of 40,300 at 85 per cent cut-off is identical to that of the King; the cylinders of 16$\frac{3}{4}$ in. with 28 in. stroke, and driving wheels of 6 ft 6 in., are King-size.

Russian sieve

ACCORDING to a report in the *Daily Telegraph* a staff of 14,000 Russian scientists, engineers and librarians constantly sifts through technical publications which arrive in Moscow at the rate of 500 a day.

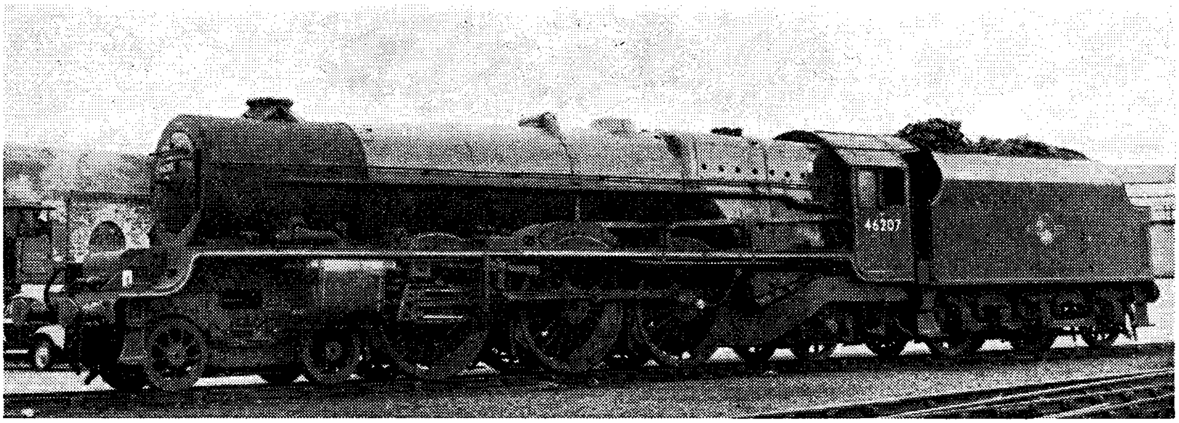
This gigantic organisation, housed in the Soviet Institute of Scientific Information, prepared 200,000 reports in 1955. The following year the number rose to 184,000 in the first six months.

I wonder how many were based on information in the pages of MODEL ENGINEER.

To our readers

across the world

A MERRY CHRISTMAS



PRINCESS ARTHUR OF CONNAUGHT *in store at Willesden in* 1961

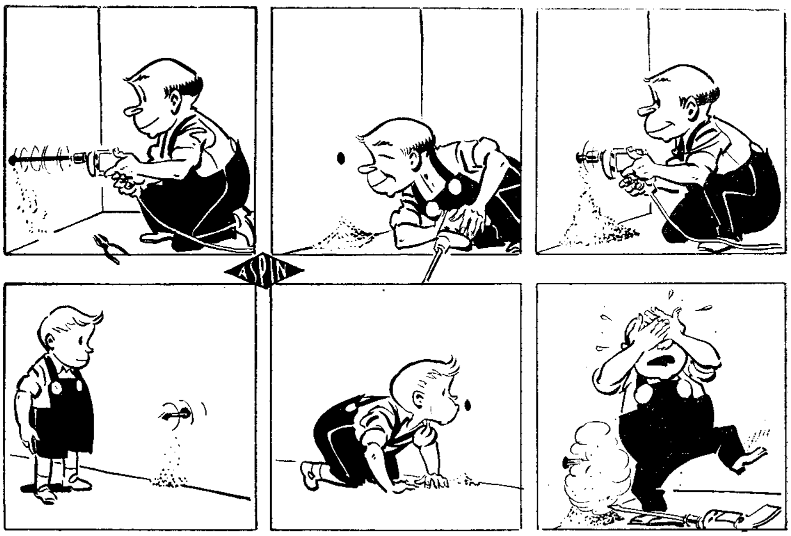
No 6202, the third to be built in this class number, was an exceptional locomotive: it was the turbine pacific. Metropolitan-Vickers equipped it with a Lysholm-Turbomotive power unit at their Trafford Park works.

Steam reached the multi-stage turbine at 250 p.s.i. and approximately 750 deg. F. A separate turbine drove the locomotive reverse. The engine was not a success, though it did a useful amount of work. It is a pity that more development was not put into the prototype.

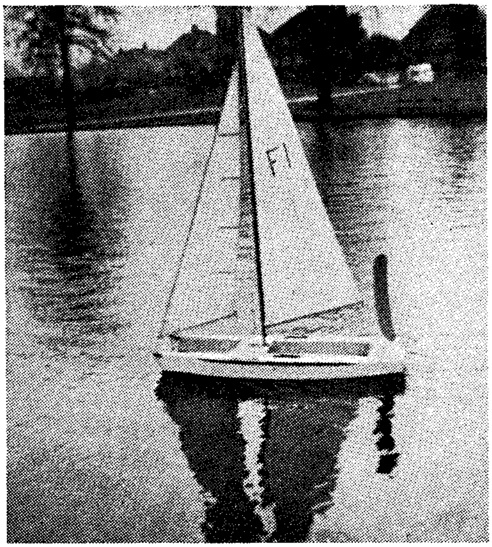
The engine was named *Princess Anne* and after several years experimental work it was converted in 1952 to a conventional Princess Royal. A few months later it crashed in the terrible Harrow and Wealdstone disaster on October 8. As a turbine locomotive *Princess Anne* covered nearly half a million miles, mostly on the Euston-Liverpool run.

The four Princess Royals which have been withdrawn are 46204 *Princess Louise*, 46210 *Lady Patricis*, 46211 *Queen Maud* and 46212 *Duchess of Kent*.

CHUCK . . . . . . THE MUDDLE ENGINEER



PROBLEMS OF MODELLING A CATAMARAN



E. J. CHARLTON solved them one by one. This is the first article of an unusual series

AFTER reading about catamarans and their fantastic speeds, I thought that I would like to own a model racing catamaran sailing yacht of my own construction.

I wrote to Eric Manners, yacht designer, of Westcliff-on-Sea, Essex, and he—a complete stranger—offered to lend me plans of any of his catamarans at about half-price. His suggestion was that I scale them down to the size I needed.

I gave the matter plenty of thought, for I was unsure of certain problems. How, for instance, would I counteract the lack of mobile human ballast? The crew of a full-sized catamaran correct the list, as she heels over in gusts of wind.

Another problem was the position of the steering gear, for on a full-sized catamaran there is no deck between the twin hulls at the extreme stern. This would mean the designing of two bridges, one amidships and one aft, to take the mast and steering gear.

I had heard it said that scaled-down boats are rarely successful. The modifications meant that I must almost completely re-design the plans as I emphatically do not believe that model yachts are capable of carrying more sail than full-sized boats, but I think that models sail faster than full-sized boats, mathematically.

While the idea of designing my own model catamaran crept into my mind, I am so wretched at mathematics that I would not allow the thought to germinate. Yet the idea was so novel and persistent that I kept telling myself to try it on paper.

Before I did so, I looked around for books on catamarans, and came across a little gem by John Fisher in the Bosun series. To me it was worth its weight in gold. It had 13 illustrations of catamarans and a passage by the famous Uffa Fox on their general principles of construction.

These are the principles:

The beam should be half the water line length;

Floats beam a quarter of the total beam;

Draught at least one-eighth of beam;

Sail area equal to 10 sq. ft to a foot of load water line;

Mainsail luff the length of the l.w.l.;

Mast diameter 1/6th of l.w.l. in inches;

Displacement on sailing water line of each float equal to total all-up weight;

The deepest part of the hull and highest amount of freeboard forward of midships;

The stem well raked, to avoid plunging or diving in sailing from the crest of one wave to the crest of another.

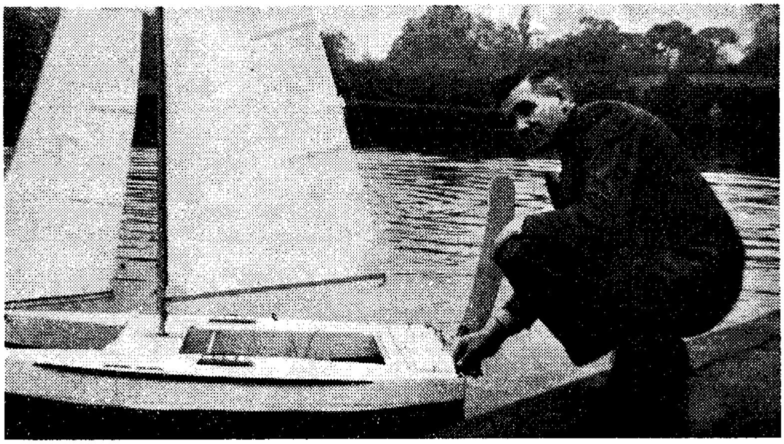
I had to determine how far I could use his general principles in designing a model. If the mainsail luff was to be the length of the load water line, and yet carry 10 sq. ft to a foot of l.w.l., as Uffa Fox said, the sail would extend beyond the stern of the boat and the foresail extend aft beyond the mast, like a Genoa sail. Braine steering would then have to be used instead of Vane gear, because the high Vane would foul on the mainsail boom and the jibsail would fail to tack automatically because of its large size.

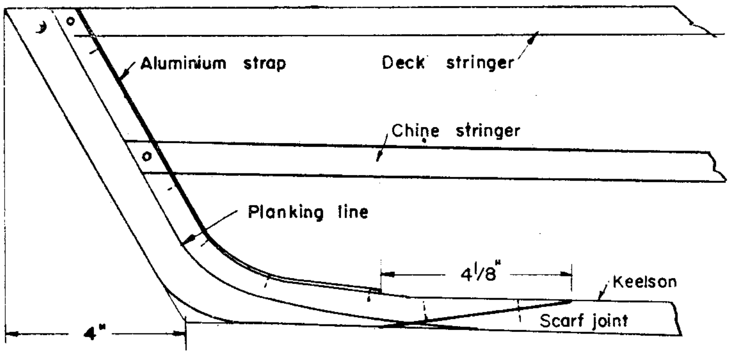
A 5 ft model has to carry 50 sq. ft of sail, if the sail area principle were applied. Imagine a sail 10 ft high and 5 ft wide on a 5 ft model!

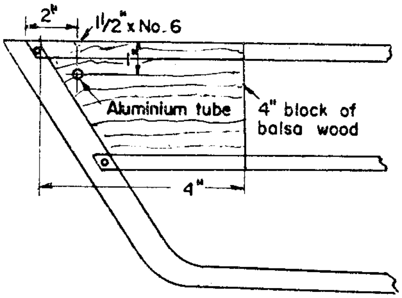
I had to work out my own sail area. First, I assumed that my boat was 5 ft long overall. The beam would then be 2 ft 6 in., float beam 7½ in., and the float height 7 in. Now, the principle put forward by Uffa Fox that the draught equals one-eighth of the beam made my waterline 3½ in. from the keelson (or bottom of the boat). The rake of the stem I worked out to be 1/15th of the load water line. The rocker shape of the keel I drew by eye. I obtained the mast position by reading about boats; which is just less than two-thirds overall length from aft.

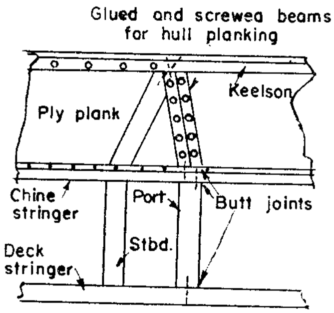
I sketched and sketched till I obtained something that looked like a catamaran. Many problems arose. The ballast, for instance, was a poser, for I did not know how to work out my water displacement though I had read somewhere that the ballast of a yacht equals just less than half the weight of the complete boat fitted up. I assumed that a catamaran would need far less than this because of her increased stability, brought about by her very wide beam. The completed weight I assessed at about 30 lb. This meant about 15 lb. ballast for a conventional yacht. I halved this and decided to use 3½ lb. ballast on each hull. But I designed my keels so that more ballast could be added if necessary.

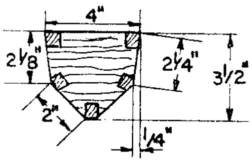
I planned to have two bridges, one forward of midships to carry the mast and to hold the floats firmly in position, and the other right aft, to carry the steering gear and so forth



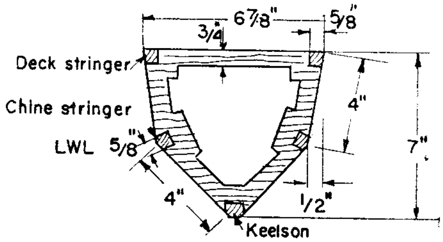








Section B-B



Section A-A

and to add to the firm fixing of the floats.

My biggest problem of all was sail shape and area. How much canvas could she carry while retaining her stability? My 50 in. Marblehead model yacht carries 800 sq. in. of sail. Knowing that my two-hulled catamaran could carry at least double this amount, I planned for 1,700 sq. in. of sail area, with roller reefing gear to lessen the area if necessary.

The ratio of area between jibsail and mainsail was a mystery to me. But I wanted to use Vane steering gear and the amount of stern deck space which I needed for it determined the shape of my sails and the height of the mast. I made a drawing of boat and sails. They looked good to me, and with no more preamble I began to scout around for the materials.

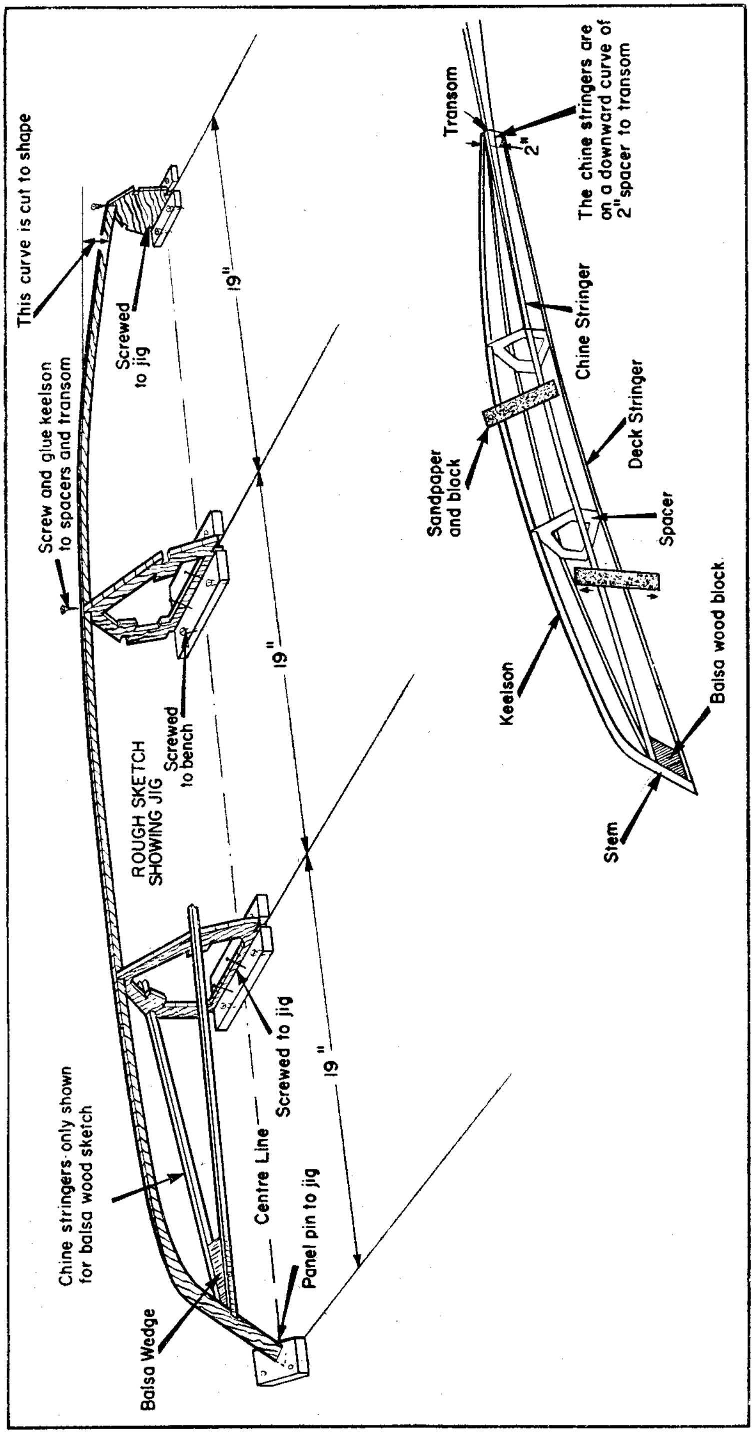
If catamarans were as fast as they were reputed to be, then mine was going to catch me out one leg and run into the concrete side of the sailing pond with great force, probably bows on. When a boat carrying pounds of steel plate ballast crashes headlong into concrete, her framework and stems would fall apart unless they were stoutly built. Yet weight had to be kept down to the absolute minimum.

In the end I decided on a hard chine construction, for the plywood hull screwed to stout timbers.

But before I started work I made an experiment in economy. As I had not designed a boat before and had no notes to guide me over the tricky bits, I did not want the choicest materials. I would use anything at hand, and make all the fittings from any odd bits of metal which I could beg from people. I set myself a target of £9, allowing out of this sum £5 for sails made to my specification.

I searched for pieces of three-millimetre plywood, and found some at Lewis's Department Store—19 in. × 28 in. at 2s. 6d. a sheet. I realised that they were rather small and that I would probably have to make my boat smaller than the planned 60 in. length. But after trying other places without success, I bought six sheets for 15s. and resolved to make them do. I went back to the drawing board and worked out the new measurements. After much careful work my figures turned out to be as follows:

Length overall ...	... 57½ in.
Load water line ...	... 55½ in.
Total beam ...	... 28¾ in.
Float beam ...	... 7½ in.
Float height ...	... 7 in.
Mast height ...	... 82 in. (altered to 96 in.)
Mast position ...	... 34¾ in. from transom
Ballast	... 7 lb. (3½ lb. each float—but trials showed that she needed about 6 lb.)
Sail area, experimental ...	1,700 sq. in. (found inadequate)



Mainsail luff	...	... 72 in.
Mainsail leach	...	... 73½ in.+3½ in. curve =77 in.
Mainsail foot	...	... 27½ in.
Jibsail luff	...	... 66 in.
Jibsail leach	...	... 60¾ in.+1½ in. curve =62¼ in.
Topsail foot	...	... 19 in.

The names which I use for parts of my boat may not be strictly in accordance with those used on conventional craft, but I think that you will understand if I explain. The keelson is the curved centre beam running the whole length of the bottom of each float; to it the steel plate keel is attached. Stringers are longitudinal beams along the length of each float, to which the side planking is fitted. Spacers are ribs keeping the stringers at the correct space apart. The transom is the stern wall of each hull.

I cut the keelsons out of a plank of timber, left over after re-roofing my garage. It was ⅝ in. thick and full of knots. I avoided them, and cut the wood on a curve to correspond with the shape of the keelsons.

The forward end of the keelsons were scarphed ready for jointing to the stems. The scarph joint length was seven times the thickness of the timber, which worked out at 4⅜ in. I planed two bevels on the bottom edges of the keelsons to accommodate the plywood planking at a later stage.

The stems I cut out of an old piece of furniture, a small door of cedar, veneered both sides and ¾ in. thick.

I glued the scarphed stems and fixed them to the keelson with two No 2 ½ in. brass screws. The glue which I used throughout was Aerolite 306, a powdered resin substance which is mixed to a paste with water and a bottle of hardener.

As soon as the scarph joint had set hard, I planed the surplus off the stem in a gentle taper along the side of the scraph joints. Then I cut two ½ in. wide strips of 20 gauge aluminium sheet about 8 in. long, and screwed it to the inside face of the stem, to strengthen the cross-grain at the curve.

The four spacers (two for each float) and two transoms were cut out of ⅜ in. plywood salvaged from an old table-top which a neighbour had given to me.

At this stage I made the simplest jig I could think up—bits of timber screwed to the bench top with the spacers and transom between them. The jig must be clearly marked along a centreline, so must each bit of timber screwed to the bench, as well as the spacers and transoms.

Placing the spacers and transom in the slots between the bits of timber and lining everything up on the centreline, I temporarily fixed them there with No 2 screws. The stem would stay in the V-shaped block.

★ *To be continued on 4 January*

LET'S GO, SIRENA !

By J. J. CONSTABLE

With this last instalment of the serial which began in February, the 5 in. Sentinel is ready to run

Make the engine bonnet from two parts in Figs 102 and 103. They are cut from 20 g mild steel plate, and all the bends indicated on the body by the dotted lines are done by hand.

Before the $1\frac{1}{2}$ in. dia. hole is cut out to the full diameter, it is better to complete the bonnet and check exactly where the hole is required. This should be done with the cab held in position by the two lugs and two small $\frac{1}{4}$ in. × $\frac{1}{4}$ in. angle pieces riveted on the inside of the cab near the doorway. The angles are drilled for 6 BA clearance and the running boards are tapped 6 BA to take short cheese-headed screws.

It will be seen from Photograph 54 that the two side edges and the slanting edges of the bonnet are fairly sharp. There is a gentle curve from the front to the top by the cover which in the full-sized engine covers the poppet valve mechanism. The bonnet is constructed in the same way as the cab.

After the end piece has been bent on the lines shown, it is inserted in the bonnet and held in place with about three rivets each side. The horizontal bends are formed by hand. Soft solder is used to make clean edges and to produce the final curve which blends into the top of the bonnet by the cap.

Photograph 55 shows the finished bonnet away from the engine, and Fig. 104 gives the dimensions for the small step and the two dummy doors at the top. The lower opening, $1\frac{3}{4}$ in. × $2\frac{3}{8}$ in., should be cut out for a small door to be removed for lubricator filling. The position of the lubricator and the cut-out of the bonnet may be seen in Photograph 56.

Apart from the cut-out, all the other doors on the sides and front are dummies. The surrounds of the doors are from $\frac{1}{8}$ in. half-round beading. I used mild steel beading, but brass would do. Half-round beading can be quickly produced in the lathe by winding wire on a mandrel and turning it away to half the diameter.

The corners of all the frames are carefully mitred and the pieces are riveted to the casing with 1/32 in. dia. copper wire. Slight countersinks were made in the beading, and all was filed flat after it had been fixed. I did not risk soft solder for fear of spoiling the appearance with an unfortunate blob. Some readers could perhaps solder the beading into place.

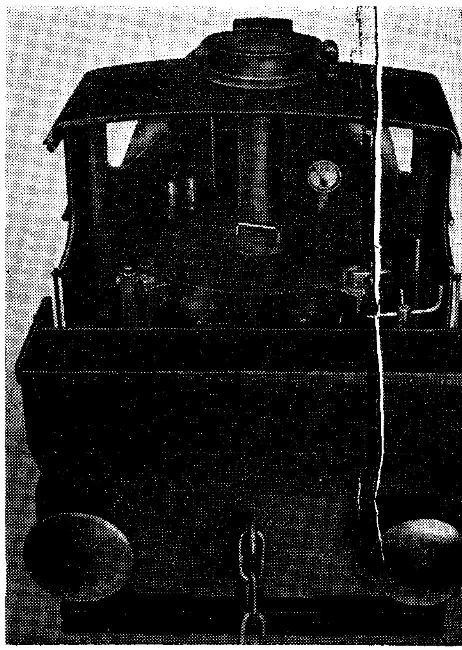
The two sides of the bonnet have an angle-piece of $\frac{1}{4}$ in. × $\frac{1}{4}$ in. × 16 g riveted on, and the front edge has a $\frac{1}{16}$ in. × 16 g strip which is also riveted. The angle and flat strips give a finished appearance and considerable strength to the casing.

The angle strip on the side has rivets on the flat part which rests on the running boards. These are dummies on the model; on the full-sized engine they hold down the casing.

Fig. 105 gives details of the hand rail knobs. You will need 28 of them. As I could not get the correct pattern I turned my own. By making a small form tool from a piece of high speed steel, or from a piece of mild steel filed to shape and then case-hardened, the knobs can soon be produced. The tool should be as sharp as possible, as all the shaping, except for the screwed part, is cut at one pass. The brass rod is held in the chuck with about $\frac{5}{8}$ in. protruding and the 8 BA portion is turned down to 0.086 in. and threaded 8 BA. Then the form tool is advanced to turn the body shape and is so arranged that the embryo knob is parted off with the smallest amount of pip, to be filed and smoothed with emery.

To drill the 3/32 in. dia. hole for the rails I held the knobs in a simple jig—of two plates held together by a spring and with a 3/32 in. dia. hole is drilled through both of them. I placed the knob between the plates and used the 3/32 in. hole as a guide for drilling.

For the actual hand rails I employed 3/32 in. dia. stainless steel. Fig. 106



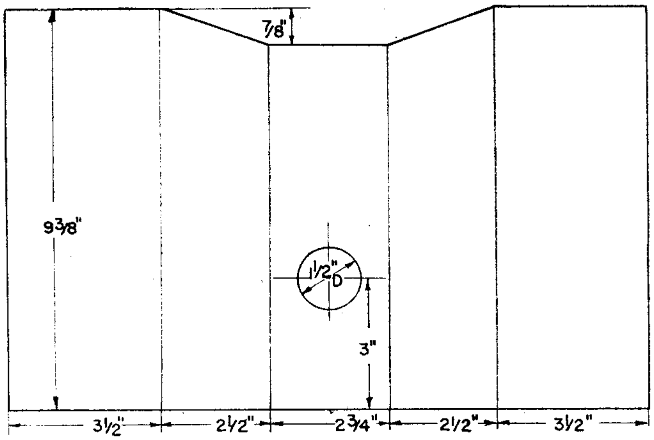


Fig 102 ENGINE BONNET 20g b m s

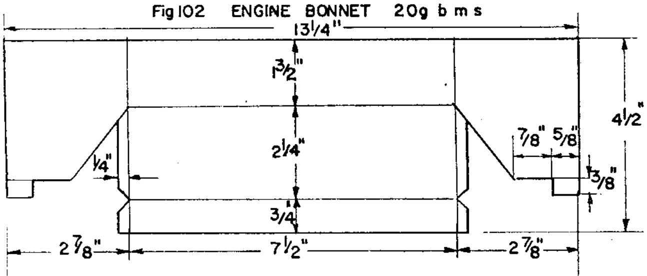


Fig 108 BUNKER 20g. bms

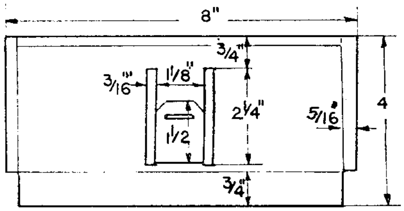


Fig 109 BUNKER PLATE 20g. bms

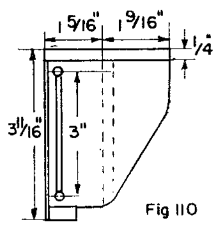
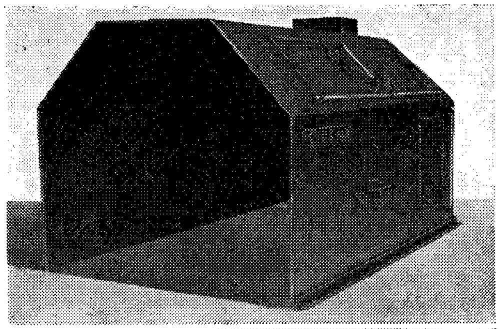
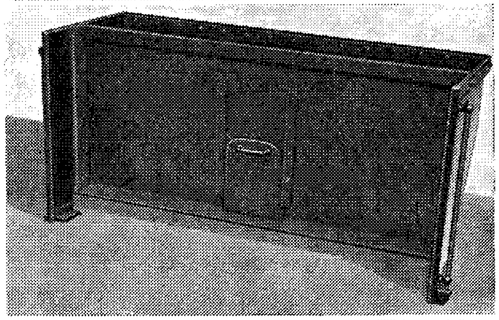
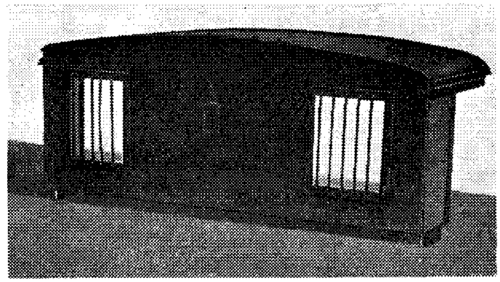


Fig 110

BUNKER SIDE ELEVATION







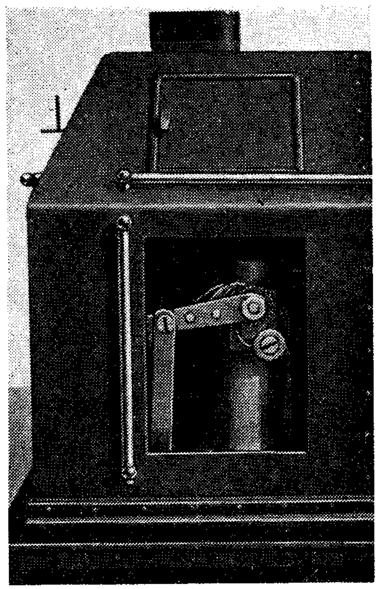
gives details of the door handles, ten of which are needed. All were made at once by silver soldering the stems to a piece of ½ in. × 16 g mild steel plate about 3 in. long. The stems were turned from ⅛ in. dia. rod and two of them were additionally threaded 8 BA. As they were parted off from the rod, a pip of $\frac{1}{16}$ in. dia. was left at the end and placed in a $\frac{1}{16}$ in. dia. hole drilled in the flat plate. The holes were spaced at ½ in. centres to allow for cutting and trimming.

I made two door handles with the threaded part in the door to close the opening in the bonnet, which was cut out as in the photograph to permit the oil pump to be filled. The door is merely a piece of 20 g mild steel cut to fit the cut-out exactly. Half-round beading is then solt soldered in such a way that half of the beading overlaps the edge.

Top of page, right: Photograph 55. This is the bonnet. Centre, 57: Coal bunker. Above, 59: How the cab looks from the rear. Right, 56: Access to lubricator

At one side of the door the two handles are put through No 44 holes. On the inside they thread into a piece of ¼ in. × ½ in. × 16 g flat mild steel lock-nutted to the handle with an 8 BA. When the handle is turned, the latches hold on the inside. On the opposite side to the handle, a small piece of 20 g mild steel strip is riveted to latch behind the casing. The door in the closed position can be seen in Photograph 54.

Two frames needed for the rear windows are made in the same way as those for the front and are fitted with coal guards. Careful marking out for fitting the piano wire is



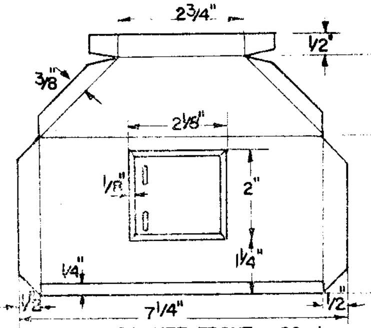


Fig 103 BONNET FRONT 20g. bms

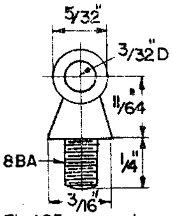


Fig 105 bms HANDRAIL KNOB

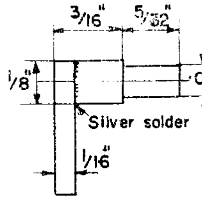
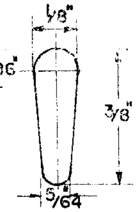


Fig 106



DOOR HANDLE bms

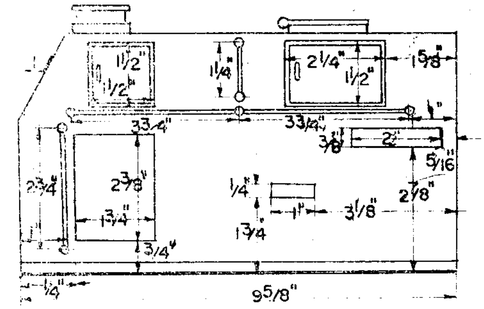


Fig 104 BONNET SIDE ELEVATION

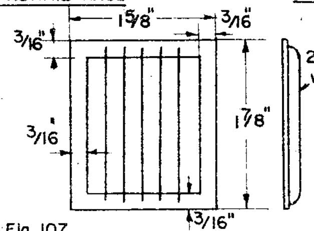
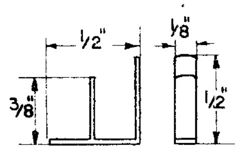


Fig 107 WINDOW FRAME brass



LAMP BRACKET Fig 115 bms

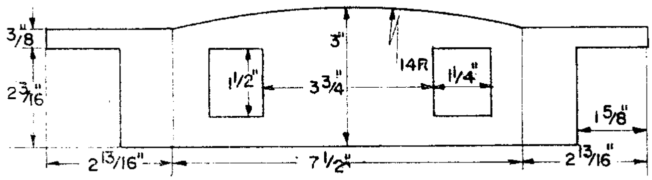


FIG 111 REAR CAB 20g. bms

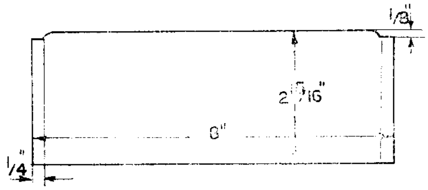


Fig 113 REAR CAB ROOF 20g. bms

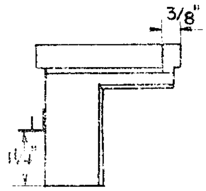


Fig 112 REAR CAB SIDE ELEVATION

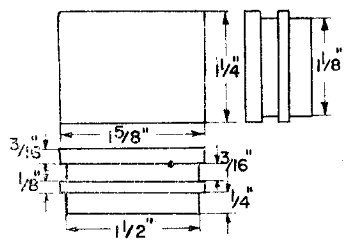


Fig 114 BONNET CAP Brass

essential as small discrepancies will show up badly.

To get all the bars the same distance from the frame I placed them in position and interposed a piece of 0/32 in. gauge plate. Any spare ends of piano wire were then filed off after soldering.

Photograph 57 illustrates the coal bunker; details are given in Figs 109 and 108. The bunker is cut from a 20 g mild steel plate and all bends are made by hand, as far as possible. The bunker plate is cut from the same material and is riveted to the inside of the bunker by the dotted lines in Fig. 110. It can also be soft soldered, but the outside finish is quite smooth and rivet heads must be filed off.

Although a coal shute plate is shown complete with slides, there is no hole behind! It would in any event be of little use in the model.

In Fig. 110 the small pieces of ¼ in. × ¼ in. × 1/16 in. angle seen at the foot of the bunker are fitted both inside and out. Those inside are screwed down to the footplate in the same way as those of the cab. The bunker is also fastened down to the rear buffer beam with five 6 BA countersunk screws. A ½ in. wide piece of 16 g mild steel strip fits on the ¾ in. bunker part which in turn fits on the buffer beam. The strip acts as a long washer with countersunk holes to take the screws.

The rear part of the cab is removed for driving. All bending is done by hand and the seams are filled with soft solder where it is needed.

From the side-view of the cab in Fig. 112 you will see a ⅜ in. wide mild steel strip of 20 g. It is above and below the roof and extends ¼ in. beyond the roof proper. The front part of the cab fits between the two strips when the rear part is in position. You may also find it a help to have two small extension pieces on the 1¼ in. part. They will hold the rear part of the cab in position.

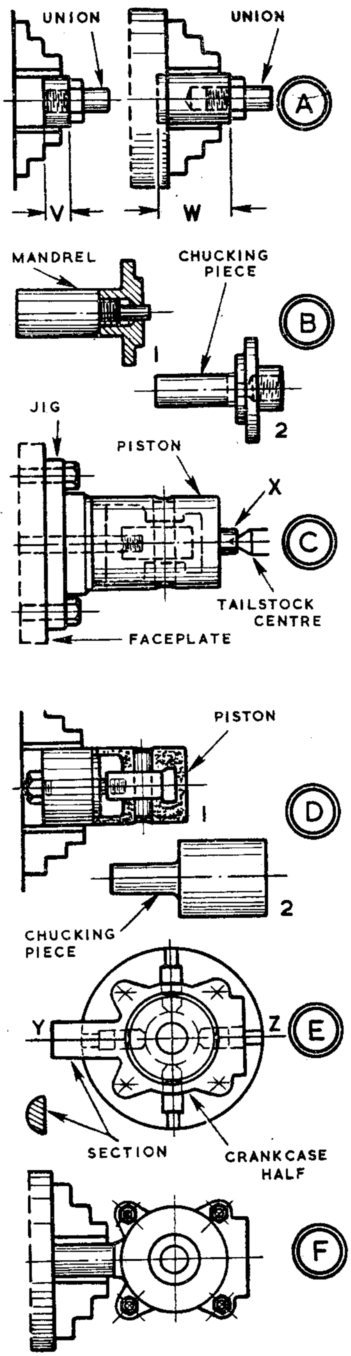
Fig. 114 shows details of a small cap on the front part of the bonnet. On the full-sized engine it covers the top of the valve spindles, and on the model it could be used to accommodate a reservoir for lubricating the main bearings.

The only other parts required are the two lamp brackets in Fig. 115. I fitted one at the front on the bonnet

● *Continued on page 767*

Holding and resetting

By GEOMETER



WITHIN the range of standard chucks, there are many ways of holding work for first operations and of resetting it for those which follow.

The three-jaw chuck is used for holding round and hexagon bars from which many small parts are machined. Some may be finished and parted off at a single setting, which ensures concentricity—except with a drill running. Others must be machined as far as possible at the first setting and then parted off and reset for further operations. Naturally, the later machining must be true with that already performed; and the usual method of ensuring the essential accuracy is to machine a mandrel in the chuck and mount the parts on it. At times this applies to components made from castings, such as covers, endplates, pulleys and flywheels.

With the four-jaw chuck, the range of holding and resetting methods is extended through its reversible and independently-adjustable jaws. The chuck can be used in the same way as the three-jaw for mounting bar stock and second-operation mandrels, with the additional advantage that adjustments are easily made to eliminate eccentricity.

Accuracy—which includes freedom from eccentricity—is the most important feature of a second-operation mandrel. If the mandrel is machined in the chuck and used once, the result is not in doubt. But it is if the mandrel is removed and kept for further use—unless precautions are taken. This may be seen from diagram *A*, where a double-ended union is set up in a short mandrel (left) and a long mandrel (right).

The short mandrel can be made from a scrap of material, faced with a turning tool and centred, drilled and tapped from the tailstock. The union will screw in and spin truly. But when the mandrel has been removed, it is unlikely to rechuck truly again, because of its short length (*V*) and the fact that it is gripped only at the outer ends of the jaws. To be reasonably certain that a mandrel of this sort will rechuck truly, you must extend it well into the chuck jaws (*W*); and if it is turned in the three-jaw chuck, you should make a reference mark with a centre punch opposite No 1 jaw.

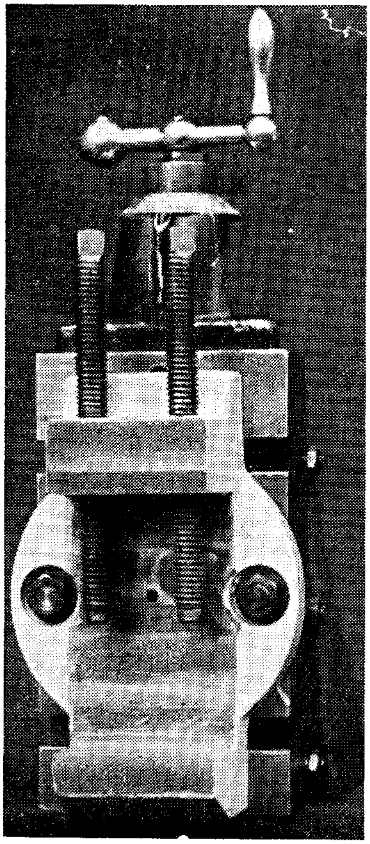
Sometimes a faulty part can be trued on a mandrel, when light cuts will suffice to correct it. As an example, a cylinder cover in which the piston rod binds, or which affects the smooth working of the cross head, can be mounted on a mandrel, as at *B*1, for skimming each side of its flange.

The setting up of castings is often facilitated through cast-on pieces which can be gripped in the chuck. These may allow all-over machining at one setting—and so avoid the use of a second-operation mandrel; or they may provide alternative, simpler mountings for components which would normally be set up by other methods. An example is a cover, as at *B*2, with a chucking piece which serves for holding it, and from which it is finally separated with a parting tool.

A piston of commercial size may be set up for machining the outside, as at *C*. The jig is bolted to a faceplate (or driving plate) and machined with a short spigot which fits inside the skirt of the piston. A drawbolt pulls on a pin in the gudgeon pin bosses; and support is provided by the tailstock to a short extension piece (*X*) which is finally machined off.

In model size, a piston can be set up in the same way, as at *D*1, or if a chucking piece has been provided on the casting, *D*2, it can be held by that in the chuck.

Many other components can be set up through chucking pieces, a method which on occasion is unorthodox but effective. As an instance, each half of a small crankcase, split on the vertical centre line, can be provided with a half-round chucking piece. Facing of each half is done as at *E*, and a line (*Y-Z*) is scribed. With the halves bolted up, centres are made at the ends. The chucking piece is machined between centres. Holding by it, as at *F*, you can machine the face for the cylinder. ■



MILLING VICE

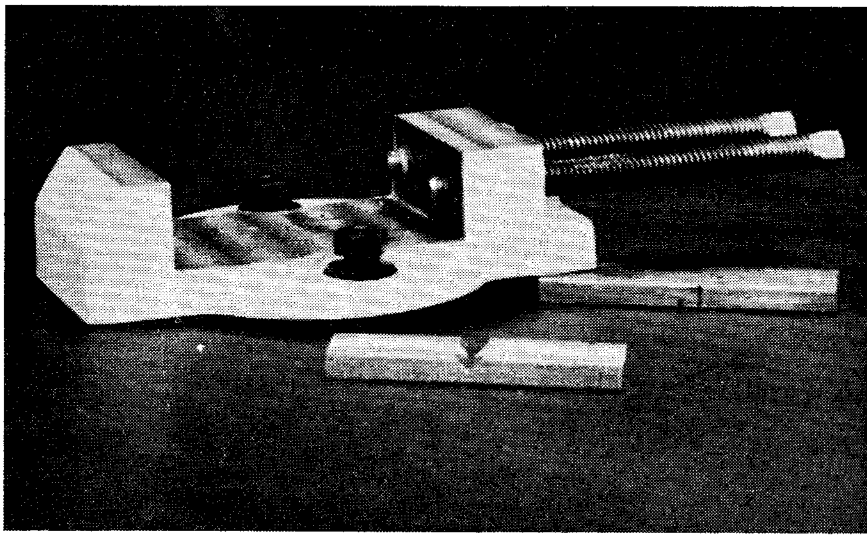
FOR A MYFORD SLIDE

By WILLIAM MOORE

MY small drilling vice was designed and made to suit the Myford slide. Only one simple iron casting is required, and the pattern is easy to make.

Pine (or any soft wood) 5 in. long, $3\frac{1}{2}$ in. wide and $\frac{5}{8}$ in. thick (finished sizes) was used for the base, and the curved sides—which are part of a $3\frac{1}{2}$ in. circle—were reduced to $\frac{3}{8}$ in. thick. The jaws are 2 in. long $\times \frac{7}{8}$ in. $\times \frac{7}{8}$ in. They are glued and pinned to the base. The angle web is $\frac{3}{16}$ in. thick, and is also glued and pinned. One jaw is bevelled on the outer side.

It is advisable to radius the inner angles of the jaws in the pattern, as sharp angles lead to cracks in the casting. I applied fillets of plastic wood. Besides sanding the pattern well, I gave it a coat of aluminium paint to help in drawing it from the sand. The casting should be wire brushed to remove the sand, and rough parts should be filed down.



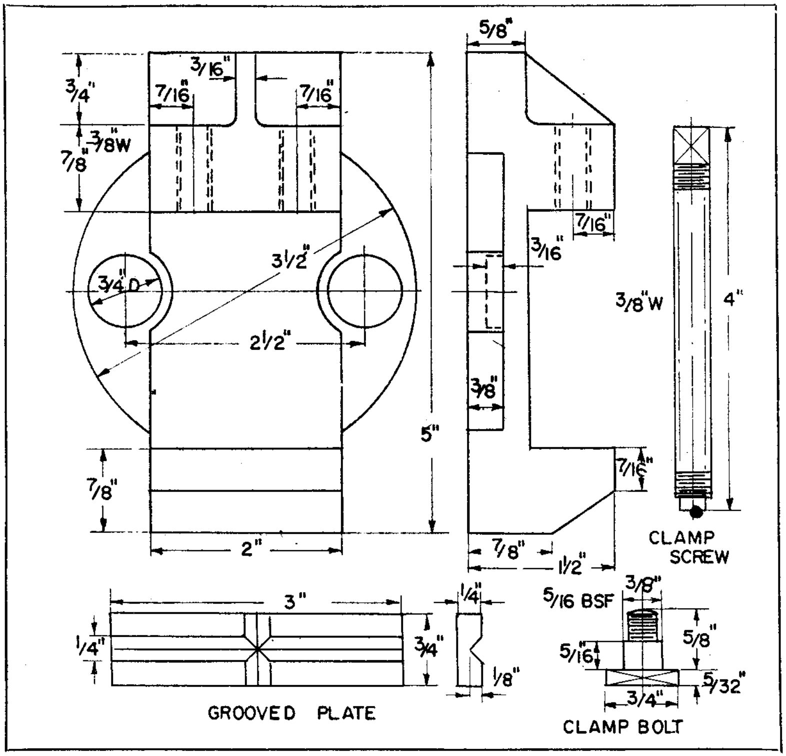
Put the jaw-side in an independent chuck, and face off the back perfectly flat to about $\frac{5}{16}$ in. on the thinnest part. Reverse in chuck, and take a cut off the top of the jaws to clean them up. Remove from chuck; mark and centre-drill. Drill $\frac{3}{8}$ in. holes on the centre-line of the circular part of the base for the clamping bolts, and countersink them $\frac{3}{4}$ in. in diameter with a spot-face cutter. Make their depth $\frac{3}{16}$ in., or deep enough for a $\frac{1}{4}$ in. standard steel nut, with a steel washer underneath to be about $\frac{1}{8}$ in. proud of the surface of the $\frac{5}{16}$ in. flanges.

You can make the clamping bolts from $\frac{3}{4}$ in. mild steel rod. I made mine from scrap steel bolts. The bolt heads are 5/32 in. thick for the T-slots in the slide, and the body is $\frac{3}{8}$ in. for the same purpose. The threaded part is reduced to $\frac{5}{16}$ in. and screwed BSF. File the heads on opposite sides to slide easily in T-slots. The nuts are $\frac{1}{2}$ in. steel, drilled out 17/64 in. and tapped $\frac{5}{16}$ in. BSF.

Set up your vertical slide dead parallel with the chuck face. Place a thick steel parallel scale or rule—I use the rule of a combination square—in the chuck, and tighten the jaws up lightly to hold it. Bring up the face of the slide to it, and tighten up.

Setting it level

Bolt your casting to the slide, set true—if your lathe is perfectly level use a small spirit level (I used a line level on the lower jaw) or the scribing block on the bed. Bolt firmly. A tube spanner ($\frac{1}{4}$ in.) fits in the recesses around the bolt holes in the vice.



I used a $\frac{3}{8}$ in. endmill in a mandrel holder—it could be held in the three-jaw—to face up the base and jaws. If you have a shaper, you could do the jaws and base in that, but I prefer facing the work in position on slide, so that it is true when in the working position. Clamp the saddle firmly to the bed.

If an endmill is used, you will doubtless have to face the bed of the vice in two parts, as the vertical slide may not extend enough to complete it in one setting. With two settings, reverse the vice for the second, so that you can see how the cleaning up is going on the inside of the jaw. Set the jaw which you have already finished (do not omit to run the endmill over the top of the first jaw before reversing) with the level or scribing block on the underside of the finished jaw.

Be careful to get the second facing cut to the same depth as the first; I used a micrometer stop on the bed. Skim the top of this jaw to the same height as the previous one. If you have a long cross-slide travel, you may do the milling in one setting, by placing the vice horizontally on the slide, and using a clamp if necessary to hold it in position.

Remove the vice from the slide. If there is enough clearance under the drill, press, and remove the slide from the lathe, leaving the vice in position (if it is in the vertical position on the slide) and mark out for clamping screws. Centre punch, centre drill, drill $\frac{5}{16}$ in., and tap $\frac{3}{8}$ in. Whitworth. If you cannot get the vice under the drill, remove and clamp to an angle plate and set true with the level on the jaw. Place a $\frac{3}{8}$ in. Whitworth tap in the chuck and tap a few threads to get the screws square with the surfaces of the vice.

The long clamping screws were 4 in.$\times\frac{3}{8}$ in. steel set ones, screwed to head—a standard product. The points are reduced to $\frac{5}{16}$ in. dia. bare for $\frac{1}{4}$ in. and point chamfered. The heads can be left or reduced to fit the $\frac{1}{4}$ in. tube spanner. I reduced the heads to fit my square toolpost key by turning them down to size over the corners and filing them square to fit. I also case-hardened heads and points.

All arrises were taken off lightly with a file, cleaned all over with cleaning fluid, given a coat of aluminium paint where they were not machined, and finished with enamel to match the slide. The clamping bolts and nuts to fix the vice to the slide were heated to blue and quenched in thick oil.

To complement the vice, you need two pressure plates about 3 in.$\times\frac{3}{4}$ in. $\times\frac{1}{4}$ in., of mild steel—one plain and the other V-grooved longitudinally and transversely, about $\frac{1}{8}$ in. deep, to hold the circular sections in the vice.

The V-grooved plate was my first job in the vice. It was packed up with a piece of steel to clear the cutter. The $\frac{3}{8}$ in. endmill with V-slide was set at an angle of 45 deg. to chuck—and I was completely satisfied with its performance. It has done away with the bother of clamping plates and bolts.

If the vice is required for angular work toe plates and short bolts can be used to clamp it. ■

DRILLING CARBON STEELS

The Production Engineering Research Association is carrying out a series of investigations to determine the effect of point shape on drill life.

Tests were made on low carbon steel En 3A, and on high carbon steel En 10, and the principal recommendations are:—

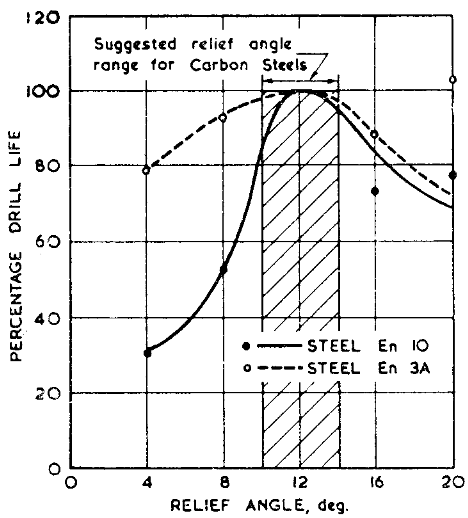
When drilling steel En 3A, the point angle should be 110 deg.

When drilling steel En 10, the point angle should be 100 deg.

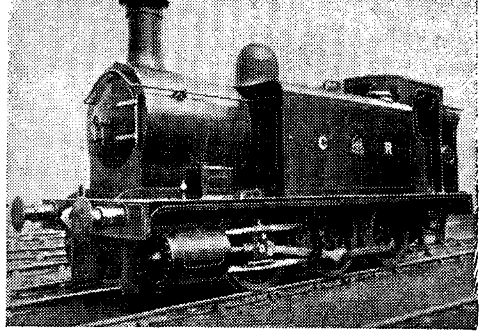
As a compromise, when mixed batches of low and medium carbon steels are to be drilled with a single set of drills, a point angle of between 100 deg. and 105 deg. is suggested.

The relief angle should always be 12 deg. ± 2 deg.

The effect of variation of relief angle on drill life is illustrated in the diagram.



ROB ROY



Build this neat 0-6-0 Caledonian tank engine in $3\frac{1}{2}$ in. gauge and enter it in our locomotive Building Competition. Entries will be judged at the next Model Engineer Exhibition.

END OF A YEAR'S PROJECT

CONCLUDING
AN ME STAFF FEATURE
From November 23, pages 630 to 633
By MARTIN EVANS

Rob Roy's safety valves are very easy to make, and as they are fairly tall, we can use good long springs which allow of more accurate setting and steadier action.

We can use $\frac{7}{16}$ in. hexagon gunmetal though brass is a reasonable substitute. Chuck a suitable length, turn down the outside, with the top towards the right, drill right through with No 24, and ream 5/32 in. dia. Open out with a 7/32 in. drill to a depth of $\frac{11}{16}$ in., and bottom with a 7/32 in. D-bit. Tap $\frac{1}{4}$ in. × 40 t to a depth of $\frac{5}{16}$ in.

Now, reverse in the chuck, holding the fitting by the hexagon base, turn down to $\frac{5}{16}$ in. dia. for a length of $\frac{1}{4}$ in., chamfer, and thread 26 t. Form the ball seat in the usual way, using a $\frac{3}{16}$ in. steel ball and a piece of brass rod hollowed at one end. One tap with a light hammer should be sufficient.

Turn the spring pin from 5/32 in. dia. gunmetal reducing the shank to 3/32 in. dia. The adjusting nut, which is threaded $\frac{1}{4}$ in. × 40 t, should be drilled centrally with a No 40, and four No 55 holes are provided as the steam outlet. You will probably find 22 s.w.g. stainless steel spring wire all right for a working pressure of 80 lb., but this can be better determined when the finished engine is in steam. Make the spring an easy fit around its pin. The length should be such that the adjusting nut can just be started before compression begins.

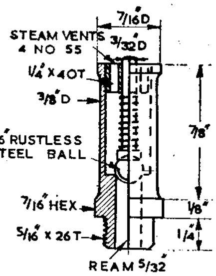
You can build up the manifold, or turret and whistle valve from $\frac{5}{16}$ in. square brass and $\frac{3}{8}$ in. hexagon brass or gunmetal. Turn up the vertical part first, drilling it $\frac{1}{8}$ in. dia. right through. Press it into a suitable length of the $\frac{5}{16}$ in. square, allowing enough material each side for chucking. Drill right through the square bar 3/32 in. dia., open out 5/32 in. dia., and form the seating for the $\frac{1}{8}$ in. ball. Then tap $\frac{3}{16}$ in. × 40 t. Reverse, open out 5/32 in. dia. × 5/32 in. deep, and tap $\frac{3}{16}$ in. × 40 t.

The three branches can be turned up, threaded and drilled, and a $\frac{3}{16}$ in. dia. shoulder can be turned on the inner end. They can then be pressed into the main body. Silver solder the whole. Make certain that the joints are absolutely clean and use the minimum possible of best grade solder.

The union threads can be protected by steel nuts. I always keep a few rusty nuts $\frac{1}{4}$ in. × 40 t specially for this purpose. They are less likely to become accidentally soldered to the unions.

Normally the ball is held on to its seating by a light rustless spring about 30 s.w.g. To operate the whistle, a $\frac{1}{16}$ in. dia. pin is moved by a lever made from flat steel about $\frac{3}{16}$ in. × $\frac{1}{16}$ in. section.

The water gauge may be any standard pattern, with fittings threaded



SAFETY VALVE
2 OFF BRASS OR GM
SET UNDER STEAM TO 80 LBS PER SQ. IN.

$\frac{1}{4}$ in. × 32 t. While the bottom fitting screws into a normal bush, the top fitting requires a special piece which is screwed on to the side of the boiler as shown in the view of the cab fittings. Use 6 BA brass screws and soft-solder the fitting to the boiler to ensure steam-tightness. A Hallite washer could be used, but as the seating is a curved one and not machined it is rather difficult to keep it steam-tight. A $\frac{3}{4}$ in. or 1 in. dia. pressure gauge reading up to 150 lb. is installed as shown; the syphon pipe is thin-walled $\frac{1}{8}$ in. dia. copper tube.

I have redrawn the buffers to show the large heads which are so prominent on the full-size *Rob Roy*. The bodies are turned from $\frac{11}{16}$ in. dia. round mild steel. Turn the backs first, leaving them at least $\frac{1}{2}$ in. long, and thread $\frac{5}{16}$ in. × 26 t or 32 t. Chuck a short length of the same material, and face, centre, drill and tap it to match the buffers.

Screw each of the buffer bodies home in turn. Turn the outside to shape, drill right through $\frac{1}{8}$ in. dia., and then open out to a depth of $\frac{5}{8}$ in. with a 13/32 in. drill. As the bodies have to be screwed in fairly tightly, it may prove difficult to screw them out again without damaging them. The way I do it is to insert the shank of the 13/32 in. drill, bend a piece of thin brass sheet around the outside parallel part of the body, and tighten a toolmaker's clamp over the sheet. The drill shank prevents the buffer from being squeezed out of shape, while the brass sheet prevents scoring.

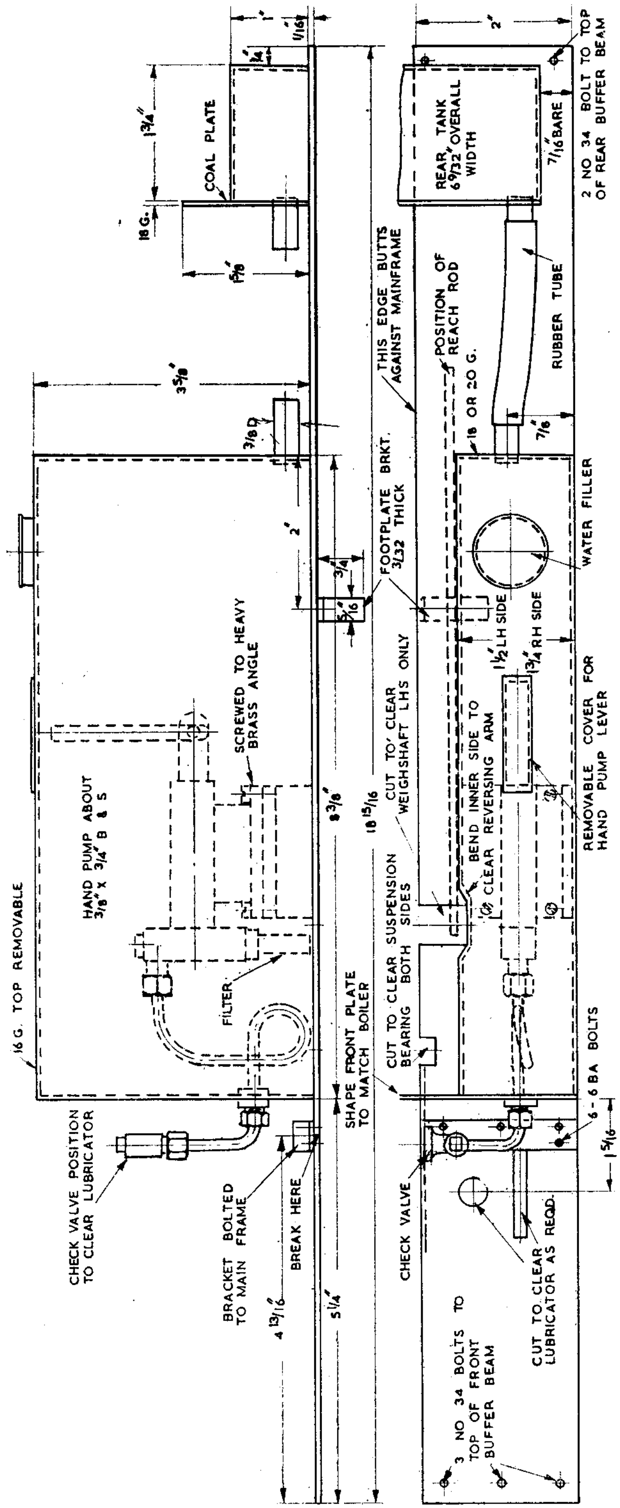
The heads are turned from $1\frac{1}{8}$ in. dia. mild steel.—use Ledloy if you can. Skim the outside and reduce to 13/32 in. dia.—a close working fit in the bodies—leaving a good radius between head and shank. Centre drill and tap 5 BA about $\frac{3}{16}$ in. deep. Part off, and re-chuck by the shank to finish the heads.

You can make the spring pins from $\frac{1}{8}$ in. dia. silver steel, threaded 5 BA at each end. The springs should be wound up from 18 s.w.g. wire for the front buffers and from 20 s.w.g. wire for the rear. To complete the buffers, four fixing nuts will be tapped $\frac{5}{16}$ in. × 26 t or 32 t. They can be made from $\frac{7}{16}$ in. A/F hexagon steel.

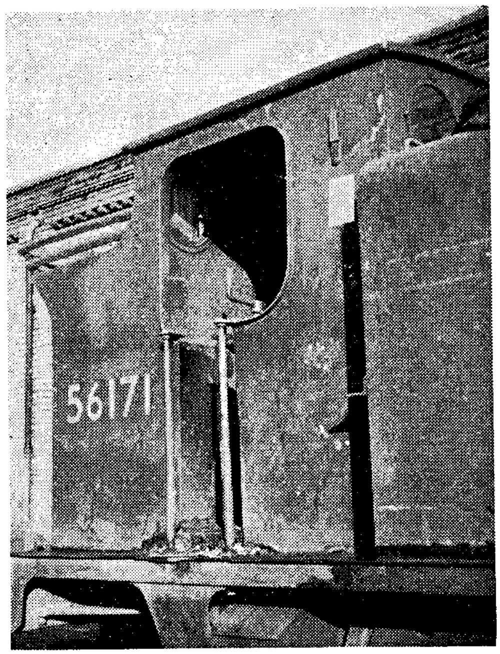
Three-link couplings are fitted to *Rob Roy*. The hook can be filed up from $\frac{1}{2}$ in. × $\frac{1}{8}$ in. bright mild steel. All sharp edges should be removed and the hole for the top link well countersunk on both sides. The section which passes through the $\frac{3}{16}$ in. × $\frac{1}{2}$ in. slot in the buffer beams may be made a fairly easy fit, which will give a little flexibility on sharp curves. Bend up the links from 15 or 14 s.w.g. mild steel wire, brazing the joins.

The shape of the boiler mountings can be seen in the General Assembly (page 202, February 16). While you are turning them, have a photograph of the engine in front of you.

The method of dealing with the chimney and dome must depend on the casting. I prefer to have a decent chucking spigot on the top. It can then be used to hold the chimney or dome while the underside is fly-cut to the desired radius. The casting is clamped under the toolholder by the spigot, at lathe centre-height, and the fly-cutter is set out to describe the radius.



FOOTPLATE AND TANK LH & RH LH DRAWN CAB & BUNKER SIDES NOT DRAWN

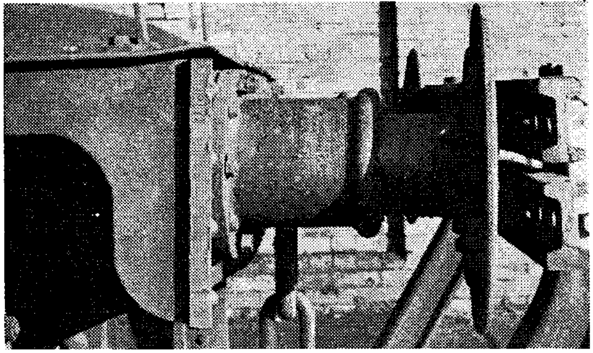


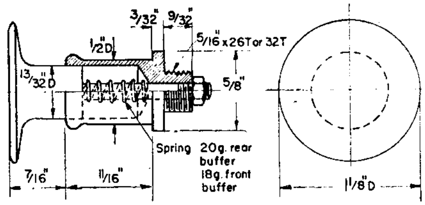
To turn the outside, I use a normal parting tool with the face quite square, and a similar tool with both edges radiused off at about $\frac{1}{16}$ in.

As a boring gauge use a piece of tube similar to the piece for the petticoat pipe. If the chimney is a good push fit on it, no further fixing will be required.

The top of the dome is best machined by a temporary spigot fitted to the underside. After the fly-cutting operation has been completed, the dome casting is chucked in the three-jaw, underside outwards, and the inside is drilled and then bored out to a push fit on the inner dome. A No 34 drill is put right through.

Now, turn up in the lathe a brass stub mandrel of such a diameter that





BUFFER. 4 OFF BMS

the dome is a tight push fit on it, but not so tight that you have difficulty in getting it off again.

The outside can then be finished off in the usual way. When the engine is completed, the dome cover is held down by a single 6 BA hexagon head screw into the tapped hole in the top of the inner dome.

You will find 26 s.w.g. hard brass sheet about right for the boiler cleading. For the lagging I recommend asbestos string, wound tightly around the barrel and right around the firebox. After the brass cleading sheet has been rolled tightly around, it is held in place by four boiler bands, about $\frac{3}{16}$ in. × 1/32 in. section stainless steel, nickel silver, or brass, in that order of preference.

As the three front boiler bands are on the barrel they can be secured by making sharp right-angle bends underneath the boiler, and putting a 6 BA steel screw and nut through each of them. The rear boiler band comes on the firebox, and its ends could be held down by 8 BA brass screws put into the foundation ring. After all bands are in position and tightened up, cut away the excess asbestos string where it crosses the grate area.

The first parts of the platework to be tackled are the running boards. On the left-hand side of the engine we already have a short piece, $4\frac{13}{16}$ in. long, extending from the front to a short distance ahead of the side tank. Cut out another piece (2 in. × $\frac{1}{16}$ in. thick) to complete the left-hand side, noting that the running board overlaps the extreme edge of the buffer beam by roughly 1/32 in. This section of running board should be of brass; it is supported by the rear buffer beam, by the bracket joining it to the front piece, and by a second bracket cut from 3/32 in. or $\frac{1}{8}$ in. thick brass angle as shown.

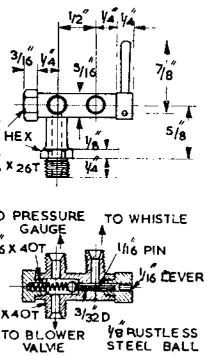
There are several cut-aways, the first one to clear the suspension bearing, the second to clear the end of the weighshaft, and the third (not shown in the drawing) to clear the stand of the reversing gear. They should all be carefully marked off on the job itself.

The right-hand running plate will not need the slot for the weighshaft or for the reversing stand, but it will require clearance for the upper part of the feed pump.

We shall now use two short pieces of $\frac{1}{16}$ in. brass sheet to complete the spaces underneath and in front of the smokebox, and at the back, under the bunker. The one at the back need not be more than $\frac{3}{8}$ in. long × $3\frac{1}{8}$ in. wide as the bunker water tank sits on top of it. Hold it down to the rear buffer beam by two 6 BA countersunk screws.

Make the side tanks next, using 18 s.w.g. brass sheet for preference. The top of the left-hand tank must be made removable, so that you can get at the hand pump, which is screwed to a piece of heavy brass angle. Use cheesehead brass screws, about 5 BA, so that you can reach them from above with a screwdriver. Do not employ loose nuts, but tap the angle itself.

A little union fitting should be made up for the water pipe from hand pump to clack. It could be soldered into



TURRET & WHISTLE VALVE BRASS OR GM.

the front of the tank. The pipe to the clack should be thin-walled and well annealed, or trouble may be encountered in lining up the two unions.

Note that the left-hand side tank is considerably narrower than the right-hand, to allow clearance for the reach rod (see drawing of cab layout, page 503, October 26). The right-hand side tank contains the water suction filter, which can be rolled up from fine copper gauge (sold by motor-cycle spares people). Solder the filter to a brass turning put in from the outside with two or three 8 BA brass screws. You can use an oiled paper washer.

The water by-pass valve can be a standard 5/32 in. pipe " steam " valve. As it is screwed home into the front of the tank, it would be advisable to thicken the brass sheet locally to allow more threads.

Into the tank side of the by-pass valve screw a length of 5/32 in. copper tube, arranged to end just underneath the left-hand water filler. The tube enables the driver to check whether the pump is functioning properly on the run. It must, of course, be fitted before the top of the tank is sealed down.

A small bunker water tank is also provided. It should measure 6 9/32 in. wide × $1\frac{3}{4}$ in. long × 1 in. high overall dimensions. The tank can be soft-soldered up, using 18 s.w.g. hard brass sheet, and do not forget that *an air vent must be fitted*, or the air will, of course, get trapped in the tank, which will not fill with water from the main tanks.

A simple air vent can be made from $\frac{5}{16}$ in. dia. brass tube. It may be fitted to one side of the tank, and rise to a height of $3\frac{3}{4}$ in. from footplate level. Blank off the top of the tube and then drill a couple of small holes just below the top edge.

Communication between the bunker tank and the main tanks is made by short lengths of $\frac{3}{8}$ in. dia. tube as shown. Rubber tubes can be slipped over them after the footplate has been placed in position.

The spectacle plate can be made and fitted now. It can be formed in one piece. Make the cut-away for the firebox $3\frac{1}{4}$ in. wide, together with the necessary minimum clearance for the double thickness of lagging and cleading—about 5/32 in. The overall width of the spectacle plate should be 6 9/32 in., as for the bunker water tank. With the addition of two side sheets of 18 s.w.g. material, this makes a width over the cab of $6\frac{5}{8}$ in. overall.

The bunker could be made the full height if desired, but probably a better method of achieving a reasonable amount of accessibility would be to cut a piece about 4 in. wide × about 2 in. deep in the upper part of the bunker back, and make this piece removable for driving. The cab roof, too, could be made a fixture as far as the centre batten, the other half being a sliding fit. With these two modifications, *Rob Roy* should not be difficult to fire on the run.

I have not given any drawings of the hand pump, as a commercial casting is generally used, and the internal works should be almost self-evident after the crosshead pump has been successfully completed. You could use 3/16 in. rustless steel or bronze balls on 5/32 in. dia. seatings.

A suitable whistle was described a few weeks ago (November 30, page 670). It is a good idea to make the end cap a sliding fit in the tube, try the whistle in steam, and shift the end cap until the desired note is produced. Then fix the whistle permanently.

I believe I am right in saying that the old Caley whistles were very deep toned, in which event it might be better to use ¾ in. dia. tube and begin with a length of 4½ in. The completed whistle can be tucked away underneath the right-hand cab step.

Painting

My advice is to paint the chassis as you go. Bright parts can be temporarily preserved from the rust enemy with Shell Ensis or a similar oil.

Those who have no spraying equipment should buy the best artist's flat brush that they can afford. About ½ in. wide Sable or Sable-Ringcat is ideal. Make sure that the model is really clean, and do not apply too much paint at a time.

Another important point: do not paint in a damp atmosphere, and, of course, cover the model immediately you have applied each coat. It pays to knock up a light wooden box to enclose the engine.

I prefer a good quality eggshell oil paint, with a proper undercoat, carefully rubbed down. Three coats of paint can be applied by brush, the first two well rubbed down with the finest pumice powder or a similar material. After the lettering and so forth, one coat of best carriage varnish should be applied.

The full-size *Rob Roys* were, I believe, painted black, but if anyone has a go at the full passenger colours in all their glory, I certainly would not blame him! The crests alone will keep him busy for many evenings.

Painting is a difficult art. One virtue we must all possess in abundance if we are to master it is patience.

This brings me now to the end of our serial. If you meet any snags, do not hesitate to write to me through the Editor; I will do my best to help. Equally welcome are suggestions for improvements, and constructive criticisms of all kinds. Two heads are better than one!

I hope and believe that we shall see a fine line-up of *Rob Roys* at the next ME Exhibition; until then, builders all, *au-revoir* and good luck. ■

This serial was introduced, with details of the Building Competition, on January 19 (*page* 67). *The first opening instalment was published on February* 16 (*First Make the Mainframes, page* 201).

Dates of other instalments were:—

March 16 (*Ahead with the Wheels and Axles, page* 324);

April 13 (*Eccentrics and Cylinders, page* 448);

May 11 (*Cylinders, Crossheads and Slide Bars, page* 590);

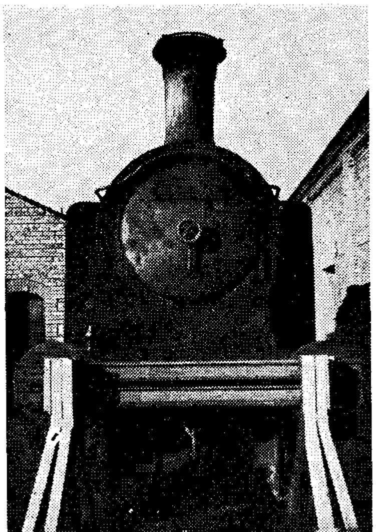
June 8 (*Motion Plates, Slide Bars, Crossheads and Stephenson Gear, page* 715);

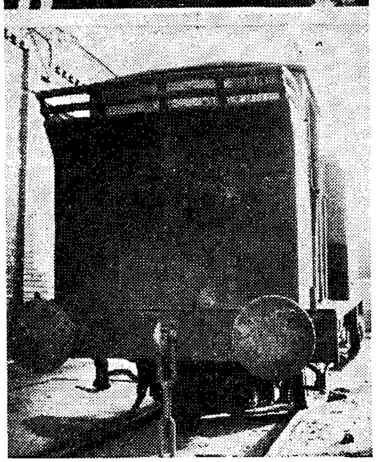
August 31 (*Steam and Exhaust Pipes, page* 264);

September 28 (*Work Begins on the Boiler, page* 372);

October 26 (*Boiler, Firebox and Grate, page* 502);

November 23 (*Boiler on the Frames, page* 630).





GENERAL CONDITIONS

1. The prizes are intended to encourage beginners in model locomotive construction, and the competition is, therefore, primarily intended for those who have not previously built a complete model steam locomotive. A previous incomplete attempt will not disqualify.

2. The model must be strictly in accordance with the design published in ME and with the working drawings from the Plans Service of Percival Marshall and Co. Ltd. If any minor departures from the design are made for special reasons (such as the use of parts already made for a similar model), they must be disclosed on the entry form. If they are considered detrimental to the engine, or are thought to give the competitor an unfair advantage, they may involve loss of marks.

3. All completed models must be entered and exhibited in the competition section of the next ME Exhibition (venue and date to be announced later) in accordance with the Exhibition rules at the time.

4. Judging will be carried out by a specially appointed panel on which the Editor of Model Engineer will be represented.

5. In the final assessment, marks will be given for construction and (if conditions permit) for performance on the track under steam. After a preliminary examination of all the competing models, a selection will be made of those showing the best construction, and the selected models will be submitted to steam raising, and if possible, to track tests. The principal trophy will be awarded to the entry which, in the opinion of the judges, shows the best all-round qualities and represents the most meritorious effort.

6. Models may be shown painted or unpainted at the discretion of the competitor; while a good clean finish will be taken into consideration, no extra marks will be awarded or elaborate lining or other decoration, or for polished parts or fittings. The essential points are good construction, good fitting and sound joints, and good steaming.

7. All boilers must stand a hydraulic pressure test of 160 p.s.i. without defects or signs of failure. Maximum working pressure of models submitted should be 80 p.s.i., but models arranged for working pressures not more than 10 per cent higher than this figure will not be disqualified.

8. Competitors are at liberty to purchase castings and unfinished parts and materials from any source. Each competitor must sign a declaration that, except where otherwise stated, the whole of the construction is his own unaided work. The only finished part a competitor may purchase without loss of marks is the steam pressure gauge. Other finished parts, such as water feed pump, mechanical lubricator, water gauge, and regulator, may be bought and fitted, but their use will involve some loss of marks, at the discretion of the judges.

9. If a model is not completed in time for the judging, it may still be entered, provided that it can raise steam. If such an unfinished model is well constructed it will be sympathetically considered.

10. Articles covering details of the construction of the model which is known as Rob Roy, have appeared each month in ME, beginning on February 16 last.

11. The closing date for entering models will be announced in Model Engineer in due course.

12. The complete set of six working drawings is now obtainable at 22s. 6d. (or 4s. 6d. for a single sheet) from the Plans Service.

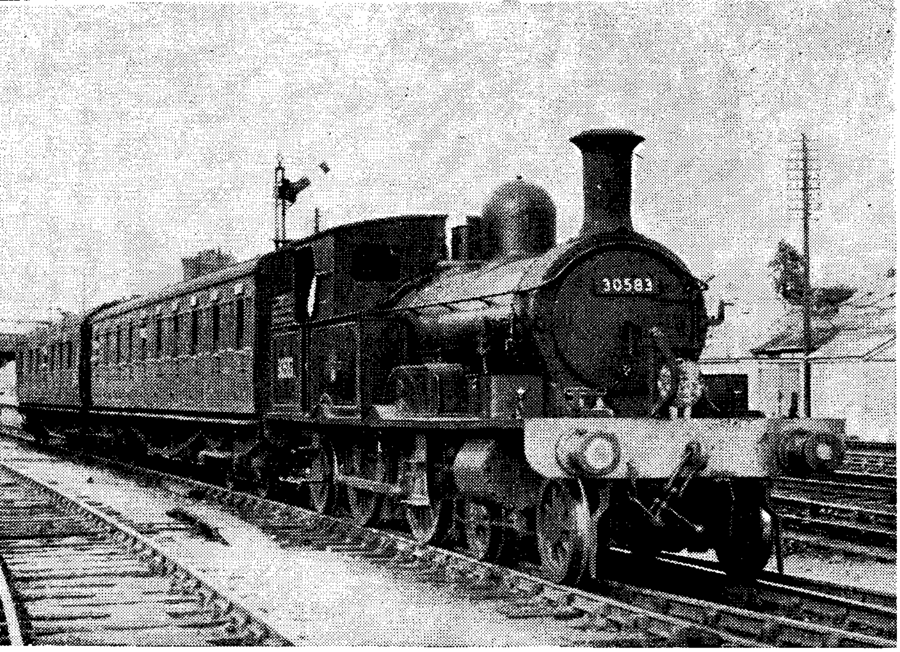


Photo by Ivo Peters

side-play to the bogie, alterations which had been made on the other two engines some years earlier. She was then put to work with the other two as a spare engine.

The three were identical except in their boilers. There was a Drummond boiler with a Drummond dome, and there were two Adams boilers, one with a short dome and one with a tall. The boilers were switched around evermore than in earlier times. For example, in 1953 No 30583 (488) had the Drummond boiler, while at a later date it was fitted to 30584 (520). Today this boiler is on 30582 (125).

Throughout the 1950s the class continued on its duty but most people realised that it could not last for ever. Sooner or later one of the locomotive

NOTHING ELSE WOULD DO

ROBIN ORCHARD laments the passing of the Adams Radial tank engines from the Lyme Regis branch line in Dorset

BEFORE we turn to the Adams engines which lived on, let us go back and look at some of the changes which were made. They were not large. The chimneys were changed on most of the classes, the handsome stovepipe giving way to the elegant Drummond; and the brasswork, of course, was painted over.

Between 1895 and 1898 Nos 57, 170, 483, 486, 490 and 492 were given new Adams boilers. This indicates that they must have been used extensively. The normal life of a boiler is more than fourteen years which was as long as some of the engines had been built. In 1904-5 two of the class, Nos 486 and 520, received Drummond boilers with direct-loaded safety valves on the dome. There was pretty free interchange of boilers between the class, especially in later days.

Now why were two left ? The 415s had been used on the difficult grades and twists of the Axminster-Lyme Regis line, and when the Southern came to replacing the engines no other class was found to be suitable. All the other types which were used caused damage to the track.

With the hammer already passing through the air, the last two engines were snatched away. From that time they were always kept in peak condition and were used alternately. No trouble resulted. From time to time the boilers were changed, and in 1941 we find that No 125 has the Drummond boiler while 520 has the Adams.

All went well until 1946 when both engines were put out of service together. The traffic had to be handled by pairs of 0-4-4 Ts with their tanks only half full; but they were not very successful. As the Southern could not afford to have the same thing happen again, it tried various other locomotives—D1 tanks, E1 tanks, O2s, Zs and many more, all without success. Even the Terriers were useless. About three of these would have been needed in the middle of summer.

It happened that one other 415 (or 0415 as it was then numbered) remained—old 488, sold to the Government in 1917 From her salvage yard work she was bought by the East Kent Railway and became the East Kent's No 5. The Southern took her back in 1946 and provided her with new frames and increased experiments was going to bear fruit. Earlier this year an Ivatt class 2 2-6-2T No 41297 was tried over the line and was successful. Only a few months later the first of the trio was withdrawn. In February, 30584 (520) went to Eastleigh. No 30583 (488) followed in August and 30582 (125) in September. But none of them has been cut up, probably because the full effect of the Midland class 2s cannot be appreciated until after they have worked for some time on the route. So the Adams are unlikely to be scrapped yet. Nor will they all be broken up; one has been preserved and there is rumour that another will join it.

The Bluebell Railway has bought No 30583, renumbered 488, and has already used her for hauling trains. It is rather amusing to see an engine which is about twice the size of the Bluebell P tanks waltz three coaches out of the station with a gentle, effortless pull.

In the same area the Kent and East Sussex Railway Preservation Society hopes to get one of the remaining pair. I would like to see both engines in their original livery. It is a shame that the K and ES could not buy

No 488; the old EKR engine would have been more appropriate on their line especially if it were restored to its EKR colours.

The two outside cylinders had a bore of $17\frac{1}{2}$ in. and a stroke of 24 in. The coupled wheels were 5 ft 7 in. dia. and the bogie and radial wheels 3 ft, except for the last Stephenson and Dübs batches which had 3 ft 6 in. radial wheels. A total wheelbase of 29 ft 5 in. was made up of 7 ft plus 6 ft 5 in., plus 8 ft 6 in. and 7 ft 6 in. Over the buffers the engine was 38 ft $8\frac{1}{4}$ in. long.

With a diameter of 4 ft 2 in. and a barrel length of 10 ft, the boiler was pitched 7 ft above rail level and contained 201 tubes of $1\frac{3}{4}$ in. dia. The firebox was 5 ft 6 in. long inside and 6 ft 2 in. outside; grate area was 18.14 sq. ft. The heating surface was 1055.9 sq. ft. made up, 944.7 sq. ft for the tubes and 11.2 for the firebox. Total weight was 54 tons 2 cwt, with 30 tons 16 cwt availaole on the coupled wheels for adhesion. Tractive effort was 14,920 lb.

Originally the engines were painted in a light attractive shade of pea-green, I would that this pleasing colour was used today! The green was edged in black and lined out with white.

This style persisted for a long time. The number was also put on tastefully. Each digit was a separate brass casting fitted to the tank side; whenever you look at pictures of these Adams engines you are struck by the neatness of the numbering. Power classification was on the splasher. The initials LSWR did not appear on the class.

Drummond changed the colour to an even lighter shade of green. The cab sides were edged in purple brown, while the remainder of the engine still used the black edging although it now had a white line on each side. When the Southern took over, the colour had become the rather dark green known as sage. Lining was in mid-chrome yellow and on the bunker side was the number in large gilt figures. The word *Southern* appeared on the side tank, in the peculiar but rather attractive extended form shown in one of my photographs.

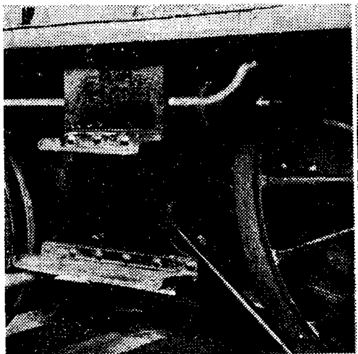
Later, of course, the green changed to the malachite with which the Southern is always associated. By the time of the Second World War the livery was black, usually unlined.

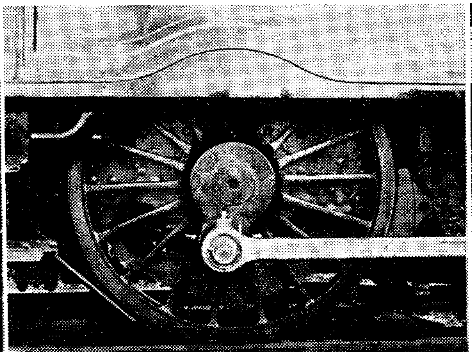
Under British Railways the engines received the customary black with chrome and red lining and the BR lion, which was put on the side tanks. The number was placed on the bunker side with the power classification beneath. The letter *K*, the classification which had persisted since mid-LSWR days, was changed in the early Fifties to 1*P*, over the top of the number. There was also a period during which the classification did not appear. Of the three, only No 30582 received the new crest.

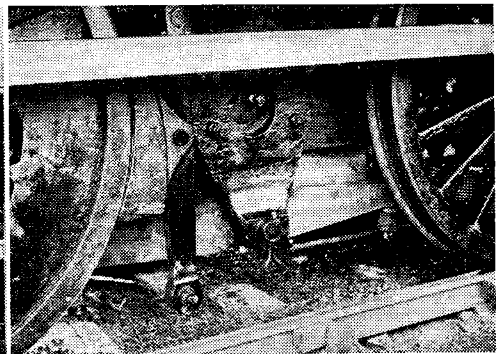
It is sad to think that the beautiful Axminster line will no longer be graced bv these elegant engines. The old Lyme Regis branch will never be the same without its Radials. The habit will cease of looking out of the window of a West Country express at Axminster for by no stretch of the imagination can the Ivatt Mickey Mouse ever conjure up the enthusiasm and interest that the old Radials could.

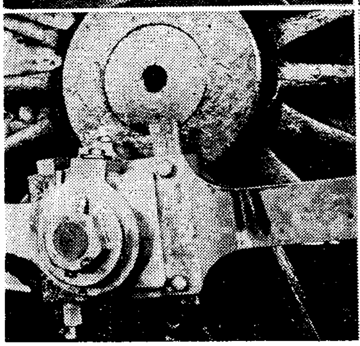
I can still go down to Sheffield Park and see one of them. But the line is too easy for these engines; they need curves to show their mettle. Such, I am afraid, is the price of progress; at least, there are no diesels on the Lyme Regis branch—yet. ■

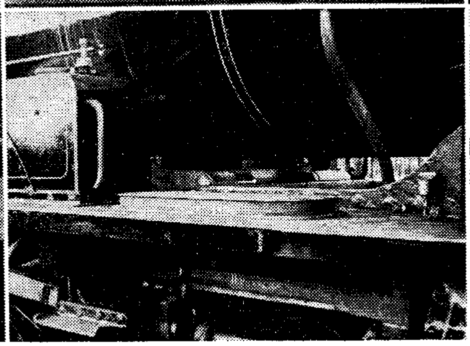
For co-operation with this series on the Adams tanks, thanks are extended to the works manager and shed master at Eastleigh, the public relations officer and the photographic department of the Southern Region, and Mr Ivo Peters for his excellent photographs of the engines working at Axminster. The series will conclude with a selection of pictures on January 4.

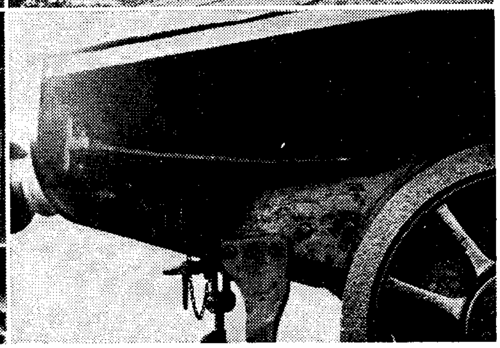


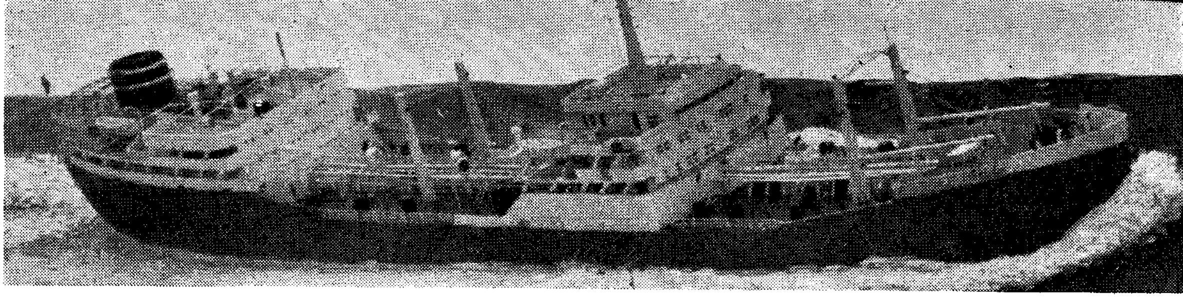












BRITISH FULMAR

CYRIL SESTON models a tanker at 1 in. to 50 ft

THREE " firsts " can be claimed by the *British Fulmar*. She was the first tanker of a new series, all with a deadweight of 15,500 tons, delivered to the BP Tanker Co. Ltd of London in 1959; she was the first tanker to be built by Alexander Stephen and Co. Ltd of Linthouse, Glasgow, for 32 years; and she was fitted with the first Stephen turbo-charged engine.

She has a length overall of 525 ft; a length between perpendiculars of 495 ft; a moulded breadth of 69 ft, a summer deadweight of 15,500 tons, a service deadweight of 14,000 tons, a gross tonnage of 11,186, and a service speed of 14½ knots.

After seeing a film of her speed trials I decided to make a model 1 in. to 50 ft. Builder's deck plans and a good selection of photographs were kindly given to me by the BP Company. I used them to make the drawing. It gives the colours of the *British Fulmar*; and except for minor differences, the colour scheme remains constant throughout the fleet.

I used well-seasoned limewood for the hull; best quality single-ply Bristol board for bulwarks, superstructure, decking and so forth; Polyester fibre thread for the rails; copper fuse wire of various diameters for such details as awning stanchions, oil pipes, steam pipes and davits; cigarette papers; mustard seeds for ventilator cowls; oddments of many different sorts of timber, for the numerous small fittings; and miscellaneous bits and pieces.

The construction of the hull does not present any difficulty because there is no sheer line between stations 8 and 27, and from these stations forward and aft the sheer is represented by a virtual straight line. You can true up a rectangular piece of wood and screw and glue the stern and forecastle blocks on to it. The flare at the bow and stern can be carved with templates. You must recess the hull to take the thickness of the superstructure midships and at the stern and forecastle.

After smoothing down the hull block, you can fit the sloping deck from the forecastle to the forward well deck. I used a wedge-shaped piece of wood decked with painted Bristol board. To accommodate the flush bulwarks it had to be narrower than the full width by two thicknesses of Bristol board.

One of the difficulties encountered on the model is the complex shape of the bridge and after superstructure. I made many attempts to get the correct shape before I achieved something very near to it.

After the superstructure has been faired into the hull, the whole can be painted in the colours on the plan. I found this a good method because of the difficulty of touching up after all the decks and so forth are in place.

Around the top of each bulwark, as a prominent feature on the bridge and after superstructure, is a teak capping rail 5 in. wide × 2½ in. It can be represented by dark brown thread or by painted strips of paper.

The poop, boat deck, bridge, upper bridge and navigation bridge houses are next cut to shape and painted. Then the doors and windows are fitted and the portholes painted. The windows are Bristol board, painted pale blue with thin strips of white paper glued across.

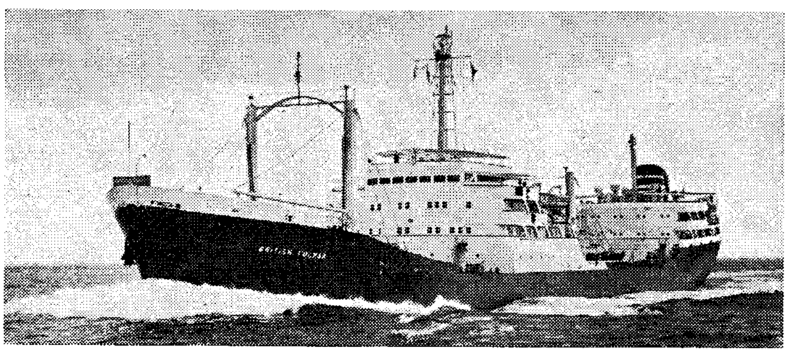
A method of improving the appearance of the portholes is to wrap thin wire around a needle or pin and cut the coil with a razor blade. This leaves a number of perfect circles which need only be closed with a pair of tweezers and then stuck over the painted porthole. The doors are painted dark brown to represent varnished wood.

Where the covering decks, are shown planked, they are made from Bristol board painted with Reeve's Old Oak. They could be planked as Donald McNarry describes in his excellent PM book *Shipbuilding in Miniature*. Note that the 'tween decks height is 8 ft. Allowance must be made for the covering deck thicknesses to be included in the build up of the superstructure.

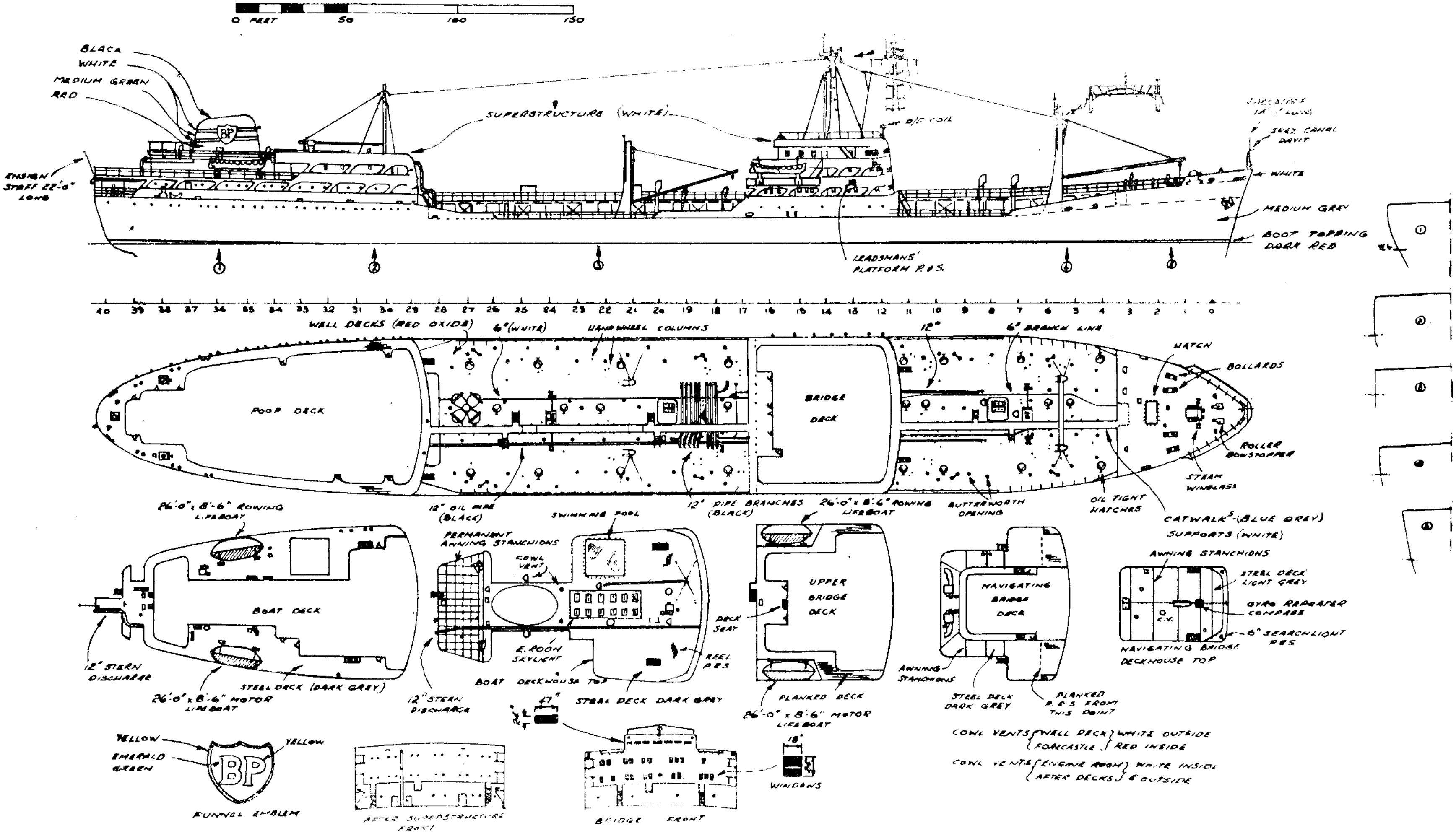
You can make the swimming pool as a rectangular box painted pale green on the inside, with a piece of celluloid to represent the water, which must be at the same level as the sea. The boat deckhouse top must have a recess cut in it to take the pool.

● *Continued on page 767*

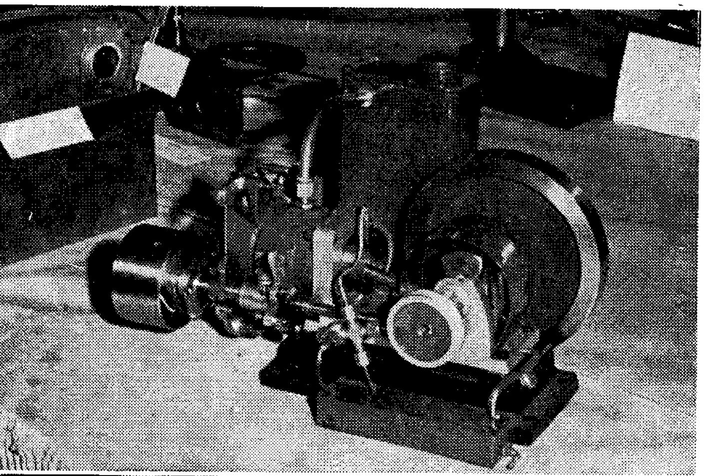
Top of page: This picture of the BRITISH FULMAR *is about half the size of the author's model which received a Highly Commended diploma at the 1961 Model Engineer Exhibition. Below: The* BRITISH FULMAR *on her trials off the Isle of Arran in the Firth of Clyde.* (*British Petroleum picture*)

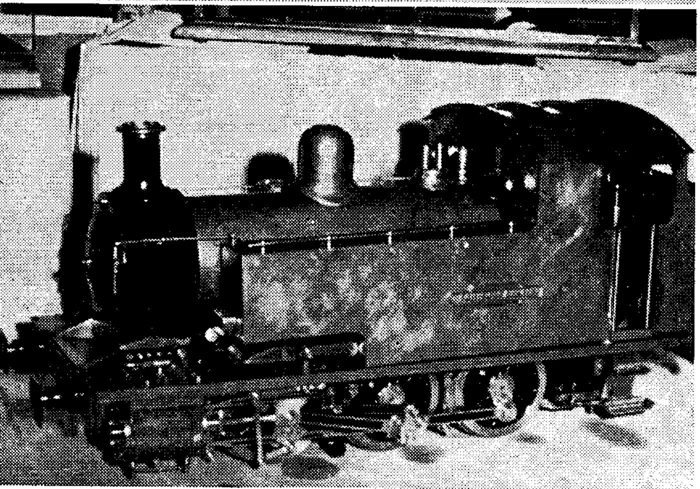


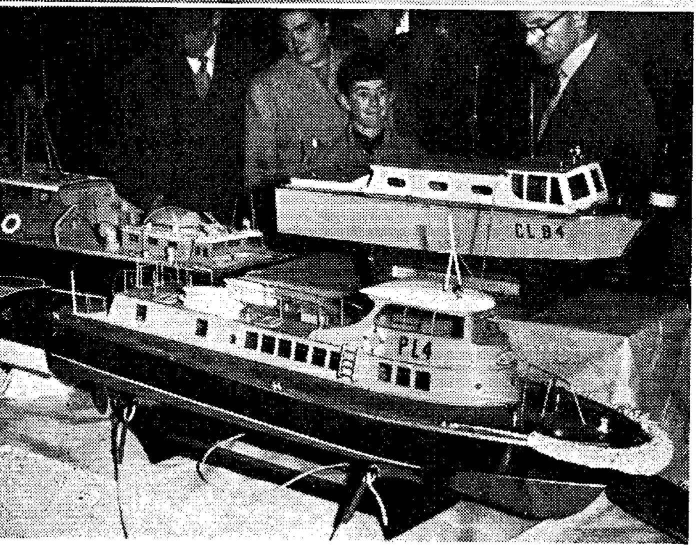
BRITISH FULMAR.



BRADFORD'S BEST By NORTHERNER







PARTS of the club locomotive *Butch* made at an evening school, where members form a special class, were shown at the Bradford Exhibition. The chassis was complete, the boiler about three-quarters finished, and the plate work well on the way.

Another 0-6-0 *Butch* had been built as a first attempt by Ernest Graham of Bradford.

The Amos Barber Trophy was awarded to J. Bickerdyke of Bradford for his 1 in. scale model of *Locomotion No* 1. Mr Bickerdyke was an old friend of Amos, and a fellow pioneer of the Bradford club. Amos would have liked his old-time model. It steams well. Mr Bickerdyke made many trips to Darlington to be sure that his detail work was right and of good proportion.

An old-timer of a different sort was the steam-driven and spirit-fired 2½ in. gauge *Black Prince* 4-4-0, built by Bassett-Lowke in 1910 and now owned by the club. It was running from time to time on its tinplate oval, complete with home-made station, footbridge and engine-shed. I could not help comparing its performance—or lack of it—with the operation of a 2½ in. gauge LBSC engine. It created great interest among all the visitors.

Top: Westbury CENTAUR, *by H. D. Smith won the Amos Barber Memorial Trophy. Centre: Ernest Graham, who built this 0-6-0 engine, is a beginner. Bottom: D. Sims' radio-controlled river cruiser*

On the same stand was another interesting old model—a 3 ft long three-funnel destroyer of German origin, found recently by Walter Ashworth in a cellar where she had lain for many years in her original box—labelled "Cambrian Railway to Bradford." Mr Ashworth applied a spot of oil to the clockwork mechanism and took the boat to the local park lake where she sailed beautifully with no further attention. We could not see her perform at the exhibition because the polythene pond rigged up to demonstrate marine models and radio control had been holed by the screw of a tug.

Another working marine model was the *Scillonian*, built on the kitchen table at a total cost of under £1 for motor and all—by J. Pitts. The hull, which was 4 ft 5 in. long, had been made with cardboard hull-plates on formers cut from a ply packing case. Of card, too, was the superstructure. The fittings had been made from scrap.

D. Sims exhibited a passenger river service launch. She was 4 ft long, with a 15 c.c. ohv petrol engine, and radio control for the ignition, throttle and steering.

The Clyde paddle steamer by Douglas Miller of Brighouse continues to make progress. She is about 6 ft long. Her hull, of copper plates on frames of angle iron, incorporates the Westbury diagonal paddle engines with fully feathering paddles. Calor gas fires the centre-flue boiler. When the superstructure is completed, the boat should look very well indeed,

Walter Ashworth has managed to make a fresh start on his ¾ in. *Duchess* Pacific. With probably 2,500 hours' work already done, the engine is almost complete. A few hundred hours more on the tender should finish off a first-class model which was begun several years ago.

Home-made internal combustion engines are not as numerous as they used to be, but interest in the small gas engine has revived with the publication of that excellent ME design, the 60 c.c. *Centaur*. ▣

SIRENA ...

Continued from page 754

and another between the two rear windows. They were quite simple to make and were bent to shape after they had been riveted in place.

A small step riveted to the side of the casing in Fig. 114 is a piece of 20 g mild steel plate bent to an angle, with ¼ in. for the driver's boot and each end slightly turned up to prevent his boot from slipping off.

The platework was painted a dark green matt. Roof, window frames, bonnet cap, footplate, and all the chassis were black, with the buffer beams, stocks and rubbing plates red. I used Cerrux low-temperature flat enamel. It was sprayed on, and each coat was baked for about half an hour at 200 deg. F. The coats were applied fairly thinly, without runs. For masking I used wet newspaper.

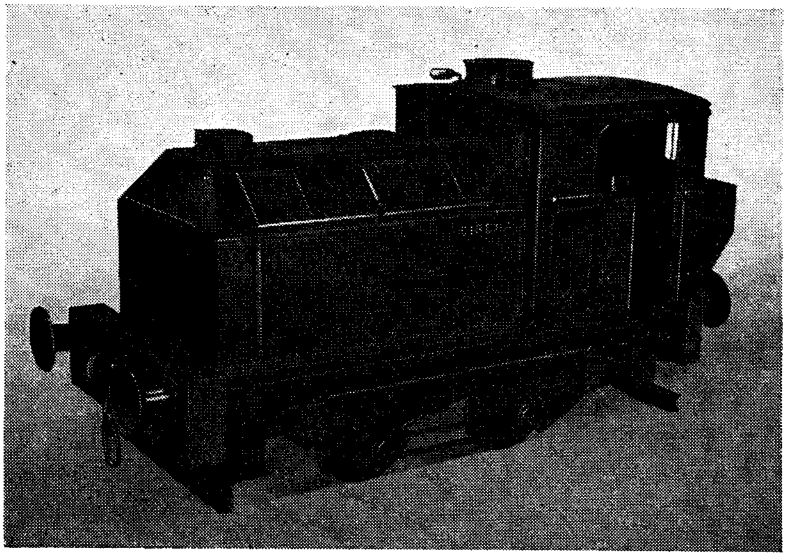
My oven was a hardboard box inverted over a piece of asbestos with an electric fire element so arranged in length that the correct temperature could be kept fairly constant. It might be better to use the kitchen gas stove and set the Regulo.

I hope that you will have fun with *Sirena.* I can assure you that she is a favourite wherever she goes.

If any of you have questions to ask, or suggestions to make, I will be delighted to hear from you. My next model will be a 3½ in. gauge 4-4-0 American-type locomotive with Baker gear, piston valves and all the trimmings. Farewell to you all and good steaming! ▣

Dates of earlier instalments were:

February 2 (*Lured on by a Siren, page* 140);
February 16 (*Cross tubes*, 191);
March 2 (*Cross tubes again*, 260);
March 16 (*Testing the Boiler*, 336);
March 30 (*Hand pump*, 389);
April 13 (*Whistle valve*, 444);
May 11 (*Boiler fittings*, 578);
May 25 (*Last boiler fittings*, 638);
June 8 (*Chassis, panes*, 720);
June 22 (*Wheels and axles*, 784);
July 6 (*Cutting the sprockets*, 22);
July 20 (*Work on the pump*, 87);
August 3 (*Bell-sprung buffers*, 148);
August 31 (*Eccentric and crankshaft*, 268);
September 14 (*Lubricator*, 326);
September 28 (*Changing the water*, 375);
October 12 (*Reversing lever*, 432);
October 26 (*Brake gear*, 496) *and November* 9 (*Plumbing and platework*, 566).



BRITISH FULMAR ...

Continued from page 764

Bristol board and paper, painted in the correct colours, are used for the forward and after catwalks. Colours and sizes of the steam and oil pipes are given in the drawing. On the plan view circles of various diameters represent the Butterworth openings and the oil-tight hatches (which are black).

The handwheels on the columns are painted in a distinct sequence: green on the starboard side outboard, red on the port side outboard, and white midships. The dividing line where the colours change is taken 10 ft from the catwalk port side and 8 ft from the catwalk starboard.

Even at this small scale hatches and handwheels should not be omitted as they are an important feature of a tanker deck.

Awning stanchions should be made next. You can use wire, Bristol board and shaped-up pieces of wood for the hatches, windlass, bollards, fairleads and other fittings.

On the superstructure decks the rails are 3 ft 6 in. high and the stanchions about 4 ft 6 in. apart as they also are on the well deck, where the rails are 4 ft in height.

The lifeboats, which are of glass fibre, can be carved from the solid wood, and provided with thwarts, engine-casing and other details. I put the lifelines on the boat sides as I think that this adds to the realism. If the boats are left solid, the canvas cover should be represented by painting the top off-white.

Davits can be built up with pieces of Bristol board and wire. The falls are short lengths of wire painted black after they have been stuck between the davit hook and the inside of the boat. For the blocks you can use minute blobs of glue; they are allowed to dry nearly hard and are then moulded between the thumb and forefinger.

I made the rails and stanchions on a jig, using polyester thread. After you have wound the thread on to the jig, you must carefully paint the whole assembly with several thin coats of white and set it aside to dry thoroughly. Lengths are trimmed with a single-edge razor blade and are then attached to the model by specks of glue at the foot of each stanchion.

The model is mounted in a Plasticine sea. Wake and bow wave are built up of successive layers and wave crests, and the troughs are formed with a teaspoon. I used household gloss paint as an experiment and found it satisfactory.

My case was made with an ordinary picture moulding for the base and a plywood shelf to which the sea base was glued. Picture glass was fixed with clear Bostik. As I am a poor woodworker, I made the frame around the edges of the glass from oak patterned *passe partout*.

At this year's Model Engineer Exhibition the model received a Highly Commended diploma. ▣

NO MORE CHATTER

P. A. STOCK found a way of overcoming this trouble on his lathe

OTHER lathe-owners may be interested in how I overcame chatter in a $3\frac{3}{8}$ in. Zyto. My method applies to any lathe with similar bearings.

The bearings in a Zyto are thin-walled cylindrical steel shells lined with bronze, and are retained in the split headstock casting by pinchbolts. They are prevented from rotating by grubscrews screwed through the headstock casting into dimples in the bearing shells.

As it was not possible to take up the wear sufficiently by compressing the shells with the pinchbolts, I decided to get more movement by splitting the shells. I therefore withdrew the mandrel after slackening the socket grubscrew locking the bullwheel, and removing the threaded end-play adjustment ring and tumbler-drive pinion on the tail of the spindle. You may have difficulty in withdrawing the mandrel because of burrs raised by the bullwheel grubscrew. The burrs can be removed with a warding file introduced between the bullwheel boss and the headstock casting.

I cut through the shells with a hacksaw while they were nipped in the headstock by the pinchbolts, and then well chamfered their cut edges with a small fine file. It is a good idea, while the headstock is dismantled, to file a small flat on the mandrel where the bullwheel grubscrew bears to prevent burrs from causing difficulty in the future, and also to give a more positive drive to the mandrel.

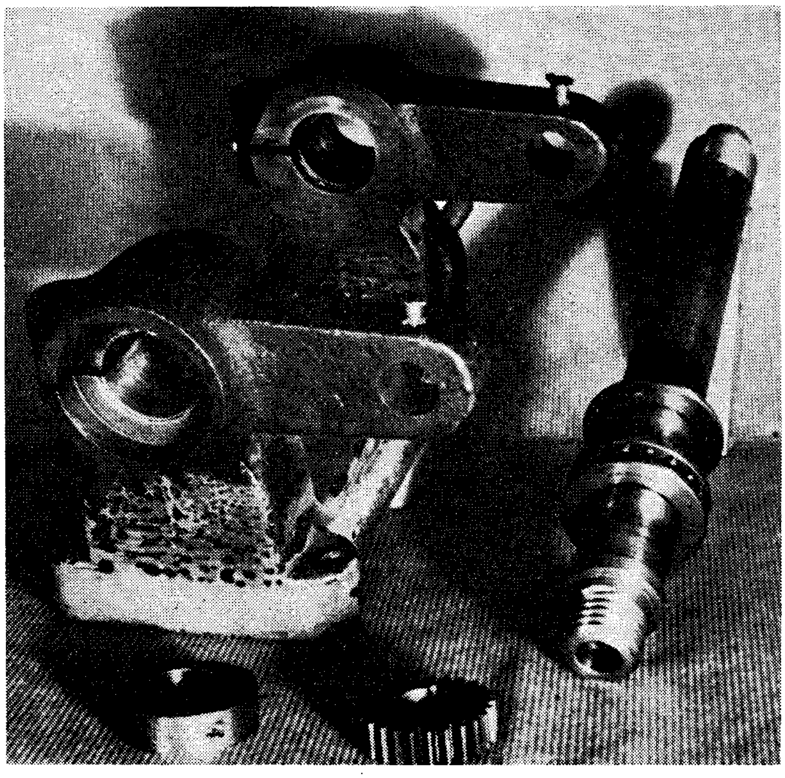
After assembly, I noticed a big improvement, but chatter was still present on heavy operations, such as parting off and flycutting. The trouble seemed to be that there was working clearance not only between the mandrel and the bearing shells, but also between the shells and the headstock casting. If the pinchbolts were tightened up to reduce the second clearance, the first was, of course, reduced at the same time, so that the mandrel would not turn easily and a satisfactory adjustment was impossible. It was clear that the shells would have to be fixed solidly into their housings, and I decided to solder them in, despite my misgivings that the heat might distort the headstock casting.

When I again dismantled the headstock, I removed the bearing shells as well. I thoroughly cleaned their outside surfaces with emery paper and tinned them with solder paint over a small spirit lamp, heating them as evenly as possible and wiping off the excess solder while it was still molten. The bronze which lined the bearing shells did not seem to suffer any ill effects from the heating. If you solder the bearings on your own lathe, you would be wise to check that the shells are not lined with white metal which would melt and run out, ruining the shell.

After tinning the outsides of the shells, I cleaned the front headstock housing surface and tinned it with solder paint, this time using a half-pint blowlamp. I slid the front bearing shell into place while the lamp kept the solder molten, and fed additional solder through the grubscrew hole in the casting. Resin-cored solder was used as it contains its own flux and may be easily fed into the screw holes.

While the solder was still liquid, I made sure that the split in the bearing shell coincided with the split in the headstock casting, and that the front edge of the shell did not protrude beyond the seating for the ball thrust bearing. This bearing is extremely important.

After the cooling, I scraped away the excess solder from the seating to



make the thrust bearing bed squarely against the casting. The rear bearing received the same treatment.

I passed a straight piece of 1 in. dia. steel bar through the bearings so that, if the shells had twisted in their housings, they could be reheated with the bar in place while they cooled. But it was not necessary to reheat as the bearings had stayed in line.

Removing the bar, I inserted the mandrel and tested the fit with a smear of engineer's blue. On the high spots shown up I then carefully used a half-round scraper. I repeated this process, tightening the pinchbolts as needed, until the bearings made contact all over. Fortunately, only a small amount of scraping was required.

The only task that remained was to reassemble the headstock completely and try it out. I knew that the effort had not been in vain when the lathe parted off a piece of 3 in. dia. mild steel in the chuck without support of any kind and without chatter.

For the reader who decides to solder his bearings and has not already split them, it would obviously be an advantage to solder them in first and split them afterwards. While I had no trouble with misalignment, you might like to turn up two bronze bearings slightly undersize in the bore, and bore them out in line after soldering. This would make the alignment accurate and would also help those whose bearing shells were lined with white metal.

In the early stages I thought of bonding the shells in place with one of the phenolic resins such as Araldite, as this would involve negligible heat with no risk of distorting the casting. But I had no experience of this process, and it would not have been possible, once the resin had set, to alter the position of the bearings if they shifted. The process offers possibilities, and it may be that someone with suitable experience may care to try it.

The arrow in the photograph shows the seating that must be kept clean of lumps of solder or other projections. You will also see the mandrel with the thrust bearing threaded over it. In the foreground are the tumbler reverse drive pinion and threaded ring which must be removed before the mandrel can be withdrawn. Note that the threaded ring is locked with a grub-screw. The pinion has a screw tapped half into itself and half into the mandrel; before you remove the pinion you must withdraw the screw completely. ■

HIGH-SPEED STEEL TAPS

MAY I butt into the Cleeve-McGrath discussion? Neither Mr Cleeve nor Mr McGrath has so far mentioned one fundamental reason why industry prefers h.s.s. taps.

I call attention to the British Standard Specification for screwing taps, number BS 949 : 1951, and its amendment, No 1 of December 1954. Briefly, taps are classified into five so-called zones, which establish their dimensional tolerances for basic nominal dimensions. Tools in Zones one and two are ground-thread hand-taps, very slightly over nominal size, made to very small pitch diameter and lead variations. Those in Zones three and four are similarly of ground thread, but of larger mean pitch diameters, and have larger permitted variations in diameter and lead. Zone five is reserved for cut-thread taps and permits the widest variation.

Most commercial work uses "second" taps; their nose taper is about 8 deg. with the axis. If the tapping machine does not have leadscrew control, the tap is driven rotationally but is allowed some axial freedom. Hence the ditch-digging part of the operation is done by the nose threads, backed off to permit free cutting; the threads in the rest of the tap follow into the nut cut by the nose, and so control the lead. The very slight back-taper in these tap-threads has little influence on lead control.

Without quoting the standard at length, I may sum up by saying that the permitted lead error in Zone 5 (cut thread) taps is *ten* times as great as for Zone 1, and six and two-thirds times as great as for Zones 3 and 4.

The *maximum* pitch diameter of a ½-16 BSF tap in Zone 1 is the same as the *minimum* pitch diameters of the corresponding Zone 3 ground and Zone 5 cut thread taps; and the permitted ranges of variation of pitch diameters for Zones 3 and 5 taps are three times and almost 7½ times the corresponding figure for the Zone 1 tap.

The size cut by any tap is governed by several factors apart from its own dimensions, among them are the material, the use of hand or machine tapping, the lubricant, the question of whether the tap is separately guided, the rotational speed of the tap, the distribution of material around the tapped hole, and the percentage of full thread attempted.

All the minimum pitch diameters called out are larger than basic in the above standard, and its text advises users to select zones by trial to match their needs. General Motors Corporation has adopted several more such zones, identified in the US by letters covering pitch diameters ranging from considerably under nominal to about the same oversizes as British maxima, with about 0.0005 pitch diameter tolerance in each range for medium sized taps and comparable permissible lead error for ground thread taps. This larger range of choice has been forced by experience in getting fast accurate production with widely varying conditions of material.

In making medium sized taps, the cost of material is to some extent often somewhat secondary; while ground thread carbon steel taps may have been made, the regular material today is high speed steel.

Taps made to the first four dimensional zones are so marked on their shanks, while Zone 5 taps are unmarked "for Zone." General Motors has a somewhat similar practice.

High speed steel taps are often apparently stronger than those of carbon steel, but part of this may be the result of groove design. In production set-ups, where many holes may often be tapped simultaneously, tap breakage is generally caused by something basically wrong, such as using the incorrect tap for the job, mis-locating or mis-holding the work, or employing a workpiece of unusual hardness—the last is rare. Once a satisfactory procedure has been set, its continuance is a reasonable guarantee of freedom from grief.

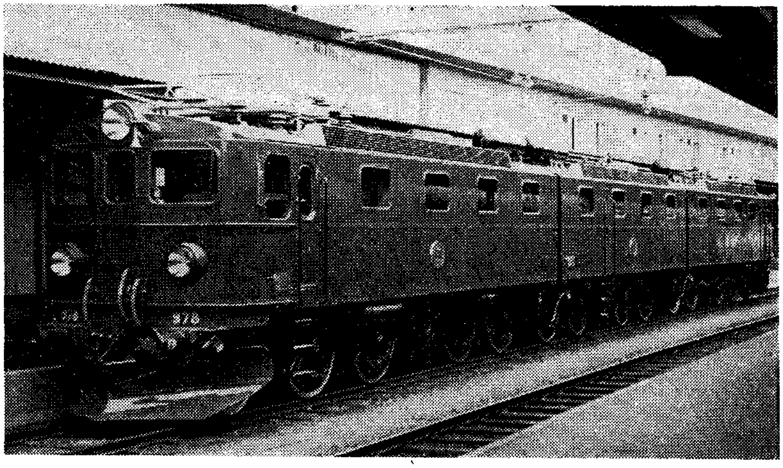
The cost of salvaging by removing the broken tool is often excessive, and so the part is scrapped. When the workpiece—for instance, a rear-axle carrier or a cylinder block—is costly it is usual to neck the tap shanks to localise a possible fracture and allow a broken tap to be removed easily.

Where lead accuracy is essential (as when the length of thread engagement becomes considerably longer than 1½ diameters) the use of ground thread taps becomes almost mandatory regardless of the quantities made. For the more usual short engagements, as of ordinary bolts, nuts and cap-screws, the customary cut-thread carbon steel tap will often suffice, particularly when the screw may be cut to fit the tapped hole and interchangeability is of no importance.

But when cost is important, the high-speed steel tap wins. Back in 1922, when ground thread high-speed steel taps were regarded by some as

● *Continued on next page*

POWER FOR AN ARCTIC TRAIN



By MATS HEDE
of Stockholm

About a year ago the Swedish State Railways introduced a very powerful electric locomotive for the transport of iron ore on the Kiruna-Riksgränsen-Narvik line far north of the Arctic Circle.

By the beginning of the Fifties loads had increased in thirty years from 1,500 tons in 40 three-axle wagons to 2,400 tons with a total train weight of 3,200. When demand rose still higher, the construction of a second track was ruled out for the time being because of the cost. It was decided to construct more powerful locomotives and wagons of greater capacity, so that the train length could remain about the same as before, to avoid lengthening the sidings and the general trackwork at the stations.

The photograph shows the engine, which is the most powerful electric locomotive in the world. Much heavier trains run in the USA, but their locomotives are multiple-unit coupled. The Swedish engine consists of three permanently coupled units with the wheel arrangement $1\text{-}D_0+D_0+D_0\text{-}1$ and a blind axle in the middle. Six traction motors drive the twelve axles and develop 7,500 h.p. with a maximal tractive effort of 80,000 kgs. (176,000 lb.) at a maximum speed of 75 kilometres an hour (45 miles).

Current supply is 16,000 v. single phase a.c. Of the total weight of 260 tons 230 are available for adhesion. The total length over buffers is 35 metres (115 ft).

The new wagons will have a capacity of 60 tons of ore, and the train load will be increased from 2,400 tons to 3,900 tons—more than half—without increasing the length of the train. The total weight of the train will be 5,135 tons.

Work is now going on to strengthen certain parts of the line and to make experiments with American central couplings designed to stand a pull of 200 tons and a push of 300. Before this is accomplished full advantage cannot be taken of the enormous locomotive power. ▣

HIGH-SPEED STEEL TAPS

Continued from previous page

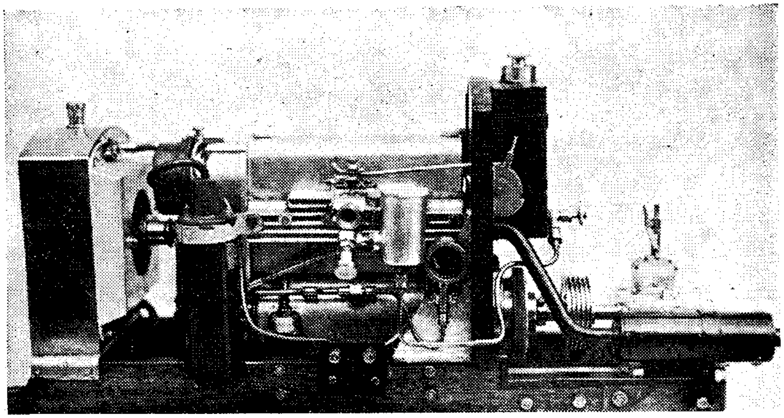
a new luxury, I had the chance to compare the lives of some taps for sparking plug holes in cylinder heads. While the conditions were not the same, the figures were significant. Carbon steel cut thread $\frac{7}{8}$-18 plug (second) taps did fewer than 250 holes to a sharpening in cast iron of about 170 Brinell hardness, while high speed 18 mm. × 1.5 mm. second taps did about 8,000 holes to a sharpening in harder cast iron of about 210 Brinell. The time for a hole was about the same, but the saving of down-time was enormous. I have since seen 18 × 1.5 mm. taps thread over 55,000 holes in 170 BHN cast iron before they were worn undersize; and they still looked good.

As Mr MacGrath says, where industrial production is concerned there is little room for argument; but the amateur, unless very good lead accuracy is essential, can usually get by with a cut-thread carbon steel tap.

Ronald V. Hutchinson.

SUCCESS WITH SEALION

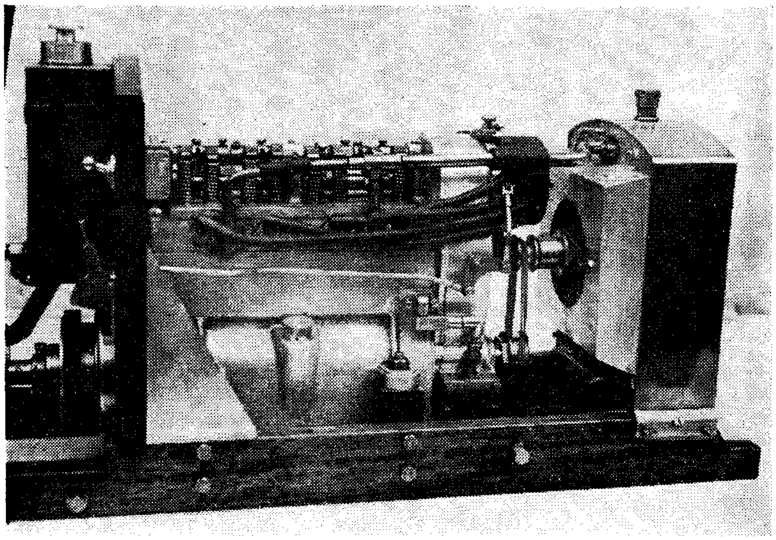
F. G. BETTLES COMMENTS ON THE 30 c.c. WESTBURY ENGINE



IN building the *Sealion* I followed Edgar T. Westbury's drawings in detail. The machining of the different parts depended on what tools were available. I did quite a number on a vertical miller; the cylinder head was almost completely machined on it. To get in the crankshaft a slot had to be cut in the timing-case end.

I do not think it is wise to lay down any set arrangement for minor fittings, such as water pipes and ignition, as all depends on the use for which you intend the *Sealion.* But I would prefer a larger sump to hold more oil and I would certainly prefer side valves—if you want the cylinder head off, to look at things inside, or for any other reason, you have to take down half the engine.

If the water pump could be put on a bridge piece outside the timing case, and the shaft extended so that



the packing gland was outside, any leak could be seen and adjusted. With a $\frac{1}{4}$ in. dia. plug in the bottom of the timing case, I can test for any leak, and then remove pump and repack.

All the water and oil pipes are fitted with running joints and union nuts, for easy disconnection if it is wanted. I also extended the oil pipe and put an indicator on the end—a $\frac{3}{16}$ in. bore cylinder and piston loaded against a light spring, coupled to a hand fitted in and old steam gauge case. It tells if the oil pressure is working.

In fitting a radiator and gearbox, all depends again on the use of the engine. As I have no open water to sail a boat on and no railway track to run a locomotive, I couple the engine to a generator.

From what I have read in ME, a locomotive in $3\frac{1}{2}$ in. gauge needs about 100 c.c. to be satisfactory. After I had fitted the dashboard and petrol tank, it was quite a task getting the starting cord around the flywheel groove. I made a freewheel arrangement which works very well, to my surprise. When I tried an electric motor before fitting the gearbox, the engine did not start nearly as well as with the cord—apparently it could not get away.

After trying different carburettors (I like float feed) I took the carburettor off *Kiwi* Mark II and used it on *Sealion.* It was a success right away and so I got some more castings and made another.

If this engine is well made it is a credit to Mr Westbury. I have worked on internal combustion for over 30 years, with engines much larger than *Sealion.*

When one considers the time that it took to get away with steam, and the coal, the water, and the dirt after a day's work, no wonder that steam engines are nearly gone. All the same, they were beautiful things. I still love them—to look at but not to repair. Oh, the grease, the soot and mud!

Edgar T. Westbury writes:

Mr Bettles is to be congratulated on making a successful job of his SEALION, *which attracted considerable interest at the ME Exhibition and received the well-merited award of a Bronze Medal. His comments on certain details of design are all practical, but in his own words " it all depends on the use for which you intend the engine."*

The SEALION *design was produced in the first place to meet the requirements of readers who wanted a more powerful four-cylinder engine than the 15 c.c. or 30 c.c. side valve* SEAL *engines, mostly for large cruising model boats. Many attempts had been made by readers to convert the* SEAL *to overhead valves, which are generally agreed to be more efficient than side valves. I considered that an entirely new design was called for, with an overhead camshaft to operate as directly as possible on the valves.*

While a large oil reserve would be highly desirable for continuous running, the space normally available below the shaft line in a boat is usually very restricted, and the sump, therefore, had

● *Continued on page* 773

READERS' QUERIES

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE OF THIS ISSUE

- Queries must be within the scope of this journal and only one subject should be included in each letter.
- Valuation of models, or advice on selling cannot be undertaken.
- **Readers must sent a stamped addressed envelope with each query and enclose a current query coupon from the last page of the issue.**
- Replies published are extracts from fuller answers sent through the post.
- Mark envelope "Query," Model Engineer, 19-20 Noel Street, London W1.

Reed valve

You seem to be able to solve many engineers' problems with skill and alacrity.

My problem is that I have built a two-stroke racing engine of 50 c.c. and have incorporated in its design a crankcase reed valve for induction.

The engine itself is a success, but the reed valves last a few minutes only, as they are of brass shim. I originally wanted spring steel shim of 8 thou thickness but I have been completely unsuccessful in obtaining them.

The amount required is 6 in. × 2 in. for two reeds. Can you tell me where I can get it ?—T.D., RAF, Benson, Oxfordshire.

▲ *The material recommended is beryllium-copper, which has the highest resistance to fatigue. You might write to T. W. Senier Ltd, St John Street, Clerkenwell, London.*

An alternative material would be phosphor bronze, which is highly elastic but has a much lower fatigue resistance. You are no doubt aware that you must limit the movement of the reed so that it is not excessively deflected.

Blowpipe in Gwanda

Looking back through my old copies of MODEL ENGINEER, I see in the issue of 26 June 1958, on page 839, a drawing for a gas/air blowpipe. I wonder if you can help me in my attempt to make a blowpipe to work from a miner's hand lamp, using carbide or bottled gas ? I have tried the carbide lamp, using the Bunsen burner principle, but it keeps blowing back and burning at the jet. I want to work it on the Bunsen idea.

I have tried a German commercial brazing set in which the carbide is lowered into the water, which I suppose would generate more pressure to the gas.—R.F., Gwanda, Southern Rhodesia.

▲ *ME has published several articles on this subject.*

There are several difficulties in using acetylene gas in a Bunsen type of burner, and it is not generally recommended for this purpose. Bottled gas is extensively used for brazing, with or without air blast, but the exact proportions of gas and air apertures may have to be found by experiment, as there is no published information on this matter.

If you intend to experiment with acetylene gas generated from calcium carbide by the addition of water, it is very important that some form of safety or excess pressure release valve should be fitted to the generator, as carbide under pressure can be violently explosive. Avoid the use of copper or its alloys in contact with acetylene gas, as it can form an explosive compound on the surface of the metal.

Baker valve gear

I am busy building a freelance 5 in. gauge with Greenly double-ported piston valves and outside cylinders of 2¼ in. stroke.

Could you please advise me how to modify the dimensions given in *The Live Steam Book* for the Baker valve gear ? The parts will only be put in to suit your measurements as I am fabricating the cylinders and saddle in one—the engine is a bar frame job.—H.I.N., Uitinhage, South Africa.

▲ *Try drawing out the Baker gear on your drawing board, basing it on the drawing in* The Live Steam Book, *but increasing everything in the ratio 3 : 2. With dividers prick out the position of each link at the front and rear dead centres, and at top and bottom half stroke positions of the main crankpin. From this you will obtain the full gear valve travel. If it is too great (more than 11/16 in.), reduce it by altering the length and angle of the return crank.*

Forward-reverse

I wish to construct a simple forward-reverse gearbox, using a third shaft, as on a car, to obtain reverse. I intend to have constant mesh gears, as on some motor cycles, and to have a sliding dog clutch arrangement. I have a motorcycle gearbox mainshaft which I can easily adapt for the input shaft.

As the forward and reverse pinions will, at times, be rotating independently of the input shaft, should both the bores of the pinions and the shaft be hardened, or would it be better to bush the pinions with bronze ?

Speeds may be up to 2,000 r.p.m. If the shaft should be hardened, could you please tell me of a suitable steel for the reverse pinion layshaft and where it could be obtained—or could silver steel be used ?

Could you also tell me where I might obtain some discs of mild steel about 6 in. to 8 in. dia. × ½ in. thick ?—R.H., Sanderstead, Surrey.

▲ *Running bearings should always be bushed, and the shafts on which they run should be case hardened.*

Silver steel, as supplied, is not sufficiently hard, and if it is hardened it is liable to be too brittle. A good quality mild steel could be case hardened after machining.

Suitable steels for case hardening are obtainable from London Metal Warehouses Ltd, Summer Road, Thames Ditton, Surrey, and Macready's Metal Co., 131, Pentonville Road, London, N1. These companies may also be able to supply you with the large diameter steel discs, though the sizes specified are larger than those generally obtainable.

Watchmaker's lathe

I am a regular reader of your excellent magazine and although I have not attempted very much serious work as yet, it has been suggested that I could make a watchmaker's lathe. I understand that it is possible to make all the parts except the chuck, which would be bought.

I shall be glad of any advice you can offer.—M.F.G., Sutton Coldfield, Warwickshire.

▲ The Watchmaker's Lathe And How To Use It *(NAG Press, 226 Latymer Court, Hammersmith, London, 30s.) contains some very good general arrangement drawings of several types of watchmaker's lathe.*

There is nothing very difficult in the design of a watchmaker's lathe but it requires extremely high precision in machining and fitting the parts. Most of the work in lathes of this kind is done in collet chucks. It is quite practicable to produce them in your own workshop, but the same precision should be observed as in all other parts of the lathe.

Docker's umbrella

Can you settle an argument that has come up at the place where I am employed ?

It concerns the now defunct Liverpool Overhead Railway. Where did it start and finish ? I have travelled on the line many times but I do not remember that it went any further south than the Dingle. I have an idea that the northern terminus was Southport.

One man claims that he used to travel from Liverpool to Birkenhead on the Liverpool Overhead !—H.G.S., Lightwater, Surrey.

▲ *The Liverpool Overhead Railway was the first elevated electric railway in the world. It served the dock area of Liverpool and ran from Dingle to Seaforth Sands. a distance of* 6½ *miles.*

The line was formally opened in 1893, *when it ran from Herculaneum Dock to Alexandra Dock. It was authorised on* 24 *July* 1888. *Extensions to Seaforth Sands and Dingle were made on* 30 *April* 1894 *and* 21 *December* 1896.

The Lancashire and Yorkshire Railway completed a link between Seaforth Sands and Seaforth Litherland so that through trains could operate to Southport. This service was suspended many years before the Elevated was closed on December 1956, *but the LOR continued to run trains to Seaforth Litherland until the end of its days.*

Joseph Martin wrote about the Liverpool Overhead in ME for 12 *April* 1956.

Can You Help ?

Readers who can offer information to those whose queries appear below are invited to write c/o Model Engineer. Letters will be forwarded.

Trouble with valve-gear

I am building LBSC's *Speedy* and have run into trouble with the valve gear. I have put sighting holes in the valve chambers and I find that, having set the valves for correct lead, I get only 7/16 in. total valve travel, 1/16 in. port opening, and 52 per cent cut off in full gear.

All dimensions have been carefully checked. It seems to me that the reversing arms are much too short.

Will the valve setting, as designed, give satisfactory running ? Have any other readers corrected the fault ?—J.J.S., Cwmbran, Monmouthshire.

▲ *A cut-off in full gear of only* 52 *per cent is quite clearly too short. For a two-cylinder locomotive it should be nearer* 80 *per cent.*

As the engine is not an ME design, it would be helpful to hear from other builders how this trouble was overcome.

Two German warships

Having just completed a model of the German battle cruiser *Scharnhorst*, I now wish to build the *Prinz Euzer* and *Bismarck*. But I am having difficulty in getting photographs of these ships and if any ME readers have photographs of either which I could borrow for details I would be very grateful.

Could you run a series on warships of the last war ? The Italians had some fine looking snips, and the Americans, too. The Japanese had some ungainly-looking battle wagons. German warships were formidable and British battleships to be feared. I feel sure that a series of articles on them would go down very well indeed.

Thanks for a very good magazine, but there are not enough ships in it! —R.P.N., Luton, Bedfordshire.

Cliff railway

The Merseyside Model Railway Society is considering the building of a cliff railway similar to the one between Lynton and Lynmouth.

This railway operates by gravity; the base of the upper car is filled with water to make it draw up the lower car by a cable.

We would be grateful if any reader could put us in touch with a source of supply of postcards or photographs giving clear side and end views of the cars. It is not intended that the working model should be an exact replica. Any photograph which showed details of the manual and governor brakes would be extremely helpful.—H.H.W., Merseyside MRS, Liverpool.

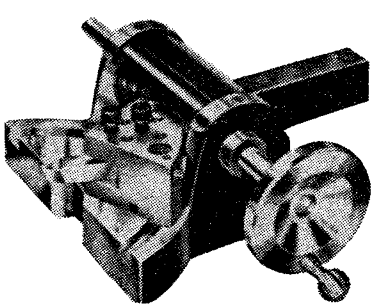
[*This is an interesting project which readers will be glad to help—but surely the best source of information is the Lynton and Lynmouth Railway itself*? —EDITOR.]

SUCCESS WITH SEALION

Continued from page 771

to be kept shallow. Similarly, the water and oil pumps had to be kept as close to the sides of the engine as possible to save space athwartships; but there is nothing to stop readers from spacing them out away from the engine so that external glands can be fitted. These and several other details are capable of being adapted to particular conditions and preferences; the same applies to all my engine designs; pains have been taken to make them as adaptable as possible.

I do not agree with the suggestion that an engine of at least 100 *c.c. would be necessary to drive a passenger hauling* 3½ *in. gauge locomotive. The* 15 *c.c.* KIWI, *in an* 0-6-0 *chassis of this gauge, has hauled three adult passengers comfortably, and the* 30 *c.c. twin engine* 1831 *will produce all the power which can be handled within the limits of adhesive weight in similar size. But a great deal must obviously depend on the design of the transmission gear, which must be not only mechanically efficient, but also capable of applying the power gradually and progressively to the driving wheels.* ▣



A SPHERICAL AND RADIUS TURNING ATTACHMENT

A COMPACT tool for radius turning has been developed which can be clamped in the toolpost of a lathe or shaping machine and used without further accessories.

The cutting tool is held in a block, which can be traversed in a semi-circular path by means of a concave-shaped worm engaging driving teeth in the rear of the block. If the tool is positioned with its cutting tip precisely at the centre of this circle, the position of the tip will not change as the block is traversed; if the tip projects beyond this centre point, it will trace a path which will result in a concave cut. If, on the other hand, the tool point is nearer to the holding block, it will produce a convex cut. Hence the radius of the cut depends only on the setting of the tool in its holder, and in the commercial model, adjustment from ¾ in. radius convex to 2½ in. concave is possible by the use of a simple setting gauge.

Based on Machine Shop Magazine, June 1961. Manufactured by Habit Geometric Tooling, Lurgan Avenue, London W6.

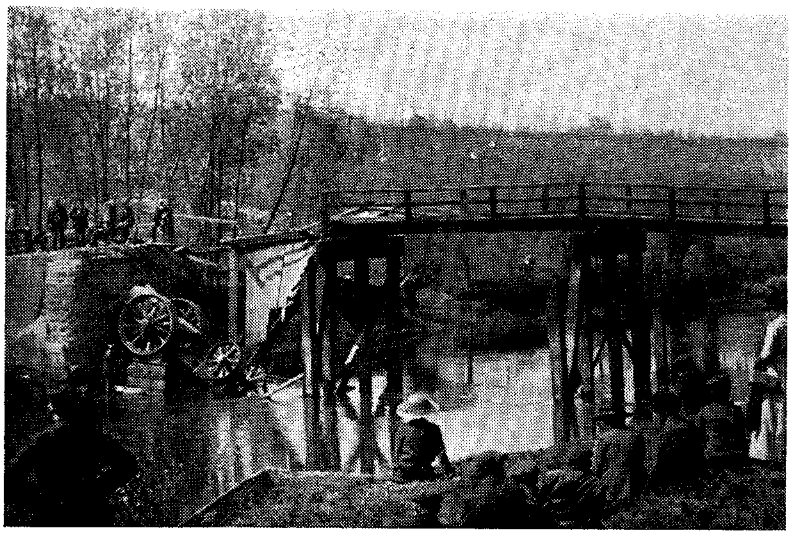
POSTBAG

The Editor welcomes letters for these columns. A PM Book Voucher for 10s. 6d. will be paid for each picture printed. Letters may be condensed or edited

OLD POSTCARD

SIR,—Readers may be able to identify the make of the traction engine on a postbard which I have. The picture was taken after an accident.

The postmark is Maidstone, 6 August 1914. I do not know if the accident took place in that area, as I have only just bought the card from a local antique dealer, but it would seem likely, especially as the printer was in Maidstone, too. Perhaps some Kent reader might know of the event.



Who knows anything about this postcard?

The place ought to be fairly simple to identify even today.

The engine is obviously in the process of being righted—one can see the massive wooden blocks under the wheels and a line stretching to the other shore.

Can we have more articles in your excellent magazine in the nature of the recent "Black Sand" series? This was a fascinating document in industrial and social history.

Brighton. STEPHEN MUSGRAVE.

BRAKES

SIR,—I was interested to read Mr Fred Massey's letter on the subject of brakes for trains hauling large passenger loads. Earlier this year I devised an air-brake system for the rolling stock in use at Middlesbrough, where loads regularly exceed half a ton. The system has so far been fitted to only one passenger truck, but the results obtained have been so encouraging that I intend fitting it to others as soon as time permits.

Compressed air at up to 30 p.s.i. is supplied by a $\frac{5}{8}$ in. bore and stroke pump (exactly similar to a water pump) feeding into a 28 cubic inch reservoir. Pump and reservoir are mounted on the engine (a 5 in. gauge LMS 2-6-4T), though usually they would be more conveniently fitted to a driving truck or to a passenger truck.

Air is fed to the brake cylinders by a regulating valve, by means of which any desired pressure may be applied. The valve incorporates an auxiliary vent valve for releasing the brakes.

The brake cylinders are $2\frac{1}{4}$ in. dia. and the pistons are made an airtight and nearly frictionless fit by rubber rolling rings. The movement of the pistons is transmitted to conventional brake shoes by a simple linkage.

Thirsk, Yorkshire. J. R. W. HESLOP.

BILL BAILEYS

SIR,—I am indeed sorry that we have at last come to the final article by J.N.M. That the subject should be the "Bill Baileys" is to me of special interest.

I worked on more than one of the class in No 8 Erecting (Repair) Shop when I was a premium apprentice at Crewe. It was not only the Running Department men who execrated them. Anyone who has ever stripped or refitted the steam pipes will remember what it was like to get at inaccessible steam pipe flange nuts, which could be tightened only with a hammer and chisel.

The Bill Baileys were not alone in that respect. The three-cylinder compound Long Backs were the only three-cylinder compounds of which I had personal experience. My mate and I broke up the last of the John Hick Class No 1505 *Richard Arkwright*, As far as my memory serves, there were at least four steam pipe flange nuts, which could not be undone (or tightened) by any sort of spanner made then or since.

When I was a pupil of C. J. Bowen Cooke, and doing my footplate work, I had a little experience of the Bill Baileys. One can hardly imagine a more uncomfortable footplate. From the boiler back to the back of the footplate was less than three feet. The fall plate, as can be seen from J.N.M.'s drawing, sloped down at a considerable angle to the tender floor. The tender, like all Webb tenders, was a horseshoe tank, and the coal had to be shovelled from the floorplate. It was like firing up hill.

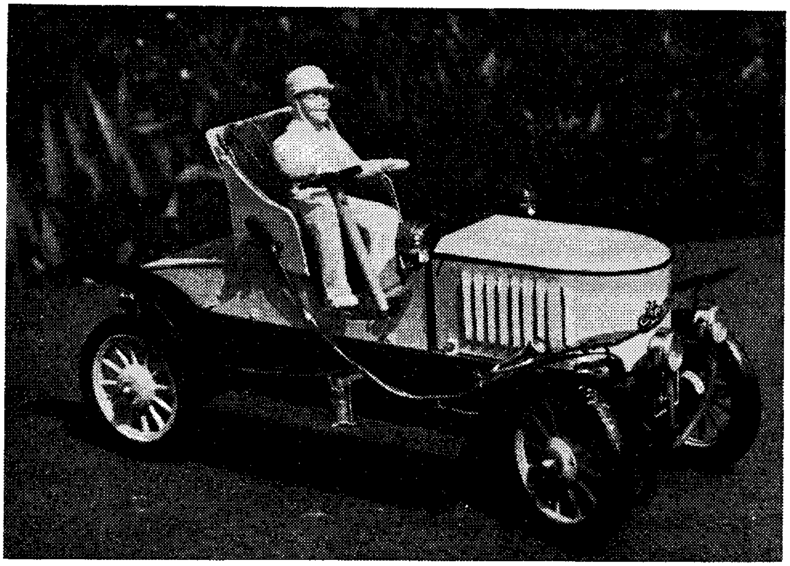
The coupled wheels were on helical springs, and at certain speeds the footplate danced to such an extent as to lift one's feet almost out of contact with it. At other speeds the tail-waggle could be quite alarming when one was firing and unable to hold on to the cab sides. There was also a peculiar shouldering action, as though the engine was labouring to get over compression. At other times there was, as they say in Twenty Questions, "any combination of all three." There was little good that could be said of the engines except they were good haulers at slow speed.

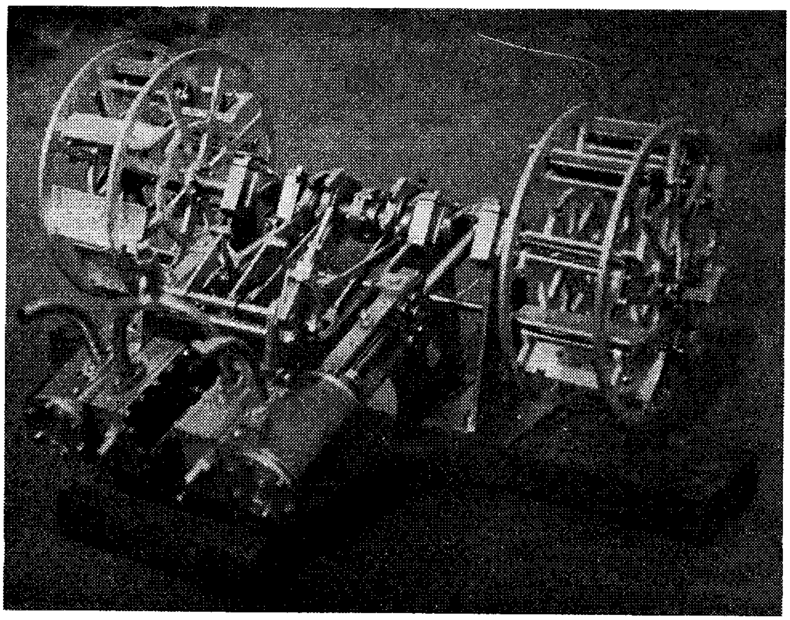
J.N.M. expressed surprise that George Whale "should have approved the construction of so many of this class." The Board would have approved their construction during the regime of Webb, and material would have been ordered and the manufacture of components have begun before Whale took over. Any alteration of design would have delayed considerably the completion of much needed power, and dislocated the progress of work through the manufacturing shops.

The employment of 3 ft 3 in. instead of 3 ft 9 in. wheels for the four-wheeled radial truck was necessary because the frames had to be cut away to allow clearance, and they could not have been cut sufficiently to clear wheels of 3 ft 9 in. The first Precursor tanks were, I think, the last LNWR engines to have the 3 ft 9 in. wheels, except for the Prince of Wales class, though why the larger wheel was retained on them I have never understood. The way the large wheels rubbed against the engine frames was sufficient justification for the smaller ones. The later Precursor tanks, the 19 in. 4-6-0 goods, the 4-6-2 tanks, and the George the Fifths and Claughtons all had the 3 ft 3 in. wheels.

Like some of your other correspondents I, too, hope that this last series of J.N.M. articles will be published as Vol. II of *Locomotives I Have Known.*

Lymington, Hampshire. E. V. M. POWELL.





W. C. Martin of Broadstairs in Kent has made these two models: a Stanleyette steam car from the LBSC design, and diagonal paddle engines from Edgar T. Westbury's Power by Paddles articles in ME

NERVOUS

SIR—I sometimes feel apprehensive about steam tests of boilers which every now and then I read of in MODEL ENGINEER. The latest recommendation is that the *Rob Roy* boiler should be given a steam test at 140 p.s.i. after a hydraulic test at 160.

I am not an expert on boilers but tables reveal that at 140 lb. the steam temperature is about 360 deg. F. and that at 400 deg. copper has only 85 per cent of its normal strength. Perhaps it is not unreasonable to suggest that some of the copper forming the firebox would be at 400 deg. or more; and as 85 per cent of 160 is 136 it would seem that the steam test is more likely to split the boiler open than is the hydraulic test. The hydraulic would therefore be of little value.

Probably someone will be able to point out errors in my calculations. But until they do I shall do my utmost to avoid being within 200 yards of any such test.

Virginia Water, Surrey. J. N. INNES.

CAR COMPASS

SIR,—After reading "Mystery of the Magnetic Car" (Can You Help? November 23) I would like to ask what means are used for checking the compass used on the car, as a compass does not point true North and has a variation changing from year to year and according to where on the earth's surface it happens to be. In addition, of course, there is deviation, and this inaccuracy comes about according to which way the car happens to be facing.

These factors may have been overlooked by your correspondent.

Rothley, Leicestershire. R. S. FARMER.

CORNISH ENGINE

SIR,—My son, on a recent visit to England, was able, with the help of friends, to locate and photograph the exterior workings of a Cornish beam engine.

What would be its applications in use? Hoisting, pumping, or both? At what period would it have been made and installed?

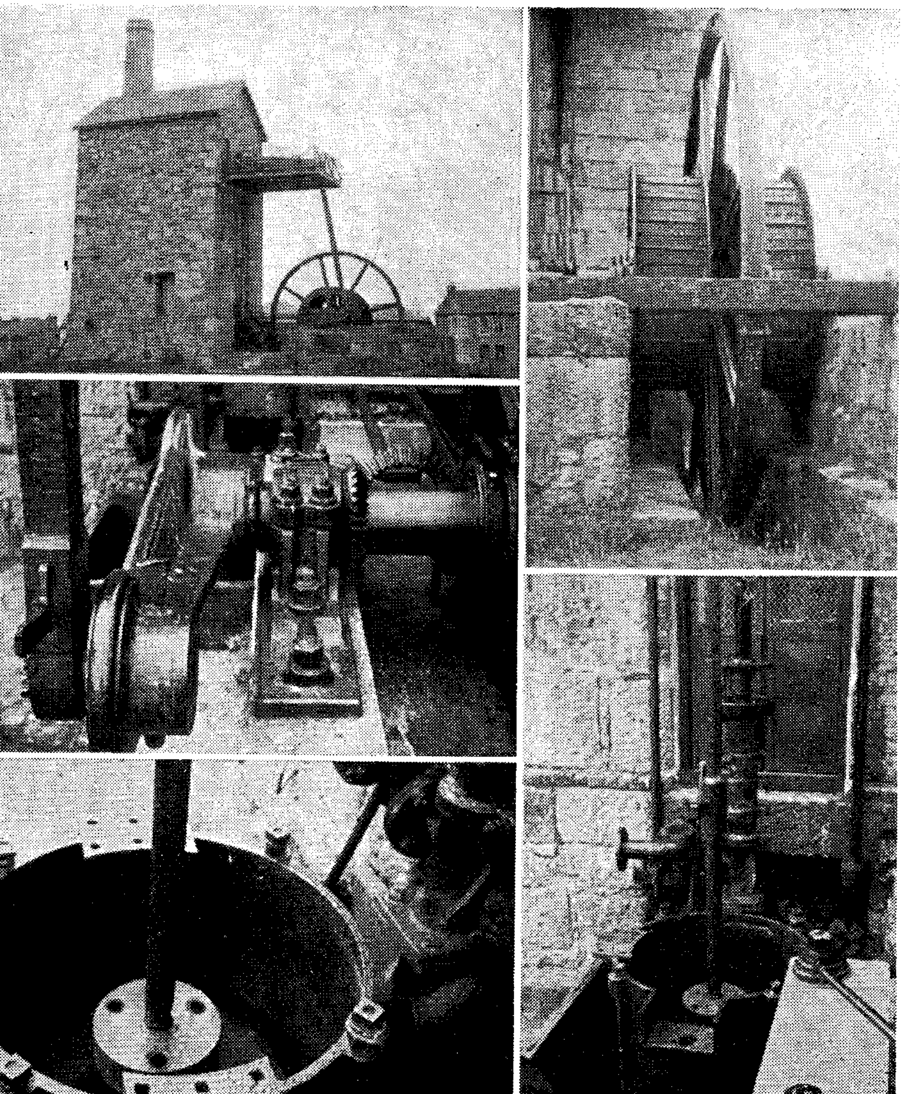
Some facts I can give are as follows: The plant is near Redruth, in Cornwall. A plaque on the building shows that it is being restored and maintained by some society but the lettering was indecipherable in the picture. The building was locked, but a circular brick wall was visible through a window.

The two eccentrics would indicate that there was a Stephenson valve gear. If so, the link was inside the building. The large lift pump cylinder would point to its use in draining the mine, but were such engines used for both purposes? The bevel gears are also rather puzzling. No shaft or other mine workings were to be seen.

Willodale, Ontario. A. H. BRADEN.

[*The engine in the picture has drums on the main shaft. Its main purpose was for hauling or hoisting. Quite probably it was also used for pumping, to keep the mine drained; without pumps a Cornish mine quickly floods—a fate which has overtaken the abandoned Bals. The reversing gear would be needed for a winding engine, and the bevel gears may have been used to drive some form of governing device or a " tell-tale " indicator to show the winding limits. Mr Braden should join the Cornish Engines Preservation Society, founded by William Tregoning Hooper of Trevaunance Road, St Agnes, Cornwall, an old reader of* MODEL ENGINEER.—EDITOR.]

Beam engine in the Trevithick country. It was photographed by the son of a reader in Ontario where Cousin Jacks, leaving their native mines, went to di —as in other parts of North America—for silver copper and old



BRIDGE OF MEMORY

SIR,—Well! I had thought of writing and asking about Dugald Drummond's No 720—and then she suddenly appeared in Locomotives I Have Known on September 7. I remember her when I was a kid and cleaning two tenders for a night's work in the Nine Elms Sheds in the days when engines were *cleaned.* It must have been around 1898-1899. Then Drummond safety valves were known as coffee pots, and how we used to scour them. We used brick dust and socker oil rubbed into an old flag, and then watched the colour come up when the coffee pots grew warm.

When No 720 was bedded down at Nine Elms she was put into the local sheds as she was too long to be moved on the turntable for the main line ones. Believe, she was the first outside cylinder engine of the Drummond brand.

I have sent ME a magazine in which there is a good picture of the Glen Canyon bridge. I have been over the Narajo Bridge but not over this one—yet.

Your series on bridges some years ago was really interesting.

Lombard, Illinois. HERBERT J. ASHER.

THE GREATER SPAN

Soaring above the superhighway's floor
Like spirits lifted, linking mile with mile,
Bridges of steel perform their fearless chore
Insensitive to every weather guile.
Locking the banks of water-parted trails
The covered bridges, cut from hearts of trees,
Are made in stubborn strength from wood and nails
And hold great, restless rivers at their knees.
Arching their chasms like a ray of hope.
Bridges across the world defy old foes
In ancient brick, immortal iron or rope,
Enduring endless centuries of blows.
But greater still, one span outlasts demanding—
The unseen bridge of human understanding

D.G. *Chicago Tribune.*